

# Kesmas

Jurnal Kesehatan Masyarakat Nasional  
(National Public Health Journal)

**Quarterly Journal**

## **Invited Article:**

**Benign Prostatic Hyperplasia (BPH): A Comprehensive Analysis of the Malaise and Summarizingble Management Options through Phytotherapeutic Agents** (pp. 81-88)

## **Research Articles:**

**Knowledge, Attitudes, and COVID-19 Prevention Practices of Healthcare Workers in Indonesia: A Mobile-based Cross-sectional Survey** (pp. 89-97)

**Determinants of the Coexistence Dual Form of Malnutrition in Pairs of Mother and Child Aged 6–59 Months in Bogor District 2019** (pp. 129-135)

**The Influence of Intrapersonal Constraints on Travel Intention of People at High Risk from COVID-19 during the New Normal** (pp. 144-150)

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# Kesmas

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As a teenager, I am amazed by how *Kesmas: Jurnal Kesehatan Masyarakat Nasional* (National Public Health Journal) Volume 17-1 provided the articles that are relatable to me. I first read the article entitled “Consumption of Sugar-Sweetened Beverages and Its Potential Health Implications in Indonesia” and realized that I’ve been living side by side with the sugar-sweetened beverages, moreover with all of the promos provided by the food delivery service application that makes me consume them more. The second, I read “Body Image, Quality of Life, and Their Predicting Factors in Pregnant Woman: A Cross-Sectional Study” and discovered how the social construction of beauty and body image created a burden for pregnant women. I also read “Factors Related to Café Workers’ Lung Capacity in Pontianak, Indonesia,” which highlighted the condition of café workers’ lungs because they have to breathe the smoky air every day because of work. It will be more relatable if there is similar research but with passive smokers in the café as the subjects. (Laksmita, Jakarta)

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# Benign Prostatic Hyperplasia (BPH): A Comprehensive Analysis of the Malaise and Summarizing Possible Management Options through Phytotherapeutic Agents

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## Abstract

Benign prostatic hyperplasia (BPH) is a severe illness affecting middle-aged and geriatric male patients. This disease normally occurs at the age of 40 or above and is also associated with sexual dysfunction. Alpha-blockers and 5 $\alpha$ -reductase inhibitors are the preferred drugs practiced to treat BPH. However, invasive surgical therapy remains the gold standard for managing the condition in the case of refractory and intricate BPH conditions. Due to the fear of sexual dysfunction and the detrimental influence on their quality of life, most patients seek to avoid synthetic drugs and surgery. For this reason, several patients turn to phytotherapy and other alternative therapies. The authors looked at the existing perceptions of epidemiology, etiology, and pathophysiology associated with BPH in this review article. In addition, this article contained basic information on the pathological roles of inflammation in BPH and various diagnoses and treatment options. It was well reported that the administration of medicinal herbs played a vital role in managing BPH. In recent years, many researchers worldwide have reported the efficiency and safety of phytochemicals in managing numerous pathological disorders in-vivo and in-vitro conditions and the prevention of illness.

**Keywords:** benign prostate hyperplasia, etiology, pathogenesis, pathophysiology, phytotherapy

## Introduction

Benign prostatic hyperplasia (BPH) is one of the most prevalent illnesses affecting older men. It is the most common cause of lower urinary tract symptoms (LUTS) in men, causing a deterioration in the functioning of the urinary system, heightened risk of urinary tract infections, and an increased risk of severe acute urinary retention. Approximately 50% of men aged 50 years are diagnosed with BPH conditions, and more than 90% of men aged 80 years have BPH, with the most significant prevalence occurring among those aged between 70 and 79 years.<sup>1,2</sup> BPH is a term that refers to a proliferative process of the prostate's cellular parts, an enlarged prostate, or voiding dysfunction caused by prostatic enlargement and bladder outlet blockage. It is a histological term that describes proliferative processes in the stromal and epithelial parts of the prostate gland.<sup>3</sup> BPH conditions usually develop in the periurethral and transition zones of the prostate, and it causes an increase in prostate dimensions and urethral blockage and finally results in LUTS.<sup>2,4</sup> Men suffering from BPH may experience severe

urination issues, as well as complications, such as recurring renal failure and severe urinary tract infections.<sup>2</sup> As previously stated, BPH condition has a significant impact on the aging male population; therefore, healthcare practitioners should pay special attention when diagnosing BPH to ensure better identification and the best treatment to manage it effectively.

An important symptom associated with BPH is the formation of hyperplastic nodules in the transition and periurethral regions of the prostate gland. As shown in Figure 1, the formation of hyperplastic nodules results in prostate enlargement and, after that, invades the urethra. This process eventually triggers a set of signs, very commonly known as LUTS. The three major kinds of LUTS associated with BPH conditions are storage (this includes urination urgency, urination frequency, nocturia, and urine incontinence), voiding (which provides for reduced flow of urine and a strong sense of incomplete emptying after urination), and post-void dribbling (Table 1).<sup>5</sup> Validated questionnaires recommended by the International Prostate Symptom Score or the American Urological

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Association (AUA) symptom score are the best means of evaluating the severity of LUTS.<sup>6</sup> In older men, urodynamic abnormalities in the lower urinary tract, including benign prostatic blockage and detrusor overactivity/under activity, are the most common causes of LUTS.<sup>7</sup>

Most male patients with LUTS do not seek any medical assistance or avoid medical treatment to manage this condition, leading to a severe burden that affects their lives. One of the primary reasons for this is their concern about the adverse side effects, particularly those that involve sexual functions and performance.<sup>8</sup> Hence, patients' expectations and goals are becoming increasingly important to manage LUTS and effectively obtain the best possible outcome. All these factors should be considered when choosing an ideal treatment plan. The major therapies recommended for LUTS include watchful waiting, medicinal treatment, and surgical intervention based on pertinent guidelines released by national and international urological societies.<sup>8</sup>

**Literature Review**

*Prostate Gland: Anatomy and Function*

The prostate is a thick fibromuscular gland located in the true pelvis that enables the male reproductive system to function properly. It is a dense structure and has the shape of an inverted cone, with the base above the neck of the urine bladder and the apex below the external urethral sphincter. The major function of the prostate is to release an alkaline solution that protects the sperm from the acidic environment prevalent in the vaginal cavity. The prostate fluid helps to equipoise the vaginal acidity, which extends the sperm's lifespan and allows it to fertilize an egg for the longest possible time. The fluid also comprises several proteins and enzymes that help the sperm grow and thrive. In addition, it adds volume to the semen and sperm to facilitate quicker mechanical propulsion through the urethral canal.<sup>9</sup>

*Benign Prostatic Hyperplasia (BPH): Prevalence of BPH and Histologic BPH*

Benign prostatic hyperplasia described as the most common benign neoplasm in American men and a chronic condition that is associated with progressive lower urinary tract symptoms and affects almost three of four men during the seventh decade of life.<sup>10</sup> According to the autopsy data, microscopic or anatomic indications of BPH are present in more than 40% and 90% of men aged 50–60 and 80–90 years, respectively.<sup>11</sup> Intercontinental variation is commonly cited as evidence for emphasizing the significance of various environmental factors, especially dietary behavior, in developing BPH conditions. Increased garlic consumption through the diet may cause a lower occurrence of BPH conditions in China.<sup>12</sup> To comprehend the multifactorial alterations that lead to BPH

as a pathophysiological modification resulting in complex symptoms within a man's inner and outer environment, it may be helpful to review what is now known about its etiology and pathophysiology.

*Role of Etiological Factors*

Although the etiology of BPH is unknown, it seems to be a complex process with both mechanical and dynamic components.<sup>13</sup> The static or mechanical component of BPH involves the enlargement of the prostate, whereas the dynamic component is LUTS, which is caused by the heightened tone of the smooth muscle of the prostate. The sympathetic nervous system controls the dynamic components. Androgens and age are the only two well-established variables linked to BPH.<sup>14</sup> In the population-based Olmsted County study, 13% of men aged 40–49 years had moderate to severe urinary signs compared to 28% of those more than 70 years old.<sup>16</sup> The median rate of prostatic volume change per year was 0.6 ml, corresponding to a 2.5% annual growth rate.<sup>16</sup> A substantial tissue-remodeling process occurred within the prostate of aging men, which finally increased the gland volume.<sup>17</sup>

*Role of Age and Genetics*

Aging is one of the significant risk factors associated with the development of BPH and LUTS. In the prostate

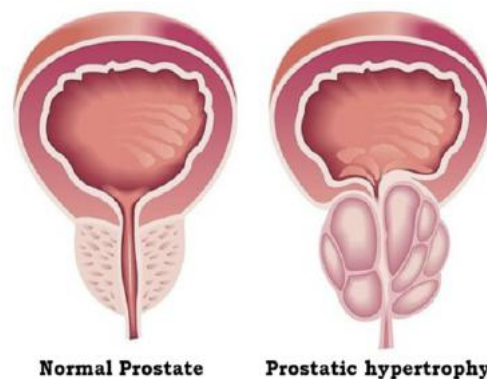


Figure 1. Normal Prostate and Benign Prostatic Hyperplasia

Table 1. Symptoms of Benign Prostatic Hyperplasia

| Symptoms                  |   |
|---------------------------|---|
| Associated with Storage   | Associated with Voiding                     |
| Frequency of urination    | Difficulty in initiating the urinary stream |
| Urgency of urination      | Hesitancy in urination                      |
| Incontinence in urination | Straining to void                           |
| Nocturia                  | Weak urine stream                           |
| Dysuria                   | Decreased urinary flow                      |
|                           | Intermittency                               |
|                           | Dribbling                                   |
|                           | Incomplete bladder emptying                 |



gland, the process of aging encompasses cellular mitogenesis and hormonal homeostasis variations, which then lead to chromosomal aberration and death.<sup>18</sup> In addition to this, the aging process is also linked to various inflammatory conditions and microvascular illnesses. All these processes trigger the occurrence of ischemia and oxidative stress, making BPH more likely. Over the last few years, researchers have looked into the linkage of genetic factors associated with the development of clinical BPH in men under the age of 60. Moreover, BPH appears to be an inheritable disease, probably associated with an autosomal overriding pattern. Furthermore, the hereditary components are responsible for more than 70% of the escalated risk that leads to the development of moderate to severe BPH and LUTS in older adults.<sup>19</sup>

### Role of Hormones

The BPH has been definitively related to the generation and maintenance of sex steroid hormones in men. Androgen is the major hormone that has been studied the most. Through dihydrotestosterone (DHT)/androgen receptor signaling, testosterone is transformed into DHT in the prostate, influencing cell proliferation, differentiation, morphogenesis, and functional maintenance.<sup>20</sup> In a clinical environment, 5 $\alpha$ -reductase inhibitors are reported to lower DHT levels in the blood and halt the progression of clinical BPH.<sup>19</sup> As said earlier, the prostate is usually considered a target of androgens, but estrogens can play a significant role in prostate growth, differentiation, and development via regulating stromal-epithelial interactions.<sup>21</sup> Additionally, extreme estrogenization during prostate development may contribute to the higher occurrence of BPH in aging men. No clear and reliable relationship has been established between other sex hormones, including dehydroepiandrosterone, androstenedione, and 5 $\alpha$ -androstenedione and BPH.

### Role of Growth Factors

Multiple growth factors and associated receptors have been well recognized in the stroma and epithelium of the prostate gland. These factors can excite or impede cell division and further differentiation steps that lead to BPH development. Although far from complete, this includes epidermal growth factor, fibroblast growth factor, and transforming growth factor- $\beta$ . The activation of the abovementioned growth factors, either individually or in combination, can cause stromal cell proliferation, which leads to considerable tissue remodeling and prostate enlargement.<sup>21</sup>

### Role of Inflammation

Inflammation has been associated with the development and progression of BPH; however, the precise impact and role(s) of immune cells in these conditions re-

mains unclear. The infiltrates associated with inflammation are the most common histological feature associated with BPH, and the severity of the inflammatory condition is directly proportional to the prostate size and mass.<sup>22</sup> Inflammation has been shown to impact various prostate cell types' growth, morphology, and function. It is hypothesized that inflammation promotes epithelial cell proliferation and differentiation in BPH, leading to abnormal prostatic growth.<sup>23</sup> An increased C-RP level has been recorded in men diagnosed with LUTS, and this may be a probable indication of systemic inflammation.<sup>20</sup>

### Role of Metabolic Disorder, Lifestyle Aspects, and Obesity

The latest organized review on the association between metabolic disorder and BPH focused on subsets of metabolic syndrome and their connection with total prostate volume (TPV) and LUTS in men. Contrary to earlier study,<sup>24</sup> no significant variations were observed in the scores of LUTS symptoms between men with and without metabolic syndrome. Furthermore, men with metabolic syndrome had a considerably greater TPV than those without metabolic syndrome (Figure 2). Obese people with low levels of blood high-density lipoprotein cholesterol had considerably more significant TPV disparities. Smoking, inactivity, and a high protein diet can bestow the development of symptomatic BPH and LUTS in men.<sup>25</sup>

## Discussion

### Association between BPH and Prostate Cancer

The first autopsy of the prostate gland in the 1950s discovered a clear link between BPH, and prostate cancer.<sup>26</sup> Zhang, et al.,<sup>27</sup> described significant correlations

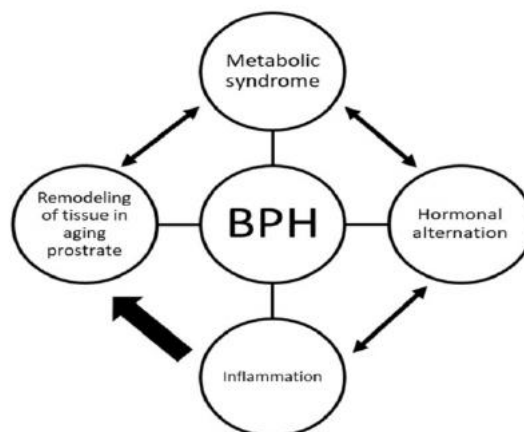


Figure 2. The Association between Aging, Metabolic Disorder, Inflammatory Condition, and Hormonal Changes on the Progress of Benign Prostatic Hyperplasia

**Table 2. Collation of General Features of Benign Prostatic Hyperplasia and Prostate Cancer**

| Benign Prostatic Hyperplasia   | Prostate Cancer  |
|--|--|
| Normally the non-malignant type of cells which are localized with enlarged size.<br>The maximum affected area is the central zone.<br>Higher levels of prostate specific antigen (PSA)<br>Symptomatic treatments with several other options are available. | Usually malignant cell type. Tumor cells will show clear multiplication and significant spreading ability.<br>The sides of the prostate are affected maximum.<br>Higher levels of both PSA and alkaline phosphatase<br>Treatment is decided based on the patients' health and stage of cancer. |
| As per the biopsies, inflammation is observed in major cases.<br>Partly associated with metabolic disorder.<br>No blood will be observed in the semen.   | Same as that of benign prostatic hyperplasia<br>Here also, it is partly associated with metabolic disorder.<br>No blood will be observed in the semen.   |

between prostatitis, BPH, and prostate cancer. Persons with history of prostatitis are more vulnerable to BPH.<sup>27</sup> Still, no consensus has been reached to prove the association. The BPH is a non-malignant prostate gland enlargement caused by cellular hyperplasia within the transitional zone.<sup>28</sup> Prostate cancer is purely an adenocarcinoma that primarily develops in the peripheral location of the prostate gland.<sup>29</sup> Surprisingly, BPH and prostate cancer share a few common features (Table 2). Chronic inflammation, metabolic distraction, and genetic variation play essential roles in developing BPH and prostate cancer.<sup>30</sup> A collation of general features of BPH and prostate cancer is briefed in Table 2.

*Diagnosis Method Available for BPH*

The standard investigation of BPH may include bedside urine dipstick, post-void residual, International Prostate Symptom Score (IPSS), and urine flow studies to establish if there is evidence of obstructive voiding. Further tests include prostate-specific antigen (PSA), Ultrasound, Flow Studies, Urethrocystoscopy, and Transrectal ultrasound scanning.

*Therapeutics and Management of BPH*

The major drugs available for managing BPH conditions include alpha-blockers, Phosphodiesterase inhibitors, Anticholinergics, and Beta-3 agonists. It is often difficult to achieve satisfactory efficacy with a single drug in LUTS-BPH patients, and patients often discontinue treatment due to the side effects. As a result, there is an urgent need to develop novel combination therapies with acceptable efficacy and disease progression inhibition that improve patient adherence to treatment. However, the combination of different drugs may result in additional side effects. Thus, it is imperative to find alternative drugs for managing BPH, especially those derived from medicinal plants.

*Role of Phytotherapy in the Managing BPH*

Phytotherapy uses plant extracts as medicine to treat various urinary system problems. Due to their benefits of

minimal side effects, high positive effects, excellent curative effects, and reduction of signs and symptoms, these alternative therapies are gaining popularity in treating BPH.<sup>31</sup> In many parts of the world, herbal supplements formulated from medicinal plants are also widely employed as an alternative or complementary therapy technique for male patients who have been diagnosed with BPH and prostate cancer.<sup>31</sup>

*Effect of Prunus Africana in Managing BPH*

*P. africana* bark extracts are used to treat BPH. The bark of this plant is used to treat various conditions like inflammation, urogenital problems, kidney disease, malaria, allergies, fever, and stomach aches. In 1966, a patent was administered with the *P. africana* bark extracts to treat BPH.<sup>32</sup> In the study by Nyamai, *et al.*, the bark extracts significantly affected chronic BPH symptoms such as inability to urinate, frequent urination, nocturnal urination, voiding volume, residual urine, prostate volume, and peak flow.<sup>32</sup> The scientific study on the therapeutic effects of the bark extract clearly demonstrates that the synergistic activity of several bioactive compounds counteracts the functional and biochemical changes that characterize the formation of BPH.<sup>32</sup>

*Serenoa repens (Saw palmetto)*

*S. repens* is a 20 to 25-foot-tall evergreen shrub with horizontal rhizomes.<sup>33,34</sup> *S. repens* extracts are one of the predominantly used phototherapeutic agents in treating BPH conditions. Saw palmetto-based herbal preparations are widely used to manage BPH symptoms in several parts of the world.<sup>35</sup> This preparation has a significant advantage over conventional therapy as it does not affect PSA levels and has fewer side effects.<sup>36,37</sup> Unfortunately, conventionally used drugs like Proscar significantly lower the PSA level, which in turn masks prostate cancer because PSA levels in serum are generally used as screening tests to measure prostate cancer.

Double-blind research studies found that medicinal herbs effectively alleviate urinary symptoms. The preparations made from this species are thought to work by in-

hibiting the type 1 and 2 isoenzymes of 5 $\alpha$ -reductase, the crucial enzyme which converts testosterone to dihydrotestosterone.<sup>38</sup> Anti-inflammatory and anti-estrogenic activities of saw palmetto liposterolic extracts had been demonstrated in BPH patients. Moreover, this extract can inhibit the production of growth factors and prolactin-induced cell proliferation.<sup>39</sup> This extract also lowers levels of testosterone binding globulin.<sup>40</sup> This will significantly ameliorate the symptoms associated with the urinary tract and urine flow in men diagnosed with BPH. The effect is almost comparable to finasteride in terms of effectiveness, but it is less expensive and has fewer side effects.

#### Crataeva nurvala

*C. nurvala* comprising herbal formula named PR-2000 at a dose of 2 tablets three times daily for continuous six months improved urine peak flow rate (PFR) and decreased sonographic prostate size in study subjects diagnosed with BPH.<sup>41</sup> *C. nurvala* is one of the major constituents in Himalaya Himplasiatablets (Himalaya Company) that promotes optimum prostate health, urogenital function, bladder function. This medicine has been shown to have 5 $\alpha$ -reductase inhibitory and adreno-receptor antagonist properties.<sup>42</sup> Inhibiting 5 $\alpha$ -reductase prevents testosterone from converting to dihydrotestosterone, the primary hormone responsible for developing BPH.<sup>42</sup> Furthermore, an aqueous extract of *C. nurvala* was found to be protective against ethylene glycol-induced nephrotoxicity.<sup>43</sup>

#### Tribulus terrestris

*T. terrestris* has significant diuretic properties because of the large amounts of nitrates and essential oils present in the whole fruit. *T. terrestris* water extract can induce a positive diuresis. In addition to the *T. terrestris* extract, it can significantly increase the tonicity of the smooth muscles and its diuresis property, aiding in the effective propulsion of kidney stones.<sup>44</sup> This plant was also reported to prevent the formation of kidney stones in several models of urolithiasis studied using ethylene glycol and sodium glycolate.<sup>45</sup> *T. terrestris* inhibits glycolate oxidase, which accounts for its antiurolithic properties. *T. terrestris* ethanolic extract can significantly reduce the expression of inflammatory mediators and cytokines, which provides significant relief from various inflammatory diseases.<sup>46</sup> Additionally, *T. terrestris* alcoholic extract was very effective against both gram-positive and negative bacteria. However, its petroleum ether and chloroform extracts recorded only moderate antibacterial activity.<sup>47</sup>

#### Boerhaavia diffusa

Many experimental studies have shown that *B. diffusa* treatment significantly reduces prostate weight and pro-

static index in rats. The prostate weight to body weight ratio is used to calculate the prostate index, one of the most important disease markers. An in-vitro research study suggests that herbal extracts have a beneficial outcome on the smooth muscle prostate, which will result in the alleviation of various symptoms associated with the urinary system. *B. diffusa* extract has been shown to have anti-inflammatory and anti-proliferative properties.<sup>48</sup>

#### Quercetin

Quercetin is a rich flavonoid molecule in fruits, vegetables, and greeneries.<sup>49</sup> This molecule is widely used to manage various inflammatory conditions as well as prostate cancer as it can deplete oxidative stress,<sup>50</sup> lower the DHT level, and possess significant anticancer properties.<sup>51</sup> An earlier study by Shoskes and co-workers showed that it could significantly improve the symptoms associated with prostatitis (both acute and chronic).<sup>52</sup> All of the effects quercetin has on the prostate signifies its possible role in managing the BPH condition. Ghorbanibirgani, et al., conducted a clinical trial on 200 BPH-confirmed patients to confirm the effectiveness of quercetin in managing the condition.<sup>53</sup> The BPH-confirmed male patients were split into two groups, namely the quercetin and placebo. The quercetin group received 40 drops of quercetin daily three times, whereas the placebo group received 40 drops daily three times for three months.<sup>53</sup> In the quercetin group, the mean AUA symptom score was 4.6 less, and the mean maximal urine flow rate was 3.2 ml/s more than in the placebo group.<sup>53</sup> From those reports, it can be concluded that quercetin has improved effects on lowering BPH indications and further increases the flow rate of urine compared to placebo.

#### Cucurbita pepo seed (Pumpkin)

The *Cucurbitaceae* family includes pumpkins, often known as dubba and the scientific name is *C. pepo*. It is a well-known traditional herbal medication, especially in Europe, for treating various diseases, including diabetic conditions, hypertension, BPH, and several types of microbiological infections.<sup>54</sup> Pumpkin seed oils have anti-inflammatory and antiandrogenic properties and the ability to reduce prostate enlargement, and have antioxidant properties. The properties showed the excellence of pumpkin seeds in treating BPH conditions.<sup>55</sup> Pumpkin seeds have also been shown to inhibit testosterone conversion to DHT, preventing testosterone-induced BPH in a rat model and treating BPH.<sup>56</sup>

#### Lycopene

Lycopene is found in tomatoes. A well-designed clinical study,<sup>57</sup> suggested that lycopene can effectively prevent BPH development and alleviate the symptoms asso-

ciated with the BPH condition. In addition to this, supplements comprising lycopene are safe for humans.

### *β-sitosterol*

β-sitosterol is an important constituent of phytosterols, a class of compounds under phytosterols. It has a similar structure to that of cholesterol. Even though β-sitosterol has a similar structure to cholesterol, it cannot be converted to testosterone. This compound can also inhibit aromatase and 5α-reductase. A placebo-controlled double-blind clinical study using a 20 mg β-sitosterol found that the treatment group had increased urinary flow and decreased residual volume in the bladder.<sup>58</sup>

### Conclusion

Benign prostatic hyperplasia prevalence is expected to rise as the world's population ages. The primary health care professionals must understand the definition, pathophysiology, related risk issues, examination, diagnosis, therapy, prevention, and consequences of BPH condition. In addition, the medications used for managing BPH conditions have a diverse set of clinical applications, pharmacological actions, and adverse effects. It is also known that the treatment efficacy and side effects may vary within the same patient group. Moreover, different BPH patient populations' susceptibility to the same BPH medicine may vary. For these reasons, there is no one-size-fits-all treatment for BPH-LUTS patients. Hence, personalized treatment strategies are essential to ensure the best medical resources for patients. Advice on exercise and diet, in addition to drugs, is a key method for enabling the patient to self-manage the disease condition. This could help avoid the need for surgery, which is known to have several possible side effects and high jeopardy of long-term recurrence in the patients.

Benign prostatic hyperplasia is also not the initial step in developing prostate cancer, and it is time to conduct a large-scale study to clarify the relationship between the two. Various clinical studies have found that medicinal plants have a significant effect in managing the BPH condition, comparable to synthetic medications. Plant extracts are thus much more helpful for patients with minimal risk of advancement since they are well brooked and have no contraindications or interactions with other medicines. Hence, advanced research is required to study the effects of herbal extracts and phytochemicals in managing BPH conditions with special emphasis on the therapeutic goals, including the normalization of nutrient levels in the prostate, further restoration of steroid hormones to normal levels, impediment of surplus production of DHT, reduction of inflammatory markers and curbing of promoters required for the hyperplastic process.

### Abbreviations

BPH: Benign Prostatic Hyperplasia; LUTS: Lower Urinary Tract Symptoms; AUA: American Urological Association; DHT: dihydrotestosterone; TPV: Total Prostate Volume; PSA: Prostate Specific Antigen; PFR: Peak Flow Rate.

### Ethics Approval and Consent to Participate

Not Applicable

### Competing Interest

The author declares that there are no significant competing financial, professional, or personal interests that might have affected the performance or presentation of the work described in this manuscript.

### Availability of Data and Materials

The analyzed dataset is available in published documents and on the internet.

### Authors' Contribution

SS is the primary contributor to the article who meticulously conducted the literature review and wrote the manuscript drafts. KPS, SP, AB, SKD, and HNJ initiated the project, supervised the work, and edited the final manuscript.

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### References

1. Unnikrishnan R, Almassi N, Fareed K. Benign prostatic hyperplasia: evaluation and medical management in primary care. *Cleve Clin J Med.* 2017; 84 (1): 53-64.
2. Homma Y, Gotoh M, Yokoyama O, et al. Outline of JUA clinical-guidelines for benign prostatic hyperplasia. *Int J Urol.* 2011; 18 (11): 741-56.
3. Madersbacher S, Sampson N, Culig Z. Pathophysiology of benign prostatic hyperplasia and benign prostatic enlargement: a mini-review. *Gerontology.* 2019; 65 (5): 458-64.
4. Kapoor A. Benign prostatic hyperplasia (BPH) management in the primary care setting. *Can J Urol.* 2012; 19 (Suppl.1): 10-17.
5. Das K, Buchholz N. Benign prostate hyperplasia and nutrition. *Clin Nutr ESPEN.* 2019; 33: 5-11.
6. Gratzke C, Bachmann A, Descazeaud A, Drake MJ, Madersbacher S, Mamoulakis C, et al. EAU guidelines on the assessment of non-neurogenic male lower urinary tract symptoms including benign prostatic obstruction. *Eur Urol.* 2015; 67 (6): 1099-109.



7. Matsukawa Y, Majima T, Ishida S, Funahashi Y, Kato M, Gotoh M. Useful parameters to predict the presence of detrusor overactivity in male patients with lower urinary tract symptoms. *NeuroUroUrodyn*. 2020; 39 (5): 1394-400.
8. Fornara P, Madersbacher S, Vahlensieck W, Bracher F, Romics I, Kil P. Phytotherapy adds to the therapeutic armamentarium for the treatment of mild-to-moderate lower urinary tract symptoms in men. *Urol Int*. 2020; 104 (5-6): 333-42.
9. Aaron L, Franco OE, Hayward SW. Review of prostate anatomy and embryology and the etiology of benign prostatic hyperplasia. *Urol Clin North Am*. 2016; 43 (5): 279-88.
10. Wei JT, Calhoun E, Jacobsen SJ. Urologic diseases in America project: benign prostatic hyperplasia. *The Journal of urology*. 2005; 173 (4): 1256-61.
11. Cannarella R, Condorelli RA, Barbagallo F, La Vignera S, Calogero AE. Endocrinology of the aging prostate: current concepts. *Front Endocrinol*. 2021; 12: 554078.
12. Devrim E, Durak I. Is garlic a promising food for benign prostatic hyperplasia and prostate cancer? *Mol Nutr Food Res*. 2007; 51 (11): 1319-23.
13. Espinosa G. Nutrition and benign prostatic hyperplasia. *Curr Opin Urol*. 2013; 23 (1): 38-41.
14. Vickman RE, Franco OE, Moline DC, Vander Griend DJ, Thumbikat P, Hayward SW. The role of the androgen receptor in prostate development and benign prostatic hyperplasia: a review. *Asian J Urol*. 2020; 7 (3): 191-202.
15. Nimeh T, Magnan B, Almallah YZ. Benign prostatic hyperplasia: review of modern minimally invasive surgical treatments. *Semin Intervent Radiol*. 2016; 33 (3): 244-50.
16. Chokkalingam AP, Yeboah ED, Demarzo A, Netto G, Yu K, Biritwum RB, et al. Prevalence of BPH and lower urinary tract symptoms in West Africans. *Prostate Cancer Prostatic Dis*. 2011; 15 (2): 170-6.
17. Liu TT, Thomas S, Mclean DT, Roldan-Alzate A, Hernando D, Ricke EA, Ricke WA. Prostate enlargement and altered urinary function are part of the aging process. *Aging*. 2019; 11 (9): 2653-69.
18. Altok M, BağcıÖ, Umul M, Güneş M, Akyüz M, Uruç F, et al. Chromosomal aberrations in benign prostatic hyperplasia patients. *Investig Clin Urol*. 2016; 57(1):45-9.
19. Lee SWH, Chan EMC, Lai YK. The global burden of lower urinary tract symptoms suggestive of benign prostatic hyperplasia: a systematic review and meta-analysis. *Sci Rep*. 2017; 7 (1): 7984.
20. Wen S, Chang HC, Tian J, Shang Z, Niu Y, Chang C. Stromal androgen receptor roles in the development of normal prostate, benign prostate hyperplasia, and prostate cancer. *Am J Pathol*. 2015; 185 (2): 293-301.
21. Nicholson TM, Ricke WA. Androgens and estrogens in benign prostatic hyperplasia: past, present and future. *Differentiation*. 2011; 82 (4-5): 184-99.
22. Bostanci Y, Kazzazi A, Momtahan S, Laze J, Djavan B. Correlation between benign prostatic hyperplasia and inflammation. *Curr Opin Urol*. 2013; 23 (1): 5-10.
23. Gandaglia G, Briganti A, Gontero P, Mondaini N, Novara G, Salonia A, et al. The role of chronic prostatic inflammation in the pathogenesis and progression of benign prostatic hyperplasia (BPH). *BJU International*. 2013; 112 (4): 432-41.
24. Gacci M, Corona G, Vignozzi L, Salvi M, Serni S, De Nunzio C, Tubaro A, et al. Metabolic syndrome and benign prostatic enlargement: a systematic review and meta-analysis. *BJU international*. 2015; 115 (1): 24-31.
25. Choo MS, Han JH, Shin TY, Ko K, Lee WK, Cho ST, et al. Alcohol, smoking, physical activity, protein, and lower urinary tract symptoms: prospective longitudinal cohort. *IntNeuroUroJ*. 2015; 19 (3): 197-206.
26. Lacouture A, Lafront C, Peillex C, Pelletier M, Audet-Walsh É. Impacts of endocrine-disrupting chemicals on prostate function and cancer. *Environ Res*. 2022; 204 (Pt B): 112085.
27. Zhang L, Wang Y, Qin Z, Gao X, Xing Q, Li R, et al. Correlation between prostatitis, benign prostatic hyperplasia and prostate cancer: a systematic review and meta-analysis. *J Cancer*. 2020; 11 (1): 177-89.
28. Shah A, Shah AA, K N, Lobo R. Mechanistic targets for BPH and prostate cancer-a review. *Rev Environ Health*. 2020; 36 (2): 261-70.
29. Dai X, Fang X, Ma Y, Xianyu J. Benign prostatic hyperplasia and the risk of prostate cancer and bladder cancer: a meta-analysis of observational studies. *Medicine*. 2016; 95 (18): 3493.
30. Orsted, DD, Bojesen, SE. The link between benign prostatic hyperplasia and prostate cancer. *Nat Rev Urol*. 2013; 10: 49-54.
31. Bishop FL, Rea A, Lewith H, Chan YK, Saville J, et al. Complementary medicine use by men with prostate cancer: a systematic review of prevalence studies. *Prostate Cancer Prostatic Dis*. 2011; 14: 1-13.
32. Nyamai DW, Mawia AM, Wambua FK, Njoroge A, Matheri F, et al. Phytochemical profile of prunus africana stem bark from Kenya. *J Pharmacogn Nat Prod*. 2015; 1: 110.
33. Russo GI, Scandura C, Di Mauro M, Cacciamani G, Albersen M, Hatzichristodoulou G, et al. Clinical efficacy of serenoa repens versus placebo versus alpha-blockers for the treatment of lower urinary tract symptoms/benign prostatic enlargement: a systematic review and network meta-analysis of randomized placebo-controlled clinical trials. *EurUrol Focus*. 2021; 7 (2): 420-31.
34. Paterniti I, Campolo M, Cordaro M, Siracusa R, Filippone A, Esposito E, Cuzzocrea S. Effects of different natural extracts in an experimental model of benign prostatic hyperplasia (BPH). *Inflamm Res*. 2018; 67 (7): 617-26.
35. Scaglione F, Lucini V, Pannacci M, Dugnani S, Leone C. Comparison of the potency of 10 different brands of Serenoa repens extracts. *Eur Rev Med Pharmacol Sci*. 2012 May 1; 16 (5): 569-74.
36. Leisegang K, Jimenez M, Durairajanayagam D, Finelli R, Majzoub A, Henkel R, et al. A systematic review of herbal medicine in the clinical treatment of benign prostatic hyperplasia. *Phytomedicine Plus*. 2022; 2(1): 100153.
37. Kwon Y. Use of saw palmetto (*Serenoa repens*) extract for benign prostatic hyperplasia. *Food Sci Biotechnol*. 2019; 28 (6): 1599-606.
38. Latil A, Pétrissans MT, Rouquet J, Robert G, de la Taille A. Effects of hexanic extract of *Serenoa repens* (Permixon® 160 mg) on inflammation biomarkers in the treatment of lower urinary tract symptoms related to benign prostatic hyperplasia. *The Prostate*. 2015; 75 (16): 1857-67.
39. Sudeep HV, Venkatakrishna K, Amrutharaj B, Anitha, Shyamprasad



- K. A phytosterol-enriched saw palmetto supercritical CO<sub>2</sub> extract ameliorates testosterone-induced benign prostatic hyperplasia by regulating the inflammatory and apoptotic proteins in a rat model. *BMC Complement Altern Med*. 2019; 19 (1): 270.
40. Yun JM, Lee M, Kim D, Prasad KS, Eun S, Kim OK, Lee J. Standardized saw palmetto extract directly and indirectly affects testosterone biosynthesis and spermatogenesis. *J Med Food*. 2021; 24 (6): 617-25.
41. Kumar DG, Deepa P, Rathi MA, Meenakshi P, Gopalakrishnan VK. Modulatory effects of *Crataeva nurvala* bark against testosterone and N-methyl-N-nitrosourea-induced oxidative damage in prostate of male albino rats. *Pharmacogn Mag*. 2012; 8 (32): 285-91.
42. Shrivastava A, Gupta VB. Various treatment options for benign prostatic hyperplasia: a current update. *J Midlife Health*. 2012; 3 (1): 10-9.
43. Sridhar N, Venkataraman S, Mishra M, Ravikumar R, Jeeva SKE. Anti-nephrolithiatic effect of *Crataeva magna* Lour. root on ethylene glycol induced lithiasis. *Int J Pharm Ind Res* 2011; 1 (2): 135-7.
44. Chhatre S, Nesari T, Somani G, Kanchan D, Sathaye S. Phytopharmacological overview of *Tribulus terrestris*. *Pharmacogn Rev*. 2014; 8 (15): 45-51.
45. Kaushik J, Tandon S, Bhardwaj R, Kaur T, Singla SK, Kumar J, Tandon C. Delving into the antiurolithiatic potential of *tribulus terrestris* extract through -in vivo efficacy and preclinical safety investigations in wistar Rats. *Sci Rep*. 2019; 9 (1): 15969.
46. Oh JS, Baik SH, Ahn EK, Jeong W and Hong SS: Anti-inflammatory activity of *Tribulus terrestris* in raw 264.7 Cells. *J Immunol*. 2012; 188 (1) 54.2.
47. Soleimanpour S, Sedighinia FS, Safipour Afshar A, Zarif R, Ghazvini K. Antibacterial activity of *Tribulus terrestris* and its synergistic effect with *Capsella bursa-pastoris* and *Glycyrrhiza glabra* against oral pathogens: an in-vitro study. *Avicenna J Phytomed*. 2015; 5 (3): 210-7.
48. Vyas AB, Desai NY, Patel PK, Joshi SV, Shah DR. Effect of *Boerhaavia diffusa* in experimental prostatic hyperplasia in rats. *Indian J Pharmac*. 2013; 45 (3): 264-69.
49. Lesjak M, Beara I, Simin N, Pintać D, Majkić T, Bekvalac K, et al. Antioxidant and anti-inflammatory activities of Quercetin and its derivatives. *JFunctFoods*. 2018; 40: 68-75.
50. Gardi C, Bauerova K, Stringa B, Kuncirova V, Slovak L, Ponist S, et al. Quercetin reduced inflammation and increased antioxidant defense in rat adjuvant arthritis. *Arch BiochemBiophys*. 2015; 583: 150-7.
51. Hashemzaei M, Delarami Far A, Yari A, Heravi RE, Tabrizian K, Taghdisi SM, et al. Anticancer and apoptosis-inducing effects of quercetin in vitro and in vivo. *OncolRep*. 2017; 38 (2): 819-28.
52. Shoskes DA, Zeitlin SI, Shahed A, Rajfer J. Quercetin in men with category III chronic prostatitis: a preliminary prospective, double-blind, placebo-controlled trial. *Urology*. 1999; 54 (6): 960-5.
53. Ghorbanibirgani A. Efficacy of quercetin in treatment of benign prostatic hyperplasia in a double-blind randomized clinical trial in Iran 2011. *Contraception*. 2012; 85 (3): 321.
54. Morgia G, Privitera S. Phytotherapy in benign prostatic hyperplasia. In *Lower Urinary Tract Symptoms and Benign Prostatic Hyperplasia*. Cambridge: Academic Press; 2018: 135-75.
55. Damiano R, Cai T, Fornara P, Franzese CA, Leonardi R, Mirone V. The role of *Cucurbita pepo* in the management of patients affected by lower urinary tract symptoms due to benign prostatic hyperplasia: a narrative review. *Arch Ital UrolAndrol*. 2016; 88 (2): 136-45.
56. Vahlensieck W, Theurer C, Pfitzer E, Patz B, Banik N, Engelmann U. Effects of pumpkin seed in men with lower urinary tract symptoms due to benign prostatic hyperplasia in the one-year, randomized, placebo-controlled GRANU study. *Urol Int*. 2015; 94 (3): 286-95.
57. Ilic D, Misso M. Lycopene for the prevention and treatment of benign prostatic hyperplasia and prostate cancer: a systematic review. *Maturitas*. 2012; 72 (4): 269-76.
58. Ulbricht CE. An evidence-based systematic review of beta-sitosterol, sitosterol (22,23-dihydrostigmasterol, 24-ethylcholesterol) by the natural standard research collaboration. *J Diet Suppl*. 2016; 13 (1): 35-92.

# Knowledge, Attitudes, and COVID-19 Prevention Practices of Healthcare Workers in Indonesia: A Mobile-based Cross-sectional Survey

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## Abstract

Knowledge of disease can affect attitudes and prevention practices, and wrong attitudes and practices can directly increase the risk of disease infection. This study aimed to describe the knowledge, attitudes, and COVID-19 prevention practice of healthcare workers in Indonesia and factors associated with prevention practices. A mobile-based cross-sectional survey was conducted in August 2020 with 254 healthcare workers in Indonesia. The self-administered questionnaire consisted of four parts: 1) sociodemographic information, 2) knowledge of COVID-19, 3) attitudes and anxiety toward COVID-19, and 4) COVID-19 prevention practices. The results indicated that healthcare workers in Indonesia had excellent knowledge and positive attitudes about COVID-19, but their prevention practices were lacking. The multiple logistic regression analysis results revealed that the factors associated with the COVID-19 prevention practices of healthcare workers in Indonesia were knowledge, attitudes, anxiety, domicile island, age, income, and education. Healthcare workers who had excellent knowledge, positive attitudes, and high anxiety exhibited better COVID-19 prevention practices than others. Healthcare workers in Sumatra Island, aged 41–50 years, and an undergraduate education showed better COVID-19 prevention practices than others.

**Keywords:** attitudes, COVID-19, healthcare workers, knowledge, practices

## Introduction

Coronavirus disease 2019 (COVID-19), a disease caused by SARS-CoV-2, was first identified in the city of Wuhan in China's Hubei Province in December 2019.<sup>1</sup> On January 30, 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a public health emergency of international concern.<sup>2</sup> On March 11, 2020, WHO declared the COVID-19 outbreak a pandemic.<sup>3</sup> This ongoing pandemic has spread extremely quickly, with more than 162.7 million confirmed cases of infection and more than 3.37 million deaths (2.1%) worldwide as of May 18, 2021.<sup>4</sup> In Indonesia, the first case of COVID-19—a mother and child—was reported on March 2, 2020.<sup>5</sup> To date (May 18, 2021), there have been 1,748,230 confirmed cases of infection in Indonesia and more than 48,477 deaths (2.8%).<sup>6</sup>

Countries worldwide have implemented various methods to prevent wider transmission, such as social distancing, washing hands, limiting means of transportation, closing public places, testing, and contact tracing.<sup>7</sup> Healthcare workers are at high risk of contracting COVID-19 because they are directly involved in provid-

ing services to help control the ongoing outbreak. Therefore, all precautions should be taken to control the spread of infection to health workers. Prevention efforts can be initiated by identifying risk factors for infection and taking appropriate action to reduce these risks.

Previous study had shown that the occurrence of disease transmission among healthcare workers was associated with overcrowding, the absence of isolation room facilities, and environmental contamination. The risk of transmission is exacerbated by the fact that some healthcare workers do not have sufficient awareness of infection prevention practices.<sup>8</sup> Knowledge of disease can affect the attitudes and practices of healthcare workers, and wrong attitudes and practices can directly increase the risk of infection.<sup>9</sup> A good understanding of health workers' knowledge, attitudes, practices, and possible risk factors can help predict expected positive behaviors.

Currently, the use of mobile-based surveys is growing and is an opportunity that can be utilized for research. The existence of technology support and adequate mobile-based infrastructure is something positive that must be utilized. The use of mobile survey vases has great po-

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tential to support data collection in the health sector, including surveys on COVID-19. There has been no study on the knowledge, attitudes, and prevention practice of healthcare workers in Indonesia related to COVID-19. Therefore, this study aimed to analyze the knowledge, attitudes, and COVID-19 prevention practices of healthcare workers in Indonesia and factors associated with prevention practices using a mobile-based cross-sectional survey.

## Method

A cross-sectional survey was conducted throughout Indonesia in August 2020. The survey was conducted online (mobile-based data collection) because it was impossible to conduct face-to-face interviews during the large-scale social distancing (LSRR)/*Pembatasan Sosial Berskala Besar* (PSBB) that had been in place since the beginning of the COVID-19 pandemic. The study population consisted of health personnel, including doctors, nurses, midwives, nutritionists, laboratory assistants, and public health experts who provided health services during the COVID-19 pandemic as eligibility criteria. The sample size was calculated using the proportion estimation formula at a 95% confidence interval. An estimated proportion of healthcare workers with prevention practices regarding COVID-19 was at 60%, and a precision of 6%, the minimum sample required was 257 respondents. Of the 311 responses, 35 respondents filled in incomplete, and 22 filled in double. The final sample comprised 254 respondents who completed the entire survey.

A self-administered questionnaire collected data on health workers' knowledge, attitudes toward, and prevention practices regarding COVID-19. Surveys were hosted on the KoBoToolbox platform. The KoBoToolbox platform allowed for questionnaire design, data collection, descriptive analysis, and data download via Excel spreadsheets for further analysis. The questionnaire link contained the invitation to participate in the online survey, and eligibility criteria were sent randomly via a WhatsApp group of healthcare workers. The WhatsApp groups of healthcare workers included medicine, nursing, midwifery, public health, nutrition, and laboratory assistants. WhatsApp message delivery contained an explanation of the survey and informed consent, as well as the respondent's eligibility criteria. If potential respondents agree, they could click on the questionnaire link available on the KoboToolbox platform. In the questionnaire on the KoboToolbox platform, informed consent and eligibility criteria were asked again. If the respondent agrees, a list of questions would appear, and the respondents fill that in.

The completed questionnaires were taken from the KoBoToolbox form and exported to Microsoft Excel 2010 for data cleaning and coding. The clean data was

exported to IBM SPSS Statistics in the Computer Laboratory of Faculty of Public Health, Universitas Indonesia (IBM SPSS Version 17). The respondents' knowledge of COVID-19 consisted of 18 questions (true or false) about symptoms, transmission, prevention, and control of COVID-19. Correct answers were given a score of 1, and incorrect answers were given 0. The total knowledge score ranged from 6 to 18. A score of 13 or less was considered quiet, 14–15 was considered good, and 16–18 was considered very good.

The respondents' attitudes toward COVID-19 consisted of ten questions (agree or disagree) about prevention, use of masks, beliefs, worship in mosques, and physical distancing. Positive attitude answers were given a score of 1, and negative attitude answers were given 0. The attitude score ranged from 1 to 10. Scores less than 8 were categorized as negative, scores 8–9 were classified as positive, and a score of 10 was categorized as very positive.

The respondents' anxiety about COVID-19 consisted of four questions about the pressure of family members and respondents' health. The answers were ranged from 1 (not at all anxious) to 100 (very anxious). An anxiety score of 80 or less was categorized as low anxiety, and a score of 81 or more was classified as high anxiety. The respondents' practices related to COVID-19 consisted of 12 questions about COVID-19 prevention and control methods, including wearing masks, keeping distance, washing hands, avoiding crowds, and avoiding mobility. Answers ranged from 1 (never practicing) to 100 (always practicing). A prevention practice score of 80 or less was categorized as less, and a score above 80 was classified as good.

The survey questionnaire was adopted from previous studies on COVID-19 and other materials about the COVID-19 pandemic.<sup>10-14</sup> Several questions were added according to Indonesian conditions, including knowledge and prevention practice of COVID-19 referring to the COVID-19 Prevention and Control Guidelines published by the Ministry of Health of the Republic of Indonesia.<sup>15</sup> This survey questionnaire has the advantage of being valid and reliable and adopting the Indonesian context. The knowledge questionnaire of COVID-19 was valid and reliable with good internal validity and reliability testing (Cronbach's alpha = 0.661, item-total correlation more than 0.3). The attitudes questionnaire toward COVID-19 was valid and reliable with good internal validity and reliability testing (Cronbach's alpha = 0.674, item-total correlation more than 0.3). The anxiety questionnaire about COVID-19 was valid and reliable with good internal validity and reliability (Cronbach's alpha = 0.844, item-total correlation more than 0.4). The prevention practices questionnaire related to COVID-19 was valid and reliable with good internal validity and reliabil-

ity testing (Cronbach’s alpha = 0.885, item-total correlation more than 0.5).

The data analysis consisted of descriptive statistics, and the frequency, percentage, mean, and standard deviation distribution were included. The bivariate analysis using a Chi-square test was also utilized to assess the relationship between healthcare workers’ knowledge, attitudes, and sociodemographic characteristics of COVID-19 prevention practices. Multiple logistic regression with a significance level of 0.05 was carried out to identify the odds ratio and factors associated with COVID-19 prevention practices.

**Results**

The results will be presented in the form of tables and narratives. The description of the respondent’s characteristics, knowledge, attitudes, anxiety, and COVID-19 prevention practices will be followed by factors associated with COVID-19 prevention practices.

A total of 254 healthcare workers participated in the survey. Respondents were scattered throughout

Indonesia, from Java Island (40.6%), Sulawesi Island (30.7%), Sumatra Island (19.7%), and Kalimantan Island (9.1%). Mainly, the respondents were 21–30 years old (44.9%) and had an IDR 2.5–5.0 million per month income (42.1%). There were more female respondents (83%) than male respondents. Respondents with a diploma education level constituted the largest proportion (47.6%). Most of the respondents worked as midwives (52.4%).

Knowledge of COVID-19 symptoms was measured through questions about symptoms and transmission. The level of the respondents’ knowledge is presented in Table 1. In general, healthcare workers’ knowledge about the symptoms and transmission of COVID-19 was good. Fever, cough, and asphyxiate were the three main symptoms recognized by more than 97% of healthcare workers. In comparison, only 68% of respondents knew that headaches were a symptom of COVID-19 and that all infected people show symptoms. Interestingly, only 34% of respondents knew that loss of the sense of taste or smell was a symptom of COVID-19.

**Table 1. Knowledge of COVID-19 (n = 254)**

| Knowledge of COVID-19 |   | *Correct Answer (%) |
|-----------------------|---|---------------------|
| Symptoms              | Fever   | 98.4                |
|                       | Cough   | 97.2                |
|                       | Asphyxiate  | 97.2                |
|                       | Sore throat   | 96.9                |
|                       | Cold  | 87.4                |
|                       | Headache  | 68.5                |
|                       | Everyone infected with the COVID-19 will show symptoms of illness                                 | 68.9                |
|                       | Loss of taste/smell   | 34.3                |
| Transmission          | COVID-19 is transmitted through physical contact (touching/shaking hands)                         | 92.9                |
|                       | Washing hands with a hand sanitizer is effective in preventing transmission of the COVID-19       | 94.5                |
|                       | Touching the mouth/nose/eyes with hands is at risk of being infected with the COVID-19            | 98.0                |
|                       | Washing hands with soap and running water is effective in preventing transmission of the COVID-19 | 99.2                |
|                       | COVID-19 is transmitted through droplets when sneezing/coughing                                   | 98.4                |
|                       | Infected people who experience no symptoms can still transmit the virus to others                 | 98.8                |
|                       | The use of masks is effective in preventing transmission of the COVID-19                          | 99.2                |
|                       | Staying at home is effective in preventing the spread of the COVID-19                             | 99.2                |
|                       | Avoiding handshakes is effective in preventing transmission of the COVID-19                       | 99.2                |
|                       | Physical distancing is effective in preventing transmission of the COVID-19                       | 100.0               |

Note: \*Percentage of the respondents that answered correctly

**Table 2. Attitudes about COVID-19 Prevention (n = 254)**

| Attitudes about COVID-19 Prevention   | *Agrees (%) |
|---|-------------|
| Apply physical distancing during the COVID-19 pandemic  | 99.6        |
| Wear a mask when meeting relatives/friends/neighbors  | 98.8        |
| Avoid handshakes/physical contact when meeting relatives/friends/neighbors  | 98.4        |
| Avoid going to malls, markets, or other crowds  | 96.9        |
| Implement large-scale social restrictions (lockdown) during the COVID-19 pandemic                                   | 95.7        |
| Not attending religious recitation in mosques   | 87.0        |
| Large-scale social restrictions violators must be subject to sanctions/fines  | 80.3        |
| Avoid congregational prayer in mosques/public places during LSRR  | 75.6        |
| Leaving Friday prayers for Muslims during the lockdown and replacing them with midday prayers at home               | 71.3        |
| Keep praying in congregation at the mosque during lockdown because you believe that illness is a provision of Allah | 62.2        |

Note: \*Percentage of the respondents that agrees with the statement



**Table 3. Anxiety about COVID-19 (n = 254)**

| Anxiety about COVID-19                             | *Mean Score±SD |
|--|----------------|
| The news about COVID-19 worries me                 | 82.8±19.2      |
| I am worried about my health                       | 84.6±21.7      |
| I am worried about the health of my family members | 87.6±20.3      |
| I worry when I have to leave the house             | 87.8±18.2      |

Notes: SD: Standard Deviation, \*Not at all anxious (Score 1), very anxious (Score 100)

**Table 4. COVID-19 Transmission Prevention Practices (n = 254)**

| COVID-19 Transmission Prevention Practices                       | *Mean Score±SD |
|--|----------------|
| Use hand sanitizer   | 35.0±47.8      |
| Wear a mask  | 39.4±49.0      |
| Avoid using public transportation                                | 65.4±47.7      |
| Avoid congregational prayer in mosques/other public places       | 66.9±47.1      |
| Avoid handshakes   | 68.1±46.7      |
| Avoid touching objects in public areas                           | 75.2±43.3      |
| Avoid crowds at malls, markets, or others                        | 75.6±43.0      |
| Wash hands with soap   | 78.7±41.0      |
| Avoid gatherings, crowds, or long queues                         | 78.7±41.0      |
| Keep a distance of two meters when interacting with other people | 79.5±40.4      |
| Avoid touching the face, eyes, nose, or mouth                    | 85.4±35.3      |
| Wear gloves  | 86.6±34.1      |

Notes: SD: Standard Deviation, \*Never (score 1), Always (score 100)

Regarding the transmission of COVID-19, all (100%) healthcare workers knew that physical distancing was an effective way to prevent transmission of the COVID-19. More than 99% of healthcare workers knew that washing their hands with soap, wearing masks, avoiding handshakes, and staying at home were effective ways to prevent transmission. A total of 92.9% of healthcare workers knew that COVID-19 could be transmitted through handshakes, and 94.5% knew that hand sanitizer effectively prevented transmission.

Respondents' attitudes and anxiety are presented in Tables 2 and 3. In general, healthcare workers in Indonesia had positive attitudes about the prevention of COVID-19 (mean score 86.4%). Three positive attitudes (highest ranking) that were answered agreeably by more than 98% of respondents related to 1) physical distancing, 2) wearing a mask, and 3) avoiding handshakes or physical contact. The less positive attitudes shown by respondents (answered agree 62%–75%), related to 1) continuing congregational prayer at the mosque during the lockdown period (because they believe that illness is a provision of Allah) and 2) not leading Friday prayers for Muslims in lockdown areas. Scores related to respondents' anxiety are presented in Table 3. In general, healthcare workers in Indonesia had a very high anxiety score related to COVID-19. Anxiety about the health of family members (mean 87.6) was higher than anxiety about res-

pondents' own health (mean 84.6). Respondents were also very anxious when they needed to leave the house (mean 87.8) and worried about news about COVID-19 (mean 82.8).

The COVID-19 prevention practices of healthcare workers are presented in Table 4. In general, healthcare workers in Indonesia had poor practices related to the prevention of COVID-19. These poor practices were reflected in the low level of use of masks and hand sanitizer (mean scores of 35.0 and 39.4, respectively). Many healthcare workers indicated that they did not avoid using public transportation, praying in congregations in mosques, or shaking hands (mean scores 65.4, 66.9, and 68.1, respectively). However, the healthcare workers had also implemented many good COVID-19 prevention practices, including wearing gloves (mean score 86.6); avoiding touching their face, eyes, nose, and mouth (85.4); washing hands with soap (78.7); avoiding crowds (78.7); keeping a distance of two meters when interacting with others (79.5).

Table 5 shows an overview of the health workers' COVID-19 prevention practices and their distribution according to knowledge, attitudes, anxiety, and demographic characteristics. The practice scores were categorized as either poor practice or good practice. Less than half (46.5%) of the healthcare workers properly practiced COVID-19 prevention. COVID-19 prevention practices varied according to respondents' characteristics relating to respondents' knowledge, attitudes, and anxiety.

A relationship between knowledge, attitudes, and anxiety and COVID-19 prevention practices was identified. The higher the worker's knowledge, the better COVID-19 prevention practices. As much as 53.9% of the well-informed healthcare workers had good COVID-19 prevention practices. Only 41–45% of less well-informed healthcare workers had good COVID-19 prevention practices.

The more positive the worker's attitude, the better they will handle COVID-19 prevention practices. The 48–49% of healthcare workers with positive or very positive attitudes had good COVID-19 prevention practices. Only 41% of healthcare workers with negative attitudes had good COVID-19 prevention practices. Anxiety was found to enhance good COVID-19 prevention practices. A total of 56.4% of anxious healthcare workers had good COVID-19 prevention practices. In contrast, only 28.6% of healthcare workers who were not anxious had good COVID-19 prevention practices.

Prevention practices were lacking among healthcare workers in Sumatra and Java Island (32.0% and 38.8%, respectively). In comparison, healthcare workers on Kalimantan and Sulawesi Islands had good practices (56.5% and 62.8%, respectively). COVID-19 prevention



**Table 5. The Relationship between Knowledge, Attitudes, Anxiety, and Demographic Characteristics with COVID-19 Prevention Practices (n = 254)**

| Independent Variable | Category  | COVID-19 Prevention Practices |      |         |      |         |      |
|----------------------|---|-------------------------------|------|---------|------|---------|------|
|                      |   | Less                          |      | Good    |      | Total   |      |
|                      |   | n = 136                       | %    | n = 118 | %    | n = 254 | %    |
| Knowledge            | Quite   | 46                            | 54.8 | 38      | 45.2 | 84      | 33.1 |
|                      | Good  | 55                            | 58.5 | 39      | 41.5 | 94      | 37.0 |
|                      | Very good   | 35                            | 46.1 | 41      | 53.9 | 76      | 29.9 |
| Attitudes            | Negative  | 46                            | 59.0 | 32      | 41.0 | 78      | 30.7 |
|                      | Positive  | 44                            | 50.6 | 43      | 49.4 | 87      | 34.3 |
|                      | Very positive   | 46                            | 51.7 | 43      | 48.3 | 89      | 35.0 |
| Anxiety              | Low   | 65                            | 71.4 | 26      | 28.6 | 91      | 35.8 |
|                      | High  | 71                            | 43.6 | 92      | 56.4 | 163     | 64.2 |
| Domicile Island      | Sumatra   | 34                            | 68.0 | 16      | 32.0 | 50      | 19.7 |
|                      | Java  | 63                            | 61.2 | 40      | 38.8 | 103     | 40.6 |
|                      | Kalimantan  | 10                            | 43.5 | 13      | 56.5 | 23      | 9.1  |
|                      | Sulawesi  | 29                            | 37.2 | 49      | 62.8 | 78      | 30.7 |
| Age                  | 21–30 years   | 65                            | 57.0 | 49      | 43.0 | 114     | 44.9 |
|                      | 31–40 years   | 52                            | 54.7 | 43      | 45.3 | 95      | 37.4 |
|                      | 41–50 years   | 19                            | 42.2 | 26      | 57.8 | 45      | 17.7 |
| Sex                  | Male  | 17                            | 39.5 | 26      | 60.5 | 43      | 16.9 |
|                      | Female  | 119                           | 56.4 | 92      | 43.6 | 211     | 83.1 |
| Income               | <IDR 2.5 million  | 36                            | 36.4 | 63      | 63.6 | 99      | 39.0 |
|                      | IDR 2.5–5.0 million   | 69                            | 64.5 | 38      | 35.5 | 107     | 42.1 |
|                      | >IDR 5.0 million  | 31                            | 64.6 | 17      | 35.4 | 48      | 18.9 |
| Education            | 3-year diploma  | 62                            | 51.2 | 59      | 48.8 | 121     | 47.6 |
|                      | 4-year diploma  | 25                            | 69.4 | 11      | 30.6 | 36      | 14.2 |
|                      | Bachelor  | 14                            | 32.6 | 29      | 67.4 | 43      | 16.9 |
|                      | Professional education                                      | 19                            | 65.5 | 10      | 34.5 | 29      | 11.4 |
| Profession           | Master  | 16                            | 64.0 | 9       | 36.0 | 25      | 9.8  |
|                      | Doctor  | 4                             | 80.0 | 1       | 20.0 | 5       | 2.0  |
|                      | Nurse   | 15                            | 48.4 | 16      | 51.6 | 31      | 12.2 |
|                      | Professional nurse  | 7                             | 58.3 | 5       | 41.7 | 12      | 4.7  |
|                      | Midwife   | 78                            | 58.6 | 55      | 41.4 | 133     | 52.4 |
|                      | Public health expert, nutritionist, or laboratory assistant | 32                            | 43.8 | 41      | 56.2 | 73      | 28.7 |

practices differed according to age group and sex. Healthcare workers aged 41–51 years had better practices (57.8%) than healthcare workers aged 21–40 years (43.0–45.3%). Male healthcare workers had better practices (60.5%) than female healthcare workers (43.6%). COVID-19 prevention practices also differed according to income. Healthcare workers with low incomes (less than IDR 2.5 million per month) had better practices (63.6%) than healthcare workers with incomes above IDR 2.5 million per month (35%).

COVID-19 prevention practices also differed by education level and type of profession. Workers who had completed an undergraduate degree (67.4%) exhibited better knowledge of prevention practices than workers who had completed a diploma, professional education, or master’s degree (30.6–48.8%). Public health experts, nutritionists, and laboratory assistants exhibited better practices (56.2%) than other professions (20.0–51.6%).

The multiple logistic regression analysis results (Table 6) show the factors associated with COVID-19 prevention practices among healthcare workers in Indonesia.

Healthcare workers with very good knowledge of COVID-19 were twice as likely to practice good COVID-19 prevention behavior than healthcare workers with less knowledge (ORa = 2.03, p-value = 0.090). Healthcare workers with positive or very positive attitudes were twice as likely to practice good COVID-19 prevention behavior than healthcare workers with negative attitudes (ORa = 2.02 and 2.03; p-value = 0.071 and 0.095, respectively). Healthcare workers with high anxiety were three times more likely to practice good COVID-19 prevention behavior than healthcare workers with low anxiety (ORa = 3.14, p-value<0.001).

Healthcare workers from Sumatra Island had the worst COVID-19 prevention practices compared to healthcare workers from other islands. Healthcare workers from Java, Sulawesi, and Kalimantan Island were 2.58–3.36 times more likely to practice good COVID-19 prevention behavior than those from Sumatra Island (ORa = 2.58–3.36, p-value = 0.039–0.067). Healthcare workers aged 41–50 years were 2.6 times more likely to practice good COVID-19 prevention behavior than

**Table 6. Multiple Logistic Regression Results for Factors Associated with COVID-19 Prevention Practices (n = 254)**

| Independent Variable            | Category               | Sig (2-tailed) | Coeff B | ORa  | 95% CI ORa |       |
|---------------------------------|------------------------|----------------|---------|------|------------|-------|
|                                 |                        |                |         |      | LL         | UL    |
| Knowledge (Ref. quite)          | Good                   | 0.277          | 0.431   | 1.54 | 0.71       | 3.34  |
|                                 | Very good              | 0.090          | 0.710   | 2.03 | 0.89       | 4.63  |
| Attitudes (Ref. negative)       | Positive               | 0.095          | 0.704   | 2.02 | 0.88       | 4.62  |
|                                 | Very positive          | 0.071          | 0.708   | 2.03 | 0.94       | 4.38  |
| Anxiety (Ref. high)             |                        | 0.001          | 1.144   | 3.14 | 1.65       | 5.97  |
| Domicile island (Ref. Sumatera) | Java                   | 0.039          | 0.959   | 2.61 | 1.05       | 6.49  |
|                                 | Kalimantan             | 0.053          | 1.212   | 3.36 | 0.98       | 11.49 |
|                                 | Sulawesi               | 0.067          | 0.948   | 2.58 | 0.94       | 7.12  |
| Age (Ref. 21–30 years)          | 31–40 years            | 0.540          | 0.214   | 1.24 | 0.63       | 2.45  |
|                                 | 41–50 years            | 0.041          | 0.967   | 2.63 | 1.04       | 6.66  |
| Income (<IDR 2.5 million)       | IDR 2.5–5.0 million    | 0.011          | -0.949  | 0.39 | 0.19       | 0.81  |
|                                 | >IDR 5.0 million       | 0.031          | -1.141  | 0.32 | 0.11       | 0.90  |
| Education (Ref. 3-year diploma) | 4-year diploma         | 0.289          | -0.493  | 0.61 | 0.25       | 1.52  |
|                                 | Bachelor               | 0.088          | 0.777   | 2.17 | 0.89       | 5.31  |
|                                 | Professional education | 0.787          | -0.141  | 0.87 | 0.31       | 2.41  |
| Constant                        | Master                 | 0.994          | 0.004   | 1.00 | 0.35       | 2.86  |
|                                 |                        | 0.048          | -1.342  |      |            |       |

Notes: Sig = Significant, Ref = Reference group, ORa = adjusted Odds Ratio, LL = Lower Limit, UL = Upper Limit

healthcare workers aged 21–30 years (ORa = 2.63, p-value = 0.041). Healthcare workers with an undergraduate level of education were twice as likely to practice good COVID-19 prevention compared to healthcare workers with a 3-year diploma (ORa = 2.17, p-value = 0.088).

**Discussion**

This research was carried out in the early and middle stages of the COVID-19 outbreak in Indonesia (August 2020), still in a critical transmission period after the Muslim religious festivals of Ramadan and Eid al-Fitr. An understanding and analysis of the knowledge, attitudes, and practices of healthcare workers and the factors that influence them can help prevent the wider spread of COVID-19 among healthcare workers and from healthcare workers to the general public. The results of this study were in line with those of previous studies on healthcare workers in China, Pakistan, Nigeria, and Sierra Leone.<sup>11-14</sup> This could explain that many healthcare workers have contracted COVID-19 because of their poor COVID-19 prevention practices. This study showed that most healthcare workers in Indonesia had a good knowledge of and positive attitudes toward fighting COVID-19, but the practices of preventing COVID-19 were still not good. So that more strenuous efforts are needed to improve COVID-19 prevention practices among healthcare workers. It is not enough to increase knowledge and attitudes only, but more importantly, discipline healthcare workers who do not comply with COVID-19 prevention practices.<sup>11,16</sup>

The finding of this study showed that proper preventive practices among Indonesian healthcare workers were

still lacking, the use of hand sanitizers and masks was still very low (mean score 35.0 and 39.4). They had a high potential for contracting and transmitting COVID-19 because many used public vehicles, came to the area crowds at malls and markets, did handshakes, and congregational prayer in mosques or other public places. The use of hand sanitizer and masks needs to be improved. At the beginning of the COVID-19 pandemic, masks and hands were scarcely sanitized due to high demand and limited production capacity. A measure to manage the scarcity of masks for use by healthcare workers by WHO was the recommendation that only COVID-19 patients with respiratory symptoms or COVID-19 caregivers should use masks.<sup>17</sup>

The logistic regression analysis results indicated that knowledge affected disease prevention practices. The better the health workers’ knowledge, the better their prevention practices (ORa = 2.03; 95% CI = 0.89–4.63). This finding aligned with studies on healthcare workers in Pakistan and Nigeria, which found a positive correlation between knowledge and practice (r = 0.142, p-value = 0.016).<sup>12,13</sup> Knowledge is a prerequisite for building beliefs, forming positive attitudes, and promoting good behavior or practice. Individuals’ knowledge and attitudes toward disease influence their effectiveness in disease prevention strategies and practices.<sup>9</sup>

This study also revealed that 86.4% of healthcare workers in Indonesia had positive attitudes toward COVID-19. This study shared the same result with a study on healthcare workers in Nigeria in which 88.5% of healthcare workers expressed positive attitudes toward COVID-19.<sup>13</sup> The results of the multiple logistic regres-

sion analysis showed that healthcare workers who had positive attitudes were twice as likely as healthcare workers with negative attitudes to practice good preventative practices (ORa = 2.02; 95% CI = 0.88–4.62). These findings were consistent with studies of healthcare workers in Pakistan and Nigeria, which found a positive correlation between knowledge, attitudes, and COVID-19 prevention practices ( $r = 0.174$ ,  $p\text{-value} = 0.004$ ).<sup>12,13</sup> This correlation can be explained by reasoned action theory. This theory states that a person's intention to carry out a particular behavior is a function of his knowledge and attitude toward that behavior.<sup>18</sup> In the highly dynamic COVID-19 pandemic situation, it is essential to update the knowledge and attitudes of healthcare workers so that they can carry out better prevention practices.

This study indicated that healthcare workers in Indonesia had good knowledge (67%) and positive attitudes (69.3%) about COVID-19. However, their prevention practices were lacking (46.5%). There were gaps in specific aspects of knowledge and practice that warrant attention. It is important to carry out information dissemination, training, and workshops on a regular basis to maintain the knowledge and good attitude of healthcare workers and to oblige them to practice COVID-19 prevention. Involving professional organizations of health workers and government support is very important to make this happen. It is necessary to develop a pocketbook and educational videos containing practical guidelines for COVID-19 prevention practices that are easily accessible. In addition, it is also important to provide rewards and punishments for healthcare workers who are obedient and disobedient to COVID-19 prevention practices.<sup>16,19</sup> Besides, the factors associated with COVID-19 prevention practices of healthcare workers in Indonesia were knowledge, attitudes, anxiety, the island of domicile, age, income, and education. Healthcare workers who had very good knowledge, positive attitudes, and high anxiety exhibited better COVID-19 prevention practices than others. Healthcare workers in Sumatra Island showed bad COVID-19 prevention practices compared to other regions. Healthcare workers aged 41–50 years and undergraduate education exhibited better COVID-19 prevention practices than others.

The important finding of this study was that healthcare workers who have good knowledge and positive attitudes regarding COVID-19 tend to implement good COVID-19 prevention practices in health services and their daily life. It recommends that it is essential to regularly monitor the implementation of preventive practices during the pandemic to provide continuous improvement responses.<sup>16</sup> The government needs to issue health service practice guidelines modified following the COVID-19 pandemic and disseminated in online forums involving all professional organizations. This is expected to help

the readiness of healthcare workers to provide safer services, both for themselves and for others, to prevent the transmission of COVID-19.<sup>20</sup>

### Strength and Limitations

The use of a mobile-based survey becomes the strength of this study. It will be an opportunity to be utilized for research, including data collection in the health sector and surveys on COVID-19. The existence of technology that supports and adequate mobile-based infrastructure is something positive that had been utilized in this survey. The research questionnaire was adopted from previous research, and the results of the Cronbach's alpha test and item-total correlation found that the questionnaire was valid and reliable. The results of this study can be initial information about knowledge, attitudes, and practices for healthcare workers during the COVID-19 pandemic. These results can be utilized in effective risk communication and education on COVID-19 epidemic control.

This study has several limitations and biases that need to be considered when interpreting the findings. First, the design of the study—the cross-sectional study, cannot conclude direct causality between independent and dependent variables. Secondly, sample coverage—this online survey and a convenient sample were employed to target healthcare workers. With that in mind, the findings may not represent all types of healthcare workers in Indonesia, for instance, the lack of sample size for the subgroup of doctors and uneven distribution of healthcare workers (dominated by midwives and public health experts). Therefore, the generalization of the results of this study must be carried out with caution because it could not describe the whole healthcare workers in Indonesia, especially the subgroup of doctors. It is recommended that future studies should focus on each healthcare worker, for example, the doctor's population only or the nurse's population only, to provide better and more representative results.

Thirdly, internet access selection bias—to participate in this online survey, respondents relied heavily on the availability of internet access. Respondents were also limited to healthcare workers who used a specific WhatsApp group. It is recommended that future studies not only use WhatsApp groups but also combine with other social media such as Telegram, Facebook, Twitter, Instagram, and e-mail. Although internet access in Indonesia covers 73.7% of the entire population,<sup>21</sup> limitations in sample selection still exist in this study, especially for health workers who do not have internet access.

### Conclusion and Recommendations

This study reveals that most healthcare workers in

Indonesia have a good knowledge of and positive attitudes toward COVID-19 and high anxiety about personal and family health. However, their COVID-19 prevention practices are still not good. There is a positive correlation between knowledge and attitudes and COVID-19 prevention practices. The healthcare workers who have good knowledge and positive attitudes regarding COVID-19 tend to implement good COVID-19 prevention practices in health services and daily life.

It recommends that public health education be continuously improved, focusing on groups of healthcare workers with a lack of knowledge, attitudes, and practices. It is necessary to involve professional organizations of health workers to oblige all healthcare workers to practice covid-19 prevention, carry out information dissemination, conduct online workshops on a regular basis, provide websites related to COVID-19 prevention practices, and distribute regular messages and educational videos on COVID-19 prevention practices through social media to maintain the good knowledge, attitude, and practices of healthcare workers.

#### Abbreviations

COVID-19: coronavirus disease 2019; WHO: World Health Organization; OR: Odds Ratio; ORc: crude Odds Ratio; ORa: adjusted Odds Ratio; CI: Confidence Interval; Sig: Significant; Ref: Reference group; LL: Lower limit; UL: Upper limit.

#### Ethics Approval and Consent to Participate

Informed consent was obtained individually from all respondents. The study was approved by the Research and Community Engagement Ethical Committee, Faculty of Public Health Universitas Indonesia, with a letter-number: 30/UN2.F10.D11/PPM.00.02/2020.

#### Competing Interest

The author declares that there are no significant competing financial, professional, or personal interests that might have affected the performance or presentation of the work described in this manuscript.

#### Availability of Data and Materials

The datasets generated and analyzed during the current study are not publicly available due to participant confidentiality but are available from the corresponding author on reasonable request.

#### Authors' Contribution

B conceived the idea, data collection, data analysis, interpreted the study results, and drafted the manuscript. DZN, MH, RS, and MR performed data collection, critically analyzing and interpreting the study results. ZW gave his expert opinion in sampling design and data collection. PY gave her input in the manuscript drafting. All authors read and approved the final manuscript.

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#### References

1. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet*. 2020; 395 (10223): 497–506.
2. World Health Organization. Statement on the second meeting of the International Health Regulations (2005) emergency committee regarding the outbreak of novel coronavirus (2019-nCoV); 2020.
3. World Health Organization Director. General's opening remarks at the media briefing on COVID-19–March 11 2020; 2020.
4. World Health Organization. Weekly operational update on COVID-19 May 17 2021 issue no. 55; 2021.
5. Portal Informasi Indonesia. Kasus covid-19 pertama, masyarakat jangan panik; 2020.
6. Satuan Tugas Penanganan COVID-19. Peta sebaran COVID-19; 2021.
7. World Health Organization. COVID-19 strategy update–April 14 2020. Geneva, Switzerland: WHO; 2020.
8. Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention. *Jama*. 2020; 323 (13): 1239–42.
9. McEachan R, Taylor N, Harrison R, Lawton R, Gardner P, Conner M. Meta-analysis of the reasoned action approach (RAA) to understanding health behaviors. *Ann Behav Med*. 2016; 50 (4): 592–612.
10. Zhong B-L, Luo W, Li H-M, Zhang Q-Q, Liu X-G, Li W-T, et al. Knowledge, attitudes, and practices towards COVID-19 among Chinese residents during the rapid rise period of the COVID-19 outbreak: a quick online cross-sectional survey. *Int J Biol Sci*. 2020; 16 (10): 1745.
11. Zhang M, Zhou M, Tang F, Wang Y, Nie H, Zhang L, et al. Knowledge, attitude, and practice regarding COVID-19 among healthcare workers in Henan, China. *J Hosp Infect*. 2020; 105 (2): 183–7.
12. Saqlain M, Munir MM, Rehman SU, Gulzar A, Naz S, Ahmed Z, et al. Knowledge, attitude, practice and perceived barriers among healthcare workers regarding COVID-19: a cross-sectional survey from Pakistan. *J Hosp Infect*. 2020; 105 (3): 419–23.
13. Ejeh FE, Saidu AS, Owoicho S, Maurice NA, Jauro S, Madukaji L, et al. Knowledge, attitude, and practice among healthcare workers towards COVID-19 outbreak in Nigeria. *Heliyon*. 2020; 6 (11): e05557.
14. Kanu S, James PB, Bah AJ, Kabba JA, Kamara MS, Williams CEE, et al. Healthcare workers' knowledge, attitude, practice and perceived health facility preparedness regarding COVID-19 in Sierra Leone. *J Multidiscip Healthc*. 2021; 14: 67–80.
15. Ministry of Health Republic Indonesia. COVID-19 prevention and control guidelines (In bahasa: pedoman pencegahan dan penanggulangan COVID-19), revise-5, July 2020. Jakarta: Ministry of Health Republic Indonesia; 2020.
16. Zhang P, Gao J. Evaluation of China's public health system response to COVID-19. *J Glob Health*. 2021; 11: 5004.
17. World Health Organization. Advice on the use of masks in the community, during home care and in health care settings in the context of the novel coronavirus (2019-nCoV) outbreak: interim guidance, January 29 2020. WHO; 2020.

18. Fisher WA, Fisher JD, Rye BJ. Understanding and promoting AIDS-preventive behavior: insights from the theory of reasoned action. *Health Psychol.* 1995; 14 (5): 255.
19. Maude RR, Jongdeepaisal M, Skuntaniyom S, Muntajit T, Blacksell SD, Khuenpetch W, et al. Improving knowledge, attitudes and practice to prevent COVID-19 transmission in healthcare workers and the public in Thailand. *BMC Public Health.* 2021; 21 (1): 749.
20. Alrubaiee GG, Al-Qalah TAH, Al-Aawar MSA. Knowledge, attitudes, anxiety, and preventive behaviours towards COVID-19 among health care providers in Yemen: an online cross-sectional survey. *BMC Public Health.* 2020; 20 (1): 1541.
21. Riyanto GP. Jumlah pengguna internet Indonesia 2021 tembus 202 juta; 2021.



# Treatment Adherence and Incidence of Coronary Heart Disease in Type 2 Diabetes Mellitus Patients

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## Abstract

Previous studies showed that uncontrolled blood sugar and long-term use of several types of antidiabetic could increase the risk of coronary heart disease (CHD). This study aimed to compare the incidence of CHD in type 2 diabetes mellitus (T2DM) patients showing treatment adherence and non-adherence behavior over four years. This was a retrospective cohort study with data sets obtained from the Bogor Cohort Study of Non-Communicable Disease Risk Factors. All study subjects were not diagnosed with CHD at the beginning of the study. The sample was divided into two groups; one had adhered to treatment from health centers and followed the treatment instructions (adherent group), while the other had not followed the treatment instructions (non-adherent group). Of 5,690 subjects, 276 were eligible for this study (84 in the adherent and 192 in the non-adherent group). The incidence of CHD in the non-adherent group was 2.3% higher than in the adherent group ( $p$ -value = 0.564) and had a 1.7 times greater risk of developing CHD, but not statistically significant (adjusted HR = 1.739; 95% CI = 0.673-4.490). The non-adherent T2DM patients had a greater risk of developing CHD than adherent T2DM patients.

**Keywords:** coronary heart disease, diabetes mellitus, treatment adherence

## Introduction

Coronary heart disease (CHD) is the leading cause of death in diabetes.<sup>1</sup> Diabetes mellitus (DM) is associated with a two to four-fold increased risk of death from heart disease, and more than 70% of patients with DM aged more than 65 years will die from some form of heart disease or stroke.<sup>2</sup> This is because insulin resistance, a hallmark of type 2 diabetes mellitus (T2DM), is associated with a group of metabolic and biochemical disorders, including hyperglycemia, hypertension, atherogenic dyslipidemia, inflammation, endothelial dysfunction, and impaired fibrinolysis.<sup>1</sup> The type 1 diabetes mellitus (T1DM) and T2DM lead to increased atherosclerotic cardiovascular disease (ASCVD) incidence. There is strong evidence to suggest a greater risk of ASCVD in dysglycemic conditions. In addition, an 11%-16% increase in the incidence of cardiovascular disease has been reported for every 1% increase in HbA1c.<sup>3</sup>

On the other hand, the incidence of CHD is also associated with the drugs used to treat T2DM. Li, *et al.*,<sup>4</sup> conducted an 11-year observation of 4,902 women with diabetes with an average age of 68. They found that long-term use of sulfonylureas was significantly associated

with a higher risk of developing CHD.<sup>4</sup> Another study comparing the safety of monotherapy with sulfonylureas and metformin concluded that most male patients who started treatment of diabetes mellitus with sulfonylureas had a higher risk of heart failure and death from cardiovascular disease compared to those who began treatment with metformin.<sup>5</sup> According to a study by Herman, excessive use of insulin could be a predisposing factor for inflammation, atherosclerosis, hypertension, dyslipidemia, heart failure, and arrhythmias. This study supported the findings of a large-scale evaluation showing that insulin therapy had a poorer short- and long-term safety profile than many other antidiabetic therapies.<sup>6</sup>

Based on the data above, both uncontrolled blood sugar and long-term use of several types of antidiabetic drugs have the potential to increase the risk of CHD.<sup>3-6</sup> This can be a severe problem for patients with diabetes mellitus because both treatment and no treatment can increase the risk of CHD. Adherence to treatment and the right choice of antidiabetic drugs will protect patients from possible complications. Population-based scientific research and long-term observations related to the adherent and non-adherent behavior of patients with dia-

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betes mellitus related to CHD in middle-income countries such as Indonesia are still very limited. The Non-Communicable Disease Risk Factors in Bogor (the *Penyakit Tidak Menular/PTM Bogor Cohort Study*) was a population-based study managed by the National Institute of Health Research and Development, Ministry of Health of the Republic of Indonesia. This study was conducted as an initial study to assess the treatment adherence behavior of T2DM patients and to assess whether there was a difference in the risk of coronary heart disease after four years of observation.

### Method

This study was conducted as part of a long-term prospective cohort study by the National Institute of Health Research and Development, Ministry of Health, Republic of Indonesia Cohort Study of Non-Communicable Disease Risk Factors (the PTM Bogor Cohort Study), in five subdistricts of Bogor City, West Java Province, over the period of 2011 to 2018. This study used a retrospective cohort design because the study was conducted in 2019, while the study data was taken from 2011 to 2018.<sup>7</sup>

Initial observations in the study were determined when patients were diagnosed with diabetes mellitus and free from a CHD diagnosis at baseline, and had a complete blood count. The diagnostic criteria for T2DM were based on the American Diabetic Association (ADA) criteria and local criteria by *Perkumpulan Endokrinologi Indonesia (PERKENI)*.<sup>8,9</sup> These were based on fasting blood glucose (FBG) levels of  $\geq 126$  mg/dL or post-prandial blood glucose (PPBG)  $\geq 200$  mg/dL and/or classical symptoms. The patients were divided into two groups; one group had adhered to the treatment prescribed by health centers and had followed the treatment instructions (adherent group), while the other had not followed the treatment instructions (non-adherent group). They were then observed over four years to observe the differences in the incidence of coronary heart disease. If there was a change in treatment behavior, from adherence to non-adherence, or vice versa, then the patient was dropped from the study. In addition, patients who did not have complete blood tests in the fourth year or were considered absent (loss to follow-up) were also excluded.

The sampling technique used in the PTM Bogor Cohort Study was dynamic sampling, while this study used purposive sampling techniques.<sup>10</sup> The baseline data was taken from the 2011/2012 and 2013/2014 datasets, and the final data after follow-up was taken from the 2015/2016 and 2017/2018 datasets. The diagnosis of T2DM was made by doctors from the PTM Bogor Cohort Study Team based on the patient's blood examination results. The diagnosis of CHD was determined from the re-

$$n = \frac{\left\{ z_{1-\alpha/2} \sqrt{2P(1-P)} + z_{1-\beta} \sqrt{P_1(1-P_1) + P_2(1-P_2)} \right\}^2}{(P_1 - P_2)^2}$$

#### Notes:

$\alpha$  = The standard value of the normal distribution, set at 5%

$Z_{1-\alpha/2}$  = The same value, with a significant degree of 1.96

$Z_{1-\beta}$  = The same value as the desired power of 0.84

$P = (p_1 + p_2) / 2$

$p_2$  = The proportion of T2DM patients who do not take diabetes medication and were diagnosed with CHD = 0.5812,<sup>12</sup>

$p_1$  = The proportion of T2DM patients who take diabetes medication and diagnosed with CHD was calculated by estimating the difference considered significant between the proportion of diabetic patients taking medication and those not taking it, set at 30%.

$p_1 = p_2 - (30\% \times 0.58) = 0.406$ ,<sup>13</sup>

$n$  = After calculation, the result obtained was  $n = 128.2678$ , rounded up to 130

#### Formula 1. Sample Size Estimation,<sup>11</sup>

sults of an electrocardiogram (ECG) and verified by three cardiologists.

Calculation of the sample size based on the Adequacy of Sample Size Determination in Health Studies World Health Organization (WHO) guidelines to test the hypotheses related to the two different populations was as in the Formula 1.<sup>11</sup> The minimum sample size for each group was 130, meaning that as there were two groups, the minimum study sample size was 260.

The outcome data in the study were divided into two categories, increasing and not increasing, and analyzed using the Chi-square Test. The authors determined the criteria for the increasing or non-increasing changes based on the average change in each clinical characteristic. This study assessed the relative risk (RR), and the data analysis used Cox regression. In general, Cox regression is used for survival analysis and can produce HR (Hazard Ratio) values. In Cox regression analysis, if the time required for the outcome to occur is the same, the HR value is the same as the RR value.

### Result

This study is part of the PTM Bogor Cohort Study by the National Institute of Health Research and Development, Ministry of Health of the Republic of Indonesia. The sampling technique used was dynamic sampling. The PTM Bogor Cohort Study patients were monitored for clinical parameters every two years. Authors took patient data from observations over four years to observe differences in the incidence of CHD in diabetic patients with adherent and non-adherent behavior related to treatment. Out of 5,690 subjects, 541 were eligible at the baseline. After four years of observation, 276 eligible patients remained, consisting of 84 subjects who had adhered to treatment (30.4%) and 192 (69.6%) who had not and were therefore untreated (Figure 1). Characteristics of the T2DM patients are presented in Table 1.

The main factors that cause CHD were divided into two groups, the ones that can be controlled (modifiable risk) and ones that cannot be controlled (non-modifiable risk). Controllable risk factors included hypertension, high blood cholesterol levels, smoking, diabetes, obesity, lack of physical activity, unhealthy diet, and stress. Factors that could not be controlled were age (aging could increase risk), sex (men were generally at greater risk of coronary artery disease), family history, and race.<sup>14</sup>

The study subjects were mostly women (73.8% in the adherent group and 72.4% in the non-adherent group). The majority of whom were under the age of 60 years with an elementary education level. There was no significant difference between any of the baseline characteristics concerning the adherent and non-adherent groups (p-value>0.05), which means that all the T2DM patients had similar characteristics. The proportion of patients with smoking and non-smoking habits was almost the same. Smoking habit data was only taken in the 4th year to show smoking habits, so it could not be continued until a multivariate analysis was conducted. Data on the physical activity of T2DM patients showed almost the same number of patients who were quite active and less active.

Table 1 shows the differences in the changes in clinical

parameters after four years of observation, including changes in systolic blood pressure, diastolic blood pressure, PPBG, total cholesterol, low density lipoprotein

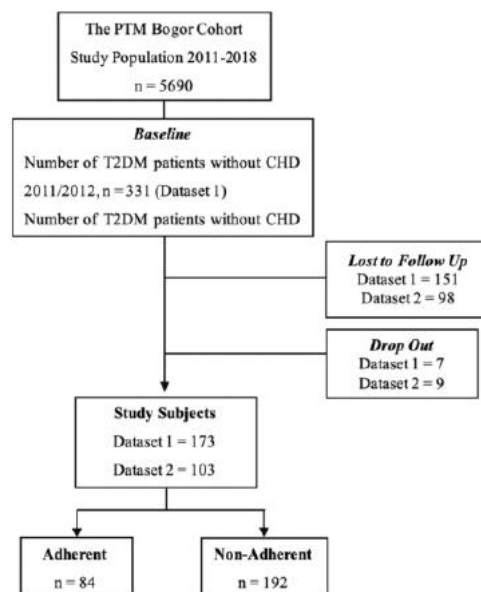


Figure 1. Patients Recruitment Flow

Table 1. Characteristics of the Type 2 Diabetes Mellitus Patients

| Variable                          | Category                 | Adherent (n = 84) | Non-Adherent (n = 192) | p-value            |
|-----------------------------------|--------------------------|-------------------|------------------------|--------------------|
| Sex                               | Male                     | 22 (26.2)         | 53 (27.6)              | 0.924 <sup>a</sup> |
|                                   | Female                   | 62 (73.8)         | 139 (72.4)             |                    |
| Age in the 4th year               | <60 years                | 48 (57.1)         | 122 (63.5)             | 0.584 <sup>a</sup> |
|                                   | ≥60 years                | 36 (42.9)         | 70 (36.5)              |                    |
| Education level in the 4th year   | Further education        | 29 (34.5)         | 80 (41.7)              | 0.326 <sup>a</sup> |
|                                   | Elementary education     | 55 (65.5)         | 112 (58.3)             |                    |
| Employment in the 4th year        | Employed                 | 79 (94.0)         | 187 (97.4)             | 0.508 <sup>a</sup> |
|                                   | Unemployed               | 5 (6.0)           | 5 (2.6)                |                    |
| Smoking status in the 4th year    | Do not smoke             | 36 (42.9)         | 99 (51.6)              | 0.185 <sup>b</sup> |
|                                   | Smoked at some time      | 10 (11.9)         | 12 (6.3)               |                    |
|                                   | Smoker                   | 38 (45.2)         | 81 (42.2)              |                    |
| Physical activity in the 4th year | Moderately active (METs) | 41 (48.8)         | 97 (50.5)              | 0.896 <sup>a</sup> |
|                                   | Less active (METs)       | 43 (51.2)         | 95 (49.5)              |                    |
| Systolic BP changes               | Increased                | 15 (17.9)         | 44 (22.9)              | 0.433 <sup>a</sup> |
|                                   | No Increase              | 69 (82.1)         | 148 (77.1)             |                    |
| Diastolic BP changes              | Increased (>14.98 mmHg)  | 8 (9.5)           | 36 (18.8)              | 0.080 <sup>a</sup> |
|                                   | No Increase (14.98 mmHg) | 76 (90.5)         | 156 (81.3)             |                    |
| PPBG change                       | Increased                | 16 (19)           | 25 (13)                | 0.266 <sup>a</sup> |
|                                   | No Increase              | 68 (81)           | 167 (87)               |                    |
| Total cholesterol change          | Increased                | 19 (22.6)         | 41 (21.4)              | 0.940 <sup>a</sup> |
|                                   | No Increase              | 65 (77.4)         | 151 (78.6)             |                    |
| LDL changes                       | Increased                | 18 (21.4)         | 33 (17.2)              | 0.505 <sup>a</sup> |
|                                   | No Increase              | 66 (78.6)         | 159 (82.8)             |                    |
| HDL Change                        | Increased                | 22 (26.2)         | 39 (20.3)              | 0.355 <sup>a</sup> |
|                                   | No Increase              | 62 (73.8)         | 153 (79.7)             |                    |
| BMI Change                        | Increased                | 19 (22.6)         | 56 (29.2)              | 0.328 <sup>a</sup> |
|                                   | No Increase              | 65 (77.4)         | 136 (70.8)             |                    |

Notes: the above data is expressed in amount (n) and percentage (%) terms, BP = Blood Pressure, PPBG = Post-Prandial Blood Glucose, LDL = Low Density Lipoprotein, HDL = High Density Lipoprotein, BMI = Body Mass Index.

**Table 2. Effect of Non-Adherent Behavior Compared to Adherent Behavior on the Coronary Heart Disease Incidence**

| Adherent Behavior | CHD (n = 24) | Non-CHD (n = 252) | p-value | Hazard Ratio | 95% CI      |
|-------------------|--------------|-------------------|---------|--------------|-------------|
| Non-Adherent      | 18 (9.4%)    | 174 (90.6%)       | 0.564   | 1.312        | 0.521–3.306 |
| Adherent          | 6 (7.1%)     | 78 (92.9%)        |         |              |             |

Notes: the above data is expressed in amount (n) and percentage (%) terms; CHD = Coronary Heart Disease, CI = Confidence Interval.

**Table 3. Effect of Non-Adherent Behavior on the Incidence of Coronary Heart Disease after Confounding Variable Control**

| Model   | Variable                     | Category          | HR    | p-value | 95% CI      |
|---------|------------------------------|-------------------|-------|---------|-------------|
| Model 1 | Adherent behavior            | Non-Adherent      | 1.312 | 0.564   | 0.521–3.306 |
|         |                              | Adherent (Ref)    |       |         |             |
| Model 2 | Adherent behavior            | Non-Adherent      | 1.739 | 0.253   | 0.673–4.490 |
|         |                              | Adherent (Ref)    |       |         |             |
|         | Sex                          | Male              | 0.455 | 0.159   | 0.152–1.362 |
|         |                              | Female (Ref)      |       |         |             |
|         | Age                          | Increase          | 0.577 | 0.182   | 0.258–1.293 |
|         |                              | No Increase (Ref) |       |         |             |
|         | LDL changes                  | Increase          | 3.566 | 0.007*  | 1.416–8.976 |
|         |                              | No Increase (Ref) |       |         |             |
|         | Changes in physical activity | Increase          | 0.220 | 0.003*  | 0.081–0.600 |
|         |                              | No Increase (Ref) |       |         |             |

Notes: HR = Hazard Ratio, CI = Confidence Interval, LDL = Low Density Lipoprotein, \*p-value<0.05

(LDL), high density lipoprotein (HDL), body mass index (BMI), and hypertension in each group. There was no significant difference in the proportion of patients who had experienced changes in the clinical parameters in the two groups. Prior to the final multivariate analysis, the author performed a bivariate analysis to compare the proportion of adherents and non-adherents in relation to the incidence of CHD after four years of observation.

The main finding of the study was that there was a higher incidence of CHD in the non-adherent group (9.4%) than in the adherent group (7.1%), but not at a significant level (p-value = 0.564) (Table 2). In addition, the adherent group had a non-CHD level of 92.9%, higher than the non-adherent group, whose level was 90.6%. This shows that the non-adherent group had a 2.3% greater proportion of CHD compared to the adherent group and had a 1.3 times greater chance of developing CHD.

The analysis of the determining confounding variables was based on the delta HR value. If the HR delta is greater than 10%, it will be considered a confounding variable in the final analysis. There are variables with HR values above 10%, which is the LDL change variable. The selection of confounding variables was also made based on a theoretical study of the variables most likely to influence the relationship between the independent and dependent variables. Changes in physical activity became a variable that was selected as a confounding variable. In addition, because CHD is a degenerative disease

in which age and sex are modifiable risk factors, sex and age were added as control variables.

### Discussion

This retrospective cohort study aimed to assess the effect of treatment non-adherence on the incidence of CHD in T2DM patients in Indonesia during a 4-year follow-up period. The main finding of the study was that the non-adherent group had a 2.3% greater level of CHD than the adherent group and a 1.3 times greater chance of developing CHD. One reason for this is that the main purpose of using antidiabetic drugs is to lower blood sugar levels. Kaaffah,<sup>15</sup> conducted a study of T2DM patients in the PTM Bogor Cohort Study, which showed that T2DM adherent group patients could make a three-fold reduction in their PPBG levels compared to the non-adherent group. In the non-adherent group, the risk of hyperglycemia was one of the causes of the accelerated ASCVD observed in patients with diabetes mellitus. Insulin resistance and insulin deficiency in the non-adherent group could also cause hyperglycemia, which could increase the production of reactive oxygen species (ROS), protein kinase C, and free fatty acids, which in turn could increase the production of inflammatory mediators such as tumor necrosis factor (TNF)- $\alpha$  and interleukin-1, allowing the formation of atherosclerosis, which would develop into CHD.<sup>3</sup> Blood sugar control was essential for the patients in the T2DM PTM Bogor Cohort Study to prevent the occurrence of CHD. This situation was in



accordance with a previous meta-analysis study in the American Heart Journal, which analyzed eight randomized control trials of 1,800 patients with T1DM, and six randomized control trials of 4,472 T2DM patients, concluding that efforts to improve glycemic control could reduce macrovascular events, including both T1DM and T2DM.<sup>16</sup>

This study showed that the non-adherent group had a 1.7 times greater risk of developing CHD than the adherent group after controlling for changes in LDL and physical activity, which means that the adherent group tended to have some protection against the incidence of CHD, even not statistically significant. A study conducted by Fung, *et al.*,<sup>17</sup> involving 3,400 patient pairs, aimed to evaluate the effect of metformin monotherapy on all-cause mortality and cardiovascular disease. The conclusion of the study showed that T2DM patients who started metformin monotherapy showed improvements in many clinical parameters and reductions in all-cause mortality and CVD incidence compared to lifestyle modification alone. Li, *et al.*,<sup>4</sup> stated that the use of sulfonylurea antidiabetic drugs could lead to a higher risk of CHD and cardiovascular death compared to metformin. Gliclazide and glimepiride are associated with a lower risk of all-cause and cardiovascular death compared with glibenclamide.<sup>18</sup> In addition, high daily insulin use in patients with T2DM is associated with an increased risk of cardiovascular events.<sup>19</sup> This shows that the type of antidiabetics used by patients is an essential variable in establishing the specific cause of CHD incidence associated with antidiabetics. This study was unable to analyze this because of the unavailability of drug data.

Several previous studies linking diabetes and cardiovascular events have shown that the duration of diabetes significantly affects cardiovascular events. The Framingham Heart Study conducted a 12-year follow-up of 588 diabetic patients and reported a 1.38-fold higher risk of coronary heart disease and a 1.86-fold higher risk of cardiovascular death for each 10-year increase in diabetes duration.<sup>20</sup> In addition, analysis conducted for the British Regional Heart Study showed that only diabetes with a period of more than 10 years equates to the risk of coronary heart disease.<sup>21</sup> These two studies showed that it took more than ten years to analyze the relationship between diabetes and CHD. As this study was conducted over less than ten years, this may result in the absence of statistically significant results. However, this study can still be used as an initial description to assess the relationship between the adherent behavior of T2DM patients and CHD incidence.

This study also showed that higher LDL levels could increase CHD risk by 3.5 times. This result is consistent with a study conducted by Ference, *et al.*,<sup>22</sup> which assessed whether the association between LDL and AS-

CVD met the criteria for causality by evaluating evidence from genetic studies, prospective epidemiological cohort studies, Delian randomization studies, and randomized trials involving more than 2 million patients and more than 150,000 cardiovascular events. However, the results of this study are consistent with and support a variety of previous clinical and genetic studies that have clearly demonstrated that elevated LDL may increase the risk of ASCVD.<sup>22</sup> In addition, according to Arsana, *et al.*,<sup>23</sup> as well as LDL, an increase in total cholesterol, triglyceride levels, and a decrease in HDL also play an important and related role in the process of atherosclerosis. Besides, this study also showed that increased physical activity lowers the risk of CHD by 78%. This result was reinforced by the study conducted by Setyaji, *et al.*,<sup>24</sup> in 2018 involving 374,506 women and 347,823 men aged over 15. Patients who did not engage in strenuous activity or did less than 80 minutes of exercise per week were found to have a higher prevalence of CHD than those who were much more active ( $p$ -value<0.001).<sup>24</sup>

There are several limitations to this study. It employs a retrospective cohort study design and uses secondary data. The authors could not control the state and quality of the data that enumerators previously collected in the role of interviewers. There are no detailed data on types of antidiabetic drugs or on drug use compliance which could affect the study results. The authors suggest that the National Institute of Health Research and Development of the Ministry of Health of the Republic of Indonesia add questions in the PTM Cohort Bogor Study questionnaire about common drugs consumed by patients. In addition, this preliminary study was conducted over four years and needed to be continued with observations over a more extended period. Given the important findings in this study, the researchers suggested that the Indonesian government needs to focus on improving Indonesian T2DM patients' adherence to treatment.

## Conclusion

In this study, the number of non-adherent T2DM patients was higher than the adherent. After being observed over four years, the adherent and non-adherent groups did not differ significantly in CHD incidence. Changes in LDL and physical activity were selected as confounding variables and significant contributing variables to the incidence of CHD. This is an essential consideration for T2DM patients to control LDL levels, physical activity, and medication adherents to avoid CHD.

## Abbreviations

CHD: Coronary Heart Disease; T2DM: Type 2 Diabetes Mellitus; DM: Diabetes Mellitus; T1DM: Type 1 Diabetes Mellitus; ASCVD: Atherosclerotic Cardiovascular Disease; PTM: *Penyakit Tidak Menular*; ADA: American Diabetic Association; PERKENI:



*Perkumpulan Endokrinologi Indonesia*; FBG: Fasting Blood Glucose; PPBG: Post-Prandial Blood Glucose; ECG: Electrocardiogram; WHO: World Health Organization; RR: Relative Risk; HR: Hazard Ratio; BMI: Body Mass Index; HDL: High Density Lipoprotein; LDL: Low Density Lipoprotein; ROS: Reactive Oxygen Species; TNF: Tumor Necrosis Factor.

#### Ethics Approval and Consent to Participate

This study has received ethical approval from the Health Research Ethics Committee, Faculty of Medicine, Universitas Indonesia, with number KET-934/UN2.F1/ETIK/PPM.00.02/2019, and has received approval for data collection through a statement letter number 05081901-044 from the Head of the Data Management Laboratory, the National Institute of Health Research and Development, Ministry of Health, Republic of Indonesia.

#### Competing Interest

The author declares that there are no significant competing financial, professional, or personal interests that might have affected the performance or presentation of the work described in this manuscript.

#### Availability of Data and Materials

This study has received approval for data collection through a statement letter number 05081901-044 from the Head of the Data Management Laboratory, the National Institute of Health Research and Development, Ministry of Health of the Republic of Indonesia.

#### Authors' Contribution

ASB conceptualized, designed, and prepared the initial draft and framework, analyzed and interpreted the data. RS and WR conceptualized, designed, determined the methodology, supervised, wrote, reviewed, and edited the manuscript. RS also contributed to funding acquisition. PS conceptualized, designed, and determined the methodology.

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#### References

1. Carnethon MR, Biggs ML, Barzilay J, Kuller LH, Mozaffarian D, Mukamal K, et al. Diabetes and coronary heart disease as risk factors for mortality in older adults. *Am J Emerg Med*. 2010; 123 (6): 556.e1-556.e9.
2. Go AS, Mozaffarian D, Roger VL, Benjamin EJ, Berry JD, Blaha MJ, et al. Heart disease and stroke statistics—2014 update. *Circulation*. 2014; 129 (3): e28–292.
3. Low Wang CC, Hess CN, Hiatt WR, Goldfine AB. Atherosclerotic cardiovascular disease and heart failure in type 2 diabetes – mechanisms, management, and clinical considerations. *Circulation*. 2016; 133 (24): 2459–502.
4. Li Y, Hu Y, Ley SH, Rajpathak S, Hu FB. Sulfonylurea use and incident cardiovascular disease among patients with type 2 diabetes: prospective cohort study among women. *Diabetes Care*. 2014; 37 (11): 3106–13.
5. Rounie CL, Greevy RA, Grijalva CG, Hung AM, Liu X, Murff HJ, et al. Association between intensification of metformin treatment with insulin versus sulfonylureas and cardiovascular events and all-cause mortality among patients with diabetes. *JAMA*. 2014; 311 (22): 2288–96.
6. Herman ME, O'Keefe JH, Bell DSH, Schwartz SS. Insulin therapy increases cardiovascular risk in type 2 diabetes. *Prog Pediatr Cardiol*. 2017; 60 (3): 422–34.
7. Euser AM, Zoccali C, Jager KJ, Dekker FW. Cohort studies: prospective versus retrospective. *NEC*. 2009; 113 (3): c214–7.
8. American Association Diabetes. Classification and diagnosis of diabetes: standards of medical care in diabetes. *Diabetes Care*. 2021; 44 (Supplement 1): S15–35.
9. Soelistijo, Soebagijo Adi, Lindarto D, Decroli E, Permana H, Sucipta KW, Kusnadi Y, et al. Pedomon pengelolaan dan pencegahan diabetes melitus tipe 2 dewasa di Indonesia 2019. PB. PERKENI; 2019.
10. Robinson RS. Purposive Sampling. In: Michalos AC, editor. *Encyclopedia of quality of life and well-being research*. Dordrecht: Springer Netherlands. 2014, p. 5243–5.
11. Lemeshow S, World Health Organization, editors. *Adequacy of sample size in health studies*. Chichester. New York : New York, NY, USA: Published on behalf of the World Health Organization by Wiley; Distributed in the U.S.A., Canada, and Japan by Liss. 1990, p. 239.
12. Husni H, Lapau B, Hardhana B. Hubungan dislipidemia dan diabetes mellitus dengan kejadian penyakit jantung koroner di RSUD Ulin Banjarmasin. CNJ: *Caring Nursing Journal*. 2018; 2 (2): 66–9.
13. Dahlan S. Seri 2 besar sampel dalam penelitian kedokteran dan kesehatan. Jakarta: *Epidemiologi Indonesia*; 2019.
14. Hajar R. Risk factors for coronary artery disease: historical perspectives. *Heart Views*. 2017; 18 (3): 109–14.
15. Kaaffah S. Evaluasi perilaku berobat terhadap penurunan parameter glikemik penderita diabetes melitus tipe 2: studi kohor Bogor. [Master's Thesis]. Depok (ID): Universitas Indonesia; 2019.
16. Stettler C, Allemann S, Jüni P, Cull CA, Holman RR, Egger M, et al. Glycemic control and macrovascular disease in types 1 and 2 diabetes mellitus: meta-analysis of randomized trials. *American Heart Journal*. 2006; 152 (1): 27–38.
17. Fung CSC, Wan EYF, Wong CKH, Jiao F, Chan AKC. Effect of metformin monotherapy on cardiovascular diseases and mortality: a retrospective cohort study on Chinese type 2 diabetes mellitus patients. *Cardiovascular Diabetology*. 2015; 14 (1): 137.
18. Simpson SH, Lee J, Choi S, Vandermeer B, Abdelmoneim AS, Featherstone TR. Mortality risk among sulfonylureas: a systematic review and network meta-analysis. *The Lancet Diabetes & Endocrinology*. 2015; 3 (1): 43–51.
19. Stoekenbroek RM, Rensing KL, Moens SJB, Nieuwdorp M, DeVries JH, Zwiderman AH, et al. High daily insulin exposure in patients with type 2 diabetes is associated with increased risk of cardiovascular events. *Atherosclerosis*. 2015; 240 (2): 318–23.

20. Fox CS, Sullivan L, D'Agostino RB, Wilson PWF. The significant effect of diabetes duration on coronary heart disease mortality: the Framingham heart study. *Diabetes Care.* 2004; 27 (3): 704–8.
21. Wannamethee SG, Shaper AG, Whincup PH, Lennon L, Sattar N. Impact of diabetes on cardiovascular disease risk and all-cause mortality in older men: influence of age at onset, diabetes duration, and established and novel risk factors. *Arch Intern Med.* 2011; 171 (5).
22. Ference BA, Ginsberg HN, Graham I, Ray KK, Packard CJ, Bruckert E, et al. Low-density lipoproteins cause atherosclerotic cardiovascular disease. 1. Evidence from genetic, epidemiologic, and clinical studies. A consensus statement from the European atherosclerosis society consensus panel. *European Heart Journal.* 2017; 38 (32): 2459–72.
23. Arsana PM, Rosandi R, Manaf A, Budhiarta A, Permana H, Sucipta KW, et al. Panduan pengelolaan dislipidemia di Indonesia - 2015. Jakarta: PB. PERKENEI; 2015.
24. Setyaji DY, Prabandari YS, Gunawan IMA. Aktivitas fisik dengan penyakit jantung koroner di Indonesia. *Jurnal Gizi Klinik Indonesia.* 2018; 14 (3): 115–21.

# Local Wisdom Enriching Complementary Feeding Practices during Disaster Situations in Indonesia

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## Abstract

This study aimed to analyze complementary food fulfillment during disaster situations in Indonesia since it frequently experiences natural disasters and young children face unique challenges related to their feeding needs in disaster situations. This qualitative case study based on the Mount Merapi eruption and Sumedang landslide in 2021 collected data using observations, forum group discussions, and in-depth interviews; then, a thematic analysis was conducted. This study involved 17 participants, including Non-governmental Organizations (NGO) activists, health workers, residents involved in making complementary foods, and primary caregivers of children aged 6–24 months. This study found that there were five themes generated from the data analysis; 1) the donation of home-based complementary foods based on local wisdom, 2) inadequate complementary feeding, 3) limited resources to manage the complementary feeding, 4) clean versus dirty conditions, and 5) mothers' endeavour in complementary feeding practices. This study concluded that the complementary feeding practices during a disaster in Indonesia were supported by NGOs, residents, and nearby healthcare workers and thus represent a form of mutual cooperation among the Indonesian people.

**Keywords:** complementary feeding, disaster, local wisdom

## Introduction

Due to its location between three tectonic plates, Indonesia is vulnerable to earthquakes, tsunamis, volcanic eruptions, and other geological disasters.<sup>1</sup> In January 2021, several disasters occurred in Indonesia, including the eruption of Mount Merapi and landslides in the Sumedang District.<sup>2,3</sup> Crucially, infants and young children require more attention during disasters than other age groups. Nutritional assistance is one of their most pressing needs. Nutrition for children aged 6–24 months is fulfilled by complementary foods that are adequate, safe, timely, and given appropriately.<sup>4</sup>

Some research showed that complementary feeding practices in refugee camps might not be appropriate or adequate.<sup>5-10</sup> Problems with practices in other countries include early complementary food feeding, inadequate food variation that does not meet the World Health Organization (WHO) recommendations, insufficient infrastructure and water supplies, and hygiene issues.<sup>5</sup> In addition, instant complementary foods may be disproportionately consumed. For example, one Croatian-

Serbian refugee camp contained five tons of instant solid food that had almost expired.<sup>6</sup> The mass feeding of instant complementary foods was also found in Ukrainian refugees.<sup>7</sup> Furthermore, inadequate complementary food variety was found in Somalian refugee camps, where as many as 85% of children aged 6–23 months received complementary foods with minimum variation.<sup>8</sup> Likewise, post-earthquake Nepalese refugee camps had limited cooking facilities, high prices for ingredients, and uncertain arrival times for food aid, which led to child hunger.<sup>9</sup> During a flood, young children in a Dhaka refugee camp experienced difficulties obtaining food due to distant public kitchen facilities and food shortages.<sup>10</sup>

Applying standardized complementary feeding during disaster periods is important to support children's health. The use of complementary foods in refugee camps must be studied in Indonesia because it is a disaster-prone country that requires special efforts to improve services during and after natural disasters. In light of this, a qualitative case study was conducted to assess the feeding practice of complementary food during recent disasters

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in Indonesia.

## Method

The authors applied a qualitative case study design. The case studies focused on the scope, process, and methodological characteristics that emphasized the empirical nature of an investigation and recognized the context's importance.<sup>11</sup> Furthermore, a case study could treat a unique and specific case, including a natural disaster, as its intrinsic case.<sup>12</sup>

The authors selected the sample using purposive sampling. This study included Non-governmental Organizations (NGO) activists in the humanitarian and disaster field, community leaders, health cadres (consisted of housewives in the disaster area), health workers with experience being in charge of feeding groups of infants and children in disaster situations, and parents with children aged 6–24 months when a recent disaster occurred. The general inclusion criterion for prospective participants was that they needed to be willing to participate in the study. Initially, 17 participants were recruited. Six participated in the focus group discussion (FGD), and 11 participated in in-depth interviews. One participant was then excluded because the interview was not recorded. After data saturation was reached for the remaining 16 participants, one more participant was recruited and interviewed to ensure that the data were completely saturated. All participants were interviewed once.

The study was conducted from October 2020 to July 2021. Data were collected through field observations of one of the Sumedang landslide evacuation sites, the online FGD, and semi-structured online interviews. The authors did participants observations by helping prepare the kitchen and observing anything about complementary feeding in the landslide area, then taking photos and writing field notes. The authors were also acted as facilitators in the FGD session and as an interviewer in the interview sessions. The authors used the interview guidelines to guide the interview and the FGD guideline during the discussion process. According to each participant's consent, interviews were conducted in their homes or workplaces using Zoom Meeting, WhatsApp, and phone calls. The FGD was conducted using Zoom Meeting. All interviews were recorded.

All authors were female, had qualitative study training, and carried out the qualitative study used in this study. Prior to data collection, all authors explained the details of the study and the participants' rights. The authors carried out data collection after the participants gave their consent. The FGD was conducted for 1.5 hours, whereas the interviews lasted 25–55 minutes. The FGD was run with one co-moderator, who was in charge of managing the technical course of the discussion. The moderator introduced and explained the function of the

co-moderator to the FGD participants before starting the discussion. During each interview and the FGD, one author wrote field notes.

The authors analyzed the data using an inductive thematic analysis approach for transcripts from FGD, interview, and field notes. After these transcripts were searched for meaningful statements, a coding scheme was created. The coding scheme and themes were compiled using NVivo 12 plus software. The interviewer conducted member checking to determine the validity of the data. Each temporary coding scheme was matched to each participant. If clarification of the participants was required, the interviewer discussed the matter with the participants to agree on the most appropriate joint coding for the conditions in the field. This author terminated contact with the participants after the coding was approved.

The process continued with two authors creating thick descriptions. In addition, the authors made an overview of the location and background of the disaster. These texts were expected to help summarize the results and ensure their validity when applied to the same location or background. The data triangulation used the data obtained from the observations, FGD, interviews, and study notes. Three authors conducted this triangulation by forming a common theme with their coding scheme. The themes generated from the FGD and interview data were checked to ensure they aligned with the observations and research notes. All of the authors wrote reflective notes during the study journey.

## Results

Table 1 and 2 contains the participants' characteristics who were involved in FGD and interview sessions according to their sex, age, education, occupation, role in infant and young child feeding (IYCF) management and time started work on IYCF in disaster areas.

The five themes resulting from this study are shown in Figure 1; 1) the donation of home-based complementary foods based on local wisdom, 2) inadequate complementary feeding, 3) limited resources to manage the complementary feeding, 4) clean versus dirty conditions, and 5) mothers' endeavour in complementary feeding practices.

According to a volunteer, the IYCF kitchen in one refugee camp was used as a special kitchen for toddlers. Around 4:00 pm, the authors arrived at the kitchen. The cooking process had finished, and the food was being distributed. Cooking utensils had been tidied up on the tiled floor, which looked clean and not stepped on by dirty footwear, such as sandals or shoes. The kitchen manager stated that the ingredients for each menu were purchased every morning before cooking. The kitchen managers were the health cadres, and the kitchen organ-

Table 1. Data and Characteristics of the Participants in Focus Group Discussion Session

| Code | Sex | Age (year) | Highest Education        | Occupation       | Role in IYCF Management                                 | Time Started to Manage IYCF in the Disaster Area (year) |
|------|-----|------------|--------------------------|------------------|---|---|
| P1   | M   | 35         | High school/equivalent   | Private employee | Head of NGO in humanitarian field                       | 2020  |
| P2   | M   | 25         | High school/equivalent   | Private employee | Fundraising coordinator of the NGO                      | 2020  |
| P3   | F   | 39         | Diploma 1/2/3 (D1/D2/D3) | Nurse            | Member of the NGO, nutritional adequacy rate team       | 2020  |
| P4   | M   | 25         | High school/equivalent   | Private employee | Member of the NGO, transportation and distribution team | 2020  |
| P5   | M   | 27         | High school/equivalent   | Private employee | Member of the NGO, a public kitchen preparation team    | 2020  |
| P6   | M   | 26         | High school/equivalent   | College student  | Member of the NGO, logistics and warehousing team       | 2020  |
| P7   | M   | 39         | High school/equivalent   | Entrepreneur     | Member of the NGO, home food distribution team          | 2021  |

Notes: IYCF = Infant and Young Child Feeding, NGO = Non-governmental Organization.

Table 2. Data and Characteristics of the Participants in Interviews Session

| Code | Sex | Age (year) | Highest Education        | Occupation           | Role in IYCF Management                                     | Time Started to Manage IYCF in the Disaster Area (year) |
|------|-----|------------|--------------------------|----------------------|---|---|
| P8   | F   | 26         | Diploma 1/2/3 (D1/D2/D3) | Health Program Staff | Coordinator of one of the NGO, nutrition program            | 2021  |
| P9   | F   | 19         | High school/equivalent   | College student      | Member of distribution team                                 | 2021  |
| P10  | F   | 55         | High school/equivalent   | Homemaker            | Member of IYCF kitchen team, health cadre                   | 2021  |
| P11  | F   | 55         | High school/equivalent   | Homemaker            | Member of IYCF kitchen team, health cadre                   | 2021  |
| P12  | F   | 39         | High school/equivalent   | Private employee     | Parent of a 19-month-old child                              | -   |
| P13  | F   | 45         | High school/equivalent   | Homemaker            | Parent of an 18-month-old child                             | -   |
| P14  | F   | 36         | Bachelor (S1)            | Doctor               | Personal in charge of NGO's IYCF program                    | 2020  |
| P15  | M   | 24         | Diploma 1/2/3 (D1/D2/D3) | Nutritionist         | On-site health service nutrition worker                     | -   |
| P16  | F   | 43         | Diploma 1/2/3 (D1/D2/D3) | Midwife              | Midwife in charge of toddler health in the affected village | -   |
| P17  | F   | 27         | High school/equivalent   | Homemaker            | Parent of a 21-month-old child                              | -   |

Notes: IYCF = Infant and Young Child Feeding, NGO = Non-governmental Organization.

izers were from the NGO. The food was placed on a plate or in a food container. The completed food boxes were then placed on a table, and each table was set on the clean, dry terrace of a local resident's house.

The refugee tents looked neat inside, without mud or a strong odor. Several tents had a gallon of mineral water with a water dispenser for the occupants. In addition, they had several ready-to-eat foods, such as instant complementary food (instant baby porridge) and manufactured complementary foods. Various brands and flavors of manufactured complementary foods were available. While the researchers were still at the location, a group of donators came with multiple items. One donator explained to the refugees that they had brought various manufactured complementary foods and formula milk brands.

### Theme 1. The Donation of Home-Based Complementary Foods Based on Local Wisdom

#### Local Wisdom Food Availability

Various local wisdom-based home-cooked foods were served in the disaster area. In this context, local wisdom means the daily cuisine of the affected community

groups, such as fried tempeh marinated with salt and garlic or stir-fried carrots and beans. Another typical local food children usually consume was porridge with tofu and eggs seasoned with yellow spice (turmeric, a local spice). Local desserts such as mung bean porridge with coconut milk, sumsum porridge (made with rice powder and pandan, served with coconut milk and brown sugar), and other sweet-tasting porridges were also served as the main dishes there. One participant stated that the local food was helpful "because [the taste of the provided food or drink] is the most acceptable [to the survivors on the slopes of Mount Merapi]" (P1). Another participant even mentioned the specific ingredients of one dish: "Sometimes it includes bay leaves, galangals (a local spice), and then... What is it called?... Onion, garlic... Salt" (P5), which strengthens the statement that the local food was helpful in the disaster area.

#### Home-Based Complementary Food Programs

Local wisdom complementary food was served because of some programs initiated by some NGOs in the humanitarian field. One program served complementary foods based on local wisdom-based home-cooked such



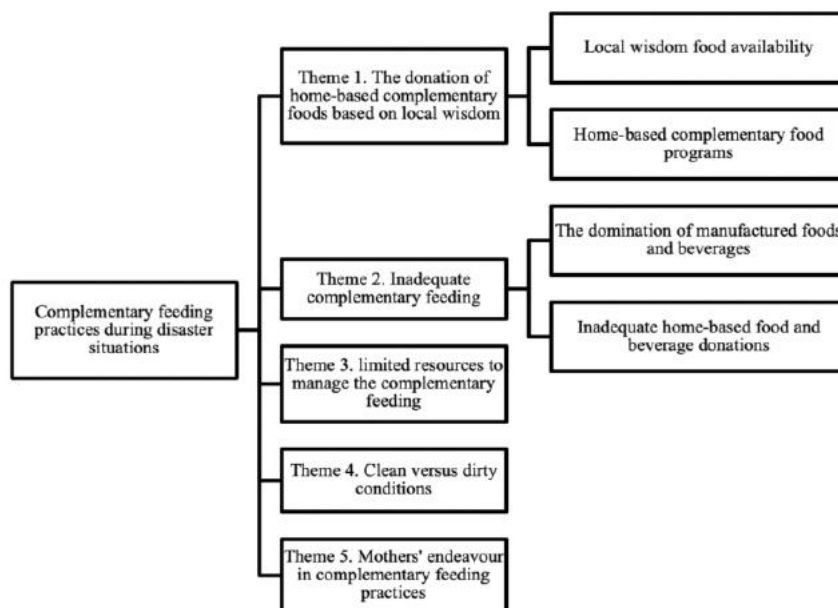


Figure 1. Coding Tree for Thematic Analysis of Complementary Feeding Practices during Disaster in Indonesia

as *jenang* (a kind of sweet porridge) and porridge with tofu or egg as side dishes. The program was given once a day in the morning for several weeks. Another program was to provide rice, side dishes, and vegetables, a typical menu for Indonesians, given twice a day for two weeks. Another NGO provided rice and vegetable soup for toddlers once a day for three days. Their implementation involved collaboration with other humanitarian activists and residents. These programs lasted for only a few days. One participant summarized the situation as follows: “Well, at that time, the NGO B sent the aid three times a day then being cooked by the cadres. That’s it” (P10).

**Theme 2. Inadequate Complementary Feeding**

*The Domination of Manufactured Foods and Beverages*

Manufactured foods and beverages such as instant complementary foods, formula milk, and Ultra High Temperature (UHT) milk affected the feeding practices of children under two. The donations of manufactured foods from nearby primary health care (PHC) included snacks and biscuits for toddlers and instant complementary foods. Even instant porridge for adults was given for the toddlers. One participant observed that the instant porridge “was given from somewhere in one sachet... So, one kid, a toddler, got some amount of it” (P11).

*Inadequate Home-Based Food and Beverage Donations*

Home-based food donations such as porridge and rice provided by the NGO had the same texture for all ages.

Those were given once a day, twice a day, or two servings at a time. The most inadequate beverage was fruit juice for toddlers. One participant summarized the situation as follows: “Well, we only can generalize it; we cannot tell in detail which food [was] for which children. We lack [knowledge] of it, so we decided to divide the food into two or three [age] categories” (P1).

**Theme 3. Limited Resources to Manage the Complementary Feeding**

The term resources in this study refer to infant and young child feeding (IYCF) counselors, breastfeeding counselors, and other nearby primary health care workers (PHCWs) who were limited in the disaster location. The number of PHCWs was limited so that the team could not carry out further food control for complementary foods or tasks related to breastfeeding support. The refugees there were also coming from all ages. One participant said, “This [problem] can be [caused by] the human resources; we lack [the participant paused to talk a few seconds] it, so [the participant paused to talk a few seconds] the [food] controlling [does not always happen.] We are not focusing only on the things to support breastfeeding” (P15).

**Theme 4. Clean versus Dirty Environment**

The environmental conditions were generally clean. Moreover, the water and kitchens used, even refugees consumed boiled drinking water when the donator pro-

vided no mineral water. The garbage was also being taken care of so that the refugees felt comfortable. One participant observed that *“there is always a dump truck once in [a] couple days, so the volunteers collecting the trash, though [it] is quite far from the camp... So, there is no garbage piling up”* (P7).

Food quality control was done safely by the NGO activists. Thus, the food was not made using expired ingredients and was covered so that bacteria would not contaminate and not be exposed to rain. However, some parents did not maintain food safety by using the same food for the whole day and storing it at room temperature. One participant said that the situation was *“first come, first served. The home-based food which was coming first will be consumed first, [then] we will consume those with the short expiry date”* (P6).

### **Theme 5. Mothers’ Endeavour in Complementary Feeding Practices**

The participants stated that children aged one year and over generally fed themselves. The children could eat easily because there were peers at the camp, and they could eat together. The parents also reported that their children ate well. *“For my kid, he likes to eat by himself. If he eats by himself, he will finish his meals, at least most of it, but if I feed him, he only eats like two to four scoops, no more than that”* (P17).

Meanwhile, the mothers continued to breastfeed. Some participants stated that breastfeeding mothers used a veil to cover their chest when doing the process. This was due to the conditions of the open refugee tents. *“Alhamdulillah [thank goodness], I used to breastfeed in a tent. I covered it with my long veil”* (P13).

### **Discussion**

Community work and the provision of complementary feeding with local specialties are one of the local wisdom that is applied when a disaster occurs. Local wisdom is a view of life and knowledge as well as various life strategies in the form of activities carried out by local communities in responding to multiple problems in meeting their needs.<sup>13</sup> Community work, known as *“gotong royong,”* is a cooperation model with the principle of mutual agreement that values the spirit of embodiment in selfless individual behaviors or actions.<sup>14,15</sup> This mutual cooperation has been illustrated in many disaster events, such as the Mount Merapi cold lava disaster in 2010. Although the incident occurred without the influence of the residents, the men worked for hand in hand to fix the damaged buildings. At the same time, the women took the initiative to collect food and create an emergency public kitchen.<sup>16</sup> These actions are similar to those of the Mount Merapi refugees in this study; the mothers cooked together to meet the refugees’ food needs. *“Gotong royong”* is

the value of local wisdom for Indonesians and thus distinguishes them from the citizens of other nations.<sup>15</sup>

This study found that the dishes at the camps were made based on the availability of local ingredients and local cuisine menus. This condition is in accordance with the complementary food principle to make foods from the local ingredients available nearby, in the market, and the household.<sup>17</sup> Study has shown that optimizing household foods made with local ingredients for complementary feeding can help children aged 6–23 months meet their nutritional needs.<sup>18</sup> Similar study has proven that complementary foods made with local ingredients in one rural area in Indonesia and distributed with the assistance of the Integrated Service Post (ISP)/*Pusat Pelayanan Terpadu* (Posyandu) enhanced the nutritional status of children.<sup>19</sup>

This study found that health workers from NGOs initiated the complementary feeding program. These health workers mobilized volunteers and residents/local communities to cook and provide insights into the food resources availability in the area. The involvement of the local community was one of the supporting factors for program success. In Indonesia, each region has its own food or menu specialty. That was why NGOs outside the region that helped during the disaster situations would find it difficult to find food ingredients and did not always know the local food tastes. Here, the residents/local community who know more about their comfort food would play a role in supporting the program’s success.

Furthermore, health workers could educate the local community about complementary feeding as part of disaster programs in disaster-prone areas for the prevention and mitigation stage. So when a disaster occurs, the community can move faster to provide proper nutrition for children aged 6-24 months. Another study asserted that the feeding of complementary foods in emergencies or disaster situations was essential to fulfilling children’s human rights in these challenging circumstances and must be done with the cooperation of parties such as community groups, certain communities, NGOs, and health service providers.<sup>20</sup>

Indonesians use the principle of *“gotong royong”* in disaster situations to bear the same burden. In the context of a disaster, mutual assistance is part of Community-Based Disaster Risk Reduction (CBDRR). The CBDRR is a disaster risk reduction program where residents carry out risk studies, plans, and actions, while outside parties, such as NGOs, act as facilitators.<sup>21</sup> Based on this study’s results and the literature,<sup>16,18</sup> formal or informal collaborations between residents to provide appropriate and adequate home-based complementary foods can be a solution to meet the nutritional needs of young children.

The participants reported that some home-based com-

plementary foods were only given to children older than one year. Thus, children aged 6–12 months consumed more manufactured foods than older children. The manufactured foods available were instant solid foods, biscuits, wafers, and instant porridge for adults. Manufactured complementary foods are the most commercially available type, and they are dominated by a mixture of smooth and sweet foods that rarely contain a single food taste. Hence, they cannot meet an infant's need to be exposed to various textures and flavors.<sup>22,23</sup> Moreover, they tend to be high in energy but do not provide the essential nutrients needed for growing children.<sup>23</sup> Manufactured complementary foods also have high salt, added sugar content, and a fatty acid profile that is not internationally recommended.<sup>24</sup> Consumption patterns that prioritize manufactured snacks contribute to the reduced nutritional intake of children under five in developing countries.<sup>25,26</sup> In the refugee camp, feeding formula milk became a daily routine. In fact, formula milk should not be given in emergency or disaster situations because of the risk of diarrhea, malnutrition, and even death caused by dirty bottles and tools.<sup>17</sup> In addition, most formula milk contains additional calorie sweeteners that are not needed by children aged 6–24 months. Various child health practitioners have reported that it is better to avoid formula milk if possible.<sup>27</sup>

This study found that the home-based foods provided to the refugees did not meet the recommended standards. Foods such as soft porridge and rice were supplied with one texture for all children. According to the Ministry of Health of the Republic of Indonesia guidelines, children aged 6–9 months should be provided with thick porridge, children aged 9–12 months can eat family foods that have been chopped or cut into small pieces, and children aged 12–24 months may have sliced food.<sup>13</sup> Infants must experience an increase from thick to plain food textures and a proper transition to family foods by trying a different kinds of textures.<sup>23</sup> The fulfillment of the right texture for children can train them to make more complex, specialized, and structured oral movements enabling them to achieve smooth and effective chewing skills at the age of six.<sup>28,29</sup> The delayed introduction of hard and chewy food textures can lead to underdeveloped muscles and jawbones.<sup>29</sup>

Based on this study's result, the provision of porridge was only accompanied by side dishes like tofu and eggs. This provision did not meet the requirements for the number of variations of complementary feeding. Minimum dietary diversity (MDD) recommendations state that at least one meal must contain four or more foods from seven food groups (carbohydrates, proteins, fats, fiber, minerals, vitamins and water).<sup>30</sup> A less diverse diet increases the risk of micronutrient deficiencies and prevents children from experiencing various flavor combi-

nations.<sup>23</sup> For the beverage, one of the NGOs donated mango juice with sugar to young children. However, the provision of juice to young children who are still in the complementary feeding category should be limited to avoid replacing more nutrient-rich foods.<sup>23</sup> Giving fruit juice to children under two years of age as a snack can increase their energy intake by 67%, which can increase their weight without providing other essential nutrients.<sup>31</sup>

This study determined that local health workers did not control the provision of foods and beverages. In addition, NGOs activists could not always bring in IYCF or breastfeeding counselors. Ultimately, the government, NGOs, health workers, and residents must prioritize support and assistance to continue exclusive breastfeeding until the age of two or more, provide safe artificial food where breastfeeding is not possible, and provide complementary foods recommended for all infants and young children in an emergency.<sup>32</sup> Recommended complementary foods should be both adequate and safe (e.g., free from bacterial contamination). Hence, complementary foods must be hygienically processed and stored. Dirty locations can contribute bacteria to the solids provided. The evacuation sites in this study were clean. The refugees also could consume clean water because the disaster conditions did not directly impact the water, given that the disaster location was in the highlands. The highland areas are still dominated by forests, and groundwater can become absorbed freely to maintain water quality, so there is no significant change.<sup>33</sup>

Likewise, this study found that responsive feeding, another practice related to complementary feeding, continued despite the situation. Children aged 12–24 months demonstrated independent eating and well. Ideally, feeding young children promotes their independence. However, it can also manage behavioral problems and avoid indulgent practices in children with long-term consequences for their nutrition and health.<sup>23</sup> In addition, structured mealtimes and responsive feeding are associated with better eating behaviors.<sup>34</sup> Based on the observation in this study, breastfeeding practices were still operated as usual for children younger than two years of age amid a disaster situation. Breastfeeding is essential to the health of the infant and young children during a disaster. Crucially, young children who do not get breast milk in disaster situations are at higher risk of being infected with pathogens, malnourished, and threatened with various diseases that can cause death.<sup>35</sup>

The strength of this study was that it involved various parties in providing complementary feeding during a disaster. These parties were not only from health workers or NGOs but also from the recipients (mothers of children aged 12-24 months). In addition, the data from this study were obtained from various methods of collection;

observation, FGD, and interviews. The use of multiple data collection methods and the variety of participants enriched the study data and increased the objectivity of the study.

The limitation of this study is that it did not assess the responsive feeding practices of children aged 6–12 months. This study did not include the parents of children aged 6–12 months during a disaster situation because their contact information was missing. So, this study could not determine how young children aged 6–12 months ate while the disaster happened.

Further study can involve parents with children aged 6–12 months to get a bigger picture of complementary foods. The following study needs to be carried out more deeply to observe the management and provision of complementary foods in natural disasters that often occur in Indonesia (flood, tsunami, and earthquakes). In addition, further authors have to study each component of complementary foods, such as the safety of the cooking process and the kitchen storage, which affects the food's safety.

## Conclusion

This study concludes that the complementary feeding practices during a disaster in Indonesia were supported by NGOs, residents, and nearby healthcare workers and thus represent a form of mutual cooperation among the Indonesian people. Responsive feeding and breastfeeding practices can fulfill the nutrition requirements of infants and young children amid a disaster, and the participants in this study confirmed that these practices were standard. The results suggest that adequate and safe nutrition can be maintained during a disaster with mutual cooperation that targets home-based complementary foods based on local wisdom. However, health workers must guide and supervise this process to avoid adverse outcomes, including IYCF counselors, midwives, nurses, doctors, and nutritionists.

## Abbreviations

NGO: Non-Governmental Organizations; WHO: World Health Organizations; FGD: Forum Group Discussion; IYCF: Infant and Young Child Feeding Counselling; UHT: Ultra High Temperature; PHC: Primary Health Care; ISP: Integrated Services Post; Posyandu: *Pos Pelayanan Terpadu*; CBDRR: Community-Based Disaster Risk Reduction; MDD: Minimum Dietary Diversity.

## Ethics Approval and Consent to Participate

All participants were first contacted by AA via an online chat platform, and AA then introduced herself and stated her intentions behind contacting them. After being informed of the research purpose, all participants gave their consent via electronic form. To protect their identities, the researcher replaced their names in the data with codes, e.g., P1 for participant 1 and P2 for participant 2. This study was reviewed and ap-

proved by the Ethics Committee of the Faculty of Nursing, Universitas Indonesia (SK-37/UN2.F12.D1.2.1/ ETIK2021).

## Competing Interest

The author declares that there are no significant competing financial, professional, or personal interests that might have affected the performance or presentation of the work described in this manuscript.

## Availability of Data and Materials

Not applicable.

## Authors' Contribution

AA and DW conducted the study's ideas and created the study's design. AA and HH collected the data. All the authors (AA, DW, HH, and FT) contributed to the data analysis, created the themes, and finished the manuscript.

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## References

1. Yanuarto T, Pinuji S, Utomo AC, Satrio IT. Buku saku tanggap tangkas tangguh menghadapi bencana. Yanuarto T, editor. Jakarta: Pusat Data Informasi dan Humas Badan Nasional Penanggulangan Bencana; 2019.
2. Jati R. Longsor kembali terjadi, sebanyak 11 warga Sumedang meninggal dunia. Badan Nasional Penanggulangan Bencana; 2021.
3. Jati R. Sebanyak 1.115 warga lereng Gunung Merapi masih menungsi. Badan Nasional Penanggulangan Bencana; 2021.
4. World Health Organization. Complementary feeding. World Health Organization; 2021.
5. Astuti, Wanda D. Complementary feeding practices in the disaster situation: a literature review. *J Per Indon.* 2021; 5 (1): 558–75. Indonesian.
6. Theurich MA, Grote V. Are commercial complementary food distributions to refugees and migrants in Europe conforming to International Policies and Guidelines on Infant and Young Child Feeding in Emergencies?. *J Hum Lact.* 2017; 33 (3): 573–7.
7. Summers A, Bilukha OO. Suboptimal infant and young child feeding practices among internally displaced persons during conflict in eastern Ukraine. *Public Health Nutr.* 2018; 21(5): 917–26.
8. Marcantonio F di, Custodio E, Abukar Y. Child dietary diversity and associated factors among children in Somalian IDP Camps. *Food Nutr Bull.* 2020; 41 (1): 61–76.
9. DeYoung S, Suji M, Southall HG. Maternal perceptions of infant feeding and health in the context of the 2015 Nepal Earthquake. *J Hum Lact.* 2018; 34 (2): 242–52.
10. Goudet SM, Griffiths PL, Bogin BA, Selim N. Impact of flooding on feeding practices of infants and young children in Dhaka, Bangladesh



- Slums: What are the coping strategies? *Matern Child Nutr.* 2011; 7 (2): 198–214.
11. Yin RK. Case study research: design and methods. SAGE Publications; 2014.
  12. Creswell JW, Poth CN. Qualitative inquiry & research design: choosing among five approaches. 4th ed. SAGE Publications. Singapore: SAGE Publications; 2018.
  13. Njatrijani R. Kearifan lokal dalam perspektif budaya Kota Semarang. *Gema Kead.* 2018; 5 (1): 16–31. Indonesian.
  14. Endro G. Tinjauan filosofis praktik gotong royong. *RESPONS.* 2016; 21 (01): 89–112.
  15. Pambudi KS, Utami DS. Menegakkan kembali perilaku gotong–royong sebagai katarsis jati diri bangsa. *CIVICUS.* 2020; 8 (2): 12–7.
  16. Gunardo G. Karakter gotong royong warga dalam menghadapi bencana lahar dingin Merapi di Kota Yogyakarta. *J Pen Hum.* 2013; 18 (2): 156–65.
  17. Kementerian Kesehatan Republik Indonesia. Pedoman pelatihan konseling pemberian makan bayi dan anak (PMBA). Jakarta: Kementerian Kesehatan Republik Indonesia; 2019.
  18. Osendarp SJM, Broersen B, Liere MJ van, De-regil LM, Bahirathan L, Klassen E, et al. Complementary feeding diets made of local foods can be optimized, but additional interventions will be needed to meet iron and zinc requirements in 6- to 23-month-old children in low-and middle-income countries. *Food Nutr Bull.* 2016; 37 (4): 544–70.
  19. Susanto T, Sulistyorini L, Yudisianto A. Local-food-based complementary feeding for the nutritional status of children ages 6 – 36 months in rural areas of Indonesia. *Korean Journal of Pediatrics.* 2017; 60 (10): 320–6.
  20. IFE Core Group. Complementary feeding of infants and young children in emergencies. IFE Core Group. 2009: 223–51.
  21. Habibullah, Pudjianto B. Gotong royong pada program bantuan stimulan pemulihan sosial di Mamuju, Sulawesi Barat. *Sosio Kons.* 2014; 3 (2): 17–35. Indonesian.
  22. Beauregard JL, Bates M, Cogswell ME, Nelson JM, Hamner HC. Nutrient content of squeeze pouch foods for infants and toddlers sold in the united states in 2015. *Nutrients.* 2019; 11 (7): 1–9.
  23. Lutter CK, Grummer-Strawn L, Rogers L. Complementary feeding of infants and young children 6 to 23 months of age. *Nutr Rev.* 2021; 79 (8): 825–46.
  24. World Health Organization. Ending inappropriate promotion of commercially available complementary foods for infants and young children between 6 and 36 months in Europe. A discussion paper outlining the first steps in developing a nutrient profile model to drive changes to product. World Health Organization; 2019.
  25. Pries AM, Huffman SL, Mengkheang K, Kroeun H, Champeny M, Roberts M, et al. High use of commercial food products among infants and young children and promotions for these products in Cambodia. *Matern Child Nutr.* 2016; 12: 52–63.
  26. Pries AM, Filteau S, Ferguson EL. Snack food and beverage consumption and young child nutrition in low- and middle-income countries: a systematic review. *Matern Child Nutr.* 2019; 15 (S4): 1–11.
  27. World Health Organization. Information concerning the use and marketing of follow-up formula. World Health Organization. 2013; 119: 17–9.
  28. Demonteil L, Tournier C, Marduel A, Dusoulier M, Weenen H, Nicklaus S. Longitudinal study on acceptance of food textures between 6 and 18 months. *Food Qual Pref.* 2019; 71: 54–65.
  29. Marduel Boulanger A, Vernet M. Introduction of new food textures during complementary feeding: observations in France. *Arch Pediatr.* 2018; 25 (1): 6–12.
  30. Solomon D, Aderaw Z, Tegegne TK. Minimum dietary diversity and associated factors among children aged 6-23 months in Addis Ababa, Ethiopia. *J Equity Health.* 2017; 16 (1): 1–9.
  31. Obaggy JE, English LK, Psota TL, Wong YP, Butte NF, Dewey KG, et al. Complementary feeding and micronutrient status: a systematic review. *Am J Clin Nutr.* 2019; 109: 852S–71S.
  32. Carothers C, Gribble K. Infant and young child feeding in emergencies. *J Hum Lact.* 2014; 30 (3): 272–5.
  33. Morintosh P, Rumampuk JF, Lintong F. Analisis perbedaan uji kualitas air sumur di daerah dataran tinggi Kota Tomohon dan dataran rendah Kota Manado berdasarkan parameter fisika. *J Biom.* 2015; 3 (1).
  34. Finnane JM, Jansen E, Mallan KM, Daniels LA. Mealtime structure and responsive feeding practices are associated with less food fussiness and more food enjoyment in children. *J Nutr Educ.* 2017; 49 (1): 11-18.e1.
  35. Bauer B, Hedlund C. Nurture project international: lactation work in crisis. *J Hum Lact.* 2018; 34 (3): 503–6.



# Infarct Diameter for Predicting Cognitive Dysfunction in Ischemic Stroke Survivors in West Nusa Tenggara, Indonesia

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## Abstract

Cognitive dysfunction is an important consequence of ischemic stroke, which can progress in the first few years and is primarily determined by clinical factors. This study aimed to investigate the clinical determinants of cognitive dysfunction in stroke survivors in West Nusa Tenggara Province, Indonesia. This cross-sectional study assessed 255 ischemic stroke survivors with a mean age of 57.1±9.3 years old and 29–79 years old, recruited consecutively in three main hospitals in West Nusa Tenggara Province between March 2019 and October 2021. Categorical data collected included age, sex, education level, clinical determinants of ischemic stroke, and cognitive status of the patients. The association between the clinical determinants of ischemic stroke and the risk of cognitive dysfunction in patients was analyzed using logistic regression after adjusting for age, sex, and level of education. The final multiple logistic regression analysis models revealed infarct diameter as the only clinical determinant significantly associated with an increased risk of cognitive dysfunction (OR = 3.14; 95% CI = 1.20–8.23). Thus, a larger infarct diameter is the only clinical determinant of cognitive dysfunction in ischemic stroke survivors in West Nusa Tenggara Province, Indonesia.

**Keywords:** brain ischemia, clinical determinants, cognitive dysfunction, stroke

## Introduction

Cognitive dysfunction is an important consequence of ischemic stroke. Cognitive dysfunction can involve several cognitive domains, including attention, memory, language, perceptual-motor function, and executive function.<sup>1</sup> The prevalence of cognitive dysfunction in ischemic stroke survivors varies and can involve up to 80% of the ischemic stroke survivor population.<sup>2</sup> The prevalence is also high in the early phase of stroke (71.9%).<sup>3</sup> The cognitive domains most often affected by stroke are attention, memory, and executive dysfunction.<sup>4</sup> If not appropriately treated, cognitive dysfunction can progress to dementia after the first few years, characterized by the loss of independence of stroke survivors in carrying out their basic functional and social activities of daily living.<sup>5</sup> However, the cognitive decline found in the early stages of ischemic stroke has been shown to reduce the work productivity of survivors.<sup>6</sup> Thus, post-ischemic stroke cognitive dysfunction has the potential to cause economic and social burdens for families as well as financial burdens for local health

authorities and the government.

Post-ischemic stroke cognitive dysfunction is primarily assessed by clinical determinants, including stroke characteristics and well-identified co-existing vascular risk factors (smoking, hypertension, dyslipidemia, overweight, diabetes mellitus, and atrial fibrillation).<sup>7</sup> Stroke characteristics, including infarct size, the affected hemisphere, and the location of the lesion in the brain, describe the extent of the brain area with impaired neural connectivity due to ischemic events regarding the involvement of brain areas that are important in conducting cognitive functions.<sup>8,9</sup> Impaired neural connectivity due to ischemic lesions in the left dorsolateral prefrontal cortex, hippocampus, and frontal insula, structures in the brain responsible for executive function, attention, and memory, is a common finding in ischemic stroke.<sup>10</sup> This fact is relevant to the findings of a previous study that indicated that these three cognitive domains are most frequently impaired in stroke.<sup>4</sup> The identification of these stroke characteristics is particularly important in predicting the severity of post-stroke

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cognitive dysfunction and in planning cognitive rehabilitation strategies specific to the impaired domain.<sup>11</sup> However, the availability of an adequate investigation modality to characterize infarct size and location of ischemic lesions, magnetic resonance imaging, is still limited in most health care facilities in West Nusa Tenggara Province. Head computed tomography scan, which is the gold standard examination for diagnosing acute-phase stroke, despite its relatively wide availability, has limitations in characterizing infarct size in the first few days of ischemic stroke onset.<sup>12</sup>

Smoking, hypertension, dyslipidemia, overweight, diabetes mellitus, and atrial fibrillation are well-known vascular risk factors for ischemic stroke and post-ischemic stroke cognitive dysfunction. A previous study showed that these risk factors could independently cause cognitive dysfunction in the absence of stroke.<sup>13</sup> The presence of these vascular risk factors are related to a pathological neurodegenerative process that disrupts neuronal connectivity in the frontal lobe, resulting in impaired executive function and perceptual-motor function.<sup>14,15</sup> Both hypertension and diabetes mellitus are correlated with beta-amyloid deposition and tau protein phosphorylation, which are hallmarks of Alzheimer's dementia in the absence of stroke.<sup>16,17</sup> Thus, the identification and management of vascular risk factors in ischemic stroke survivors theoretically also has the potential to reduce the occurrence of post-ischemic stroke cognitive dysfunction.

This study aimed to investigate the clinical determinants of cognitive dysfunction in stroke survivors in West Nusa Tenggara Province, Indonesia. West Nusa Tenggara is a province in Indonesia with a low human development index, where access to health services and the population's education level are also relatively low.<sup>18</sup> Thus, the results of this study will be essential for the government and health authorities in West Nusa Tenggara and other provinces that have similar characteristics in terms of developing promotive, preventive, curative, and rehabilitative strategies to reduce the frequency of post-ischemic stroke cognitive dysfunction.

## Method

This cross-sectional study involved ischemic stroke survivors recruited consecutively in the outpatient neurology departments of two general hospitals and one private hospital in Mataram City, West Nusa Tenggara Province. The study was described by neurologists to the patients and their caregivers when they visited the outpatient neurology department at one of the three hospitals where the study was conducted. The study was conducted between March 2019 and October 2021. Due to the coronavirus 2019 (COVID-19) global pandemic situation, this study was temporarily suspended between

$$n = \frac{Z\alpha^2(pq)}{d^2}$$

Formula 1. Sample Size Estimation

April 2020 and February 2021 and continued until September 2021 by implementing a protocol to prevent the transmission of COVID-19. Using Formula 1, where *n* is sample size, proportion (*p*) = 20%, *q* = 1-*p*,  $\alpha$  = 0.05,  $Z\alpha$  = 1.96, and margin of error (*d*) = 0.05, the minimum sample size required in this study was 255.

The inclusion criteria were patients clinically diagnosed with ischemic stroke by a neurologist with or without a head CT scan, aged 18–80 years, and fully conscious. Since a head CT scan is required in the acute-phase ischemic stroke to exclude the presence of a cerebral hematoma, while the cost is relatively expensive, it was not performed for outpatients with clinical symptoms suggestive of an ischemic stroke beyond the acute phase. The exclusion criteria included uncorrected visual and hearing impairments, illiteracy, and a history of diagnosis of dementia and psychiatric disorders before the ischemic stroke.

Categorical data collected in this study were age, sex, education level, and clinical determinants for ischemic stroke, including infarct diameter, hemiparetic side, duration of illness, smoking status, hypertension, dyslipidemia, overweight, diabetes mellitus, atrial fibrillation, and cognitive status of the patients. These data were obtained through interviews with patients and their families, neuropsychological examinations, and medical records. The age of the patients was continuously expressed in years and further categorized into four age groups: less than 40 years, 40–59 years, 60–69 years, and 70–80 years. Sex was categorized as male or female, while the educational level was categorized as elementary school, higher, and college education. Infarct diameter was continuous data expressed in millimeters (mm) and then categorized into small ( $\leq 15$  mm) and large (more than 15 mm) based on the results of the head CT scan by a radiologist.<sup>19</sup>

The hemiparetic side of the patients was categorized into right and left sides. The duration of illness was expressed in months and then categorized into early-onset ( $\leq 3$  months from stroke onset) and chronic (more than three months from stroke onset). Regarding smoking status, the patients were categorized into smokers and non-smokers. Overweight was defined as a patient's body mass index (BMI) indicating more than 25 kg/m<sup>2</sup>. Dyslipidemia was defined as fasting serum total cholesterol of 240 mg/dL.<sup>20</sup> Hypertension was defined as blood pressure 140/90 mmHg and/or patients taking antihypertensive drugs. In contrast, diabetes mellitus was

defined as fasting blood glucose levels of 126 mg/dL and/or patients taking antidiabetic drugs, as described in previous studies.<sup>3</sup> The presence of atrial fibrillation was determined based on the results of the 12-lead electrocardiography (ECG) examination of the patients reviewed by a cardiologist.

The cognitive status of the participants was assessed using the Indonesian version of the Montreal Cognitive Assessment (MoCA-Ina), a neuropsychological test instrument for evaluating cognitive function that has been validated for the Indonesian population.<sup>21</sup> This instrument has a maximum score of 30. By using a cut-off value of 26 for the standard score, cognitive status was categorized into normal (MoCA-Ina score  $\geq$  26) and dysfunctional (MoCA-Ina score less than 26). An additional score of 1 was assigned to participants with elementary- and highschool-level education as a correction factor for the effect of education level on their performance in the neuropsychological test.

The first analysis was conducted to investigate the sociodemographic characteristics and cognitive status of the participants. At this stage, continuous age data were presented as means and standard deviations. In contrast, data on the categorical variables of age, sex, education level, and cognitive status of the patients were presented as proportions. The second analysis examined the relationship between each clinical determinant of ischemic stroke and the frequency of cognitive dysfunction in ischemic stroke survivors. At this stage, the association between categorical data of infarct diameter, hemiparetic side, duration of illness, smoking status, hypertension, dyslipidemia, overweight, diabetes mellitus, atrial fibrillation, and the frequency of cognitive dysfunction in stroke survivors was analyzed using simple binary logistic regression and crude odds ratio (OR) with 95% confidence interval (CI). In the third analysis, each clinical determinant showing a  $p$ -value $<$ 0.25 in the second analysis was assigned to the final model of multiple logistic regression analysis to examine its association with the frequency of cognitive dysfunction in stroke survivors after adjustment for age, sex, and education level and the results were reported as adjusted OR with 95% CI.

**Results**

During the study, 314 patients were identified as having an ischemic stroke. Of these, 59 did not meet the inclusion criteria. Thus, 255 ischemic stroke patients were involved in this study, with a mean age of 57.1 $\pm$ 9.3 years and between 29–79 years. Of the 255 patients, 197 underwent a head CT scan to confirm the diagnosis of ischemic stroke, while 58 did not undergo a head CT scan because their ischemic stroke was beyond the acute phase when they were recruited. Table 1 shows the sociodemographic characteristics and cognitive status of

the subjects. This study showed that the proportion of subjects with post-stroke cognitive dysfunction was high (79.6%). Sociodemographically, most patients were in the productive age group, male, and with a high school education level.

Table 2 shows the results of a simple binary logistic regression analysis that examined the relationship between clinical variables and frequency of cognitive dysfunction in ischemic stroke survivors. The analysis showed that infarct diameter (OR = 3.42; 95% CI = 1.33–8.78), hypertension (OR = 2.02; 95% CI = 0.96–2.43), and atrial fibrillation (OR = 4.24; 95% CI = 0.94–19.15) were eligible clinical variables to be assigned in the final model of multiple logistic regression analysis ( $p$ -value $<$ 0.25). Although of the three variables, infarct diameter was the only variable that exhibited a significant relationship. Hypertension and atrial fibrillation also modulated the increased risk of cognitive dysfunction in the patients.

Table 3 shows the results of the final multiple logistic regression analysis models that examined the relationship between eligible clinical variables in simple binary logistic regression analysis and the frequency of cognitive dysfunction in ischemic stroke survivors after adjustment for age, sex, and education level. The analysis showed that infarct diameter was the only clinical determinant that was significantly associated with an increased risk of cognitive dysfunction in ischemic stroke survivors (OR = 3.14; 95% CI = 1.20–8.23). Consistent with the simple logistic regression analysis results, subjects with larger infarct diameters had a higher risk of developing cognitive dysfunction after ischemic stroke.

**Discussion**

This study aimed to investigate the clinical determinants of cognitive dysfunction in ischemic stroke survivors in West Nusa Tenggara, a province in Indonesia with a low human development index. This study revealed that a larger infarct diameter was the major deter-

**Table 1. Subjects Characteristics (n = 255)**

| Variable             | Category           | n (%)          |
|----------------------|--------------------|----------------|
| Age (Mean $\pm$ SD)  |                    | 57.1 $\pm$ 9.3 |
| Age group            | <40 years          | 6 (2.4)        |
|                      | 40–59 years        | 144 (56.5)     |
|                      | 60–69 years        | 82 (32.2)      |
|                      | $\geq$ 70 years    | 23 (9.0)       |
| Sex                  | Male               | 178 (69.8)     |
|                      | Female             | 77 (30.2)      |
| Education level      | College            | 78 (30.6)      |
|                      | High school        | 102 (40.0)     |
|                      | Elementary school  | 75 (29.4)      |
| Cognitive impairment | Cognitive impaired | 203 (79.6)     |
|                      | Cognitive intact   | 52 (20.4)      |

Note: SD = Standard Deviation

**Table 2. Simple Binary Logistic Regression Showing Variables Associated with Cognitive Dysfunction in the Subjects**

| Clinical Variable   | n   | Category    | Cognitive Status n (%) |                    | Crude OR (95% CI) | p-value |
|---------------------|-----|-------------|------------------------|--------------------|-------------------|---------|
|                     |     |             | Cognitive Intact       | Cognitive Impaired |                   |         |
| Infarct diameter    | 197 | Small       | 37 (26.2)              | 104 (73.8)         | 3.42 (1.33–8.78)  | 0.010*  |
|                     |     | Larger      | 6 (10.7)               | 50 (89.3)          | Reference         |         |
| Hemiparetic side    | 255 | Right       | 29 (21.8)              | 104 (78.2)         | 1.18 (0.62–2.25)  | 0.607   |
|                     |     | Left        | 23 (18.9)              | 99 (81.1)          | Reference         |         |
| Duration of illness | 255 | Early-onset | 29 (23.2)              | 96 (76.8)          | 1.23 (0.65–2.33)  | 0.524   |
|                     |     | Chronic     | 23 (17.7)              | 107 (82.3)         | Reference         |         |
| Smoking status      | 255 | Smokers     | 17 (19.5)              | 70 (80.5)          | 0.77 (0.36–1.64)  | 0.505   |
|                     |     | Non-smokers | 35 (20.8)              | 133 (79.2)         | Reference         |         |
| Hypertension        | 255 | Yes         | 37 (17.8)              | 171 (82.2)         | 2.02 (0.96–2.43)  | 0.064*  |
|                     |     | No          | 15 (31.9)              | 32 (68.1)          | Reference         |         |
| Dyslipidemia        | 255 | Yes         | 27 (19.7)              | 110 (80.3)         | 1.17 (0.61–2.25)  | 0.635   |
|                     |     | No          | 25 (21.2)              | 93 (78.8)          | Reference         |         |
| Overweight          | 255 | Yes         | 19 (17.8)              | 88 (82.2)          | 1.27 (0.66–2.42)  | 0.472   |
|                     |     | No          | 33 (22.3)              | 115 (77.7)         | Reference         |         |
| Diabetes mellitus   | 255 | Yes         | 14 (19.7)              | 57 (80.3)          | 1.00 (0.49–2.07)  | 0.985   |
|                     |     | No          | 38 (20.7)              | 146 (79.3)         | Reference         |         |
| Atrial fibrillation | 255 | Yes         | 2 (7.7)                | 24 (92.3)          | 4.24 (0.94–19.15) | 0.061*  |
|                     |     | No          | 50 (21.8)              | 179 (78.2)         | Reference         |         |

Notes: \*eligible for final model of multiple logistic regression analysis, OR = Odds Ratio, CI = Confidence Interval

**Table 3. Final Model Logistic Regression Analysis Showing Variables Associated with Cognitive Dysfunction in the Subjects after Adjustment for Age, Sex, and Education Level**

| Clinical Variable   | n   | Category | Cognitive Status n (%) |                    | Adjusted OR (95% CI) | p-value |
|---------------------|-----|----------|------------------------|--------------------|----------------------|---------|
|                     |     |          | Cognitive Intact       | Cognitive Impaired |                      |         |
| Infarct diameter    | 197 | Small    | 37 (26.2)              | 104 (73.8)         | 3.14 (1.20–8.23)     | 0.020*  |
|                     |     | Larger   | 6 (10.7)               | 50 (89.3)          | Reference            |         |
| Hypertension        | 255 | Yes      | 37 (17.8)              | 171 (82.2)         | 1.43 (0.51–4.01)     | 0.501   |
|                     |     | No       | 15 (31.9)              | 32 (68.1)          | Reference            |         |
| Atrial fibrillation | 255 | Yes      | 2 (7.7)                | 24 (92.3)          | 7.76 (0.96–62.59)    | 0.054   |
|                     |     | No       | 50 (21.8)              | 179 (78.2)         | Reference            |         |

Notes: \*significant association (p-value<0.05), OR = Odds Ratio, CI = Confidence Interval

minant of cognitive dysfunction after ischemic stroke in the patients studied. This result conformed to a study on ischemic stroke patients in Yogyakarta, an urban area in Indonesia with a high human development index.<sup>22</sup> The large infarct diameter represents the severity of both the pathological process in the brain and the disruption of its neuronal connectivity. Thus, large infarct size in the brain region responsible for the conduction of cognitive function will result in dysfunction in these cognitive domains.<sup>23</sup> This finding emphasized the importance of head CT examination in early-phase stroke, not only to determine the appropriate initial treatment for ischemic stroke but also to predict the vulnerability of ischemic stroke patients to suffer from cognitive dysfunction by characterizing the infarct diameter based on this examination. Since a head CT scan was not performed in 58 patients because their stroke was beyond the acute phase, this fact implied the magnitude of the challenge for health author-

ities in the province of West Nusa Tenggara Province in the management of stroke and cognitive dysfunction after ischemic stroke. Since all patients in this study were members of the National Health Insurance (NHI) and head CT scans were also covered by this insurance, the absence of head CT scans in some patients might be due to the low level of knowledge of the patients and lack of access to adequate healthcare facilities for head CT scans. In general, the problems described above are common in populations living in areas with a low human development index characterized by the low level of education of the population and their lack of access to available healthcare facilities.<sup>24</sup>

This study also demonstrated that the proportion of ischemic stroke survivors with cognitive dysfunction was high (79.6 %). A previous study investigating the prevalence of post-stroke cognitive dysfunction in the subacute phase showed similar results.<sup>3</sup> In general, the prevalence



of post-stroke cognitive dysfunction is in the range of 20–80 %, and this variation is highly dependent on the population studied and the diagnostic criteria used.<sup>2</sup> The high proportion of post-ischemic stroke cognitive dysfunction and the proportion of male stroke survivors of productive age shown in this study indicated a high potential for public health problems that could be caused by post-stroke cognitive dysfunction in the future. Considering that condition, cognitive dysfunction that is not appropriately managed in the early phase of stroke in 30% of cases progresses to dementia and this condition will result in a loss of work productivity for survivors. The problem of post-ischemic stroke cognitive dysfunction has the potential to add to the socioeconomic burden of the family.<sup>5</sup> Moreover, since the prevalence and incidence of stroke in Indonesia are quite high and most ischemic stroke patients are highly dependent on the National Health Insurance provided by the government, the problem of cognitive dysfunction as a complication of ischemic stroke also has the potential to increase the burden of financing treatment by the government.<sup>25</sup> Thus, local health authorities must educate the public, especially those at high risk, about the importance of stroke prevention, recognize the signs and symptoms of stroke, and disseminate information about adequate health facilities for stroke treatment. Furthermore, the adequacy of the availability of cognitive rehabilitation facilities for stroke patients needs to be considered by both local health authorities and healthcare providers.

The results of this study also indicated that neither the hemiparetic side representing contralateral cerebral hemisphere involvement nor the duration of illness was associated with an increased proportion of stroke survivors with cognitive dysfunction. These results were consistent with the following previous studies. Regarding cerebral hemisphere involvement, Dacosta-Aguayo, *et al.*,<sup>26</sup> demonstrated that an ischemic lesion in one hemisphere leads to impaired functional integrity in the contralateral hemisphere. Regarding the duration of illness, Douiri, *et al.*,<sup>27</sup> showed that the prevalence of post-stroke cognitive dysfunction in both the early and chronic phases of the stroke was similar. The clinical significance of these findings was that cognitive function should be evaluated in every ischemic stroke patient, regardless of the hemisphere involved. These findings were also clinically significant in that the cognitive dysfunction found in ischemic stroke survivors, if not treated adequately, will tend to be relatively stable until the duration of illness enters the chronic phase, which is certainly related to a poor prognosis for these stroke survivors.<sup>28</sup> Thus, early identification and management of cognitive dysfunction in stroke survivors is an important part of the curative and rehabilitative strategy for post-stroke cognitive dysfunction. Local health authorities should develop

such strategy to enable patients to obtain optimal clinical outcomes.

The study also revealed that well-identified vascular risk factors for ischemic stroke, including smoking, hypertension, dyslipidemia, overweight, diabetes mellitus, and atrial fibrillation, were not significantly associated with an increased risk of cognitive dysfunction in ischemic stroke survivors. However, hypertension and atrial fibrillation appeared to modulate the risk of cognitive dysfunction in stroke survivors, and an insignificant association between these two vascular risk factors. Previous studies have shown mixed results regarding the association between these vascular risk factors and the frequency of cognitive dysfunction associated with ischemic stroke.<sup>4,29</sup> Theoretically, these risk factors can cause post-stroke cognitive dysfunction, both independently and through their interactions with each other.<sup>30</sup> Given that vascular risk factors, including smoking, hypertension, dyslipidemia, overweight, diabetes mellitus, and atrial fibrillation, generally exist long before the occurrence of stroke. The early identification and adequate management of these vascular risk factors are essential as part of a strategy to prevent ischemic stroke and post-stroke cognitive dysfunction. Moreover, the identification of these vascular risk factors is generally possible in almost all existing healthcare facilities. In this regard, the role of healthcare workers in primary health care (PHC) facilities in supporting appropriate education, detection, and management strategies for these vascular risk factors also needs to be optimized by local health authorities.

The results of this study are important to add to previous studies related to the clinical determinants of cognitive dysfunction in patients with ischemic stroke. Furthermore, the results of this study can be used as a basis for developing promotive, preventive, curative, and rehabilitative strategies for cognitive dysfunction after ischemic stroke in the population of stroke survivors in West Nusa Tenggara and other provinces in Indonesia with similar characteristics. However, this study had some limitations. First, the timing of the head CT scans of the patients varied significantly. Given that ischemic lesions can evolve at any time in the first few weeks after stroke onset, this variation in the timing of the CT scan of the head may affect the accuracy of measuring the diameter of the brain infarct. Second, given that this study used a cross-sectional design and the study patients did not have data on their cognitive status before the stroke, it was impossible to determine precisely whether current cognitive dysfunction was a pre-existing condition or a direct impact of stroke. Information related to the history of cognitive dysfunction before stroke obtained in this study was based only on the patients' caregivers' information and was generally subjective. A longitudinal study is recommended for investigating the impact of the clin-



ical determinants identified in this study on the progression of cognitive dysfunction in ischemic stroke survivors.

### Conclusion

This study revealed the infarct diameter as the only significant determinant of cognitive dysfunction in ischemic stroke survivors in West Nusa Tenggara Province, Indonesia. A larger infarct diameter is associated with an increased risk of cognitive dysfunction in ischemic stroke survivors. These results add to previously reported data related to the clinical determinants of cognitive dysfunction in the ischemic stroke patient population in Indonesia and other developing countries. These results can also be considered a basis for developing promotive, preventive, curative, and rehabilitative strategies for cognitive dysfunction after ischemic stroke in a population of stroke survivors in West Nusa Tenggara and other provinces in Indonesia with similar characteristics.

### Abbreviations

COVID-19: coronavirus disease 2019; CT: Computed Tomography; BMI: Body Mass Index; ECG: Electroencephalography; MoCA-Ina: Indonesia version of Montreal Cognitive Assessment; OR: Odds Ratio; CI: Confidence Interval; NHI: National Health Insurance; PHC: Primary Health Care.

### Ethics Approval and Consent to Participate

This study was conducted after obtaining ethical approval from the Ethics Committee for Health Research of the University of Mataram (registration number: 401/UN/18.F7/ETIK/2018). Each participant provided written informed consent before participation.

### Competing Interest

The authors declare that there are no significant competing financial, professional, or personal interests that might have affected the performance.

### Availability of Data and Materials

Data and materials of this study are available from the corresponding author for reasonable request and non-commercial purposes.

### Authors' Contribution

HSH conceptualized and designed the study. HSH, SAP, YI, HA, and FIM analyzed and interpreted the study results. HSH drafted the manuscript. HSH, SAP, YI, HA, and FIM revised the manuscript.

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### References

1. Aam S, Einstad MS, Munthe-Kaas R, Lydersen S, Ihle-Hansen H, Knapskog AB, et al. Post-stroke cognitive impairment - impact of follow-up time and stroke subtype on severity and cognitive profile: The Nor-COAST study. *Frontiers in Neurology*. 2020; 11: 699.
2. Sun J-H, Tan L, Yu J-T. Post-stroke cognitive impairment: epidemiology, mechanisms and management. *Annals of Translational Medicine*. 2014; 2 (8): 80.
3. Harahap HS, Akbar M, Tammasse J, Bintang AK, Zainuddin AA. Characteristics of cognitive status in sub-population of sub-acute stage of ischemic stroke patients in west Nusa Tenggara, Indonesia. *Kesmas: Jurnal Kesehatan Masyarakat Nasional (National Public Health Journal)*. 2021; 16 (3): 171–7.
4. Lo JW, Crawford JD, Desmond DW, Godefroy O, Jokinen H, Mahinrad S, et al. Profile of and risk factors for poststroke cognitive impairment in diverse ethnoregional groups. *Neurology*. 2019; 93 (24): e2257-71.
5. Al-Qazzaz NK, Ali SH, Ahmad SA, Islam S, Mohamad K. Cognitive impairment and memory dysfunction after a stroke diagnosis: a post-stroke memory assessment. *Neuropsychiatric Disease and Treatment*. 2014; 10: 1677–91.
6. Li J, Wang J, Wu B, Xu H, Wu X, Zhou L, et al. Association between early cognitive impairment and midterm functional outcomes among Chinese acute ischemic stroke patients: a longitudinal study. *Frontiers in Neurology*. 2020; 11: 20.
7. Aam S, Gynnild MN, Munthe-Kaas R, Saltvedt I, Lydersen S, Knapskog AB, et al. The impact of vascular risk factors on post-stroke cognitive impairment: the Nor-COAST study. *Frontiers in Neurology*. 2021; 12: 678794.
8. Wang Y, Liu G, Hong D, Chen F, Ji X, Cao G. White matter injury in ischemic stroke. *Progress in Neurobiology*. 2016; 141: 45–60.
9. Desai SM, Rocha M, Jovin TG, Jadhav AP. High variability in neuronal loss. *Stroke*. 2019 ;50 (1): 34–7.
10. Veldsman M, Werden E, Egorova N, Khlif MS, Brodtmann A. Microstructural degeneration and cerebrovascular risk burden underlying executive dysfunction after stroke. *Scientific Reports*. 2020; 10: 17911.
11. Etherton MR, Rost NS, Wu O. Infarct topography and functional outcomes. *Journal of Cerebral Blood Flow and Metabolism*. 2018; 38 (9): 1517–32.
12. Smith AG, Hill CR. Imaging assessment of acute ischaemic stroke: a review of radiological methods. *The British Journal of Radiology*. 2018; 91 (1083): 20170573.
13. Ganguli M, Fu B, Snitz BE, Unverzagt FW, Loewenstein DA, Hughes TF, et al. Vascular risk factors and cognitive decline in a population sample. *Alzheimer Disease and Associated Disorders*. 2014; 28 (1): 9–15.
14. Iadecola C. The pathobiology of vascular dementia. *Neuron*. 2013; 80 (4): 844–66.
15. Viswanathan A, Macklin EA, Betensky R, Hyman B, Smith eric E, Blacker D. The influence of vascular risk factors and stroke on cognition in late-life: analysis of the NACC cohort. *Alzheimer Disease and Associated Disorders*. 2015; 29 (4): 287–93.
16. Iadecola C, Gottesman RF. Neurovascular and cognitive dysfunction in hypertension: epidemiology, pathobiology, and treatment. *Circ*

- Research. 2019; 124 (7): 1025–44.
17. Stanciu GD, Bild V, Ababei DC, Rusu RN, Cobzaru A, Paduraru L, et al. Link between diabetes and Alzheimer's disease due to the shared amyloid aggregation and deposition involving both neurodegenerative changes and neurovascular damages. *Journal of Clinical Medicine*. 2020; 9: 1715.
  18. Faruk FM. Regional social sustainability index in Indonesia 2017. *Jurnal Perencanaan Pembangunan: The Indonesian Journal of Development Planning*. 2017; 4 (1): 40–53.
  19. Lv P, Jin H, Liu Y, Cui W, Peng Q, Liu R, et al. Comparison of risk factor between lacunar stroke and large artery atherosclerosis stroke: a cross-sectional study in China. *PLoS One*. 2016; 11 (3): e0149605.
  20. Lin CF, Chang YH, Chien SC, Lin YH, Yeh HY. Epidemiology of dyslipidemia in the Asia Pacific region. *International Journal of Gerontology*. 2018; 12 (1): 2–6.
  21. Rambe AS, Fitri FI. Correlation between the Montreal cognitive assessment- Indonesian version ( Moca-INA ) and the Mini-mental state examination ( MMSE ) in elderly. *Open Access Macedonian Journal of Medical Sciences*. 2017; 5 (7): 915–9.
  22. Prodjohardjono A, Vidyanti AN, Sudarmanta, Sutarni S, Setyopranoto I. Higher level of acute serum VEGF and larger infarct volume are more frequently associated with post-stroke cognitive impairment. *PLoS One*. 2020; 15 (10): e0239370.
  23. Terasaki Y, Liu Y, Hayakawa K, D PL, Lo EH, Ji X, et al. Mechanisms of neurovascular dysfunction in acute ischemic brain. *Current Medicinal Chemistry*. 2014; 21 (18): 2035–42.
  24. Joubert J, Prentice LF, Moulin T, Liaw ST, Joubert LB, Preux PM, et al. Stroke in rural areas and small communities. *Stroke*. 2008; 39: 1920–8.
  25. Venketasubramanian N, Yoon BW, Pandian J, Navarro JC. Stroke epidemiology in South, East, and South-East Asia: a review. *Journal of Stroke*. 2017; 19 (3): 286–94.
  26. Dacosta-Aguayo R, Grana M, Fernandez-Andujar M, Lopez-Cancio E, Caceres C, Bargallo N, et al. Structural integrity of the contralesional hemisphere predicts cognitive impairment in ischemic stroke at three months. *PLoS One*. 2014; 9 (1): e86119.
  27. Douiri A, Rudd AG, Wolfe CDA. Prevalence of poststroke cognitive impairment: South London stroke register 1995-2010. *Stroke*. 2013; 44 (1): 138–45.
  28. Melkas S, Jokinen H, Hietanen M, Erkinjuntti T. Poststroke cognitive impairment and dementia: prevalence, diagnosis, and treatment. *Degenerative Neurological and Neuromuscular Disease*. 2014; 4: 21–7.
  29. Zulkifly MFM, Ghazali SE, Din NC, Singh DKA, Subramaniam P. A review of risk factors for cognitive impairment in stroke survivors. *The Scientific World Journal*. 2016; 2016: 3456943.
  30. Kalaria RN, Akinyemi R, Ihara M. Stroke injury, cognitive impairment and vascular dementia. *Biochimica et Biophysica Acta - Molecular Basis of Disease*. 2016; 1862 (5): 915–25.

# Muscle Dysmorphia in Fitness Center Members: Its Affecting Factors and Impacts

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## Abstract

Muscle dysmorphia (MD) has several impacts on the decline in social and health functions. This study aimed to determine the correlation between MD with eating behaviors and exercise loading among fitness center members and analyze the factors affecting it. This study used a cross-sectional design with 100 subjects chosen by a consecutive sampling method at three fitness centers in Semarang City. The subjects were all male members of an active fitness center between 17 and 45 years. The data of MD were obtained using the Drive Muscular Scale (DMS), while eating behavior data were obtained using the Eating Attitude Test-40 (EAT-40) and the training load data, including the duration and frequency of weight training data. Social influence data, self-esteem data, and perfectionism data were obtained using a questionnaire. The findings revealed that 61% of the subjects experienced MD, 80% experienced impaired eating behavior, and 80% consumed supplements. There was a correlation between the occurrence of MD with eating behavior with PR = 2.56 and consumption of supplements with PR = 2.56. The most influential factor on MD was a social influence.

**Keywords:** eating behavior, fitness center, muscle dysmorphia, social influence, training load

## Introduction

One of the places where people do physical exercise is at the fitness center. Fitness centers are popular among adult men because physical appearance has become an object of interest over the last years. Besides fitness and health considerations, the individuals working out in these fitness centers have another purpose.<sup>1</sup> A study of 12 fitness centers in Yogyakarta found that 37.5% of its subjects aged 26 to 30 years exercised in fitness centers to make their muscles bigger, 24 % of them wanted to lose weight and tighten their muscles, and 37.5% wanted to get fit.<sup>2</sup> Most adult men describe their ideal body as muscular, including prominent ab muscles, broad shoulders, and a wide chest.<sup>3</sup> To achieve that goal, men increase their physical activities to build muscles through weightlifting and attempt to improve their body shape, as they feel unsatisfied with their bodies (body dissatisfaction). A person's dissatisfaction with their body image is related to the phenomenon of body dysmorphic disorder (BDD), and muscle dysmorphia (MD) is included in it.<sup>4</sup>

The incidence of MD is indicated by excessive concern about one's body being too small or not muscular

enough. There is also a compulsive desire to maintain a training schedule.<sup>5</sup> Previous studies have stated that 46.2% of fitness center customers are diagnosed with MD.<sup>6</sup> Men with MD are proven to have a negative body image. They dislike their bodies and worry about their weight, hip, thighs, and leg shape compared with men without MD.<sup>7</sup> The incidence of MD has several impacts on the decrease of social and health functions. The affected men spend most of their time lifting weights, following strict diets, limiting social activities, or going on vacations that can reveal their body shape, such as swimming or being in the middle of a crowd.<sup>5</sup>

Strict diets encourage excess protein consumption and limited intake of other nutrients, particularly macronutrients such as carbohydrates and fats.<sup>8</sup> Supplement consumption has also become an option to increase muscle mass and obtain the desired body shape.<sup>9</sup> However, improper diet changes can affect the level of energy intake adequacy and deprive one of nutrition that can improve exercise performance.<sup>8</sup> In addition, these individuals have a higher risk of behavior disorders and eating habits, such as restrictive eating, fasting, skipping meals, bingeing, purging, consuming diet pills, androgenic drugs,

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laxatives, and enema to maintain the body shape and weight.<sup>3</sup> Extreme eating behavior changes become the main cause of eating behavior disorders and disturbing the daily diet.<sup>10</sup> Prolonged eating behavior disorders lead to imbalances in nutrition intake and health disorders such as increased blood pressure and heart rate, bradycardia, hypothermia, salivary gland swelling, anemia, dehydration, alkalosis, and other conditions related to physical and mental health.<sup>11</sup>

Further, strict diets are also balanced with overtraining in weight lifting. Continuous weight lifting is an everyday activity of fitness center members who aim to get a muscular body. Over-exercising to achieve the ideal body can degrade the immune system in addition to causing the following: chronic muscle pain, increased heart rate, decreased physical performance, muscle injuries, increased blood lactate levels, sleeping disorders, biochemical disorders, and psychological disorders such as exercise addiction and drug abuse (e.g., steroid consumption).<sup>12</sup> Studies also show that 3.4% of the men who lift weights in fitness centers at the frequency of six hours per week have a higher tendency of MD.<sup>9</sup>

The factors causing MD include biological, social, and psychological factors.<sup>13</sup> One biological factor that affects muscle dysmorphia is body mass index (BMI). An underweight or overweight person tends to have negative body image and body dissatisfaction, which will motivate them to increase their muscle mass.<sup>14</sup> Social factors that lead to MD include the influence of social media, peers, and family. Television, magazine, and other media affect body image and create unreal social comparisons, as typical male models are masculine and muscular.<sup>15</sup> In addition, men want to be more muscular to flaunt their physical strength and get acceptance from peers. When a man successfully obtains the ideal body, that makes his friends wish to imitate him.<sup>16</sup>

Psychological factors that affect MD are self-esteem and perfectionism. One study shows that self-esteem has negative correlations with it. Someone with low self-esteem will feel unsatisfied with what they have, including body shape, which tends to cause MD.<sup>17</sup> In addition, perfectionism results in MD when one puts in unrelenting attempts to have the perfect body shape. One study predicted that the higher the perfectionism, the higher the dissatisfaction with the existing body shape.<sup>15</sup> Previous studies regarding the factors affecting MD and its impact discuss psychological factors primarily.<sup>13,15-17</sup> However, this study would also thoroughly examine the biological aspects from the perspective of nutrition in an adult male who has newly become a member of a fitness center. This study would focus on the reasons behind the increase in men's awareness of body image and exercise to obtain a muscular body. Because there is still limited study on MD in fitness center members, the authors were interested in

conducting study on the factors affecting MD and its impact on eating behavior and exercise load in fitness center members.

## Method

The scientific scope of this study was in the field of community nutrition, and so this study used a cross-sectional design. Data collection was carried out in June–August 2020 at three fitness centers in Semarang City, which are Summit Gym, Argy Gym, and Be Gym. This was an observational study with a method of taking subjects by consecutive sampling. Thus, the research subjects who met the criteria were included in the study until the requirement of a minimum of 100 subjects was fulfilled.<sup>18</sup> The inclusion criteria in this study were men aged 17–45 years who were still actively weight training at the fitness center, had no history of serious illness, and were willing to become study subjects by filling out an informed consent. One hundred subjects met all the study inclusion criteria.

The MD was measured using the Drive Muscular Scale (DMS) questionnaire, containing 15 statements about individual perceptions and assessments of a person's body muscles.<sup>19</sup> The DMS consisted of two factors. The first was the attitudes oriented towards gaining a muscular body, which tested a person's attitude towards muscles, such as, "I wish I were more muscular," and "I think I would feel more confident if I had more muscle mass." The second was muscle-oriented behavior, which included supplement consumption and training adherence, such as, "I use energy or supplements," and "I feel guilty if I miss my weight training schedule."<sup>20</sup> A subject was diagnosed with MD if the T-score was  $\geq 50$  and declared non-MD if the T-score was less than 50.<sup>19</sup>

Eating behavior was measured using the Eating Attitude Test-40 (EAT-40) questionnaire containing 40 statement items designed with modifications to assess a person's attitudes, behavior, and eating disorders. A score of more than 30 was considered an indicator of eating disorders.<sup>21</sup> Exercise intensity was measured using an exercise intensity questionnaire containing questions about the type of exercise, training duration, and training frequency in the last week. Quantitative data on subject characteristics included their age, the length of their membership at the fitness center, details of the previous week's days of weight training, food and dietary restrictions, special diets, and supplement consumption.

The variable affecting MD, BMI, was obtained by dividing the body weight (in kg) with body height squared (m). In addition, social influence variables were determined using the Sociocultural Attitudes Toward Appearance Questionnaire-4 (SATAQ-4), which contained 22 questions about the internalization of body shape and the influence of media, family, and peers with a Likert scale of

1 (strongly disagree) to 4 (strongly agree). A person was counted as affected if their score was more than the mean score and not affected if it was lesser.<sup>22</sup> Another independent variable in this study was self-esteem, obtained from the total score of each sample using the Rosenberg Self Esteem Scale (RSE) instrument, which contains ten questions with a Likert scale of 0 (strongly disagree) to 3 (strongly agree). The questions with a negative expression had the opposite score. The measurement results were categorized into low (score less than 15), moderate (score 15–25), and high (score more than 25). In addition, there was a perfectionism variable using the Measure of Constructs Underlying Perfectionism (M-CUP) instrument, which contains 47 questions with a Likert scale of 1 (strongly disagree) to 5 (strongly agree). Results were categorized into low, moderate, and high using the following conditions, respectively:  $x < \text{mean} - \text{SD}$ ,  $\text{mean} - \text{SD} \leq x < \text{mean} + \text{SD}$ , and  $\text{mean} + \text{SD} \leq x$ .<sup>23</sup>

The study was conducted online by recording the responses of the fitness center members using Google Forms, which contained the several questionnaires used in this study. Univariate analysis was conducted to describe the data on the subject's characteristics along with each study variable. The correlation between the MD score, eating behavior and exercise intensity, and affecting factors was tested using the Chi-squared test and

Kendall's Tau test. On the other hand, multivariate analysis was performed using multiple logistic regression tests.

### Results

All of the participants (n = 100) in this study were males who were active members of fitness centers in Semarang City. The characteristics of the group are shown in Table 1. Participants were aged between 17 and 43 years, with a mean of 24 years. They did weight training for 1–3 hours a day, 2–7 times/week on average. The type of weight training set (combination, inner core, gym machine, free-weight, and upper-lower) and the recovery time varied. Most of the participants were members of the fitness centers for  $\geq 18$  months, with an average of 20 months. The participants regularly trained with different motivations: a hobby, fitness, keeping up with the trend and building muscles.

Based on Table 2, 61 participants (61%) suffered from MD. The highest T-score was 66, with two participants reporting that they had always thought of using steroids. Most of the participants who consumed supplements (80%) like whey protein, amino, creatine, and protein shakes, were participants with MD. Statistically, there was a correlation between MD and supplement consumption. Participants with MD have a 2.56 times higher

**Table 1. Characteristics of Study Participants (n = 100)**

| Variable                       | Category                         | n  | %  | Mean±SD    | Min–Max   |
|--------------------------------|----------------------------------|----|----|------------|-----------|
| Age (year)                     |                                  |    |    | 23.9±5.8   | 17–43     |
| Training duration (hour/day)   |                                  |    |    | 1.6±0.58   | 1–3       |
| Length of membership (month)   |                                  |    |    | 20.2±22.52 | 1–96      |
| Training frequency (time/week) |                                  |    |    | 4.1±1.40   | 2–7       |
| Muscle dysmorphia T-score      |                                  |    |    | 49.8± 9.99 | 14.7–66.2 |
| Supplement consumption         | Without supplement               | 45 | 45 |            |           |
|                                | Whey Protein                     | 35 | 35 |            |           |
|                                | Amino                            | 11 | 11 |            |           |
|                                | Creatine                         | 4  | 4  |            |           |
|                                | Shake                            | 5  | 5  |            |           |
| Type of training               | Combination                      | 49 | 49 |            |           |
|                                | Inner core                       | 27 | 27 |            |           |
|                                | Training with a gym machine      | 3  | 3  |            |           |
|                                | Free-weight                      | 20 | 20 |            |           |
|                                | Upper and lower body workout     | 1  | 1  |            |           |
| Diet                           | Without diet                     | 80 | 80 |            |           |
|                                | OCD (Obsessive Corbuzier's Diet) | 2  | 2  |            |           |
|                                | Low fat                          | 6  | 6  |            |           |
|                                | Ketogenic                        | 3  | 3  |            |           |
|                                | Carbohydrate                     | 5  | 5  |            |           |
|                                | Calorie deficit                  | 1  | 3  |            |           |
|                                | High protein                     | 1  | 3  |            |           |
| Trusted food                   | None                             | 28 | 28 |            |           |
|                                | Banana                           | 28 | 28 |            |           |
|                                | Chicken egg                      | 15 | 15 |            |           |
|                                | Coffee, milk                     | 27 | 27 |            |           |
|                                | Meat                             | 2  | 2  |            |           |
| Dietary restrictions           | None                             | 76 | 76 |            |           |
|                                | Present                          | 24 | 24 |            |           |

**Note:** SD = Standard Deviation



**Table 2. Analysis of Participants' Characteristics based on Muscle Dysmorphia Status**

| Variable              | Category            | Muscle Dysmorphia Status |      |                 |      | p-value <sup>a</sup> | PR   |
|-----------------------|---------------------|--------------------------|------|-----------------|------|----------------------|------|
|                       |                     | MD (n = 61)              |      | Non-MD (n = 39) |      |                      |      |
|                       |                     | n                        | %    | n               | %    |                      |      |
| Diet behavior         | Eating disorder     | 36                       | 80   | 9               | 20   | 0.001*               | 2.56 |
|                       | Non-eating disorder | 25                       | 45.5 | 30              | 54.5 |                      |      |
| Frequency of training | High                | 40                       | 60.6 | 26              | 39.4 | 1.000                | 0.98 |
|                       | Low                 | 21                       | 61.8 | 13              | 38.2 |                      |      |
| Training duration     | Long                | 33                       | 62.3 | 20              | 37.7 | 0.944                | 1.05 |
|                       | Short               | 28                       | 59.6 | 19              | 40.4 |                      |      |
| Special diet          | With diet           | 14                       | 66.7 | 7               | 33.3 | 0.728                | 1.28 |
|                       | Without diet        | 47                       | 59.5 | 32              | 40.5 |                      |      |
| Supplement            | With supplement     | 44                       | 80   | 11              | 20   | <0.001*              | 2.56 |
|                       | Without supplement  | 17                       | 37.8 | 28              | 62.2 |                      |      |
| Trusted food          | Present             | 47                       | 65.3 | 25              | 34.7 | 0.239                | 1.20 |
|                       | None                | 14                       | 50   | 14              | 50   |                      |      |
| Dietary restrictions  | None                | 12                       | 50   | 12              | 50   | 0.304                | 0.64 |
|                       | Present             | 49                       | 64.5 | 27              | 35.5 |                      |      |

Notes: \*significant (<0.05), <sup>a</sup>Chi-square test, MD = Muscle Dysmorphia, PR = Prevalence Ratio

risk of consuming supplements than those without.

A total of 80% of the participants who suffered from eating disorders had MD, significantly higher than non-MD participants (20%). This disorder was validated by a high EAT-40 score of 23.16. The positive answers were mainly recorded from participants' statements of consuming higher levels of protein compared to carbohydrates or fats and supplements. Statistical analysis showed that participants with MD have a 2.56 times higher risk of eating disorders than those without MD. Even though the results showed a shift in eating behavior, not all the participants with MD adhered to the principle of special diets such as a carbohydrate diet, a low-fat diet, Obsessive Compulsive Disorder (OCD), or a ketogenic diet. Statistically, there was no association between the occurrence of MD and a special diet among the members of the fitness centers.

Participants also consumed “trusted food”; the food they believe as the fittest food to help them reach their goals in the fitness center, before and after weight training based on information from different media or personal trainers. A total of 72% of the participants who consumed different trusted food/drinks were participants with MD, and this number was higher than the non-MD participants who consumed trusted food/drinks. The trusted food consumed by the participants included coffee, banana, egg, milk, meat, and chicken. Although most of the participants believed in particular food or drinks, only a small number of the participants with MD had dietary restrictions. Thus, there was no solid correlation between MD and the consumption of trusted foods and dietary restrictions among the members of the fitness centers.

Table 2 also shows that the members of the fitness centers mostly did high-frequency and long-duration weight training in both MD and non-MD groups. However, the bivariate analysis showed no significant association between the occurrence of MD and the frequency and duration of the training.

Table 3 shows that social influence, self-esteem, and perfectionism affect the occurrence of MD. While nutritional status is not related to the occurrence of MD, participants influenced by social life have a three times higher risk of suffering from it. The records stated that 92.2% of the socially influenced participants suffered from MD, compared to only 28.6% of the participants who were not. Additionally, there was a significant moderate correlation between perfectionism and self-esteem with the occurrence of MD. The  $\tau$ -score indicated a positive correlation, where the higher the perfectionism, the higher the chance of being diagnosed with MD. On the other hand, the lower the self-esteem, the higher the likelihood of occurrence of MD.

Social influence came from media, peers, and family. Although most of the socially-influenced participants were affected by these sources, media was the most dominating (33.7%) influence due to social comparison, causing someone to compare their bodies to others. Further, televisions, magazines, the internet, movies, billboards, advertisements, videos, and other media are highly accessible in this digital era. Peer pressure came from fellow gym members who exchanged stories about different ways of getting the desired body shape. For those who were married, the influence from their spouse often came as comments on appearance. These factors resulted in the pressure to improve appearance, reduce body fat per-

**Table 3. Bivariate Analysis on Factors Affecting the Occurrence of Muscle Dysmorphia**

| Variable           | Category                        | Muscle Dysmorphia Status |      |                 |      | p-value | PR                | τ                  |
|--------------------|---------------------------------|--------------------------|------|-----------------|------|---------|-------------------|--------------------|
|                    |                                 | MD (n = 61)              |      | Non-MD (n = 39) |      |         |                   |                    |
|                    |                                 | n                        | %    | n               | %    |         |                   |                    |
| Nutritional status | Abnormal                        | 39                       | 63.9 | 22              | 56.1 | 0.588   | 1.13 <sup>a</sup> |                    |
|                    | Normal                          | 22                       | 56.4 | 17              | 43.6 |         |                   |                    |
| Social influence   | Influenced                      | 47                       | 92.2 | 4               | 7.8  | <0.001* | 3.22 <sup>a</sup> | -                  |
|                    | Not influenced                  | 14                       | 28.6 | 35              | 71.4 |         |                   |                    |
|                    | Media (32.5%)                   |                          |      |                 |      |         |                   |                    |
|                    | Family (33.6%)<br>Peers (33.7%) |                          |      |                 |      |         |                   |                    |
| Self esteem        | Low                             | 4                        | 80   | 1               | 20   | 0.021*  | -                 | 0.229 <sup>b</sup> |
|                    | Moderate                        | 57                       | 62.6 | 24              | 37.4 |         |                   |                    |
|                    | High                            | 0                        | 0    | 4               | 100  |         |                   |                    |
| Perfectionism      | High                            | 15                       | 76.5 | 4               | 23.5 | 0.003*  | -                 | 0.288 <sup>b</sup> |
|                    | Moderate                        | 45                       | 65.2 | 24              | 34.8 |         |                   |                    |
|                    | Low                             | 5                        | 21.4 | 11              | 78.6 |         |                   |                    |

Notes: \*Significant (<0.05), <sup>a</sup>Chi-square test, <sup>b</sup>Kendall-tau, MD = Muscle Dysmorphia, PR = Prevalence Ratio, τ = correlation coefficient of Kendall's-tau

**Table 4. Factors Affecting the Most to The Occurrence of Muscle Dysmorphia**

| Variable            | β     | SE    | Wald   | Sig.    | OR   |
|---------------------|-------|-------|--------|---------|------|
| Socially influenced | 3.635 | 0.669 | 29.544 | <0.001* | 37.9 |
| High perfectionism  | 1.600 | 0.557 | 8.26   | 0.004*  | 4.9  |

Notes: \*Significant (<0.05), SE = Standard Error, OR = Odds Ratio

centage, and get a better body shape.

In terms of appearance, the participants enforced the impression of being neat, organized, and disciplined, and also tended to be less satisfied with their body shape. This was related to the standard nutritional status of most of the participants. Someone with normal nutritional status still had body dissatisfaction due to a high standard imposed by their perfectionism.

The variables of social influence, self-esteem, and perfectionism were further analyzed using multiple logistic regression analyses to determine the factors that affect the occurrence of MD the most. The results of the multiple logistic regression analyses are shown in Table 4. The most significant factors impacting the occurrence of MD among people who did weight training were social influence and perfectionism, with a significance of less than 0.05. Thus, it could be concluded that socially influenced people had a 38 times higher risk of MD, while those with high perfectionism had a five times higher risk.

**Discussion**

The participants in this study were aged between 17 and 43 years, with a mean age of 25 years. They were categorized as early adults and thus, were susceptible to

undergoing changes in values for acceptance by a specific social group. Therefore, they would try to fit in with the values adopted in their ideal social group (perfectionism).<sup>24</sup> This was in line with findings from a preceding study which reported that the higher the perfectionism, the higher chance of being diagnosed with MD among the male members of an early-adult fitness center.<sup>25</sup> The training process is progressive, which means that they start with easier workouts and finish with more difficult ones during the training. They graduated from simpler to more complex and general to specific exercises. Initially, they exercised their entire body and moved to targeted exercises. Their weights changed from light to heavy in quantity and quality consistently, progressively, and continuously.<sup>26</sup> However, the training process must be spread over a sufficient period, as the body cannot suddenly adapt to the effect of weight training. It requires process and time put in gradually and continuously.<sup>27</sup>

The consumption of protein supplements in males who do weight training is believed to increase muscle size, thus increasing muscle strength and reducing body fat.<sup>28</sup> The findings of this study showed that 80% of the participants who consumed supplements (whey protein, amino, and creatine) had MD. This number is higher than the prevalence in a preceding study conducted in

Ghana that reported 33% of its participants consuming supplements.<sup>29</sup> Another study conducted in Yogyakarta also stated that 44% of the males who do weight training often consume supplements.<sup>2</sup> According to statements made by the participants, the consumption of supplements followed the recommended dosage written on the label. The main reason behind the change in the eating behavior among male members of the fitness center was the obsession to gain more muscle mass in a shorter time, explaining why they did not focus on the health aspect of consuming food.<sup>28</sup> This is following the results of this study; most of the participants preferred to consume supplements to speed up muscle gain, as bodybuilding athletes do, more than changing their eating behavior naturally.<sup>29</sup> Inadequate eating practices in men with MD affect the result of the training as well as the consumption of food supplements and the abuse of anabolic steroids, which are associated with a higher frequency disorder. Further, the lack of food intake is related to worsening psychopathologies and body disorders.<sup>8</sup> An excessive consumption of supplements is harmful and may cause adverse effects such as kidney damage and other diseases. Supplements should only be an addition to complete nutrient intake in the event of inadequate levels of some nutrients.<sup>29</sup>

The results of this study showed that 80% of the participants with eating disorders had MD compared to non-MD participants. People with MD were preoccupied with appearance and worried about the muscles not being large and muscular enough. These conditions led them to do activities that could build their muscles up, like weight training, dieting, and drugs.<sup>30</sup> This finding was in line with the results of a preceding study conducted in the USA among bodybuilders, in which 58.3% of the participants were diagnosed with MD.<sup>7</sup> Another report stated that symptoms of MD start to manifest at the age of 19.5 years, indicated by the participants spending over three hours a day thinking of becoming more muscular, having control over their weight training activities, following disturbing diets and training, avoiding certain places and activities because of the worry over their muscle, and involving in body monitoring, such as checking out their body in the mirror frequently and wearing loose clothes to hide their body.<sup>3</sup>

This study revealed that people diagnosed with MD have a 2.56 times higher risk of eating disorders than people without MD. This data is consistent with a study stating that men with MD have a more irregular diet pattern than men without the condition.<sup>7</sup> Earlier studies have also noted that changes in eating behavior often happen to sports players that pay attention to their weight, as weightlifters, gymnasts, and swimmers do.<sup>28,31,32</sup> An additional study also reported a significant association between MD and eating disorders.<sup>7</sup> Participants diagno-

sed with MD scored significantly higher on EAT than those without it.<sup>32</sup> In addition to the use of supplements, weight training activists also do a diet to reduce water intake. These strategies aim to minimize subcutaneous water and optimize muscle definition. However, dehydration and sodium depletion resulting from fluid restriction is dangerous for training performance.<sup>33</sup> Psychologically, men with MD who do weight training non-professionally or non-competitively tend to yearn for approval or recognition for their appearance instead of their performance.<sup>34</sup> Body dissatisfaction, monitoring, and awareness are associated with irrational thoughts, perceptual distortion, and negative influences that damage a positive body image.<sup>35</sup>

A study showed that those with high-intensity training scored higher in MD symptoms and related psychopathy (irregular eating pattern) compared to the control group.<sup>36</sup> Another study proposed that a higher score in MD symptoms is correlated with training addiction, based on it being high among the 151 male gym users and 25 bodybuilders part of that study.<sup>37</sup> As per this study result, a total of 30 participants stated that they often, very often, and always felt guilty if they missed their training. Even though this study reported a statistically insignificant association between the occurrence of MD and training duration and frequency, people with MD recorded a higher frequency and longer training periods than non-MD participants.

Multivariate analysis indicated that social influence was the most affecting variable in the occurrence of MD, where its risk was 38 times higher than participants who were not socially influenced. This finding agreed with a study conducted by Vitari stating that there was a significant correlation between MD and media influence due to the latter's relation with social comparison; thus, media pressure may cause someone to compare their body to others.<sup>38</sup> Social influence consists of media, parents, and peers. The media influences body image, resulting in social comparisons, with changes in perception related to the ideal body being regulated by the masculine and muscular models.<sup>15</sup> The family environment thus becomes an important influence because comments on appearance may have positive or negative impacts.<sup>39</sup> Peers also play a role in developing body dissatisfaction because their comments on appearance directly influence their friendship. Furthermore, when someone achieves the ideal body shape, a desire to do the same will occur in their friends. This statement follows a study by Aliyev that found a strong association between media influence, parents, and peers with body image.<sup>40</sup> In gyms, many posters of masculine and muscular men are on display. This condition may also increase body dissatisfaction, and hence, parents must cite positive examples to their children and avoid making negative comments. Peers' in-

fluence as "role models" after achieving their goal to be muscular should help their friends succeed too.

This study also indicated a significant moderate correlation between perfectionism and MD ( $p$ -value $<0.001$ ). Perfectionism consists of a high standard, regularity, expecting perfectionism from others, perception of pressure, and reactivity to mistakes, details, evaluators, satisfaction, and dissatisfaction.<sup>13</sup> This study finding was supported by a preceding study by Pratiwi, which found a positive association between perfectionism and body image dissatisfaction. Thus, the higher the perfectionism, the higher the body image dissatisfaction.<sup>23</sup> A study by Iswidyanti and Hamidah, which found a significant positive correlation between perfectionism and the tendency of MD in male gym users, also supports this study's findings. The higher the perfectionism level in male gym users, the higher their tendency to be diagnosed with MD.<sup>41</sup>

Perfectionism indicates a dominant high standard. It is associated with pressure from other people that seems to demand or make them often say "should be" to themselves. Perfectionism affects the occurrence of MD both indirectly and directly. The direct effect can be found in the continuous effort to achieve "the perfect body." The indirect effect comes in the form of body dissatisfaction. If their body differs even slightly from the ideal body shape, they will be dissatisfied. This situation then increases the risk of MD.<sup>13</sup>

The strength of this study is that it examined the factors that influence MD and analyzed its harmful effects. However, there are weaknesses in this study as well. This study has not considered other factors that influence the incidence of MD, such as the purpose of changing eating behavior, exercise motivation, and internal body orientation of fitness center members. Fitness center members require a special approach to diet management and training load, and this is needed to prevent nutritional and health problems. Further research is required to determine the other factors that influence the occurrence of MD, such as exercise motivation and internal body orientation, and to analyze their long-term health impact on people with MD.

## Conclusion

Muscle dysmorphia (MD) correlates with eating behavior and consumption of supplements in fitness center members. Subjects with MD had a 2.56 times greater risk of experiencing disorders in their eating behavior and the consumption of supplements than the members without it. Social influence and perfectionism also have a relationship with the incidence of MD in fitness center members, with the most influential factor being the former. Further study is needed to see the long-term health impact on people with muscle dysmorphia.

## Abbreviations

MD: Muscle Dysmorphia; DMS: Drive Muscular Scale; EAT-40: Eating Attitude Test-40; BDD: Body Dysmorphic Disorder; BMI: Body Mass Index; SATAQ-4: Sociocultural Attitudes Toward Appearance Questionnaire-4; RSE: Rosenberg Self Esteem Scale; M-CUP: Measure of Constructs Underlying Perfectionism; OCD: Obsessive Corbuzier's Diet; SD: Standard Deviation; OR: Odds Ratio.

## Ethics Approval and Consent to Participate

The study received approval from the Bioethics Commission for Medical/Health Research, Faculty of Medicine, Sultan Agung Islamic University, Semarang, with the registration number: 224/VII/2020/Bioethical Commission. Informed consent was obtained from all participants before they filled out the questionnaire.

## Competing Interest

The authors declare that there are no significant competing financial, professional, or personal interests that might have affected the performance.

## Availability of Data and Materials

Data and information used as study materials were from original studies conducted by the corresponding author.

## Authors' Contribution

DYF was in charge of developing the study design, providing critical reviews to the article, analyzing and interpreting the results, and article writing. NW, ERN, AR, and FFD served as critical reviewers of the paper and wrote part of it. RP was in charge of analyzing and interpreting the result. DKS and WD were in charge of collecting data and writing the article.

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## References

1. Wiśniewska-Nogaj L. Symptoms of muscle dysmorphia in male gym users. *Psychiatri Psychol Klin*. 2019; 19 (2): 129–42.
2. Sugiarto. Hubungan asupan energi, protein dan suplemen dengan tingkat kebugaran. *Media Ilmu Keolahragaan Indones*. 2012; 2 (2): 94–101.
3. Stapleton P, McIntyre T, Bannatyne A. Body image avoidance, body dissatisfaction, and eating pathology: is there a difference between male gym users and non-gym users? *Am J Mens Health*. 2016; 10 (2): 100–9.
4. Contesini N, Adami F, Blake MDT, Monteiro CB, Abreu LC, Valenti VE, et al. Nutritional strategies of physically active subjects with muscle dysmorphia. *Int Arch Med*. 2013; 6 (1): 1–6.
5. Santaronecchi E, Dèttore D. Muscle dysmorphia in different degrees of bodybuilding activities: validation of the Italian version of muscle dysmorphia disorder inventory and bodybuilder image grid. *Body Image*. 2012; 9 (3): 396–403.



6. Dhiana MA, Dieny FF. Hubungan muscle dysmorphia dengan asupan energi dan zat gizi makro pada pria dewasa usia 19-29 tahun anggota floor sport club Semarang. *Journal of Nutrition College*. 2014; 3 (4): 972–81.
7. Devrim A, Bilgic P, Hongu N. Is there any relationship between body image perception, eating disorders, and muscle dysmorphic disorders in male bodybuilders? *Am J Mens Health*. 2018; 12 (5): 1746–58.
8. Bosse JD, Dixon BM. Dietary protein in weight management: a review proposing protein spread and change theories. *Nutr Metab*. 2012; 9: 1–11.
9. Cella S, Iannaccone M, Cotrufo P. Muscle dysmorphia : a comparison between competitive bodybuilders and fitness practitioners. *Journal of Nutritional Therapeutics*. 2012; 1: 12-18.
10. Corazza O, Simonato P, Demetrovics Z, Mooney R, Luca I De, Ven K Van De, et al. The emergence of exercise addiction , body dysmorphic disorder , and other image- related psychopathological correlates in fitness settings : a cross sectional study. *PLoS One*. 2019; 1–17.
11. Mitchell L, Hackett D, Gifford J, Estermann F, O'Connor H. Do bodybuilders use evidence-based nutrition strategies to manipulate physique? *Sports*. 2017; 5 (4): 76.
12. American College of Sports Medicine. American College of Sports Medicine position stand. Progression models in resistance training for healthy adults. *Med Sci Sports Exerc*. 2009; 41 (3): 687–708.
13. Grieve FG. A conceptual model of factors contributing to the development of muscle dysmorphia. *Eating Disorders*. 2007; 15 (1): 63–80.
14. Pickett TC, Lewis RJ, Cash TF. Men, muscles, and body image: comparisons of competitive bodybuilders, weight trainers, and athletically active controls. *British Journal of Sports Medicine*. 2015; 39 (4): 217–22.
15. George HR. The effects of media exposure on body dissatisfaction and cognitive bias in adolescent girls and boys. *Academic Unit of Psychiatry and Behavioural Sciences School of Medicine. The University of Leeds Academic*; 2010.
16. Lin L, DeCusati F. Muscle dysmorphia and the perception of men's peer muscularity preferences. *American Journal of Men's Health*. 2016; 10 (6): 78–88.
17. Olivardia R, Pope HG, Borowiecki JJ, Cohane GH. Biceps and body image: the relationship between muscularity and self-esteem, depression, and eating disorder symptoms. *Psychology of Men and Masculinity*. 2004; 5 (2): 112–20.
18. Suresh K, Chandrashekara S. Sample size estimation and power analysis for clinical research studies. *J Hum Reprod Sci*. 2012; 5 (1): 7–13.
19. Parnell R. The influence of self-esteem and body dissatisfaction on muscle dysmorphia and exercise dependence. *ProQuest Diss Theses*. 2011; 10 (2): 6–25.
20. Escoto C, Alvarez-Rayón G, Mancilla-Díaz JM, Camacho Ruiz EJ, Franco Paredes K, Juárez Lugo CS. Psychometric properties of the drive for muscularity scale in Mexican males. *Eat Weight Disord*. 2013; 18 (1): 23–8.
21. Talwar P. Factorial analysis of the eating attitude test (EAT-40) among a group of Malaysian University students. *Malaysian J Psychiatry*. 2011; 20 (2): 1–10.
22. Diehl BJ, Baghurst T. Biopsychosocial factors in drives for muscularity and muscle dysmorphia among personal trainers. *Cogent Psychology*. 2016; 3 (1): 1–20.
23. Pratiwi S. Hubungan antara perfekionisme dan ketidakpuasan terhadap citra tubuh pada masa dewasa awal. *Universitas Sanata Dharma Yogyakarta. Undergraduate Theses*; 2016.
24. Kennedy R. Sports participation and body concern in an adult population : does type of sport matter? *Theses*; 2011: 6–18.
25. Tod D, Edwards C, Cranswick I. Muscle dysmorphia: current insights. *Psychol Res Behav Manag*. 2016; 9: 179–88.
26. Sidik AM & Suharjana. Sikap member fitness center GOR FIK UNY Yogyakarta terhadap program-program latihan kebugaran. *Medikora*. 2015; 14 (1).
27. Wariyanti Y. Analisis gerak teknik penggunaan alat latihan beban member fitness GOR Fakultas Ilmu Keolahragaan Universitas Negeri Yogyakarta. *J Ilmu Keolahragaan*. 2015; 1 (1): 9–22.
28. De Sá Resende A, Santos LR, De Macedo Rodrigues Leite M, Falcão Raposo OF, Mendes Netto RS. Eating habits and body image among gym goers. *Mundo da Saude*. 2019; 43 (1): 227–48.
29. Taylor J, Mensah W. Effects of nutritional and dietary supplements on renal function among University bodybuilders in Ghana. *Int Ann Med*. 2017; 1 (10): 8.
30. Lichtenstein MB, Emborg B, Hemmingsen SD, Hansen NB. Is exercise addiction in fitness centers a socially accepted behavior? *Addict Behav Rep*. 2017; 6 (3): 102–5.
31. Mcfarland MB, Kaminski PL. Eating behaviors Men, muscles, and mood : the relationship between self-concept, dysphoria, and body image disturbances. *Eat Behav*. 2009; 10 (1): 68–70.
32. Williams J. Muscle dysmorphia, body dissatisfaction, and eating behaviors of collegiate aged male amateur weightlifters. *Oklahoma State University. Theses*; 2011: 1-37.
33. Tidmas V, Brazier J, Hawkins J, Forbes SC, Bottoms L, Farrington K. Nutritional and non-nutritional strategies in bodybuilding: impact on kidney function. *International Journal of Environmental Research and Public Health*. 2022; 19 (7): 4288.
34. Henslee J. Body image and bodybuilding : the impact commitment to bodybuilding has on body image disturbance among competitive bodybuilders. *Missouri State University. Theses*; 2017: 1-50.
35. Christopher R, Isabelle L, Olivier T, Catherine B. Muscle dysmorphia and eating disorders: comparison on self-esteem and personality traits. *Int J Psychol Psychoanal*. 2018; 4 (2): 1–8.
36. de Souza D, Santos J, de Jesus D, Gentil P. Biochemical profile and body composition alteration of amateur bodybuilders during the pre-contest period. *J Funct Morphol Kinesiol*. 2018; 3 (2): 26.
37. Sandgren SS, Giske R, Shalfawi SAI. Muscle dysmorphia in Norwegian gym-going men: an initial investigation. *Kinesiology*. 2019; 51 (1): 12–21.
38. Vitari V, Susanto M, Wirawan DN, Griadhni IPA. Predictor of muscle dysmorphia among members of fitness centers in Denpasar City, Bali, Indonesia. *Multidisciplinary Journal of Public Health and Preventive Medicine*. 2020; 8 (1): 4–10.
39. Endendijk JJ, Groeneveld MG, Mesman J. The gendered family process model: An integrative framework of gender in the family. *Archives of Sexual Behavior*. 2018; 47 (4): 877–904.
40. Aliyev B, Türkmen A. Parent, peer and media effect on the perception of body image in preadolescent girls and boys. *Universal Journal of*



- Psychology. 2014; 2 (7): 224–30.
41. Iswidyanti SS, Hamidah. Hubungan antara perfeksionisme dengan kecenderungan muscle dysmorphia pada pria dewasa awal pengguna pusat kebugaran. *Jurnal Psikologi Klinis dan Kesehatan Mental Tahun*. 2018; 7 (1): 61-71.

# Determinants of the Coexistence Dual Form of Malnutrition in Pairs of Mother and Child Aged 6–59 Months in Bogor District 2019

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## Abstract

The dual form of malnutrition (DFM) is defined as multiple nutritional problems in the same household and time. This study aimed to determine the related factor to DFM incidence in pairs of mothers and children aged 6–59 months in Bogor District in 2019. This cross-sectional study used secondary data on the Nutrition and Health of Babakan Madang Subdistrict Toddlers in 2019 and Nutrition Intake and Stunting of Children Under-Five in Bogor District, West Java Province, involving a total sample of 274 households. The dependent variable in this study was DFM, while the independent variables were maternal age during pregnancy, maternal height, maternal breastfeeding history, parity, family income, mother's and father's education level. Bivariate analysis involving the Chi-square test and multivariate analysis with multiple logistic regression tests was used in this study. The results revealed that DFM incidence in the Babakan Madang Subdistrict in 2019 was 42%. The determinants of DFM that were significantly related were maternal height (p-value = 0.000), maternal breastfeeding history (p-value = 0.027), and parity (p-value = 0.049). The analysis results showed that the dominant factor in the prevalence of DFM was the maternal height (OR = 2.704; 95% CI = 1.615-4.528). It is recommended to improving nutrition in adolescence, especially in the case of girls in their role as future mothers.

**Keywords:** dual form of malnutrition, maternal height, overweight, stunting

## Introduction

Nowadays, overnutrition problems such as overweight and obesity have become one of the major public health problems in the world. At the same time, the prevalence of malnutrition is relatively high.<sup>1</sup> These two different nutritional problems can coincide at the individual, household, population, and country levels. The dual form of malnutrition (DFM) is defined as multiple nutritional problems in the same household and time, with the possibility of overweight adults and malnutrition among children.<sup>2</sup> In this study, DFM is defined as a double nutritional burden that occurs in the same household, as shown by the presence of stunted children (height for age z-score (HAZ) < -2 SD) and overweight/obese mothers (body mass index (BMI) > 25 kg/m<sup>2</sup>). The incidence of DFM in the mother-child pair can have various negative impacts. Due to malnutrition, around 3 million children worldwide die every year. Millions of children with stunting also experience slower physical and cognitive growth.<sup>3</sup> Meanwhile, obesity or

overweight in adults can increase the risk of non-communicable diseases and is known to be the cause of 2.8 million deaths in adults each year.<sup>4</sup>

The prevalence of DFM in mother-child pairs varies considerably, ranging from less than 10% to 26.8% in various countries.<sup>5</sup> In Indonesia, there is also a high prevalence of stunted children and overweight mothers. The prevalence of stunting in children aged 0–59 months in Indonesia is 30.8%.<sup>6</sup> In West Java prevalence of stunting in children aged 0–59 months is 31.1%, while overweight and obesity in adults more than 18 years are 13.7% and 23%, respectively.<sup>6</sup> Study by Wibowo in 2015, using Indonesia Basic Health Research/*Riset Kesehatan Dasar* (Riskesdas) 2010 data showed that the prevalence of DFM in mothers and children pairs aged two to five years is 29.8%.<sup>7</sup> Study conducted previously in the West Java Province found that the prevalence of DFM involving overweight/obese mothers and stunted child pairs was 30.6%.<sup>8</sup> The determinants of DFM in mother and child pairs are maternal factors and socioeco-

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conomic aspects. Maternal factors include the mother's pregnancy age, height, higher parity, and maternal breastfeeding history—meanwhile, socioeconomic factors include household income, mother's education level, and father's education level.

Overweight/obese mothers and stunted children under-five were chosen as the target of the study. Children under-five were selected because the first five years of life are when children have rapid brain development and physical growth; besides, those were the target age group for nutritional improvement. Mothers were chosen because mothers belong to the productive age group and determined their key role in the child's growth and development in early childhood.<sup>8</sup> Mother also played an essential role in nurturing, food providing, and food distributing in the family.<sup>1</sup> Stunting was chosen as an indicator of malnutrition in this study because it reflected the cumulative effects of undernutrition and infection from birth or even before birth. Stunting in childhood was also associated with physical and cognitive growth problems.<sup>9</sup> Stunting was also reported to affect health in adulthood and the risk of chronic disease. Childhood malnutrition was a risk factor for higher glucose, blood pressure, and lipid levels.<sup>10</sup>

Indonesia basic health research 2018 data showed that stunting problems in children under-five still have the highest prevalence compared to the other nutritional problems.<sup>6</sup> Being overweight in the case of mothers was also shown to be associated with an increased risk of developing various diseases or even death.<sup>11</sup> Previous studies by de Onis M and Branca F, Williams, *et al.*, Seidu, *et al.*, and Hruby, *et al.*, tended to be focused on one specific nutritional problem.<sup>10-13</sup> Studies about the double burden of malnutrition in one household are still rare in Indonesia. The result of this study can show that two different nutritional problems can be influenced by the same factor.

The Department of Health of Bogor District found 19,557 malnourished children in 2019.<sup>14</sup> Studies in Babakan Madang Subdistrict by Putriani EB, *et al.*,<sup>15</sup> found that prevalence of stunting in children aged 6–23 months was 33.2%. The prevalence of stunting and overweight or obesity in West Java is higher compared to the national prevalence, same as stunting prevalence in Babakan Madang Subdistrict that higher than the national stunting rate. Bogor District also had a high rate of malnourished children. Previous studies in Babakan Madang Subdistrict only examined child stunting, while overweight or obesity in mothers has never been studied. Based on the above description, the authors were interested in examining whether the incidence of stunting children in Babakan Madang Subdistrict was also accompanied by the DFM incidence, where the child's mother was overweight/obese. The objective of this study were

to determine factors related to DFM in overweight or obese mothers and children 6–59 months stunted in the Babakan Madang Subdistrict, Bogor District, West Java Province, Indonesia.

## Method

This study used secondary data from the 2019 PITTA B umbrella research from the Universitas Indonesia “Nutrition and Health of Toddlers in Babakan Madang Subdistrict, Bogor District 2019”.<sup>16,17</sup> This data was obtained from a survey undertaken in May 2019 in six out of the nine villages in the Babakan Madang Subdistrict. Secondary data analysis was conducted from March to June 2021. This study used a quantitative analysis method with a cross-sectional design. The target population in this study was all households that have children aged 6–59 months in six selected villages in the Babakan Madang Subdistrict, Bogor District. Subjects that meet the inclusion and exclusion criteria were selected from the overall population. The inclusion criteria were households with children aged 6–59 months and living with birth mothers in six selected villages for a year. If more than one child under-five were in the same household, the youngest one would be chosen. The age limit of the mother was  $\geq 18$  years. The exclusion criteria included households with single form malnutrition (only mothers who were overweight/obese or their children who were stunted), pregnant women, and children with mental disorders, physical disabilities, and congenital diseases.

Outlying data were excluded from the analysis. Based on the two-proportion hypothesis analysis, the sample size of 274 had a test power of more than 80%. SPSS (version 22, SPSS Inc., Chicago, IL) application was used to analyze the results. Univariate analysis was conducted to obtain an overview of the frequency distribution of the study variables. Bivariate analysis was used to examine the relationship between the dependent variable (DFM) and independent variables (maternal age during pregnancy, maternal height, parity, maternal breastfeeding history, household income, mother's level of education, and father's level of education). The statistical test method used was the Chi-square test and multivariate analysis using a multiple logistic regression test, which aimed to determine the dominant factor of DFM. The dual form of malnutrition (DFM) was defined as the presence of stunted children ( $HAZ < -2$  SD) and overweight/obese mothers ( $BMI > 25$  kg/m<sup>2</sup>). All variables in this research were categorized into two, maternal age during pregnancy (older maternal ages for  $\geq 35$  years old and younger maternal ages for less than 35 years old), maternal height (short stature for mothers more than 150 cm and normal for mothers  $\geq 150$  cm), parity (household with more than two children and

household with  $\leq 2$  children), maternal breastfeeding history (currently breastfeeding and not currently breastfeeding), monthly household income (low for  $< \text{IDR } 3,760,000$  and high for  $\geq \text{IDR } 3,760,000$  IDR),<sup>18</sup> mother's educational level (low for no schooling, primary, secondary and high for high school, college), and father's educational level (low for no schooling, primary, secondary and high for high school, college).

### Results

The result of the bivariate analysis revealed that maternal height, maternal breastfeeding history, and parity were found to have a significant association with the incidence of DFM (Table 1). However, the results did not show a significant association between maternal age during pregnancy, household income, mother's educational level, and father's educational level with DFM incidence.

Multivariate analysis was obtained using multivariate modeling after conducting confounding and interaction tests. Variables were gradually eliminated from modeling from the variable with the largest p-value. Table 2 was the final modeling of the multiple logistic regression analysis. The results of the multivariate analysis showed

that the dominant factor concerning DFM was maternal height. It was found that households with a maternal height less than 150 cm may increase the odds of having DFM by a factor of 2.7 after being controlled by maternal age during pregnancy, mother's breastfeeding history, and parity as confounding variables (Table 2).

### Discussion

The dual form of malnutrition is defined as the presence of stunted children aged 6–59 months and overweight/obese mothers in the same household. Children are stunted when the height-for-age is less than -2 SD from the median of WHO child growth standards. Mothers are defined as overweight if the value of BMI  $> 25.0\text{--}27.0 \text{ kg/m}^2$  and defined as obese if the BMI  $> 27.0 \text{ kg/m}^2$ .<sup>19</sup> Stunting in a child under five reflects chronic nutritional problems and overweight/obesity in mothers describes the current nutritional status.<sup>18</sup> The DFM occurs due to a nutritional transition where the problem of obesity continues to develop.<sup>18</sup> At the same time, the problem of malnutrition also persists as a consequence of the long-term effects of malnutrition in early life.<sup>20</sup>

The results showed that the prevalence of DFM incidence in mothers and children aged 6–59 months

**Table 1. Determinants of Dual Form of Malnutrition**

| Variable                      | Category        | Dual Form of Malnutrition |      |     |      |       |     | p-value     | OR    | 95% CI      |
|-------------------------------|-----------------|---------------------------|------|-----|------|-------|-----|-------------|-------|-------------|
|                               |                 | Yes                       |      | No  |      | Total |     |             |       |             |
|                               |                 | n                         | %    | n   | %    | n     | %   |             |       |             |
| Maternal age during pregnancy | $\geq 35$ years | 16                        | 57.1 | 12  | 42.9 | 28    | 100 | 0.154       | 1.912 | 0.867–4.219 |
|                               | $< 35$ years    | 99                        | 41.1 | 142 | 58.9 | 241   | 100 |             |       |             |
| Maternal height               | $< 150$ cm      | 69                        | 53.5 | 60  | 46.5 | 129   | 100 | $< 0.001^*$ | 2.475 | 1.513–4.048 |
|                               | $\geq 150$ cm   | 46                        | 31.7 | 99  | 68.3 | 145   | 100 |             |       |             |
| Currently breastfeeding       | No              | 83                        | 47.2 | 93  | 52.8 | 176   | 100 | 0.027*      | 1.841 | 1.099–3.083 |
|                               | Yes             | 32                        | 32.7 | 66  | 67.3 | 98    | 100 |             |       |             |
| Parity                        | $> 2$ child     | 44                        | 51.8 | 41  | 48.2 | 85    | 100 | 0.049*      | 1.738 | 1.035–2.918 |
|                               | $\leq 2$ child  | 71                        | 38.2 | 115 | 61.8 | 186   | 100 |             |       |             |
| Household income              | Low             | 76                        | 42.5 | 103 | 57.5 | 179   | 100 | 0.924       | 1.059 | 0.639–1.755 |
|                               | High            | 39                        | 41.1 | 56  | 58.9 | 95    | 100 |             |       |             |
| Mother's educational level    | Low             | 91                        | 42.5 | 123 | 57.5 | 214   | 100 | 0.840       | 1.110 | 0.619–1.989 |
|                               | High            | 24                        | 40.0 | 36  | 60.0 | 60    | 100 |             |       |             |
| Father's educational level    | Low             | 66                        | 43.1 | 87  | 56.9 | 153   | 100 | 0.869       | 1.075 | 0.659–1.752 |
|                               | High            | 48                        | 41.4 | 68  | 58.6 | 116   | 100 |             |       |             |

Notes: \*Significance p-value $< 0.05$ , OR = Odds Ratio, CI = Confidence Interval

**Table 2. Multivariate Analysis of Determinants of Dual Form of Malnutrition**

| Variable   | Coef B | p-value | OR    | 95% CI      |
|--|--------|---------|-------|-------------|
| Maternal age during pregnancy ( $\geq 35$ years) | 0.657  | 0.155   | 1.928 | 0.779–4.771 |
| Maternal height ( $< 150$ cm)                    | 0.995  | 0.000   | 2.704 | 1.615–4.528 |
| Currently breastfeeding (No)                     | 0.707  | 0.012   | 2.028 | 1.169–3.520 |
| Parity ( $> 2$ child)                            | 0.474  | 0.109   | 1.606 | 0.899–2.868 |

Notes: \* significant (p-value  $< 0.05$ ), OR = Odd Ratio, CI = Confidence Interval

pairs in Babakan Madang Subdistrict was 42%. In comparison, other study has found that the prevalence of DFM in Malaysia was 19.4%.<sup>21</sup> Another study in Guatemala found that the prevalence of DFM was 17%.<sup>22</sup> A study conducted in rural areas of Indonesia found that the prevalence of DFM was 11%.<sup>19</sup> Another study conducted in urban areas of Indonesia found a prevalence of DFM of 24.7%.<sup>1</sup> When compared to the above studies, DFM in Babakan Madang Subdistrict has a higher prevalence. The DFM can have many negative impacts on both child and mother. Stunting in children can increase the risk of children experiencing infections, physiological disorders, mucosal integrity disorders, and undernutrition, including micronutrient deficiencies, compared to children with normal nutritional status.<sup>10,23</sup> Obesity in mothers or adults also has many adverse effects. A high percentage of body fat may increase the risk of cardiovascular disease, diabetes, cancer, asthma, and musculoskeletal disorders.<sup>12,24</sup>

There were no statistically significant differences between maternal age during pregnancy and DFM. This finding was not in line with a study in the Republic of the Marshall Islands which found such a relationship (p-value < 0.001; OR = 1.19; 95% CI = 1.12–1.26).<sup>25</sup> There was a great deal of evidence that stunting in children under five is related to maternal age during pregnancy. However, the evidence regarded maternal age during pregnancy and DFM is still limited. For more than 35 years mothers, aging can cause decreased nutritional absorption. It causes nutritional intake imbalance on the mother's part during pregnancy and increases the risk of having a stunted child.<sup>26</sup> Changes in body composition are consistent with age changes, as mothers get older BMI will also increase.<sup>27</sup> The mechanisms related to the effects of estrogen hormones can affect body composition with age when there is an increase in body fat mass and a decrease in fat-free mass.<sup>13,27</sup> This study did not find a significant relationship between maternal age during pregnancy and DFM incidence. In this study, 57.1% of families with a maternal age during pregnancy more than 35 years experienced DFM, higher than the 41.1% of families with a maternal age during pregnancy less than 35 years. These results aligned with the theory stated above, which suggests that the risk of obesity is higher with greater age. Irregular physical activity after giving birth can increase the risk. Older mothers also have a higher risk during pregnancy which can impact the growth of their children.

This study showed that parity had statistically significant with DFM (p-value = 0.049). This finding was similar to a study by Mahmudiono, *et al.*,<sup>1</sup> where OR = 1.852; 95% CI = 1.184–2.898) stated that higher parity might increase the risk of DFM. Mothers with multiple children may have less time to provide equal care to each

child when compared to families with fewer children.<sup>2</sup> Having multiple siblings can cause growth delays due to competition to get a source of nutrients available at home.<sup>28</sup> The amount of parity is also associated with the risk of low birth weight, and low birth weight can ultimately increase the risk of stunted children.<sup>29,30</sup> Another study found a positive correlation between higher parity and the risk of obesity in middle-aged women in China.<sup>31</sup> Postpartum obesity is associated with the transition that mothers experience during pregnancy. Lifestyle alteration related to energy intake and energy expenditure during pregnancy can lead to long lifestyle changes, even after pregnancy. The continuous repetition of these changes throughout pregnancies can change the mother's lifestyle forever.<sup>31</sup> It explains the increased risk of obesity in mothers with higher parity. Given that higher parity can increase the risk of DFM related to the physiology of the mother's body after repeated pregnancies, the birth spacing can be examined to support this theory. The increasing number of family members can affect family care and the ability to purchase food to meet the family's needs. Both factors can affect the children's and the mother's nutritional status.

Maternal breastfeeding history was a condition where the mother breastfeeds her child during the research period. This study showed that maternal breastfeeding history was statistically significant with DFM (p-value = 0.027). This finding was similar with Sunuwuar, *et al.*, study (OR = 1.97; 95% CI = 1.10–3.51).<sup>32</sup> Children who are breastfed may have a higher chance of achieving adequate daily nutritional needs and a lower risk of stunting.<sup>19</sup> During the first 4 to 6 months of age, exclusively breastfed infants grow faster than infants who are not.<sup>33</sup> Breastfeeding is also associated with a decreased risk of being overweight on the mother's part because it can increase the calorie expenditure of the mother.<sup>32</sup> Breastfeeding has been shown to impact both children and their mothers positively. In older children, appropriate complementary feeding should be given to support the child's nutritional needs.

There were no statistically significant differences between household income (p-value = 0.924), mother's educational level (p-value = 0.840), and father's educational level (p-value = 0.869) with DFM. Low-income levels can affect food security and access to adequate amounts of food.<sup>34</sup> Consumption expenditure is limited because of increased food prices and socio-economic constraints.<sup>35</sup> Consequently, such a household is forced to buy cheap food with excessive energy content.<sup>35</sup> This study did not find a significant relationship between family income and the incidence of DFM. The focus of the research was only to discuss household income without examining household consumption



expenditure.

Lower maternal and paternal education levels may increase the risk of DFM. The father's education level as the head of the family is a strong social determinant of his family's health. A higher education level may have an essential role in ensuring better nutritional status for his wife and children. As the person who is generally responsible for household food, the mother may be unable to make healthy food choices for the family due to the low education.<sup>1,2,36</sup> Education is always considered a determinant of food security and household nutrition. However, nutritional knowledge, accessibility, and the affordability of quality food determine DFM. This situation might be the reason why no significant relationship was found in this study.

Multivariate analysis found that the dominant factor of DFM in Babakan Madang Subdistrict was maternal height (OR = 2.704; 95% CI = 1.615–4.528). It was found that households with maternal height less than 150 cm may increase the odds of having DFM by 2.7 times higher after being controlled by maternal age during pregnancy, mother's breastfeeding history, and parity as confounding variables. The short stature of the mother indicates malnutrition at the beginning of the mother's life. Lack of an adequate nutritional history and poor development in the first 1,000 days of life can lead the mother to be of short stature in adulthood and possible complications during childbirth. The long-term impact of poor maternal health and inadequate nutrients during pregnancy will lead to the fetus having poor growth in the uterus and can increase the risk of low birth weight, which may affect the child's health and development.<sup>2,37-39</sup> Those situations explained the association between maternal height and the risk of stunting in nutritional transmission between generations. Mothers who experienced stunted or poor fetal growth were more likely to gain excess weight during adolescence and had a higher risk of nutrition-related diseases. This may eventually increase the risk of obesity and chronic disease in adulthood.<sup>19,40</sup>

This study recommends intervention in the education of adolescent girls and pregnant women to prevent DFM. Improving the awareness of the importance of nutrition for adolescent girls as future mothers can be done through intervention by providing nutrition education, micronutrient supplementations, and the treatment of comorbidities. Improving the nutritional status of adolescents can reduce the risk of them experiencing problems related to nutrition when they are adults and prepare them for pregnancy in the future. For mothers who are already short in height, intervention can occur during pregnancy by monitoring such women to ensure quality nutrition and regular antenatal care (ANC) checks. Such an intervention would aim to reduce the

risk for adolescent girls and pregnant women in terms of giving birth to stunted children and preventing the possibility of DFM incidents in the future.

The advantage of this study lies in providing the latest overview regarding the prevalence of DFM incidence in pairs of mothers and children aged 6–59 months in Babakan Madang Subdistrict. A limitation of this study is the use of secondary data, which meant that the study variables were limited. Due to the limited amount of primary data, some variables could not be analyzed in this study. Variables that were direct factors related to DFM, such as intrahousehold food distribution, could not be analyzed due to these limitations. Secondary data was used because collecting the data directly was impossible due to the pandemic. This study requires direct measurement data that cannot be obtained using online questionnaires. All available data that match the various criteria were included in the study to remedy this limitation. Possible study bias resulting from secondary data can exist during data processing, and this possibility was overcome by screening and cleaning data before data processing. Outlier data were also excluded to avoid possible bias. Future study is expected to use other determinants that directly affect the incidence of DFM, such as energy intake and the use of other nutrients in mothers and toddlers. Similar research should be conducted in the broader area.

## Conclusion

The dual form of malnutrition (DFM) incidence in pairs of mothers and children aged 6–59 months in Babakan Madang Subdistrict is high prevalence at 42%. The bivariate analysis showed that short maternal stature, not currently breastfeeding, and having higher parity are all significantly associated with DFM. Dual form of malnutrition can be prevented by improved nutrition in adolescence, especially in the case of girls in their role as future mothers. Consequently, when they become pregnant as adults, this might reduce the risk of experiencing nutritional problems.

## Abbreviations

DFM: Dual Form of Malnutrition; HAZ: Height for Age; SD: Standard Deviation; BMI: Body Mass Index; RISKESDAS: *Riset Kesehatan Dasar*; OR: Odd Ratio; WHO: World Health Organization; ANC: Antenatal Care.

## Ethics Approval and Consent to Participate

This study has been approved by the Commission for Research Ethics and Public Health Service, Faculty of Public Health, Universitas Indonesia Number: 133/UN2.F10.D11/PPM.00.02/2021.

## Competing Interest

The author declares that no significant competing financial, profession-

al, or personal interests might have affected the performance or presentation of the work described in this manuscript.

#### Availability of Data and Materials

The data supporting this study's findings are available from the corresponding author upon reasonable request.

#### Authors' Contribution

MDK, T, and AS were involved in the design study, data compilation and analysis, and manuscript revision. TS was the primary data owner.

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#### References

1. Mahmudiono T, Nindya TS, Andrias DR, Megatsari H, Rosenkranz RR. Household food insecurity as a predictor of stunted children and overweight/obese mothers (SCOWT) in Urban Indonesia. *Nutrients*. 2018; 10 (5).
2. El Kishawi RR, Soo KL, Abed YA, Muda WAMW. Prevalence and associated factors for dual form of malnutrition in mother-child pairs at the same household in the Gaza Strip-Palestine. *PLoS One*. 2016; 11 (3): 1–14.
3. United Nations Children's Fund. Malnutrition in Children. UNICEF Data. 2020 p. 1.
4. World Health Organization. Obesity: health consequences of being overweight; 2013.
5. Kosaka S, Umezaki M. A systematic review of the prevalence and predictors of the double burden of malnutrition within households. *Br J Nutr*. 2017; 117 (8): 1118–27.
6. Kementerian Kesehatan Republik Indonesia. Riset kesehatan dasar Indonesia. Badan Penelitian dan Pengembangan Kesehatan. Jakarta: Kementerian Kesehatan Republik Indonesia. 2018 p. 198.
7. Wibowo Y, Sutrisna B, Hardinsyah H, Djuwita R, Korib M. M, Syafiq A, et al. Relationship between intra-household food distribution and coexistence of dual forms of malnutrition. *Nutr Res Pract*. 2015; 9 (2): 174–9.
8. Sekiyama M, Jiang HW, Gunawan B, Dewanti L, Honda R, Shimizu-Furusawa H, et al. Double burden of malnutrition in rural west java: household-level analysis for father-child and mother-child pairs and the association with dietary intake. *Nutrients*. 2015; 7 (10): 8376–91.
9. World Health Organization. Prevalence of stunting among children under 5 years of age. *The Global Health Observatory*; 2020.
10. de Onis M, Branca F. Childhood stunting: a global perspective. *Matern Child Nutr*. 2016; 12: 12–26.
11. Williams EP, Mesidor M, Winters K, Dubbert PM, Wyatt SB. Overweight and obesity: prevalence, consequences, and causes of a growing public health problem. *Curr Obes Rep*. 2015; 4 (3): 363–70.
12. Hruby A, Manson JAE, Qi L, Malik VS, Rimm EB, Sun Q, et al. Determinants and consequences of obesity. *Am J Public Health*. 2016; 106 (9): 1656–62.
13. Seidu A-A, Ahinkorah BO, Agbaglo E, Nyaaba AA. Overweight and obesity among women of reproductive age in Mali: what are the determinants? *Int Health*. 2020; 1–8.
14. Dinas Kesehatan Kabupaten Bogor. Buku profil informasi kesehatan 2018. Dinkes Kabupaten Bogor. 2019 p. 352.
15. Putriani EB, Triyanti, Sudiarti T. Regular integrated health service visit as a dominant factor of stunting among children aged 6-23 months in Bogor, Indonesia. *Int J Sci Res Publ*. 2020; 10 (9): 263–9.
16. Sudiarti T. Project Publication Research Grant (PITTA B) nutrition and health of toddlers in Babakan Madang Subdistrict, Bogor District; 2019.
17. Yuliasini S, Sudiarti T, Sartika RAD. Factors related to stunting among children age 6-59 months in Babakan Madang Sub-district, West Java, Indonesia. *Current Research in Nutrition and Food Science*. 2020; 8 (2): 454-61.
18. Peraturan Gubernur Jawa Barat. Keputusan Gubernur Jawa Barat nomor 561 tahun 2017 tentang UMK Provinsi Jawa Barat 2018. 2018 p. 5.
19. Oddo VM, Rah JH, Semba RD, Sun K, Akhter N, Sari M, et al. Predictors of maternal and child double burden of malnutrition in rural Indonesia and Bangladesh. *Am J Clin Nutr*. 2012; 95 (4): 951–8.
20. Wells JC, Sawaya AL, Wibaek R, Mwangome M, Poullass MS, Yajnik CS, et al. The double burden of malnutrition: aetiological pathways and consequences for health. *Lancet*. 2020; 395 (10217): 75–88.
21. Wong CY, Zalilah MS, Chua EY, Norhasmah S, Chin YS, Siti Nur'Asyura A. Double-burden of malnutrition among the indigenous peoples (Orang Asli) of Peninsular Malaysia global health. *BMC Public Health*. 2015; 15 (1): 1–10.
22. Lee J, Houser RF, Must A, De Fulladolsa PP, Bermudez OI. Socioeconomic disparities and the familial coexistence of child stunting and maternal overweight in Guatemala. *Econ Hum Biol*. 2012; 10 (3): 252–41.
23. Prendergast AJ, Humphrey JH. The stunting syndrome in developing countries. *Paediatr Int Child Health*. 2014; 34 (4): 250–65.
24. Cercato C, Fonseca FA. Cardiovascular risk and obesity. *Diabetol Metab Syndr*. 2019; 11 (1): 1–15.
25. Blankenship JL, Gwavuya S, Palaniappan U, Alfred J, deBrum F, Erasmus W. High double burden of child stunting and maternal overweight in the Republic of the Marshall Islands. *Matern Child Nutr*. 2020; 16 (S2): 1–8.
26. Pamungkasari EP, Murti B, Rahmawati VE. Determinants of stunting and child development in Jombang District. *J Matern Child Heal*. 2018; 05 (01): 68–80.
27. Pasco JA, Nicholson GC, Brennan SL, Kotowicz MA. Prevalence of obesity and the relationship between the body mass index and body fat: cross-sectional, population-based data. *PLoS One*. 2012; 7 (1).
28. Dekker LH, Mora-Plazas M, Marín C, Baylin A, Villamor E. Stunting associated with poor socioeconomic and maternal nutrition status and respiratory morbidity in Colombian schoolchildren. *Food Nutr Bull*. 2010; 31 (2): 242–50.
29. Nadiyah, Briawan D, Martianto D. Faktor Risiko stunting pada anak usia 0-23 bulan di Provinsi Bali, Jawa Barat, dan Nusa Tenggara Timur. *J Gizi dan Pangan*. 2014; 9 (2): 125–32.
30. Salimo H, MS NP, Murti B. The effect of biological, social, economic,

- and nutritional factors on low birth weight: a new path analysis evidence from Madiun Hospital, East Java, Indonesia. *J Matern Child Heal.* 2018; 03 (05): 166–75.
31. Li W, Wang Y, Shen L, Song L, Li H, Liu B, et al. Association between parity and obesity patterns in a middle-aged and older Chinese population: a cross-sectional analysis in the Tongji-Dongfeng cohort study. *Nutr Metab.* 2016; 13 (1): 1–8.
32. Sunuwar DR, Singh DR, Pradhan PMS. Prevalence and factors associated with double and triple burden of malnutrition among mothers and children in Nepal: Evidence from 2016 Nepal demographic and health survey. *BMC Public Health.* 2020; 20 (1): 1–12.
33. Chomtho S. Breastfeeding to prevent double burden of malnutrition. *Southeast Asian J Trop Med Public Health.* 2014; 45 Suppl 1: 132–6.
34. Mahmudiono T, Segalita C, Rosenkranz RR. Socio-ecological model of correlates of double burden of malnutrition in developing countries: a narrative review. *Int J Environ Res Public Health.* 2019; 16 (19).
35. Lee J, Houser R, Must A, Palma P, Bermudez O. Association of the familial coexistence of child stunting and maternal overweight with indigenous women in Guatemala. *Matern Child Health J.* 2017; 21 (11): 2102–15.
36. Jayalakshmi R, Kannan S. The double burden of malnutrition: an assessment of 'stunted child and overweight/obese mother (SCOWT) pairs' in Kerala households. *J Public Health Policy.* 2019; 40 (3): 342–50.
37. Kozuki N, Katz J, Lee ACC, Vogel JP, Silveira MF, Sania A, et al. Short maternal stature increases risk of small for-gestational-age and preterm births in low and middle-income countries: individual participant data meta-analysis and population attributable fraction. *J Nutr.* 2015; 145 (11): 2542–50.
38. Young MF, Nguyen PH, Gonzalez Casanova I, Addo OY, Tran LM, Nguyen S, et al. Role of preconception nutrition in offspring growth and risk of stunting across the first 1000 days in Vietnam. *PLoS One.* 2017; 71 (Supplement 2): 538.
39. Martorell R. Improved nutrition in the first 1000 days and adult human capital and health. *Am J Hum Biol.* 2017; 29 (2): 1–12.
40. Félix-Beltrán L, MacInko J, Kuhn R. Maternal height and double-burden of malnutrition households in Mexico: stunted children with overweight or obese mothers. *Public Health Nutr.* 2020; 2012 (12): 1–11.

# Interprofessional Collaborative Practice and Health Workers Retention at Remote Primary Health Care: Case Study from Nusantara Sehat Team-based Program

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## Abstract

The Nusantara Sehat Team (NST), established in 2015 and consist of multi-professional health workers, implemented to provide comprehensive services at remote primary health cares (PHCs) for two years. This study aimed to explore how the NST leverages the Interprofessional Collaboration (IPC) and its impact on the future career prospects of health workers. Using a qualitative approach, the information was gathered from 48 informants drawn from the current 30 NST recruits and 18 alumni through semi-structured interviews. Of these 48, 20 were clinical practitioners, while the rest were non-clinical health workers. The findings revealed several challenges in promoting collaborative practice, including the community's high demand for curative services, the unclear division of tasks among the NST and local PHC staff, and inadequate health facility support. The curriculum of IPC was yet to be included in the pre-service education and in-service training before NST, allowing the staff to enter the workplace and collaborate, especially in the backward areas. The institutional support through macro and meso policies has yet to enable collaborative-practice ready workers adequately. Other factors such as personal values, family expectations, gender roles, and career sustainability also affected the retention of personnel in the NST.

**Keywords:** interprofessional collaboration, primary health care, remote area

## Introduction

Comprehensive primary health care (PHC) has become the pivotal element in improving community health status and welfare.<sup>1-4</sup> Over time, various approaches have been defined by the health system scholars to crystalize what comprises the PHC. Initially, the International Conference of Primary Health Care 1978 released the Declaration of Alma Ata, outlining that PHC is the first level of contact of individuals, families, and communities with the national health system that provides promotive, preventive, curative care, and rehabilitative services.<sup>5</sup> Furthermore, much of the prevailing discussion agree on a term that includes, but goes beyond, primary care as a level of health care in a multi-scalar referral system.<sup>6</sup> Primary health care is also identified as the integration of structural intervention and focusing attention on local, social and environmental risks.<sup>7</sup> Thus, it requires combined and concerted effort provided by many health disciplines to respond to local needs within their specific context.

This concept has been adopted by the Indonesian health system as it is reflected in its regulations. Adjust-

ment to the local context is necessary given the diversity in the country due to its geographic landscape that consists of the mainland, coastal areas, and smaller islands. Areas with no geographic difficulty require that each PHC must consist of at least nine categories of health professionals; medical doctors, a dentist, nurses, midwives, public health workers, environmental health workers, medical laboratory technicians, a nutritionist, and pharmacists who, through interprofessional collaboration, deliver health services to the people.<sup>8</sup> The minimum number of health professionals in each category will differ depending on whether the PHC is located in urban, rural, remote, or very remote areas. However, maldistribution occurs when the availability of health professionals is high or low in some PHCs, particularly when it comes to backward or peripheral areas, which then become the Nusantara Sehat (NS) deployed sites.<sup>9</sup> Inadequacy and low retention of health workers remain a challenge, hindered by the geographical conditions, fiscal capacity, and adequate policy to recruit the health workers when needed.<sup>10</sup> Thus, the quality of the health services delivered has been sub-standard, as interprofes-

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sional collaboration could not be optimally achieved under these circumstances. In addition, enabling a workplace ready for teamwork requires soft skills, which become another challenge.

To fulfill the requirement of health workers at PHCs in backward areas, in 2015, the Ministry of Health (MoH) of the Republic of Indonesia established a program, namely Nusantara Sehat (NS), as one of its affirmative policies. The Nusantara Sehat Team (NST) based program is conducting a special deployment of five to seven health professionals as a team to be assigned at selected PHCs with two-year contract-based employment. Health workers recruited have to undergo a rigorous recruitment process so that those selected have strong motivation to enhance the health of the community in backward and peripheral areas. In order to attract health workers, the NST Program offers a higher salary compared to the regular remuneration given to health workers. Before deployment begins, they undergo seven weeks of training and team building that would provide them with the ability to make an initial assessment of the prevailing health problems at the deployed site. Through this training, they must propose several innovative interventions to be implemented at their assigned PHC. At the end of the assignment, the MoH also provides scholarship opportunities to NS alumni to motivate them to pursue further education afterward. Between 2015 and 2019, 11 batches of NST have been deployed to 131 municipalities/regencies in 22 provinces, composed of 467 teams comprising 2,661 personnel.<sup>11</sup>

This study aimed to explore aspects influencing the challenges and what enables interprofessional collaboration of NST in delivering PHC services in remote areas and sustaining the retention of health workers after their deployment. The NST program has faced many technical issues in providing quality health services to the community and maintaining collaboration among health workers. Using a qualitative approach, this study captured the obstacles and best practices that could be useful for the future implementation of the NST program and the interprofessional collaboration implementation in general.

## Method

This study applied an exploratory qualitative method by conducting a series of semi-structured interviews and focus group discussions (FGD) with the current NST recruits and alumni across five sites in Bengkulu, South Sulawesi, and East Nusa Tenggara Province. The data collection process was conducted from January to March 2019. In total, 48 informants were interviewed, of whom 20 were clinical professionals; general practitioners, dentists, nurses, and midwives. The remaining 28 were from preventive and promotive health fields, including nutritionists, pharmacists, public health workers and environ-

mentalists, health workers, and lab technicians. In addition, 30 of those interviewed were currently deployed at PHCs located in remote areas, referred to as NST Active, while the rest were the NST alumni. The details of those interviewed are listed on (Table 1).

This study used the gear framework of interprofessional collaboration (Figure 1) to elaborate on the factors affecting the collaboration process at multiple levels. The first dimension, input, referred to the policy as a major and meso element that enabled the initial movement, as well as the micro team structure that was involved in the collaboration process. The next dimension focused on elaborating the micro team issues on social, formal, and attitudes. It also enlightened the individual elements, including personal beliefs, knowledge, aspiration, and professional identity. The last was the output dimension, capturing the deliverables on collaboration. As this study aimed to answer the challenge and enable adapting interprofessional collaboration in the national affirmation program, it was appropriate to explore and assess the experience of the micro team and individual level as the representation of the process dimension.

The interview questions were developed according to this study framework, and all informants received the same questions. In addition, triangulation of the study finding was conducted by confirming the information collected from the local Heads of PHCs at the deployed sites. The answers were audio-recorded with consent from all those interviewed, then transcribed and analyzed using Microsoft Excel 2010 and open source QDA Miner lite application according to two themes consisting of narrative patterns of interprofessional collaborative practice and career perspectives.

## Results

### Nusantara Sehat Program's Influence on Interprofessional Collaboration

#### *Community's Demand for Curative Services*

Across NST deployed sites, it was found that most of the community at the study sites demanded curative services; it was common for those visiting the healthcare workers to seek treatment or medication for their illness. In the remote areas, the NST recruits acknowledged that seeking promotive and preventive health care and knowledge was not the community's priority. Hence, the deployed NST, with a strong public health mindset, was trying to encourage promotive and preventive health care in the community.

As the initial demand of the community mainly was for curing illnesses, the NST put in extra service over and above their working hours fulfilled by them during their adaptation period. Though sometimes this demand created pressure leading to a conflict between them, they were able to utilize this condition to gain the communi-



ty's trust. After achieving such trust, NST-Active and the PHC staff delivered promotive/preventive health services that were usually in much lower demand.

The need for interprofessional collaboration seemed to be affected by the recruitment and pre-assignment training process as well as the common mission in the field. For example, one of the clinical cases required the expertise of all health professionals available in a PHC. The involvement of the public health promotion and environmental health officers in the community was just as important, if not more so, as the medical doctors, midwives, nurses, pharmacists, nutritionists, and medical

laboratory technicians/analysts. However, the community's lack of understanding and acknowledgment reflected an acute awareness of the importance of interprofessional collaboration.

*Collaboration Challenge with the Local PHC Staff*

The Nusantara Sehat Team (NST) attempted to practice their interprofessional collaboration not only with fellow NST-Active but also with the rest of the local PHC staff. For instance, an environmental health worker preferred facility-wide collaborative activities rather than planning for a single-profession activity.

**Table 1. List of Informants**

| Status of NS Employment         | Location of Data Collection       | Profession                         | Sex                       |        |
|---------------------------------|-----------------------------------|------------------------------------|---------------------------|--------|
| Active                          | Bengkulu Province                 | Pharmacist (1)                     | Female                    |        |
|                                 |                                   | Nurse (1a)                         | Male                      |        |
|                                 |                                   | Midwife (1a)                       | Female                    |        |
|                                 |                                   | Public health worker (1a)          | Female                    |        |
|                                 |                                   | Nutritionist (1a)                  | Female                    |        |
|                                 |                                   | Medical laboratory technician (1a) | Male                      |        |
|                                 |                                   | Public health worker (1b)          | Female                    |        |
|                                 |                                   | Medical laboratory technician (1b) | Male                      |        |
|                                 |                                   | Midwife (1b)                       | Female                    |        |
|                                 |                                   | Public health worker (1b)          | Female                    |        |
|                                 |                                   | Nutritionist (1b)                  | Female                    |        |
|                                 |                                   | Environmental health worker (1a)   | Female                    |        |
|                                 |                                   | Nurse (1b)                         | Male                      |        |
|                                 |                                   | East Nusa Tenggara Province        | Public health worker (2a) | Female |
|                                 | Midwife (2a)                      |                                    | Female                    |        |
|                                 | Nurse (2a)                        |                                    | Female                    |        |
|                                 | Medical doctor (2a)               |                                    | Female                    |        |
|                                 | Pharmacist (2a)                   |                                    | Male                      |        |
|                                 | Environmental health worker (2a)  |                                    | Male                      |        |
|                                 | Midwife (2b)                      |                                    | Female                    |        |
|                                 | Medical doctor (2b)               |                                    | Male                      |        |
|                                 | Nurse (2b)                        |                                    | Female                    |        |
|                                 | Environmental health worker (2b)  |                                    | Female                    |        |
|                                 | Medical laboratory technician (2) |                                    | Female                    |        |
|                                 | Public health worker (2b)         |                                    | Female                    |        |
|                                 | South Sulawesi Province           |                                    | Nurse (3)                 | Female |
|                                 |                                   | Medical laboratory technician (3)  | Male                      |        |
| Environmental health worker (3) |                                   | Female                             |                           |        |
| Pharmacist (3)                  |                                   | Female                             |                           |        |
| Midwife (3)                     |                                   | Female                             |                           |        |
| Alumni                          | Jakarta–phone interview           | Medical laboratory technician (4a) | Female                    |        |
|                                 |                                   | Public health worker (4a)          | Female                    |        |
|                                 |                                   | Nutritionist (4)                   | Female                    |        |
|                                 |                                   | Public health worker (4b)          | Female                    |        |
|                                 |                                   | Environmental health worker (4)    | Male                      |        |
|                                 |                                   | Pharmacist (4a)                    | Female                    |        |
|                                 |                                   | Nurse (4a)                         | Female                    |        |
|                                 |                                   | Medical laboratory technician (4b) | Female                    |        |
|                                 |                                   | Midwife (4a)                       | Female                    |        |
|                                 |                                   | Pharmacist (4b)                    | Female                    |        |
|                                 |                                   | Midwife (4b)                       | Female                    |        |
|                                 |                                   | Nurse (4b)                         | Male                      |        |
|                                 |                                   | Medical doctor (4)                 | Male                      |        |
|                                 |                                   | Jakarta–FGD                        | Nurse (5a)                | Female |
|                                 |                                   |                                    | Nurse (5b)                | Female |
|                                 | Midwife (5)                       |                                    | Female                    |        |
|                                 | Environmental health worker (5)   |                                    | Female                    |        |
|                                 | Public health worker (5)          |                                    | Female                    |        |

Notes: NS = Nusantara Sehat, FGD = Focus Group Discussion

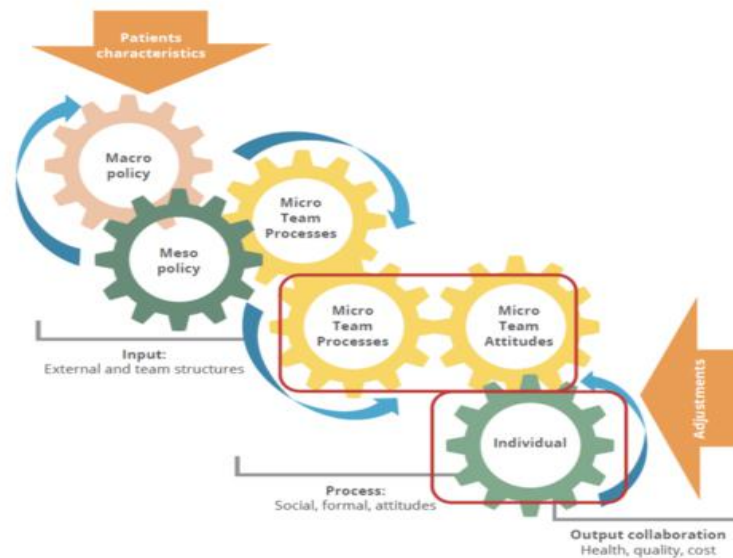


Figure 1. Gears Model of Factors Affecting Interprofessional Collaboration Within Interprofessional Care Teams,<sup>12</sup>

"It's good; I like it more when I collaborate when working, instead of just focusing on one profession. I like it like that. There are those of us [NST], and there are ones from the PHC... and then at the end, there will be reports, what activities [we do], what innovations have been done by NS for the community members in PHC. Later on, we also have NST innovations, and there are also ones from PHC." (Environmental Health Worker Active -3)

In many cases, the collaboration with local PHC staff was a challenge. Based on the observation, the impediments between NST and local staff were partly due to the PHC being disproportionately staffed. In addition, the concept of interprofessional collaboration might still be confusing and not being internalized yet by both the NST and local PHC staff. However, there were still positive examples of how the leadership initiative by local personnel might mitigate this. One of the informants explained that they had been reminded by the head of the PHC to work together, building a sense of unity between the NST and local PHC staff through the exchange of ideas and frequent discussions. This move was also useful as it helped the NST members understand the roles of other personnel in the PHC, enabling them to improve collaboration. The improved understanding prevented competition between NST and the local staff.

*The Nusantara Sehat Team Recruits had not been Acknowledged as an Added Value to the Local PHC Staff*

There was a mismatch between the perception of NST

recruits on their purpose of being deployed at the PHC and that of the local PHC staff. This condition resulted in the initial rejection or skepticism of newly arrived NST recruits by the local PHC staff, and it took them a while to warm up to each other. Several informants interpreted the skepticism as fear of local staff who thought the NST recruits were the watchful eyes of the MoH.

In addition, as the NST came bringing their proposed innovative plan and supporting budget, this was considered disruptive of the local staff's existing approach. Those who arrived in June and September were more affected by the timing of their arrival at their host PHC, as the work plan and budget of the PHC had been implemented. The situation was not conducive to start undertaking innovations in the community, which contrasted with the high spirits built during the training period, causing dissatisfaction among the NST.

### NS Active's Career Perceptions

#### *Motivation and Idealism of NST-Active for Social Equity*

All of the NST-Active came from different backgrounds and geographical regions, ranging from those who grew up in rural areas or remote islands to those who had never left the national capital of Indonesia before this assignment. Nevertheless, all recruits seemed to have a cultivated curiosity about the diverse life that their fellow Indonesians have and connected personally with them. To quote one of them:

"[The motivation] is because I want to "mengabdi" (serve). Firstly, I have been curious ever since I was

*small. Well, it's not bad; I mean [living] in Jabodetabek (a term describing the Jakarta Greater Area), which is quite urban; I'm curious about the lives of communities in the remote areas. Also, I like to speak in public (community)" (Nutritionist Active-1a)*

In addition, NST-Active personnel had an acute perception of the disparity between Java and islands outside of Java. A person from Java acknowledged that living in Java was an advantage due to the easy access to health care and its workers. Therefore, they had a strong desire to contribute, as mentioned below:

*"I had the thought, if I was here, in [a city in East Java], there were already so many..., you know, health professionals. Whereas in backward areas, I thought I usually saw them on TV; it seemed like health workers were so limited. So, I became interested, like, what does it feel like to be a health worker there? And then, to see people there who have not received health care, it's like, how to say it, I want to help them there." (Midwife Alumnus-5a)*

#### *Lack of Support for Remote Health Facilities*

Working at remote PHCs came along with its consequence of limited information technology. Considering how idealist most NS recruits were, access to information technology that would enable them to get the latest scientific updates and professional guidelines became pivotal to them. It was associated with the ability to have continuous personal and professional development to perform their task optimally aligned with updated health sciences. In addition, the supplies of equipment and materials for health care services were also sub-optimal, and support from the officials was often delayed. As one informant put it:

*"I am willing [to work in remote areas again], but, if possible, not too remote. Because we really feel left behind. Like, information, we get them always late, [sometimes] we even know nothing." (Environmental Health Worker Active-3)*

#### *The Nusantara Sehat Teams' Experiences Influenced the Career Aspirations*

During undergraduate professional training, many NST recruits admitted to having limited exposure to community-based healthcare services, especially promotive or preventive care. The experience of working at the community level via NST assignment inspired several NST recruits to shift their outlook for a future career to one that is more oriented toward PHC.

*"In [my university], they have started applying inter-professional [education], but not maximally. I only got it for the last semester, so I only learned about ethical codes [of conduct]. But the students nowadays have started the interprofessional education from the begin-*

*ning. Maybe, if there was not enough practice for a bachelor's degree, field-wise (read: in the community). It was still formal, with facilitators from the campus. There was not enough practice during my time." (Pharmacy Alumnus-4a)*

Nevertheless, the current job market and postgraduate education system have not properly acknowledged this NST experience as an asset relevant to professional development. For instance, this nurse, who had the ambition to pursue higher academics at the postgraduate level, would have been as an NST alumnus, eligible to apply for the postgraduate scholarship awarded by the MoH. However, the university she was keen to apply to only recognized two-year hospital-based employment as a work experience requirement instead of equally valuing PHC/community-based work.

*"Now, after I graduated NS, I'm confused. When I applied for the postgraduate studies program at [the university of my choice], a two-year work experience in the hospital was mandatory. I don't have that. I consulted with the Agency for Development and Empowerment of Health Professionals/Badan Pengembangan dan Pemberdayaan Sumber Daya Manusia Kesehatan (BPPSDMK) in Hang Jebat [Board of Human Resource for Health], and their answer was, you have to negotiate it with the university. Well, that should not be just my burden! There should be [communication] from institution to institution!" (Nurse Alumnus-5)*

The structure of current employment opportunities for health workers in general still places less value on NS work experience. As part of its effort to attract talent into the NST Program, the MoH has declared that those with NS assignment work experience will be assessed favorably for civil service employment. However, this will still be done through the common application route. However, this opportunity is only available when NST alumni want to apply to be civil servants at the MoH and not any other governmental agency. On the other hand, there was the aspiration to become an entrepreneur. It was found that some of the NS alumni valued NST assignment as the time to accrue adequate financial capital to start their own business.

#### *Gender Role and Family Opinion as Career Determinants*

Despite facing some challenges during the NST experience, NST recruits felt that the assignment brought value to their personal and professional development. Most were willing to return to the remote areas as NS individual-based program recruits. Unfortunately, family factors and gender role perceptions affected the future career decisions of almost all NS health workers interviewed. For many, work location has always been one strong consideration of their family's approval, especially

for female health workers. Their families did not support the idea that they pursue careers in another remote area, as their priorities should be marriage and family instead.

*"Oh dear, my parents said, "Don't prioritize that (NS Individual employment) first; what should be a priority is to get married. Even until now, you don't have anyone to get married to because you always go away, right?" So, actually, it's so good to work as Nusantara Sehat, but, well, we cannot do it forever because of age. I want to join NS again. but because I'm a female, (it becomes a challenge)" (Medical Lab Technician Active-2).*

## Discussion

Delivering comprehensive health services, particularly in remote areas, is the main purpose of the NST deployment to improve its people's health. The NST recruits are trying to encourage promotive and preventive services in addition to strengthening curative services through the interprofessional collaboration among them. However, while creating those demands in the community, the NST lacked the acceptance and support from the local PHC staff due to the uneven task allocation and disruption of regular activities. Nevertheless, the strong desire of NST to serve the country is the motivation for NST to keep contributing toward improving the community's health. In order to continue serving in the remote areas for a long time, the NST needs the proper support of health infrastructure, fixed work status, and the blessing from their families. As a basis enabler for the teamwork and interprofessional collaborative practice deployed in the PHC, at least four features were included (1) interaction and communication between team members; (2) common objectives around which collective work is organized; (3) responsibility for performing work to a high standard; and (4) promoting innovation in work practices.<sup>13</sup>

First, interaction and communication among team members and local PHC staff need to be improved, as identified in the result above. Indonesia implemented the Health Professional Education Quality (HPEQ) project from 2009 to 2014, aiming to improve the interprofessional collaborative practice among health workers by preparing them to work as a team in any workplace. This project was done by adding relevant subjects to the curricula at the undergraduate education level.<sup>14</sup> Indonesia needs to evaluate lessons learned from this project to be incorporated into its education process to implement the interprofessional collaboration values effectively. The second important element is common objectives. The mismatch in expectations between local PHC staff and NST-Active; whether the role of the NST should be to replace the current workload or work to complement the community outreach, has become the cause of disharmony in collaboration. The third is the shared responsibility

to deliver quality services. NST-Active is committed to developing quality service; however, field realities ranging from geographical challenges in reaching communities to lack of medical equipment to limitation of health promotion materials could lead to them compromising the situation. The last is the promotion and innovation in the workplace. Those informants had carried out various innovative activities at the site based on community demands and characteristics in social relations. One of which is gathering the support of community members to build a latrine in every household by holding some events at the village level. This movement is arguably positive and beneficial for the PHC to gain more attention and trust from community members.

Macro and meso policies also take part in the government's commitment to delivering comprehensive health services favoring interprofessional collaborative practices. The objective of the NST Program is to achieve comprehensive PHC services in remote areas through the decision to structure multi-professional teams is worth applauding. This situation allows various health workers to contribute and deliver promotive and preventive health programs. Offering salaries above the current average adds to the attractiveness of this program and encourages highly motivated and skilled workers to apply.<sup>15</sup> Through this mechanism, the NST Program might be able to assure the delivery of enhanced quality health services compared to other schemes. A study in Niger revealed that low salaries and poor financial compensation among health workers were factors inhibiting retention in rural areas.<sup>16</sup> Thus, the rural area needs are different. It is imperative to consider that the service delivery should operate as close to the ground as possible with adequate policy and financial support.

The lack of PHC's authority in providing adequate support to the NST recruits impedes optimal NST task performance. Firstly, the constraint on funding regulation and allocation sometimes hinders the newly NST recruits from executing their activities. For instance, there was no allocation to procure a new vehicle for the NST recruits to handle the geographical challenges when visiting the community. A similar study also showed that the significant problem in delivering comprehensive health services in remote areas was mainly because health workers were not equipped with adequate vehicle availability while performing their tasks.<sup>17</sup> Secondly, the equipment support, including health promotion material, medical tools, and drugs, also appeared sub-standard, and the NST had no authority to upgrade the equipment. Lastly, the disharmony between the NST recruits and the local PHC staff was a source of tension due to the disparity in their salaries. Informant admitted local staff was envious of the NST getting a higher remuneration. Even though the salary of health workers is regulated to meet



the minimum wage standard at the local level, a national survey on health human resources estimated that 34.5% of PHC staff were underpaid.<sup>9</sup> At the macro level, the current size of salary and underpayment issues should be evaluated closely since health professionals are an essential feature for human and national development.

According to the findings of this study, the motivation for the Indonesian young health professionals to join the NS Program is based on several factors: (i) nationalism doctrine; (ii) professional idealism and altruism; (iii) employment sustainability; and (iv) family expectation and gender role. Firstly, the NS program promotes values related to nationalism and social justice. Hence, the NST program provides young health professionals the opportunity to serve the nation, particularly in the backward areas. Secondly, young health professionals still have idealism and want to apply their knowledge and practice skills acquired during their education. Research that examined the motivation of rural community nurses showed that the philosophy and approach to the role was the most common motivating factor.<sup>18</sup> It was noted that nurses who chose to work in the community went beyond their roles of just caring for the ill and unwell. It was also about the partnership with clients and positively contributing to peoples' lives.<sup>18</sup> Thirdly, in terms of employment sustainability, the NS Program is considered suitable and appealing for young health professionals as it provides higher remuneration than the standard wages. The experience of participating in the NST program is a significant value addition for them when applying for jobs later or for further studies. The assurance that they could continue their education after a certain service period was one of the most powerful recruitment motivations. Moreover, it was also found that job security, salary, and manageable workload were identified as critical factors that provided satisfaction when working in rural and remote areas.<sup>19</sup> Lastly, this study showed that the career decisions of health workers were majorly influenced by their family's expectations, especially for female health workers if their families were against the idea of working full time in remote areas.

On the other hand, the NST assignment also provides inspiration and fulfills aspirations for the future career path of NST recruits. Some NST recruits preferred to continue working in rural and remote areas due to the motivation discussed above. However, many NST recruits expect that their commitment to being deployed should have been better acknowledged by the government, professional associations, and academia. At this time, the experience of joining NST is still not linked with the issue of getting more professional credit.

This study elaborated on the challenges and the enabler aspects of the health workers in implementing collaborative practices to deliver comprehensive health ser-

vices in remote areas. While discussing the opportunity to apply collaborative practices, this study recommends improving macro and meso policies to strengthen the deliverables. In addition, various perspectives were also gathered from clinical and non-clinical health workers, providing a viewpoint from both sides. However, this study did not collect the information from Ministry of Health officials, district health officials, and the local staff of PHCs. Hence, that viewpoint could not be included. Further research might be considered by involving policymakers and current workers at the deployed sites as the key sources of information to complete this study.

## Conclusion

In order to implement the interprofessional collaborative practices, sufficient interaction and soft communication skills, a common mission, strong motivation, and a clear division of tasks among health workers are essential to be considered as main enablers. The adaptation process among the new and the existing health staff will influence the success of this practice. This study recommends that the improvement of the undergraduate education and training on the interprofessional soft skills curricula should be considered before the program. In addition, conducting convergence sessions among NST recruits and local PHC staff is also recommended to develop positive work relationships, prevent conflict, and align work objectives and early planning before the deployment begins. Health workers need to be facilitated with adequate support, considering the various challenges of delivering health services in remote areas. Through incentive regulation, the government's role in closing the gap of the current health workers' incentive disparity and providing adequate equipment would be positive stimulants. As the NS Program is only deployed for two years, this recommendation could be implemented for another scheme of long-term deployment mechanism for health workers in remote areas.

The NS program has successfully increased the motivation of health workers to work in remote areas due to the idealism and the motive to contribute to the community in the disadvantaged and most needy areas. In addition, it provides an opportunity to serve the community through professional expertise. The experience of being NST recruits also inspires the health workers to look at their future careers beyond the medical perspectives into community-based service through PHCs. However, one cannot forget that the family and society have a say in determining their future and career selection. Promoting positive career perceptions at community-based primary health services would be advantageous for them if their experience working in remote areas is recognized. For instance, it could come as a professional credit unit by the professional organization that will have some value in



their next career choice and provides an opportunity to pursue education in keeping with their aspirations for the future.

#### Abbreviations

NST: Nusantara Sehat Team; PHC: Primary Health Care; IPC: Interprofessional Collaboration; NS: Nusantara Sehat; MoH: Ministry of Health; FGD: focus group discussions; HPEQ: Health Professional Education Quality.

#### Ethics Approval and Consent to Participate

The ethical approval for this study was given by the Research Ethics Committee of the Faculty of Public Health, Universitas Indonesia, in December 2018, with the Ethical Approval number 818/UN2.F10/PPM.00.02/2018.

#### Competing Interest

The author declares that there is no significant competing financial, professional, or personal interest that might have affected the performance or presentation of the work described in this manuscript.

#### Availability of Data and Materials

Data are available upon request under TNP2K.

#### Authors' Contribution

PS provided the conception and construction of the research and manuscript writing. PS, RP, AWP, and NMR input the result, discussion, and conclusion. RP coordinated communication with study informants during the data collection process and with the donor. PS, RP, and NMR provided the final editing of the draft manuscript.

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#### References

1. Bitton A, Ratcliffe HL, Veillard JH, Kress DH, Barkley S, Kimball M, et al. Primary health care as a foundation for strengthening health systems in low- and middle-income countries. *Journal of General Internal Medicine*. 2017; 32 (5): 566-71.
2. Atun R, De Andrade LOM, Almeida G, Cotlear D, Dmytraczenko T, Frenz P, et al. Health-system reform and universal health coverage in Latin America. *The Lancet*. 2015; 385 (9974): 1230-47.
3. Plochg T, van den Broeke JR, Kringos DS, Stronks K. Integrating primary care and public health. *American Journal of Public Health*. 2012; 102 (10).
4. Veillard J, Cowling K, Bitton A, Ratcliffe H, Kimball M, Barkley S, et al. Better measurement for performance improvement in low- and middle-income countries. The Primary Health Care Performance Initiative (PHCPI) experience of conceptual framework development and indicator selection. *The Milbank Quarterly*. 2017; 95 (4): 836-83
5. World Health Organization. The declaration of Alma Ata; 1978.
6. Muldoon LK, Hogg WE, Levitt M. Primary care (PC) and primary health care (PHC): what is the difference? *Canadian Journal of Public Health*. 2006; 97 (5): 409-11.
7. Labonté R, Sanders D, Packer C, Schaay N. Is the Alma Ata vision of comprehensive primary health care viable? findings from an international project. *Global Health Action*. 2014; 7 (1): 1-16.
8. Ministry of Health, Republic of Indonesia. Peraturan Menteri Kesehatan nomor 45 tahun 2019 tentang pusat kesehatan masyarakat (MoH regulation about primary health care). Jakarta; 2019.
9. Ministry of Health, Republic of Indonesia. Riset ketenagaan kesehatan nasional (National health workers survey). Jakarta; 2017.
10. Nurcahyo H, Bachtiar A. Analysis of the problems of general practitioners distribution in community health centers (Puskesmas) in Indonesia. *Advances in Health Sciences Research*; 2020.
11. Badan Penelitian dan Pengembangan Kesehatan. Laporan riset ketenagaan di bidang kesehatan (Risnakes) 2017: puskesmas; 2018.
12. Mulvale G, Embrett M, Razavi SD. Gearing up to improve interprofessional collaboration in primary care: a systematic review and conceptual framework. *BMC Family Practice*. 2016; 17 (1): 1-15.
13. Agreli HF, Peduzzi M, Bailey C. Contributions of team climate in the study of interprofessional collaboration: a conceptual analysis. *Journal of Interprofessional Care*. 2017; 31 (6): 679-84.
14. World Bank. Implementation completion and result report on a loan in the amount of us\$ 77.82 million to the Republic of Indonesia for a health professional education quality project (HPEQ). Jakarta: Health, Nutrition and Population Global Practice Indonesia Country Management Unit East Asia and Pacific Region; 2015.
15. Ministry of Health, Republic of Indonesia. Keputusan Menteri Kesehatan Republik Indonesia nomor 484 tahun 2017 tentang besaran penghasilan penugasan khusus tenaga kesehatan dalam mendukung program nusantara sehat (MoH decree about NST wage standard). Jakarta; 2017.
16. Belaid L, Dagenais C, Moha M, Ridde V. Understanding the factors affecting the attraction and retention of health professionals in rural and remote areas: a mixed-method study in Niger. *Human Resources for Health*. 2017; 15 (1): 1-11.
17. Abdulraheem BI, Olapipo AR, Amodu MO. Primary health care services in Nigeria: critical issues and strategies for enhancing the use by the rural communities. *Journal of Public Health and Epidemiology*. 2012; 4 (1): 5-15.
18. Barrett A, Terry DR, Le Q, Hoang H. Rural community nurses: insights into health workforce and health service needs. *International Journal of Health, Wellness and Society*. 2015; 5 (3): 109-20.
19. Ojaka D, Olango S, Jarvis J. 2014. Factors affecting motivation and retention of primary health care workers in three disparate regions in Kenya. *Human resources for Health*. 2014; 12 (1): 1-15.

# The Influence of Intrapersonal Constraints on Travel Intention of People at High Risk from COVID-19 during the New Normal

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## Abstract

Due to the COVID-19 pandemic, tourism constraints have created a challenge for inclusive tourism, especially for older people and people with comorbidities. This study examined intrapersonal constraints' effect on the travel intentions of people facing fewer opportunities for tourism due to the COVID-19 pandemic, which could disrupt their well-being fulfillment. The data were collected through an online survey of Jakarta citizens aged 46 years and older from the end of June to September 2021, and a total of 337 responses were accumulated. This study applied partial least square structural equation modeling to test the moderating effect of intrapersonal constraints toward the theory of planned behavior and revealed that the travel intentions of people at high risk from COVID-19 were considered high and were directly influenced by subjective norms, perceived behavioral control, and intrapersonal constraints. High travel intention implies that intrapersonal constraints do not extensively weaken at-risk people's desire to travel during the new normal.

**Keywords:** constraint, COVID-19, intention, theory of planned behavior, tourism

## Introduction

Human try to achieve well-being in variety of ways, one of them is tourism. In addition, an interrelatedness has been well established between travel, tourism, and health, as supported by the view that tourism experiences can have both physical and mental health benefits.<sup>1</sup> This is in line with statements by the United Nations World Tourism Organization,<sup>1</sup> acknowledging that tourism can contribute to health and well-being in various indirect ways. The World Health Organization (WHO),<sup>2</sup> has defined health as "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity." In addition to improving well-being, travel is also considered a basic need and right, as it is known that everyone is entitled to the same rights of leisure, rest, and freedom.<sup>3</sup>

Currently, world tourism activity is suffering from a decline due to the spread of the novel coronavirus disease 2019 (COVID-19). As of November 23, 2021, Indonesia recorded an 83.2% casualty of people aged 46 years and older.<sup>4</sup> Therefore, that age group can be considered vulnerable to COVID-19. This is supported by a statement by epidemiologists which is the immune system, cell

regeneration speed, and organ function of people aged 45 years and older are not as good as those of younger people, and thus, the body is more susceptible to disease.<sup>5</sup> This group is classified as older people and consists of middle age (45–59 years old) and the elderly (60 years old and above).<sup>6</sup>

In addition to the risk of transmission, the drive in the economic sector urged the Indonesian Government to implement policies for the transition period known as the "new normal." This condition refers to the presence of a new order in response to crises and includes a form of change and adaptation of new systems to prevent re-occurrence or to prepare for a crisis.<sup>7</sup> The New Normal Policy means learning to live with COVID-19 by implementing strict health protocols in various activities,<sup>7</sup> including tourism. This policy in Indonesia was introduced in June 2020 with adjustments in the intensity of people's activities based on the COVID-19 positivity rate.<sup>8</sup> Rationally, the "new normal" will become "normal" when the world has come to terms with the pandemic and it becomes endemic.<sup>9</sup> This policy was initiated by the tourism sector in the Cleanliness, Health, Safety, and Environmental Sustainability (CHSE) program for each

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tourism subsector.<sup>10</sup> The CHSE programs contain guidance to rerun the tourism sector by prioritizing sanitation, hygiene, and services without direct contact for mutual security in the form of certification within the tourism industry.<sup>10</sup>

Restarting tourism requires alteration, and as the industry prepares for this transformation, consumers must also change in light of the pandemic in terms of their perceptions, preferences, and attitudes toward traveling—and tourism industries must be prepared for those changes.<sup>11</sup> People aged 46 years and older have a high potential for traveling. In the pre-pandemic era, this age group contributed to the most increased average length of stay and travel expenditure.<sup>12</sup> However, their vulnerability to COVID-19 may limit their choices for safe spaces outside the home. These obstacles to traveling can interfere with their fulfillment of well-being. Intrapersonal constraint, including health, has been assumed to be one's most powerful constraint, as it determines the motivation for participation.<sup>13</sup> It then becomes the most effective constraint in the pre-contemplation stage.<sup>14</sup> Constraints in the form of fears and anxieties associated with uncertainty may negatively influence people's intention to visit destinations or even cause resistance to travel to destinations.<sup>15</sup>

Studies on travel intention during the COVID-19 pandemic have been growing. However, studies related to travel and people at risk of COVID-19 have been slightly overlooked. Wachyuni and Kusumaningrum,<sup>16</sup> found that millennials' post-pandemic travel intention in Jakarta is higher than their travel anxieties. Graham, *et al.*,<sup>17</sup> investigated the elderly's air travel intention during the pandemic and found that more than 50% plan to travel within one year after the pandemic. However, the age cluster used did not show significant behavioral variation. The authors recommended that future study will include older people of younger ages who have physical vulnerabilities toward COVID-19,<sup>17</sup> and this study intended to accommodate this recommendation. Concerning constraints and travel intention, Andreani and Njo,<sup>18</sup> used the theory of planned behavior (TPB) framework to analyze the effect of travel constraints on travel intention. They found that intrapersonal and structural constraints significantly influence travel intention. However, their study did not group respondents or specifically looked at the pandemic context.

In TPB, the intention is a direct determinant of behavior, and intentions are influenced by attitudes toward behavior, subjective norms, and perceived behavioral control (PBC).<sup>19</sup> Attitudes toward behavior indicate an individual's tendency toward a particular view of behavior; subjective norms indicate the amount of social pressure from individual or group referents that encourage a person's participation in certain behaviors, while PBC in-

dicates how easy or difficult it is to carry out the behavior with the resources one has.<sup>19</sup> Aiming to understand the effect of intrapersonal constraints on travel intention of people at risk from COVID-19 during the new normal, this study added intrapersonal constraints in the TPB framework, where attitudes, subjective norms, and PBC were independent variables, travel intention was the dependent variable, and intrapersonal constraint was the moderator variable. This study proposed seven hypotheses. The first hypothesis (H1) was that attitude significantly influences travel intention. The second hypothesis (H2) was that subjective norms significantly influence travel intention. The third hypothesis (H3) was that PBC significantly affects travel intention. The fourth hypothesis (H4) was that intrapersonal constraints significantly influence travel intention. The fifth hypothesis (H5) was that intrapersonal constraints significantly moderate the relationship between attitude and travel intention. The sixth hypothesis (H6) was that intrapersonal constraints significantly mediate the relationship between subjective norms and travel intention. The last hypothesis (H7) was that intrapersonal constraints significantly moderate the relationship between PBC and travel intention.

## Method

The population of this study was the ones physically vulnerable to COVID-19 in DKI Jakarta Province. Purposive convenience sampling was applied, with the sample criteria including citizens of the five Jakarta municipalities aged 46 years and older. The number of participants was drawn according to the rules that the appropriate sample size for research, in general, should be 30 to 500, with a minimum size of 30 for each category.<sup>20</sup> Kline stated that a minimum sample for structural equation modeling (SEM) should be around 100 to 200, while Tabachnick and Fidell recommended a minimum sample of 300 for statistical data analysis.<sup>21</sup> Hence, to meet the general requirements of a research sample and those for statistical data research using SEM, this study set a minimum sample of 300 respondents. In detail, the sample was divided into four groups based on their age and health condition: the elderly, with and without comorbidities, and the middle-aged, with and without comorbidities.

Data were gathered using Google Forms circulated via WhatsApp messages to support physical distancing, and respondents were allowed to complete the form at their convenience. Following Ajzen's suggestion, an eliciting questionnaire was conducted during the first data collection stage.<sup>22</sup> A pilot study completed by 30 respondents was undertaken in mid-June 2021, and all variables were confirmed to be valid and reliable—the final questionnaire comprised three parts. The first part was the respondents' profile, which consisted of demographic

characteristics and health conditions. The second part included multiple-choice statements concerning the TPB variables: attitudes (five indicators, e.g., “Traveling during the new normal is more convenient”), subjective norms (five indicators, e.g., “Most of my friends think positively about traveling during the new normal”), PBC (five indicators, e.g., “I have enough free time to travel during the new normal”), and travel intention (three indicators, e.g., “I feel excited to travel during the new normal”). The third part included multiple-choice statements on intrapersonal constraints (five indicators, e.g., “I am worried that I may get infected by COVID-19 while traveling during the new normal”). The second and third parts were assessed using a four-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree). It has been suggested that research in Indonesia should apply an even Likert scale, as Indonesians are relatively inclined to take a neutral side.<sup>23</sup>

The International Business Machines Corporation (IBM) Statistical Package for the Social Sciences (SPSS) for Windows, version 25 (IBM Corporation, Armonk, New York, United States of America) was used to calculate the percentage of respondents in the profile. Demographic information consisted of age, gender, marital status, education, and occupation, while health conditions included perception of comorbidities. Age was categorized based on the definition mentioned above. Marital status was divided into two categories. Married people were considered those who still had either a spouse and/or children, while single people were considered those who had neither a spouse nor children. This classification was aimed to distinguish people who had attachments to a nuclear family from those who did not. Education was classified based on graduation level, from elementary to postgraduate. Finally, occupation was divided into people still dynamically earning money (entrepreneur, employee) and those who did not (retired, housewife, unemployed).

The first step was the outer model evaluation, which was performed by checking the convergent validity (shown by the average variance extracted/AVE and outer loading value more than 0.5), discriminant validity (based on Fornell and Lacker’s criterion, shown by the AVE root of a variable that is higher than the correlation of the variable with other variables), and the reliability of the variables (proven by the value of the composite reliability more than 0.7).<sup>24</sup> In determining the tendency of the response, the level of respondents’ achievement (LRA) and the mode of response were referred to. Descriptive statistics were used to find the mean for each indicator to calculate the LRA, which was interpreted by using the following criteria: very low (0–20.99%), low (21–40.99%), moderate (41–60.99%), high (61–80.99%), and very high (81–100%).<sup>25</sup> The mode of re-

sponse was used to determine the Likert scale that the respondents were most inclined to. After the model was specified, the hypotheses were verified by comparing the t table and t statistics values and considering the p-value. If the t statistics value was more than t table (with a confidence level of 0.05, it should be more than 1.96), and if the p-value was less than 0.05, then the hypothesis was accepted.<sup>24</sup> The inner model evaluation was performed next by finding the value of 1) Q2 to determine the model’s predictive relevance (with a value more than 0 proving it) and 2) R2 to determine the model’s predictive ability (0.25 = weak, 0.5 = moderate, and 0.75 = significant).<sup>24</sup>

**Results**

The data collection resulted in 337 responses, more than the minimum sample number set for the study. The profile of the respondents is presented in Table 1. After deletion of the lowest outer loading, the model reached convergent and discriminant validity for 22 indicators. The model was also confirmed to be reliable according to the required AVE and composite reliability values. Table 2 shows that the group of middle-aged individuals without comorbidities had high LRAs and “agree” modes for all variables. The group of middle-aged individuals with comorbidities had relatively similar LRAs and mode results, except they had lower social pressure to travel during the new normal.

Table 3 shows that, overall, the elderly without comorbidities had high LRAs, except for in the subjective norm category. Next, although the elderly with comorbidities have a higher risk of COVID-19, they have a high level of travel intention. However, they also have very high intrapersonal constraints and demonstrate a lower attitude and pressure to travel in the new normal.

**Table 1. Respondents’ Profile**

| Demography/Condition | Category                 | n (n = 337) | %    |
|----------------------|--------------------------|-------------|------|
| Age                  | 46–59                    | 269         | 79.8 |
|                      | >60                      | 68          | 20.2 |
| Sex                  | Male                     | 110         | 32.6 |
|                      | Female                   | 227         | 67.4 |
| Marital status       | Married                  | 299         | 88.7 |
|                      | Single                   | 38          | 11.3 |
| Education            | Elementary & junior high | 12          | 3.6  |
|                      | Senior high              | 83          | 24.6 |
|                      | Associate’s degree       | 35          | 10.4 |
|                      | Undergraduate            | 139         | 41.2 |
|                      | Graduate/postgraduate    | 68          | 20.2 |
| Occupation           | Employee                 | 158         | 46.9 |
|                      | Entrepreneur             | 34          | 10.1 |
|                      | Retired                  | 50          | 14.8 |
|                      | Unemployed               | 12          | 3.6  |
|                      | Housewife                | 83          | 24.6 |
| Having comorbidities | Yes                      | 97          | 28.8 |
|                      | No                       | 240         | 71.2 |



The structural model testing in Table 4 proved that H2, H3, and H4 were supported and resulted in the structural model depicted in Figure 1. The model resulted in a Q2 of 0.494, meaning that it has predictive relevance. Next, an R2 value of 0.701 was found, which falls into the category of moderate, close to being significant. This result showed that travel intention was influenced by subjective norms, PBC, and intrapersonal constraints as much as 70.1%, while other aspects excepted from this study have a share of 29.9% of effects on travel intention.

**Discussion**

Previous studies have shown that intrapersonal constraints have a significant negative influence on travel intention.<sup>18,26</sup> This study also found a similar result, which means that people at high risk from COVID-19 realized

the importance of considering their age and physical condition when traveling during the new normal. The influence of respondents' physical condition on their psychological condition might affect their plans to travel during the new normal. High constraints justified at-risk people's attitudes regarding the inconvenience of traveling in the new normal.

Studies on travel intention in the TPB framework have shown that attitude significantly and positively influences travel intention.<sup>27-30</sup> However, this study noticed that attitude had no significant influence on travel intention when intrapersonal constraints were considered in the framework. This discrepancy might be caused by the different populations studied, as most of the respondents in previous studies were under 46 years old.<sup>27-29</sup> The contrast might also be due to different variables added in the TPB framework, as none of the other studies

**Table 2. Middle-Aged Group's Level of Respondents' Achievement Regarding Theory of Planned Behavior and Intrapersonal Constraints**

| Health Condition                | Category | AT (%)   | SN (%)   | PBC (%)  | TI (%)   | IC (%)    |
|---------------------------------|----------|----------|----------|----------|----------|-----------|
| Without comorbidities (n = 210) | LRA      | 65.4 (H) | 62.6 (H) | 70.8 (H) | 69.4 (H) | 72.1 (H)  |
|                                 | Mode     | A (42.4) | A (40.5) | A (47.6) | A (44.8) | A (33.3)  |
| With comorbidities (n = 59)     | LRA      | 64.5 (H) | 60.3 (M) | 70.3 (H) | 65.9 (H) | 77.9 (H)  |
|                                 | Mode     | A (35.6) | A (35.6) | A (54.2) | A (42.4) | A/SA (39) |
| Total (n = 269)                 | LRA      | 65.2 (H) | 62.1 (H) | 70.5 (H) | 68.7 (H) | 78.0 (H)  |
|                                 | Mode     | A (40.5) | A (39.4) | A (49.1) | A (44.2) | A (34.6)  |

Notes: AT = Attitude, SN = Subjective Norms, PBC = Perceived Behavioral Control, TI = Travel Intention, IC = Intrapersonal Constraints, LRA = Level of Respondents Achievement, M = Moderate, H = High, A = Agree, SA = Strongly Agree.

**Table 3. Elderly Group's Level of Respondents' Achievement toward Theory of Planned Behavior and Intrapersonal Constraints**

| Health Condition               | Category | AT (%)    | SN (%)    | PBC (%)  | TI (%)    | IC (%)    |
|--------------------------------|----------|-----------|-----------|----------|-----------|-----------|
| Without comorbidities (n = 30) | LRA      | 66.8 (H)  | 60.8 (M)  | 72.3 (H) | 67.2 (H)  | 73.4 (H)  |
|                                | Mode     | A (40.0)  | DA (43.4) | A (36.7) | A (36.7)  | A/SA (40) |
| With comorbidities (n = 38)    | LRA      | 59.1 (M)  | 58.4 (M)  | 68.3 (H) | 61.4 (H)  | 82.9 (VH) |
|                                | Mode     | DA (47.4) | DA (50.0) | A (50.0) | DA (36.8) | SA (44.8) |
| Total (n = 68)                 | LRA      | 62.5 (H)  | 59.5 (M)  | 70.3 (H) | 63.9 (H)  | 80.7 (H)  |
|                                | Mode     | DA (41.2) | DA (47.1) | A (44.1) | DA (36.8) | A (42.6)  |

Notes: AT = Attitude, SN = Subjective Norms, PBC = Perceived Behavioral Control, TI = Travel Intention, IC = Intrapersonal Constraints, LRA = Level of Respondents Achievement, M = Moderate, H = High, VH = Very High, DA = Disagree, A = Agree, SA = Strongly Agree.

**Table 4. Hypotheses Testing Results**

| Relationship                            | Original Sample | T Statistics | p-values | Remarks         |
|---|-----------------|--------------|----------|-----------------|
| H1: AT → TI                             | 0.083           | 1.201        | 0.230    | Not significant |
| H2: SN → TI                             | 0.277           | 4.153        | 0.000    | Significant     |
| H3: PBC → TI                            | 0.475           | 9.554        | 0.000    | Significant     |
| H4: IC → TI                             | -0.151          | 4.025        | 0.000    | Significant     |
| H5: Moderating Effect of IC on AT → TI  | -0.046          | 0.923        | 0.356    | Not significant |
| H6: Moderating Effect of IC on SN → TI  | 0.067           | 1.327        | 0.185    | Not significant |
| H7: Moderating Effect of IC on PBC → TI | -0.018          | 0.386        | 0.700    | Not significant |

Notes: AT = Attitude, SN = Subjective Norms, PBC = Perceived Behavioral Control, TI = Travel Intention, IC = Intrapersonal Constraints.



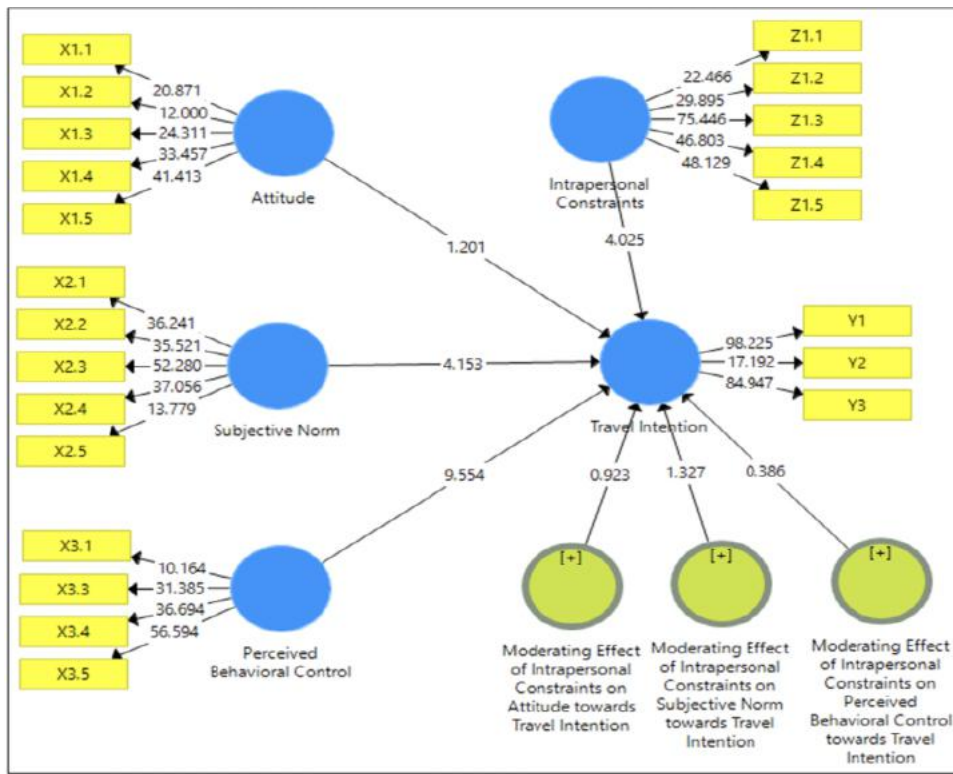


Figure 1. Partial Least Square Structural Equation Modeling Result

included intrapersonal constraints.<sup>27-30</sup> Finally, it might also be because the previous studies were conducted in the first semester of 2020 when the new normal was just deliberated or implemented.<sup>27-30</sup> The insignificant role of attitude implied that a good or bad view on traveling during the new normal does not influence the travel intention of people at risk from COVID-19. This condition might also be why intrapersonal constraints do not exhibit moderating effects on attitude toward travel intention, indicating that attitude is not shaped by one's condition but by the activity itself.

Similar to this study, previous studies have shown that subjective norms have a significant and positive influence on travel intention.<sup>28-30</sup> Respondents' answers showed that their persons or group referents do not encourage them to travel during the new normal. People seem to mind a great deal about each other's health. The presence of collective resilience could cause this, and a shift to prosocial and responsible consumption urged by the pandemic.<sup>31,32</sup> Collective resilience has thus also been a buffer toward intrapersonal constraints, causing intrapersonal constraints to be an insignificant moderator of subjective norms toward travel intention.

This study showed that PBC has a significant and positive influence on travel intention, and previous studies stated the same.<sup>27-30,33</sup> Furthermore, this study found

that, among the TPB variables, PBC has had the most significant influence on travel intention during the pandemic, indicating the confidence of at-risk people in their capacity to travel during the new normal, supporting the previous studies.<sup>27,33</sup> The insignificant moderating role of intrapersonal constraints on PBC toward travel intention in this study could be caused by the high PBC, meaning that they believe they can find negotiating strategies for the constraints in traveling during the new normal.

This study found that the travel intention of people at high risk from COVID-19 belongs to the high category, with the middle-aged group having a higher LRA than the elderly. However, although the elderly's travel intention belongs to the high category, their mode of answering falls into the "disagree" scale, which hints at a hesitation to travel during the new normal, especially for the elderly with comorbidities. This finding supports a previous study revealing that elderly tourists have a high sensitivity toward health crises.<sup>15</sup> While intrapersonal constraints belong to a high level, and they do not necessarily lead to low travel intention. This could be explained by the respondents' high PBC. Otherwise, this could also indicate that respondents deem traveling very important in fulfilling their needs and improving their quality of life.

In any case, high intrapersonal constraints imply inconvenience in traveling during the new normal. Safety

is “the new comfort” during the new normal. Hence, the application of hygiene and sanitation factors against COVID-19, such as personal protective equipment, health education, personal hygiene, and sanitation, to prevent transmission,<sup>34</sup> and make traveling safer and more convenient. Tourism activities should then refer to CHSE implementation. In addition, “untact” tourism, such as healing ecotourism, staycations, and road trips, has become quite popular to satisfy the thirst for tourism while also minimizing the health risk from COVID-19 and may be a solution for people at risk.<sup>35</sup> However, considering the price, experience, and technology applied,<sup>35</sup> it is necessary to ensure its inclusivity. The untact culture was introduced to respond to the individualist tendency of modern people.<sup>35</sup> To prevent exclusivity, it is suggested that untact tourism services in Indonesia have a range of affordable prices, provide tourism experiences preferred by all segments, and feature a user-friendly service.

This study theoretically contributes by filling the tourism and pandemic literature gap that has not widely discussed at-risk people’s behaviors. This study may belong to the initial studies on tourism consumption during the new normal in Indonesia from the standpoint of vulnerable people. It also expands TPB with the involvement of intrapersonal constraints by providing a more stable ground for explaining travel intention during a health crisis. The study offers several practical implications. First, it is necessary to lessen the psychological barriers of people at risk to travel during the new normal while balancing the effort to deal with a high travel intention by enhancing safety in traveling during the normal. In addition, it is also essential to ensure the accuracy and timeliness of information delivery in efforts to improve safety in activities during the pandemic to prevent overconfidence due to misinformation that could lead to higher vulnerability. Finally, tourism industries should also encourage visitors’ responsible behavior by monitoring conformity to the rules.

This study has some limitations. First, there was an imbalance regarding the proportion between respondents’ ages due to the type of sampling and data collection mechanism. However, besides performing SEM analysis, LRA calculation, which separates the results between the elderly and middle-aged respondents, is expected to minimize bias. Future studies can find a better data collection technique during the new normal and thus obtain a proportional sample. Second, questionnaires were distributed during Indonesia’s second peak of COVID-19 transmission. Therefore, performing the study when the positivity rate is stably low could yield a different result. However, the data collection period covered the time when cases were rising until they flattened at the end of September 2021. Next, future studies can

assess the tourism behaviors and coping strategies of at-risk people during the new normal as well as their trust perception of health protocol implementation by tourism industries.

## Conclusion

Intrapersonal constraints directly influence the travel intention of people at risk from COVID-19. Yet, this study found that they do not moderate the relationship between attitude and travel intention, subjective norms and travel intention, or PBC and travel intention. In addition, high intrapersonal constraints do not necessarily lead to low intention to participate in tourism activities. Tourism authorities are recommended to encourage consistency with CHSE implementation and adopt and promote inclusive untact tourism to enhance the safety and convenience of traveling during the new normal.

## Abbreviations

COVID-19: Coronavirus Disease 2019; H1: Hypothesis 1 (and so on); AT: Attitude; SN: Subjective Norm; PBC: Perceived Behavioral Control; TI: Travel Intention; IC: Intrapersonal Constraints; SEM: Structural Equation Modeling; TPB: Theory of Planned Behavior; SPSS: Statistical Package for the Social Sciences; LRA: Level of Respondents’ Achievement; AVE: Average Extracted Variance; N: Total Number of Individuals in the Sample; M: Moderate; H: High; DA: Disagree; A: Agree; SA: Strongly Agree.

## Ethics Approval and Consent to Participate

Electronic informed consent was distributed inclusively with the data collection instrument. Consent was obtained from all respondents prior to their starting to give responses. Therefore, respondents could withdraw from the survey at any moment without providing any justification.

## Competing Interest

The author declares that there is no significant competing financial, professional, or personal interest that might have affected the performance or presentation of the work described in this manuscript.

## Availability of Data and Materials

Authors clarify sources of data or information used as study materials.

## Authors’ Contribution

DW developed and designed the research and directed the overall work. IKW collected the data, performed the analysis, and wrote the first draft of the manuscript. Both authors discussed the results and contributed to the final manuscript.

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## References

1. Marmion M, Hindley A. Tourism and health: understanding the relationship. *Good Health and Well-Being*. 2020; 738-46.
2. World Health Organization. Basic documents. World Health Organization; 2020.
3. Assembly UG. Universal declaration of human rights. UN General Assembly. 1948; 302 (2): 14-25.
4. Komisi Penanganan COVID-19 dan Pemulihan Ekonomi Nasional (KPCPEN). Peta sebaran. KPCPEN; 2021.
5. CNN Indonesia. Ahli ungkap faktor pasien usia 45-65 rentan wafat kena corona. CNN Indonesia; 2020.
6. Kementerian Kesehatan Republik Indonesia. Buku kesehatan lanjut usia. Jakarta: Kementerian Kesehatan RI; 2016.
7. Mas'udi W, Winata PS. New normal: perubahan sosial ekonomi dan politik akibat COVID-19. Yogyakarta: Gadjah Mada University Press; 2020.
8. Governor of DKI Jakarta. Regulation of the Governor of DKI Jakarta number 51 of 2020 regarding the implementation of large-scale social restriction in transition period towards healthy, secured, and productive community; 2020.
9. BBC News Online. Corona virus may never go away, World Health Organization warns. BBC News Online; 2020.
10. Ministry of Tourism and Creative Economy. Press release: Kemenparekraf luncurkan kampanye penerapan protokol kesehatan 'Indonesia Care'; 2020.
11. Ivanova M, Ivanov IK, Ivanov S. Travel behaviour after the pandemic: the case of Bulgaria. *Anatolia*. 2021; 32 (1): 1-1.
12. Badan Pusat Statistik. Statistik wisatawan nusantara. Jakarta; BPS RI; 2019.
13. Cai S. Leisure patterns and constraints reported by selected Chinese University Students. University of Waterloo; 2015.
14. Nazir MU, Yasin I, Tat HH. Destination image's mediating role between perceived risks, perceived constraints, and behavioral intention. *Heliyon* 7. 2021; e07613: 28p.
15. Senbeto DL, Hon AH. The impacts of social and economic crises on tourist behaviour and expenditure: an evolutionary approach. *Current Issues in Tourism*. 2020; 23 (6): 740-55.
16. Wachyuni SS, Kusumaningrum DA. The effect of COVID-19 pandemic: how are the future tourist behavior? *Journal of Education, Society, and, Behavioural Sciences*. 2020; 33 (4): 67-76.
17. Graham A, Kremerik F, Kruse W. Attitudes of ageing passengers to air travel since the coronavirus pandemic. *Journal of Air Transport Management*. 2020; 87: 101865: 5p.
18. Andreani F, Njo A. The impact of travel constraints on travel intention. Promoting creative tourism: current issues in tourism research. 1st ed. Routledge; 2021.
19. Ajzen I. The theory of planned behavior. *Organizational Behaviour and Human Decision Processes* 50. 1991; 179-211.
20. Sekaran U, Bougie R. Research methods for business. 5th ed. John Wiley & Sons; 2016.
21. Kyriazos TA. Applied psychometrics: sample size and sample power considerations in factor analysis (EFA, CFA) and SEM in general. *Psychology*. 2018; 9 (08): 2207.
22. Schultz JR. Applying the theory of planned behavior to participation in sustainable tourism certification programs [Doctoral thesis]. The University of Utah; 2014.
23. Pujihastuti I. Prinsip penulisan kuesioner penelitian. *CEFARS: Jurnal Agribisnis dan Pengembangan Wilayah*. 2010; 2 (1): 43-56.
24. Ghozali I. Partial least squares konsep, teknik, dan aplikasi menggunakan program SmartPLS 3.2.9 untuk penelitian empiris (3rd Ed). Semarang: Badan Penerbit Universitas Diponegoro; 2021.
25. Riduwan MB. Belajar mudah penelitian untuk guru-karyawan dan peneliti pemula. Bandung: Alfabeta; 2019.
26. Abd Aziz N, Long F, Murad SM. Examining travel constraints and perceived risk on intention to travel during the COVID-19 pandemic: the case of Malaysian consumers. 2021; 27: 200-19.
27. Hamid S, Bano N. Behavioral Intention of Traveling in the period of COVID-19: an application of the theory of planned behavior (TPB) and perceived risk. *International Journal of Tourism Cities*; 2021.
28. Liu Y, Shi H, Li Y, Amin A. Factors influencing Chinese residents' post-pandemic outbound travel intentions: an extended theory of planned behavior model based on the perception of COVID-19. *Tourism Review*. 2021; 76 (4): 871-91.
29. Han H, Al-Ansi A, Chua BL, Tariq B, Radic A, Park SH. The post-coronavirus world in the international tourism industry: application of the theory of planned behavior to safer destination choices in the case of US outbound tourism. *International journal of Environmental Research and Public Health*. 2020; 17 (18): 6485.
30. Sánchez-Cañizares SM, Cabeza-Ramírez LJ, Muñoz-Fernández G, Fuentes-García FJ. Impact of the perceived risk from Covid-19 on intention to travel. *Current Issues in Tourism*. 2021; 24 (7): 970-84.
31. Stankov U, Filimonau V, Vujičić MD. A mindful shift: an opportunity for mindfulness-driven tourism in a post-pandemic world. *Tourism Geographies*. 2020; 22 (3): 703-12.
32. He H, Harris L. The impact of COVID-19 pandemic on corporate social responsibility and marketing philosophy. *Journal of Business Research*. 2020; 116: 176-82.
33. Nguyen NM, Pham MQ, Pham M. Public's travel intention following COVID-19 pandemic constrained: a case study in Vietnam. *The Journal of Asian Finance, Economics and Business*. 2021; 8 (8): 181-9.
34. Purnama SG, Susanna D. Hygiene and sanitation challenge for COVID-19 prevention in Indonesia. *Kesmas: Jurnal Kesehatan Masyarakat Nasional (National Public Health Journal)*. 2020; 6-13.
35. Bae SY, Chang PJ. The effect of coronavirus disease-19 (COVID-19) risk perception on behavioural intention towards 'untact' tourism in South Korea during the first wave of the pandemic (March 2020). *Current Issues in Tourism*. 2021; 24 (7): 1017-35.

# Zoom Fatigue during the COVID-19 Pandemic: Is it Real?

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## Abstract

The coronavirus disease 2019 (COVID-19) pandemic has caused drastic changes to social lives moreover the activities done outside, such as work and school. The policy of large-scale social restrictions (LSRR)/*Pembatasan Sosial Berskala Besar* (PSBB), which makes people stay at home, also plays an important role in changing the face-to-face activity online. As a solution to the major change, people use video conferencing to keep in touch and still feel like doing "offline" activities. The increasing use of video conferencing has raised concerns about the resulting fatigue, termed "Zoom fatigue." This study aimed to describe Zoom fatigue during the COVID-19 pandemic and the factors contributing to it. This study used a cross-sectional design with 376 participants. Data were gathered by completing a 45-item online questionnaire, which was analyzed using univariate, bivariate (Chi-square), and multivariate (binomial logistic regression) analyses. It was found that 68.6% of respondents experienced Zoom fatigue at a moderate to a high level. Respondents complained of several symptoms related to activity, motivation, and physical weakness after using the video platform. In brief, Zoom fatigue is real, and the frequency of video platform use is related to the incidence of Zoom fatigue.

**Keywords:** COVID-19, impact, zoom fatigue

## Introduction

A new disease caused by a novel coronavirus, called COVID-19, emerged at the end of December 2019. Currently, 224 countries and territories worldwide have been infected with this virus.<sup>1</sup> This pandemic has drastically changed social life.<sup>2</sup> To curb its transmission, the public has been advised to follow various health protocols, such as physical distancing, large-scale social restrictions (LSRR)/*Pembatasan Sosial Berskala Besar* (PSBB), and masking. According to the Centers for Disease Control (CDC), prevention of COVID-19 includes getting vaccinated, wearing a mask, remaining six feet away from others, avoiding poorly ventilated rooms and crowds, and washing hands.<sup>3</sup>

This virus has caused fear, anxiety, and uncertainty across the globe leading to provisions for social distancing and an increasingly challenging economic reality.<sup>4</sup> Changes, such as working from home (WFH),<sup>5,6</sup> studying from home (SFH), terminating employment contracts, losing one's job, and lack of physical contact with families residing outside the city, which are extremely

necessary for maintaining mental health, are enough to alter an individual's lifestyle. The educational sector has also experienced certain changes during the pandemic. Usually known to carry out face-to-face learning activities, this field adopted an online procedure,<sup>7,8</sup> using various media, such as Zoom, Google Meet, Cisco Webex, Skype, and other video platforms.

The COVID-19 pandemic has led to increased screen time.<sup>9-11</sup> In addition, reports have shown that Zoom usage rose by 360% in 2020.<sup>12</sup> The word "Zooming" has become a widespread verb to replace video conferencing, just like "Googling," which is equivalent to a web search. The increasing use of video conferencing has raised concerns about fatigue caused by video conferencing, termed "Zoom fatigue,"<sup>13</sup> caused by the complexity of interpersonal interactions because of particular spatial dynamics in video conferences.<sup>14</sup>

Bailenson's study discusses the theoretical arguments for the causes of Zoom fatigue, explaining that Zoom fatigue is caused by four dimensions of interpersonal connection (eye gaze at close distance, cognitive load, all-

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day mirror, and reduced mobility) changed as a result of video conferencing.<sup>15</sup> The use of video conferencing for an extended period has a high risk of causing stress,<sup>16</sup> and mental health issues, such as tiredness and anxiety.<sup>17</sup> However, those study was still hypothetical. Despite the findings of previous studies, almost none have been directly tested. There is still limited research discussing Zoom fatigue and the factors affecting it. Therefore, this study aimed to describe the occurrence of Zoom fatigue and the factors that contributed to it during the COVID-19 pandemic.

**Method**

This study was a cross-sectional study using convenience sampling, and this method is based on the availability and ease of obtaining respondents. The sample size was calculated based on the following Formula 1.

Based on previous research, the population proportion 1 (P1) was 0.36, and the population proportion 2 (P2) was 0.50.<sup>18</sup> With a significant level of 0.05 and a power of 95%, the minimum sample size of this study was 323. The sample size of this study was 376, which surpassed the minimal sample adequacy requirement. Data collection began in July and ended in October 2020.

The dependent variable was Zoom fatigue. In this study, "Zoom fatigue" is defined as the fatigue that occurs after video conferencing using Zoom, Google Meet, Skype, FaceTime, Cloud X, Go to Webinar, Microsoft Teams, Cisco Webex. The independent variables were frequency of use of video platforms (days/week), frequency of use of video platforms (hours/day), frequency of rest, length of rest, the tool used for video platforms, audio device, sitting position (lying around or sitting), and multitasking.

Data was collected through a questionnaire on Google Forms. The link to the online questionnaire was distributed through various social media. Individuals over 17 years old, have worked or studied from home, and are willing to fill out the questionnaire were sampled.

The questionnaire included 45 questions: seven questions about the characteristics of the respondents, eight questions about the determinants of Zoom fatigue, and 30 questions about Zoom fatigue. Questions about the determinants of Zoom fatigue included frequency of use per week (≤ three days/week or > three days/week), frequency of use per day (≤ three hours/day or > three hours/day), number of breaks (one time or ≥ two times), duration of a break (< 15 minutes or ≥ 15 minutes), the equipment used (smartphone vs. computer/laptop, used audio device or not), posture (lying around or sitting), and whether the respondent does other work while video conferencing (multitasks or not). Zoom fatigue was measured with an instrument in subjective self-rating, designed by the Industrial Fatigue Research Committee

$$n = \frac{(Z\alpha\sqrt{2PQ} + Z\beta\sqrt{P_1Q_1 + P_2Q_2})^2}{(P_1 - P_2)^2}$$

Formula 1. Sample Size Calculation

(IFRC).<sup>19</sup> The Subjective Symptoms Test (SST) questionnaire consisted of 30 questions in which the first, second, and last ten questions were based on weakening activities, motivational, and physical attenuation, respectively. In addition, an assessment design with a Likert scale scoring; "never" (never in one week), "sometimes" (one–two days in one week), "often" (three–four days in one week), and "always" (almost every day in one week), was also included. The accumulated values and results were grouped into low (30–52), moderate (53–74), high (75–98), and very high (99–120) to determine the fatigue level.

This study primarily employed univariate, bivariate, and multivariate regression analyses using SPSS 22.0 free trial version. Univariate analysis tabulated the frequency of characteristics and demographic statistics, such as sex, age, and occupation. The Chi-square test or Fisher's exact test was used to assess the association between independent (frequency of use in days/week, frequency of use in hours/days, frequency of rest, length of rest, equipment, audio device, posture, and multitasking) and dependent variables (the level of Zoom fatigue); a p-value<0.05 was considered significant at a 95% confidence interval (CI). Variables with a p-value more than 0.25 were considered for multivariate (binomial logistic regression) with backward stepwise regression. With a 95% confidence interval (CI), the results of the interpretation of the prevalence ratio (PR) values were as follows:

1. If the PR was greater than one, the 95% CI did not include a value of one, indicating that the factor under consideration was a risk factor.
2. If the PR was greater than one, the 95% CI included a value of one, indicating that the factor studied was not a risk factor.
3. If the PR was less than one, the 95% CI did not include a value of 1, indicating that the factor studied was a protective factor.

**Results**

A total of 376 respondents, consisting of 50 (13.30%) male and 326 (86.70%) female, participated in this study. The respondents' mean, mode, youngest, and oldest ages were 22, 20, 16, and 57 years, respectively. Most respondents were students (80.60%). The prevalence of moderate to high levels of Zoom fatigue was 68.6%,



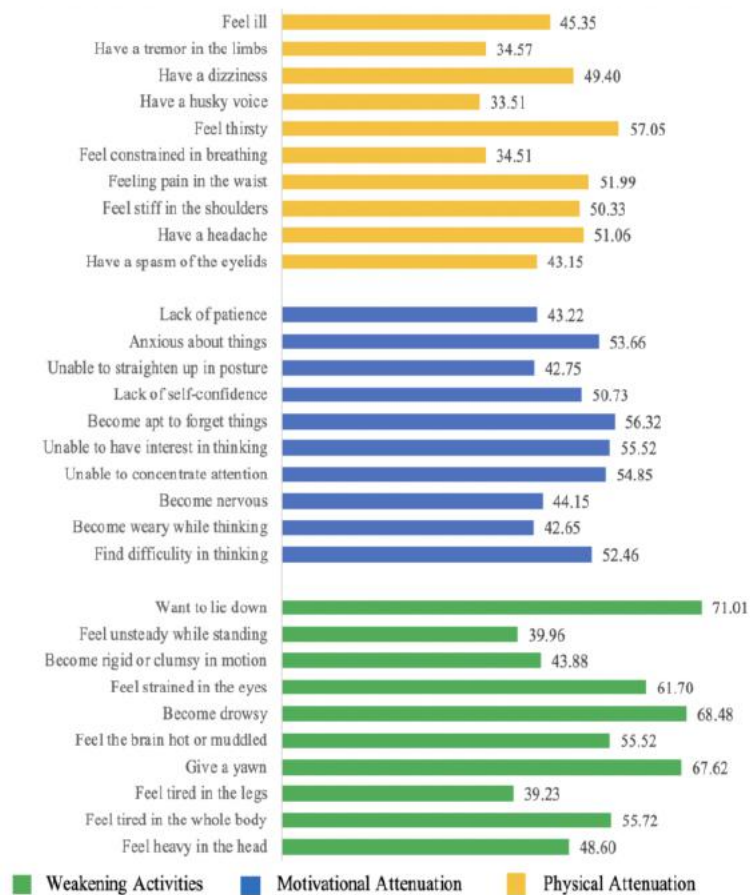


Figure 1. Zoom Fatigue Symptoms

based on the criteria in the total sample.

Zoom fatigue occurs after video conferencing with Zoom, Google Meet, Skype, FaceTime, Cloud X, Go to Webinar, Microsoft Teams, Cisco Webex. The Subjective Symptoms Test (SST) consisted of 30 questions, in which the first, second, and last 10 questions were centered on weakening activities, motivational, and physical attenuation, respectively. These 30 questions aimed to ascertain the extent of fatigue that occurred after using the online platform. This study found that the classic indicators of weakening activities were a desire to lie down, drowsiness, yawning, and eye strain. Forgetfulness, lack of interest in cognitive activities, and low concentration were all prevalent motivational attenuation symptoms. In addition, a majority of the respondents reported physical weakening symptoms, such as thirst, pain in the waist, and headaches (Figure 1).

This study measured eight factors contributing to Zoom fatigue: frequency (days/week), frequency (hours/day), frequency of rest, length of rest, equipment, audio device, posture, and multitasking. Most respon-

dents had a high frequency of using video platforms and had sufficient time to rest. Audio devices were widely used, respondents reported a good sitting posture, and most respondents multitasked. The Chi-square test showed that the frequency of use of video platforms (days/week) ( $p$ -value = 0.046), frequency of use of video platforms (hours/day) ( $p$ -value = 0.010), and equipment ( $p$ -value = 0.038) indicated a significant association with Zoom fatigue (Table 1). Respondents who frequently use video platforms were more likely to experience "Zoom fatigue."

The authors conducted a multivariate analysis with a binomial logistic regression test to explore the factors contributing to Zoom fatigue. Four variables matched the criteria for the multivariate analysis ( $p$ -value = 0.25): frequency of video platform use (days/week), frequency of video platform use (hours/day), frequency of rest, and video platform equipment. The frequency of usage of video platforms (days/week) and the frequency of rest were both eliminated from the multivariable model based on the findings. The results of the multivariate analysis showed that the frequency of use of video platforms

**Table 1. Factors Contributing to Zoom Fatigue Based on Bivariate Analysis (n = 376)**

| Variable              | Category        | Zoom Fatigue     |     |       | p-value | PR (95% CI)          |
|-----------------------|-----------------|------------------|-----|-------|---------|----------------------|
|                       |                 | Moderate to High | Low | Total |         |                      |
| Frequency (days/week) | >3 days/week    | 163              | 61  | 224   | 0.046   | 1.164 (1.005–1.349)  |
|                       | ≤3 days/week    | 95               | 57  | 152   |         |                      |
| Frequency (hours/day) | >3 hours/day    | 158              | 54  | 212   | 0.010   | 1.214 (1.048–1.406)  |
|                       | ≤3 hours/day    | 97               | 61  | 158   |         |                      |
| Frequency of rest     | 1 time          | 78               | 48  | 126   | 0.061   | 0.860 (0.735–1.0006) |
|                       | ≥2 times        | 180              | 70  | 250   |         |                      |
| Length of rest        | <15 minutes     | 48               | 21  | 69    | 0.965   | 1.017 (0.855–1.210)  |
|                       | ≥15 minutes     | 210              | 97  | 307   |         |                      |
| Equipment             | Smartphone      | 119              | 68  | 187   | 0.038   | 0.865 (0.754–0.995)  |
|                       | Computer/laptop | 139              | 50  | 189   |         |                      |
| Audio device          | No              | 88               | 46  | 134   | 0.424   | 0.935 (0.807–1.085)  |
|                       | Yes             | 170              | 72  | 242   |         |                      |
| Sitting position      | Lying around    | 14               | 4   | 18    | 0.550   | 1.141 (0.883–1.475)  |
|                       | Sitting         | 244              | 114 | 358   |         |                      |
| Multitask             | Yes             | 150              | 64  | 214   | 0.551   | 1.051 (0.914–1.210)  |
|                       | No              | 108              | 54  | 162   |         |                      |

Notes: CI = Confidence Interval, PR = Prevalence Ratio.

**Table 2. Multivariate Analysis Factors Contributed to Zoom Fatigue (n = 376)**

| Variable                 | β      | Sig.  | Exp (B) | 95% CI for Exp (B) |
|--------------------------|--------|-------|---------|--------------------|
| Frequency (>3 hours/day) | 0.594  | 0.009 | 1.811   | 1.157–2.834        |
| Equipment (Smartphone)   | -0.479 | 0.037 | 0.619   | 0.395–0.971        |
| Constant                 | -0.837 | 0.000 | 0.433   |                    |

Note: CI = Confidence Interval

(hours/day) contributed more to Zoom fatigue than equipment. Zoom fatigue was more likely to occur when using a video platform for more than three hours per day than for less than three hours per day (AOR = 1.811; 95% CI = 1.157–2.834). At the same time, respondents who used smartphones had more protective factors against Zoom fatigue than those who used computers or laptops (AOR = 0.619; 95% CI = 0.395–0.971) (Table 2).

### Discussion

At the onset of the pandemic, every individual was required to practice social distancing and communicate with others using various tools. Therefore, face-to-face communication was replaced with video platforms. However, the enhancement and accessibility of using this new means of communication has caused a physiological and psychological impact, referred to as Zoom fatigue. The term Zoom fatigue has caught on quickly as a result of the rapid rise in the use of Zoom or other video conference platforms, which have become a part of the growing concern over screen exhaustion.<sup>13</sup>

This study reported that only 31.4% of respondents experienced low fatigue. Conversely, the others experi-

enced moderate to very high fatigue (68.6%). Common symptoms of weakening activities included wanting to lie down, drowsiness, yawning, and eye strain. Commonly experienced motivational attenuation symptoms were forgetfulness, lack of interest in cognitive tasks, and low concentration. Moreover, most respondents complained of physical weakness symptoms, including feeling thirsty, pain in the waist, and headaches.

Based on the findings of this study, Zoom fatigue is real and occurs due to the use of video platforms. Under normal conditions, communicating with others aids in acquiring additional information obtained from gestures or facial expressions. In addition, these are an essential part of nonverbal feedback, which shows whether an individual is listening and whether the communication is going as planned. Moreover, the brain focuses on the words being voiced during the conversation, although additional meanings are derived from various nonverbal cues, such as the interlocutor's expressions. These nonverbal cues help paint a holistic picture of the conveyed message and the listener's response. Because humans are social creatures, understanding these cues comes naturally, although less effort is required to break them down for emotional intimacy with others. However, additional

obstacles, such as noise, signal interference, and the inability to see the opponent's expressions, especially when interacting with several individuals, are encountered when using a video platform. This condition leads to confusion, energy wastage, and eventually, fatigue. Therefore, it is a challenge to stay focused in a video conference. However, when several individuals are present, the platform becomes heavier, and everyone has a smaller screen size.<sup>20</sup> The limited screen view from head to shoulder makes it difficult for an individual to notice hand movements or other body languages.

Gaze is the most potent nonverbal cue available on a video call and tends to have adverse effects when carried out over a long time.<sup>21</sup> In addition, multiple screens that appear during video conferences can also cause fatigue. Furthermore, the 'Gallery View,' in which each meeting participant simultaneously engages, tends to cause certain challenges to the brain's central vision, forcing it to decode many individuals simultaneously, which no one understands, not even the speaker.<sup>21</sup> Individuals tend to focus on the screen during video conferencing, which causes the eye and ciliary muscles around the lens to contract. This results in increased lens curvature and near-visual stress.<sup>22</sup>

In face-to-face communication, individuals interact and respond to each other. Nevertheless, this interaction is less visible when using a video platform because most microphones or displays are muted to reduce noise. This impedes verbal responses spontaneously, which, from the communication perspective, tends to be negatively interpreted by the listener.<sup>23</sup> Furthermore, viewers are often distracted by other things such as notifications from smartphones, e-mail, or social media during video conferencing. This interference causes them to respond to the devices twice as much.<sup>22</sup>

Zoom fatigue is even more of a problem when video chat rooms are less collaborative and panel-like, with only two individuals speaking while the rest are listening. Consequently, a parallel conversation is impossible because each participant uses the same audio stream and is aware of every sound. The prolonged distraction causes confusion and drains energy in some individuals, making it seem like nothing was achieved. The brain becomes exhausted due to overstimulation and, at the same time, attempts to focus on finding impossible nonverbal cues.

Another effect caused by the increased use of social media and online platforms as a means of communication is mental health issues. The absence of feedback from conversations, off-screen behavior, time spent on standby even when not talking, and satiation can be underlying causes.<sup>24</sup> Some of the visible effects, such as high screen time through online platforms, have been proven to disrupt mood and increase depression in Asians.<sup>25</sup> Other preliminary studies have shown that students find it dif-

ficult to focus during online classes. Several complaints such as feeling lonely, anxious, and depressed have also been reported.<sup>20</sup> Communication through video platforms is challenging because many students are less active in class.<sup>26</sup> Teachers also tend to feel stressed because they do not receive the expected feedback during the course.<sup>26</sup>

This study showed that prolonged use of video platforms increases the risk of Zoom fatigue. It involved the simultaneous use of multiple video conferencing methods. It is due to a person's focus becoming disrupted, as well as signal and sound problems caused by holding two or more video conferences simultaneously. Instead of attending multiple video conferences, setting aside a certain time to participate in online meetings could enhance well-being and resilience. Video conferences could also be recorded so that individuals can see the outcomes of the recording instead of attending several video conferences at the same time.

This study had several limitations. First, the number of references related to Zoom fatigue was limited. This is because the emergence of Zoom fatigue only received attention after increased video conferencing use during the COVID-19 pandemic. Second, the data were collected using self-reported questionnaires, leading to reporting bias. To overcome bias, the authors determined the criteria for the research sample, explained the objectives, guaranteed the confidentiality of the respondents, and used a valid questionnaire. Despite these limitations, this study provided valuable information regarding Zoom fatigue and its determinants, allowing individuals to take preventive measures. This study potentially paves the way for future studies, such as utilizing a case-control or cohort design to study Zoom fatigue, or examining the long-term effects of video conferencing, not just on Zoom fatigue but also on physical and mental health.

## Conclusion

This study indicates that Zoom fatigue is real, as evidenced by the symptoms of weakened activity, weakened motivation, and physical weakness. The frequency of use of video platforms, such as Zoom, Google Meet, and Microsoft Teams, impacts Zoom fatigue. Therefore, some recommendations are to reduce the frequency of daily use of this platform, including avoiding attending multiple video conferences simultaneously. Video conferencing should only be used when absolutely necessary and avoided on occasions where phone calls or e-mails suffice.

## Abbreviations

COVID-19: coronavirus disease 2019; LSRR: Large-scale Social Restrictions; PSBB: *Pembatasan Sosial Berskala Besar*; CDC: Center for Disease Control; WFH: Working From Home; SFH: Studying From

Home; IFRC: Industrial Fatigue Research Committee; SST: The Subjective Symptoms Test; CI: Confidence Interval; PR: Prevalence Ratio.

#### Ethics Approval and Consent to Participate

This study was approved by the Malang Health Institute Ethics Committee (number 956/KEPK-POLKESMA/2020) and all participants provided informed consent. The respondents were informed of the aim of the study at the beginning of the questionnaire. They were required to complete the informed consent by selecting "yes" in the online questionnaire for the question: "Are you willing to be a respondent for this research?". Respondents were informed that their identity would be kept confidential and that the data would only be used for research purposes.

#### Competing Interest

The author declares that there are no significant competing financial, professional, or personal interests might have affected the performance or presentation of the work described in this manuscript.

#### Availability of Data and Materials

Data and information used as study materials were from the original study conducted by the corresponding author.

#### Authors' Contribution

PW conceptualized, design, and prepared the manuscript. AF provided additional analysis for the manuscript.

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#### References

1. World Health Organization. WHO Coronavirus (COVID-19) Dashboard. 2021.
2. Belot M, Choi S, Tripodi E, Broek-Altenburg E van den, Jamison JC, Papageorge NW. Unequal consequences of Covid 19: representative evidence from six countries. *Rev Econ Househ.* 2021; 19: 769-83.
3. Center for Disease Control. How to Protect Yourself and Others. 2022.
4. Nicola M, Alsafi Z, Sohrabi C, Kerwan A, Al-Jabir A, Iosifidis C, et al. The socio-economic implications of the coronavirus pandemic (COVID-19): A review. *Int J Surg.* 2020; 78: 185-93.
5. Bonacini L, Gallo G, Scicchitano S. Working from home and income inequality: risks of a 'new normal' with COVID-19. *J Popul Econ.* 2021; 34 (1): 303-60.
6. Bouziri H, Smith DRM, Smith DRM, Descatha A, Dab W, Jean K. Working from home in the time of COVID-19: How to best preserve occupational health? *Occup Environ Med.* 2020; 77 (7): 509-10.
7. Fontichiaro, K., & Stephens WS. Blurring the boundaries between home and school: how videoconference-based schooling places American education's cultural values at risk during COVID-19. *J Child Media.* 2021; 15 (1): 96-100.
8. Damşa C, Langford M, Uehara D, Scherer R. Teachers' agency and online education in times of crisis. *Comput Human Behav.* 2021; 121.
9. Colley RC, Bushnik T, Langlois K. Exercise and screen time during the COVID-19 pandemic. *Heal Reports.* 2020; 31 (6): 3-11.
10. Qin F, Song Y, Nassis GP, Zhao L, Dong Y, Zhao C, et al. Physical activity, screen time, and emotional well-being during the 2019 novel coronavirus outbreak in China. *Int J Environ Res Public Health.* 2020; 17 (14): 1-16.
11. Sultana A, Tasnim S, Hossain MM, Bhattacharya S, Purohit N. Digital screen time during the COVID-19 pandemic: a public health concern. *F1000Research.* 2021; 10: 81.
12. Williams N. Working through COVID-19: 'Zoom' gloom and 'Zoom' fatigue. *Occup Med (Lond).* 2021.
13. Fauville G, Luo M, Queiroz ACM, Bailenson JN, Hancock J. Zoom exhaustion & fatigue scale. *Comput Hum Behav Reports.* 2021; 4: 100119.
14. Nadler R. Understanding "Zoom fatigue": theorizing spatial dynamics as third skins in computer-mediated communication. *Comput Compos.* 2020; 58: 102613.
15. Bailenson JN. Nonverbal overload: A theoretical argument for the causes of Zoom fatigue. *Technol Mind, Behav.* 2021; 2 (1).
16. Riedl R. On the stress potential of videoconferencing: definition and root causes of Zoom fatigue. *Electron Mark.* 2022; 32: 153-77.
17. Mamtani H, Karaliuniene R, de Filippis R, Nagendrappa S. Impact of videoconferencing applications on mental health. *BJPsych Int.* 2021; 19 (1).
18. Dhir A, Kaur P, Chen S, Pallesen S. Antecedents and consequences of social media fatigue. *Int J Inf Manage.* 2019; 48: 193-202.
19. Saito K. Measurement of Fatigue. *Ind Health.* 1999; 37 (2): 134-42.
20. Peper E, Yang A. Beyond Zoom Fatigue : Re-energize Yourself and Improve Learning Learning. *Acad Lett.* 2021; 1-7.
21. Sklar J. 'Zoom fatigue' is taxing the brain. Here's why that happens. *Natl Geogr Mag;* 2020.
22. Peper E, Wilson V, Martin M, Rosegard E, Harvey R. Avoid Zoom Fatigue, Be Present and Learn. *NeuroRegulation.* 2021; 8 (1): 47-56.
23. Roberts F, Margutti P, Takano S. Judgments concerning the valence of inter-turn silence across speakers of American English, Italian, and Japanese. *Discourse Process.* 2011; 48 (5): 331-54.
24. Pantic I. Online social networking and mental health. *Cyberpsychol Behav Soc Netw.* 2014; 17 (10): 652-7.
25. Tang CSK, Wu AMS, Yan ECW, Ko JHC, Kwon JH, Yogo M, et al. Relative risks of Internet-related addictions and mood disturbances among college students: a 7-country/region comparison. *Public Health.* 2018; 165: 16-25.
26. Mishra L, Gupta T, Shree A. Online teaching-learning in higher education during lockdown period of COVID-19 pandemic. *Int J Educ Res Open.* 2020; 1: 100012.

# Diabetes Mellitus and Mortality among COVID-19 Patients in Jakarta, March-August 2020

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## Abstract

Diabetes mellitus (DM) comorbidity is one of the risk factors for coronavirus disease 2019 (COVID-19) mortality. This study aimed to determine the association of comorbid DM and mortality among COVID-19 confirmed cases in DKI Jakarta Province, controlled with confounding variables from March to August 2020. The study design was a retrospective cohort using cox proportional hazard regression, with a total sample of 1,480. The data consisted of 740 COVID-19 cases with and 740 without comorbid DM. The inclusion criteria were COVID-19 confirmed cases with polymerase chain reaction (PCR) laboratory testing reported to the DKI Jakarta Provincial Department of Health, and the exclusion criteria were pregnant women. The study result indicated that the Crude Hazard Ratio (CHR) of DM and mortality among COVID-19 confirmed cases was 7.4 (95% CI = 4.5-12.3, p-value<0.001), while the adjusted Hazard Ratio, controlled by covariates (comorbid hypertension and age groups) was 3.9 (95% CI = 2.2- 6.8, p-value<0.001). This concludes that the risk of death from COVID-19 cases with comorbid DM was 3.9 times compared to those without comorbid DM after controlling for confounding variables comorbid hypertension and age group (<50 years and ≥ 50 years).

**Keywords:** diabetes mellitus, COVID-19, DKI Jakarta, mortality

## Introduction

The coronavirus disease (COVID-19) pandemic has had a devastating impact on global health and socioeconomic stability, including in Indonesia.<sup>1-5</sup> From January 2020 to February 21, 2021, a total of 110,763,898 COVID-19 cases with 2,455,331 deaths were reported globally, including 1,271,353 confirmed cases with 34,316 deaths reported in Indonesia and the DKI Jakarta Province reported the highest number of COVID-19 cases.<sup>6</sup> Several studies indicated that Diabetes Mellitus (DM) was included in the top three comorbidities in COVID-19 patients. There was an increase in the incidence and severity of COVID-19 in patients with comorbid DM.<sup>7-10</sup> The WHO-China joint mission report showed that the Case Fatality Rate (CFR) of COVID-19 patients with comorbid DM was 9.2%, second only to cardiovascular comorbidities (13.2%) and higher than that of patients with hypertension (8.4%). Mortality increases with age, with the most increased mortality among patients over 80 years old (estimated CFR is 14.8%).<sup>11</sup>

Based on the 2018 National Basic Health Research in

Indonesia/*Riset Kesehatan Dasar* (Riskesdas), the prevalence of DM in Indonesia, according to a doctor's diagnosis in the age 15 population, increased from 2.5% in 2013 to 3.4% in 2018. The DKI Jakarta is the province with the highest DM prevalence in Indonesia, higher than the national DM prevalence rate in 2018 (2%).<sup>12</sup> According to the study by Harbuwono, *et al.*,<sup>14</sup> DM was observed in 705 out of 20,481 (3.44%) COVID-19 patients in Jakarta, which was included in the study. The proportion of deaths from COVID-19 patients who have comorbid DM is 21.28%, which is higher than the proportion of deaths in COVID-19 patients without comorbid DM (2.77%).<sup>14</sup> It is also higher than COVID-19 mortality in the overall population included in the study (3.41%).<sup>13,14</sup> The study by Karyono, *et al.*, indicated that the proportion of DM deaths in COVID-19 patients in Indonesia was 15.3%, the second-highest after hypertension (19.2%).<sup>15</sup>

In DM patients, there is an increased expression of the receptor Angiotensin-Converting Enzyme 2 (ACE-2), which increases the binding of SARS-CoV-2 and furin. This facilitates viral replication, resulting in a high viral

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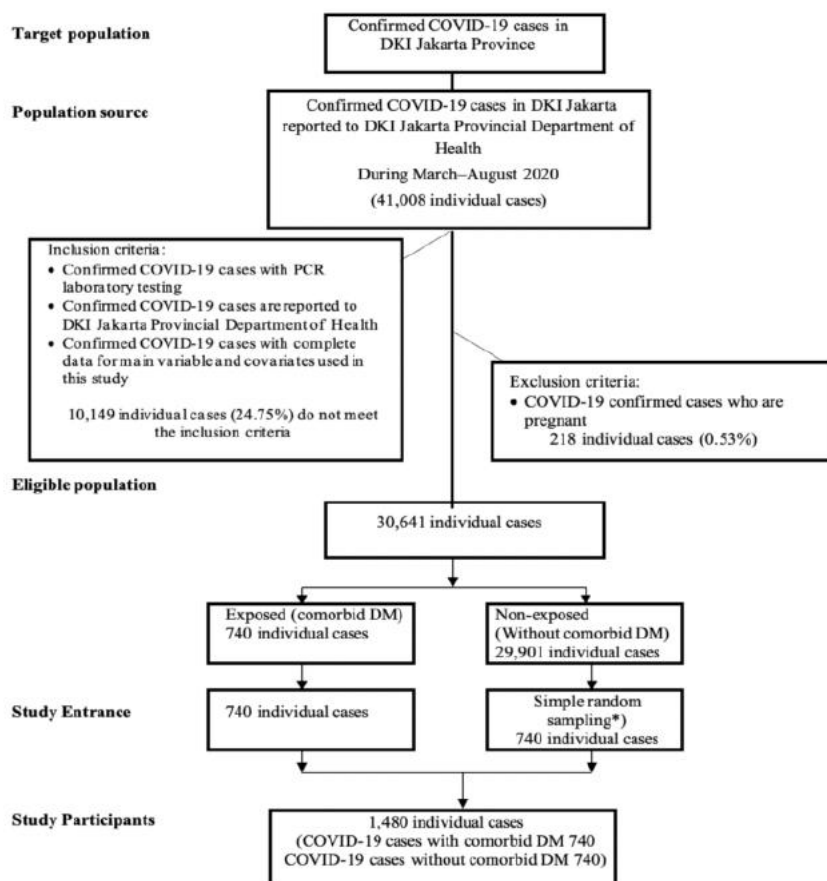
load and affects severity. The DM patients infected with COVID-19 are susceptible to cytokine storms due to immune disorders that can lead to Acute Respiratory Distress Syndrome (ARDS), multi-organ failure, and death.<sup>16</sup> This study aimed to determine the magnitude of association between comorbid DM and death in confirmed COVID-19 cases in DKI Jakarta Province after controlling the confounding variables (Hazard Ratio Adjusted). The authors hope this study will contribute to scientific evidence based on priority interventions. These include prevention, triage, and case management to reduce the incidence and mortality of COVID-19 in patients with comorbid DM in DKI Jakarta Province.

### Method

This study used a retrospective cohort design with secondary data from the COVID-19 DKI Jakarta report from March to August 2020.<sup>17</sup> The inclusion criteria were COVID-19 cases confirmed by a Polymerase Chain Reaction (PCR) laboratory testing, reported to the DKI Jakarta Provincial Department of Health (PDoH) with complete data of variables used in this study. The exclu-

sion criteria were pregnant women. The conceptual framework in this study was to understand the association between comorbid DM among confirmed COVID-19 patients with COVID-19 mortality by considering potential confounders like age group, gender, comorbid hypertension, cardiovascular diseases, chronic obstructive pulmonary disease (COPD), chronic liver failure, immunology disorder, and cancer. The operational definition of "comorbid DM" is an individual with comorbid DM in the COVID-19 report data. At the same time, "COVID-19 death" is a confirmed COVID-19 patient who is reported to have died in the COVID-19 report from the DKI Jakarta PDoH. Confirmed COVID-19 patient is based on laboratory testing results using PCR showing positive results.

Figure 1 describes the study population and sampling. Out of the total source population of 41,008 cases in the COVID-19 report from the DKI Jakarta PDoH, 30,641 cases met the inclusion and exclusion criteria. Out of 30,641 cases, 740 cases were with comorbid DM, and 29,901 cases were without. All 740 cases with comorbid DM were included in this study. Out of 29,901 cases



Notes: \*) Random sampling using the random sampling function in Microsoft Excel was conducted for 740 samples out of 29,901 individual COVID-19 cases without comorbid DM.

Figure 1. Study Population and Sampling

without comorbid DM, 740 samples were selected using the random sampling function in Microsoft Excel. A total of 1,480 samples in this study consisted of all (740) cases of COVID-19 with comorbid DM and the 740 cases of COVID-19 without comorbid DM from the simple random sampling of COVID-19 cases without comorbid DM.

Data analysis was conducted using cox proportional hazard regression. Statistical analysis was performed using statistical data analysis software. The multivariate logistic regression was used to measure the association between comorbid DM with COVID-19 death.

**Results**

The study indicated that 164 out of 1,480 confirmed COVID-19 cases were dead (CFR 11%). Out of 1,480 total confirmed COVID-19 cases, 146 cases with comor-

bid DM died (CFR 9.9%), while the CFR of COVID-19 cases with comorbid DM was 20%, higher than the CFR of COVID-19 cases without comorbid DM (CFR 2%). The univariate analysis (Table 1) indicated that the proportion of death among COVID-19 cases with comorbid DM (20%), hypertension (24%), and cardiovascular diseases (29%) was higher than COVID-19 patients without comorbid DM. The proportion of death in COVID-19 cases among > 50 years old is higher (19%) than that of COVID-19 cases under 50 years old. The proportion of death among COVID-19 cases with immunity disorders, comorbid cancer, and chronic liver failure was not included in the further analysis as there were only a small number of cases.

Bivariate analysis (Table 2) indicated a significant association between comorbid DM, comorbid hypertension, comorbid cardiovascular diseases, and age group

**Table 1. Frequency Distribution of Diabetes Mellitus and Covariates with COVID-19 Mortality**

| Variable                | Category      | Total | Death |    |
|-------------------------|---------------|-------|-------|----|
|                         |               | n     | n     | %  |
| Diabetes mellitus       | Yes           | 740   | 146   | 20 |
|                         | No            | 740   | 18    | 2  |
| Hypertension            | Yes           | 390   | 92    | 24 |
|                         | No            | 1,090 | 72    | 7  |
| Cardiovascular diseases | Yes           | 174   | 51    | 29 |
|                         | No            | 1,306 | 113   | 9  |
| Chronic liver failure   | Yes           | 28    | 2     | 7  |
|                         | No            | 1,452 | 162   | 11 |
| COPD                    | Yes           | 45    | 7     | 16 |
|                         | No            | 1,435 | 157   | 11 |
| Immunology disorder     | Yes           | 23    | 0     | 0  |
|                         | No            | 1,457 | 164   | 11 |
| Cancer                  | Yes           | 22    | 0     | 0  |
|                         | No            | 1,458 | 164   | 11 |
| Sex                     | Male          | 775   | 94    | 12 |
|                         | Female        | 705   | 70    | 10 |
| Age group               | ≥50 years old | 750   | 139   | 19 |
|                         | <50 years old | 730   | 25    | 3  |

Note: COPD = Chronic Obstructive Pulmonary Disease

**Table 2. The Association of Diabetes Mellitus and Covariates with COVID-19 Mortality**

| Variable                | Category      | Death | CHR | 95 CI (%) | p-value |
|-------------------------|---------------|-------|-----|-----------|---------|
| Diabetes mellitus       | Yes           | 146   |     |           |         |
|                         | No            | 18    | 7.4 | 4.5-12.3  | <0.001* |
| Hypertension            | Yes           | 92    | 3.3 | 2.4-4.6   | <0.001* |
|                         | No            | 72    |     |           |         |
| Cardiovascular diseases | Yes           | 51    | 3.4 | 2.4-4.7   | <0.001* |
|                         | No            | 113   |     |           |         |
| COPD                    | Yes           | 7     |     |           |         |
|                         | No            | 157   | 1.6 | 0.7-3.4   | 0.228   |
| Sex                     | Male          | 94    |     |           |         |
|                         | Female        | 70    | 1.2 | 0.9-1.7   | 0.171   |
| Age group               | ≥50 years old | 139   |     |           |         |
|                         | <50 years old | 25    | 5   | 13.3-7.7  | <0.001* |

Notes: COPD = Chronic Obstructive Pulmonary Disease, CHR = Crude Hazard Ratio, CI = Confidence Interval, \*Significant at p-value<0.01

with COVID-19 mortality (p-value<0.05). Meanwhile, there was no significant association between comorbid COPD and sex with COVID-19 death (p-value>0.005). Stratification analysis indicated that hypertension, cardiovascular diseases, and age group were potential confounders and that there was no potential interaction.

The full model of multivariate analysis is shown in Table 3. The full model included the main comorbid DM and five potential confounders; comorbid hypertension, cardiovascular diseases, COPD, age group, and sex.

The goodness of fit test indicated that the variables included in the multivariate analysis met the proportional hazard assumption. The HR value was constant over time (p-value>0.05). Log-log survival curves to evaluate PH assumption graphically. Figure 2 indicates Log-Log Survival Curve of DM Comorbid with COVID-19 Mortality after Controlling for Comorbid hypertension and Age Group meet PH assumption.

A Schoenfeld scale graph indicated that comorbid DM, hypertension, cardiovascular diseases, COPD, sex, and age group were in a relatively horizontal line, thus

indicating that the proportional hazard assumption was fulfilled, where the risk of death in confirmed COVID-19 cases with comorbid DM compared to confirmed COVID-19 cases without comorbid DM tended to be constant during the observation time. Log-log survival curves indicated that the proportional hazard assumption was fulfilled. Therefore, the multivariate analysis used Cox proportional hazard regression.

Interaction analysis was performed for all independent variables included in the full model (initial model) by comparing -2 LL (log-likelihood) in the complete model with interaction and full model without interaction. No interaction was found based on the analysis conducted (p-value>0.05). Confounding assessment found covariates hypertension and age group variable as confounding variables (changes of HR>10%). Therefore, these were included in the final multivariate model. Changes in HR>10% were indicated as confounding variables.<sup>18</sup> The final model of multivariate analysis is shown in Table 4. The final model indicated that the adjusted HR was 3.9 (95% CI = 2.2–6.8; p-value<0.001). This meant the

Table 3. Full Model of Multivariate Analysis

| Variable                | SE   | p-value | HR  | 95% CI   |
|-------------------------|------|---------|-----|----------|
| Diabetes mellitus       | 0.28 | <0.001* | 3.6 | 2.1-6.3  |
| Hypertension            | 0.17 | 0.045** | 1.4 | 1-1.99   |
| Cardiovascular diseases | 0.18 | 0.001*  | 1.8 | 1.2-2.6  |
| COPD                    | 0.4  | 0.705   | 0.9 | 0.4-1.9  |
| Age group               | 0.23 | <0.001* | 2.7 | 1.74-4.3 |
| Sex                     | 0.16 | 0.224   | 1.2 | 0.9-1.7  |

Notes: COPD = Chronic Obstructive Pulmonary Disease, SE = Standard Error, HR = Hazard Ratio, CI = Confidence Interval, \*Significant at p-value<0.01, \*\*Significant at p-value<0.05.

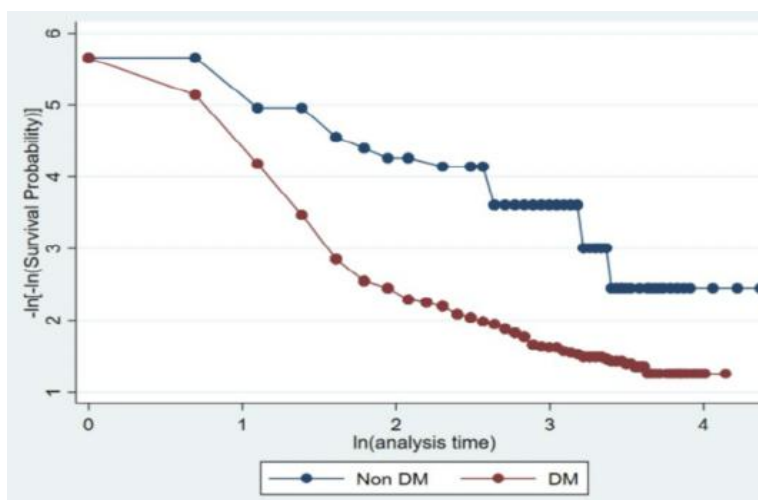


Figure 2. Graph of Log-Log Survival Curve of DM Comorbid with COVID-19 Mortality after Controlling for Comorbid Hypertension and Age Group

Table 4. The Final Model of Multivariate Analysis

| Variable          | SE   | p-value | HR  | 95% CI  |
|-------------------|------|---------|-----|---------|
| Diabetes mellitus | 0.28 | <0.001* | 3.9 | 2.2–6.8 |
| Hypertension      | 0.17 | 0.005*  | 1.6 | 1.2–2.2 |
| Age group         | 0.23 | <0.001* | 2.7 | 1.7–4.3 |

Notes: SE = Standard Error; HR = Hazard Ratio; CI = Confidence Interval, \*Significant at p-value<0.01.

incidence of death among confirmed COVID-19 cases with comorbid DM was 3.9 times higher than confirmed COVID-19 cases without comorbid DM after controlling for confounding variables comorbid hypertension and age group.

### Discussion

This study indicated that deaths from COVID-19 cases with comorbid DM were 20% higher than deaths from COVID-19 cases without comorbid DM (2%). After controlling for comorbid hypertension and age group, the incidence of death among confirmed COVID-19 cases with comorbid DM was 3.9 times higher risk than confirmed COVID-19 cases without comorbid DM. This study was in line with Zhang's on 258 COVID-19 patients in China, showing that comorbid DM increased mortality (HR = 3.6; 95% CI = 1–12),<sup>19</sup> and Harbuwono, *et al.*,<sup>14</sup> study that indicated higher mortality in patients with DM in DKI Jakarta. Study on the factors of COVID-19 death in DKI Jakarta Province on 4,265 COVID-19 patients during March–July 2020 showed that DM is one of the risk factors for COVID-19 death (Crude Odd Ratio = 3.8; 95% CI = 2.5–4.1).<sup>20</sup> Several other studies have shown that comorbid DM increases the risk of death in COVID-19 cases from 1.5 to 4.3 times.<sup>10,11,19,21–25</sup> A study in Korea of 12,646 patients showed that comorbid DM increases the death risk from COVID-19 (HR 1.5 with 95% CI = 1.1–1.9).<sup>26</sup> A meta-analysis study conducted by Kun'ain, *et al.*,<sup>27</sup> showed that comorbid DM increased the risk of death from COVID-19 (OR = 2.17; 95% CI = 1–4.5). Another meta-analysis conducted by Huang, *et al.*,<sup>10</sup> which included 30 studies with 6,542 patients, showed that comorbid DM increased the death risk from COVID-19 (RR = 2.12; 95% CI = 1.44–3.11). Satria, *et al.*,<sup>14</sup> study on 253 COVID-19 patients in Surabaya showed that comorbid DM increased the risk of COVID-19 death 4.3 times (OR = 4.3, p-value 0.016).<sup>24</sup> The study by Graselli, *et al.*,<sup>28</sup> showed an association of comorbid DM with an increased risk of dying from COVID-19 in the ICU (HR = 1.7; 95% CI = 1.47–1.88). Kshanti, *et al.*,<sup>14</sup> study showed high mortality in COVID-19 patients with comorbid type 2 DM, who were hospitalized with hyperglycemia.<sup>29</sup> Complications of DM increase the risk of death, and respiratory failure and sep-

tic shock are more commonly found in hospitalized patients with hyperglycemia.<sup>29</sup>

There is an increase in ACE-2 receptors in response to hyperglycemia and an increase in furin in people with comorbid DM, which facilitates viral replication, thus influencing the susceptibility to SARS-CoV-2 infection and an increase in viral load in the body, which can increase the severity of illness and death.<sup>30</sup> In DM patients infected with COVID-19, dysregulation of the immune response can occur, which increases the pro-inflammatory cytokine response, leading to a cytokine storm that results in multi-organ failure. This condition increases the risk of death. Inflammatory conditions due to dyslipidemia and insulin resistance in comorbid DM patients exacerbates the inflammatory response to SARS-CoV-2 and result in pulmonary dysfunction, leading to ARDS.<sup>31</sup> In DM patients, the virus can also attack the pancreas, damaging pancreatic cells that produce insulin, thereby exacerbating hyperglycemic conditions.<sup>16,31</sup>

ACE-2 receptor expression is increased in patients with comorbid DM. SARS-CoV-2 binds to target cells via the ACE-2 receptor on epithelial cells of the lung, throat, intestine, kidney, and blood vessels.<sup>23,33</sup> The increased expression of ACE-2 predisposes DM patients to SARS-CoV-2 infection and affects the viral load, increasing the severity of the disease and can lead to death. In COVID-19 patients with DM, there is dysregulation of the immune response. These include dysfunction of neutrophils, decreased T-cell-mediated response, increased pro-inflammatory cytokine response, increased interleukin-1 (IL-1), interleukin-6 (IL-6), and Tumor Necrosis Factor (TNF)-alpha, which causes severity in COVID-19 patients due to a cytokine storm that increases the risk of death.<sup>16,30</sup>

COVID-19 infection that occurs in patients with comorbid DM triggers a stress response, increases the secretion of hyperglycemic hormones such as glucocorticoids and catecholamines, and results in increased blood sugar levels and complications of DM.<sup>30,32</sup> Inflammatory conditions in DM patients due to dyslipidemia and insulin resistance exacerbates the inflammatory response to SARS-CoV-2.<sup>32</sup> In patients with DM, more ACE2 protein is also present in the pulmonary alveolar, which can cause more severe disease manifestations.<sup>32,34,35</sup> In DM patients, there are thicker alveolar, epithelial, and basal pulmonary capillaries. Hyperglycemia in DM patients can cause alveolar capillary microangiopathy, causing reduced lung elasticity and resulting in impaired lung function. High glucose causes oxidative stress and triggers inflammatory reactions.<sup>36</sup> The studies of Graselli, *et al.*, and Roncon, *et al.*, showed that comorbid DM is associated with an increased risk of death for COVID-19 patients in the ICU.<sup>28,37</sup>

In this study, the association between comorbid DM

and death in confirmed COVID-19 cases was controlled by confounding variables comorbid hypertension and age group (less than 50 years and more than 50 years), where covariates of comorbid hypertension and age group influenced the association between comorbid DM and death in confirmed COVID-19 cases. These results were in line with meta-analysis studies showing that comorbid hypertension affected the risk of death from COVID-19.<sup>38,39</sup> Several studies have shown that age more than 50 years increases the risk of dying from COVID-19. The study by Kandi, *et al.*, showed that the proportion of deaths in patients aged 50 years and over (50–80 years 12.9% and > 80% 14.8%) was higher than the proportion of deaths in patients aged less than 50 years (1%).<sup>40</sup> Kang's study confirmed that deaths at age more than 50 years are higher than the proportion of deaths at age less than 50 years (1%).<sup>41</sup> This is in line with Freund's study, which mentions an increase in pro-inflammatory mediators such as IL 6 and TNF alpha which is quite significant (2–4 times) in patients older than 50 years compared to the group younger than 50 years.<sup>42</sup> This study found that the adjusted Hazard Ratio (HR = 3.9) was lower than the Crude Hazard Ratio (CHR = 7.4) because comorbid hypertension and age group covariates (confounders) also increased the risk of death from COVID-19. People with comorbid hypertension and aged more than 50 years have a higher risk for COVID-19 death, thus influencing the association between comorbid DM and COVID-19 mortality. Therefore, after controlling for these covariates, the adjusted Hazard Ratio became HR = 3.9 (95% CI = 2.2–6.8; p-value < 0.001).

This study used data from DKI Jakarta Provincial Department of Health to determine the association between DM and COVID-19 mortality after controlling the confounding variables of hypertension and age group using the retrospective cox proportional hazard cohort method. This cohort study is the best research design to determine exposure and outcome with causality and temporal relationships that are better than other study methods carried out using the logistic regression method. The limitations of this study included the use of secondary data, whereas the researcher cannot control the data quality, incomplete data, and limited data used for variables included in this study. Due to the limitation of data, this study does not have data on other potential confounders such as obesity, COVID-19 treatment, other supporting laboratory tests such as complete blood count, blood levels, blood sugar, vaccination, occupation, education, socioeconomic status, and others, as well as information on the treatment of comorbid diseases.

Secondary data on the COVID-19 report from the DKI Jakarta PDoH was obtained from the results of epidemiological investigations. The comorbid data reported was based on anamnesis, interviews of health workers

with patients, and not from laboratory examinations. The comorbid DM cases included in this study were comorbid cases that a doctor had previously diagnosed. Selection bias could occur because this study uses COVID-19 data from the DKI Jakarta PDoH. The cases in this study were detected by the DKI Jakarta PDoH surveillance system. However, other cases may not be detected, especially asymptomatic cases or have mild symptoms. Information bias could also occur if health workers incorrectly input data on COVID-19 case reports in DKI Jakarta Province. This limitation has been minimized by training health workers in data entry, reporting, and verifying data by surveillance officers in DKI Jakarta municipalities and province offices. DKI Jakarta PDoH conducted training on case detection and reporting for health workers according to COVID-19 guidelines, using standard reporting form, and increasing detection by increasing laboratory testing and contact tracing.

## Conclusion

The risk of death from COVID-19 cases with comorbid DM was found to be 3.9 times compared to COVID-19 cases without comorbid DM after controlling for confounding variables; comorbid hypertension and age group (less than 50 years and more than 50 years). This study emphasizes that special attention and priority should be given to people with comorbid DM to prevent, early detection, and manage COVID-19 to reduce COVID-19 mortality among COVID-19 cases with DM. People with comorbid DM should be a priority for COVID-19 prevention efforts, including COVID-19 vaccination, targeted Education Information Communication (EIC) materials for people with DM for COVID-19 prevention, and ensuring continued essential health services for DM patients, like the access to physician consultation and DM drugs via telemedicine to avoid the severity that can increase risk of death. Further studies can be conducted to understand the association between death in COVID-19 patients with comorbid DM, considering COVID-19 vaccination status, DM drug administration, and blood sugar level.

## Abbreviations

DM: Diabetes Mellitus; COVID-19: coronavirus disease 2019; PCR: Polymerase Chain Reaction; CHR: Crude Hazard Ratio; CI: Confidence Interval; Riset Kesehatan Dasar; ACE-2: Angiotensin-Converting Enzyme 2; ARDS: Acute Respiratory Distress Syndrome; SARS-CoV-2: Severe Acute Respiratory Infection Corona Virus 2; PdoH: DKI Jakarta Provincial Department of Health; COPD: chronic obstructive pulmonary disease; CFR: Case Fatality Rate; SE = Standard Error; HR: Hazard Ratio; IL: Interleukin; OR: Odd Ratio; TNF: Tumor Necrosis Factor; EIC: Education Information Communication.



### Ethics Approval and Consent to Participate

This study has received approval from the Ethics Committee of the Faculty of Public Health, Universitas Indonesia, with a certificate of ethical approval: No. 37/UN2. F10.D11/PPM.00.02/2021.

### Competing Interest

The author declares that there is no significant competing financial, professional, or personal interest that might have affected the performance or presentation of the work described in this manuscript.

### Availability of Data and Materials

The data is obtained from COVID-19 Surveillants DKI Jakarta Provincial Department of Health.

### Authors' Contribution

EW conceptualized, designed, prepared the initial draft, and conducted data analysis. SR delivered technical inputs for the design, data analysis, and interpretation of data. NS provided input for data analysis and interpretation.

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### References

- Gates B. Responding to COVID-19 — A once-in-a-century pandemic? *N Engl J Med.* 2020; 382: 1677-9.
- Mckibbin W, Fernando R. The global macroeconomic impacts of COVID-19: seven scenarios. *Asian Economic Papers.* 2021; 20 (2): 1-30.
- Kandel N, Chungong S, Omaar A, Xing J. Review of health security capacities in light of 2019-nCoV outbreak – opportunities for strengthening IHR (2005) implementation. *SSRN eLibrary;* 2020.
- Global Preparedness Monitoring Board. *A world at risk;* 2019.
- Djalante R, Lassa J, Setiamarga D, Sudjatma A, Indrawan M, Haryanto B, et al. Review and analysis of current responses to COVID-19 in Indonesia: period of January to March 2020. *Prog Disaster Sci.* 2020; 6: 1-9.
- World Health Organization. COVID-19 weekly epidemiological - update 23 February 2021. 2021.
- Hu Y, Sun J, Dai Z, Deng H, Lin X, Huang Q, et al. Prevalence and severity of corona virus disease 2019 (COVID-19): a systematic review and meta-analysis. *J Clin Virol.* 2020; 127: 104371.
- Zhu L, She Z-G, Cheng X, Qin J-J, Zhang X-J, Cai J, et al. Association of blood glucose control and outcomes in patients with covid-19 and pre-existing type 2 diabetes. *Cell Metab.* 2020; 31 (6): 1068-77.
- Singh AK, Gupta R, Misra A. Comorbidities in COVID-19: outcomes in hypertensive cohort and controversies with renin angiotensin system blockers. *Diabetes Metab Syndr Clin Res Rev.* 2020; 14 (4): 283-7.
- Huang I, Lim MA, Pranata R. Diabetes mellitus is associated with increased mortality and severity of disease in COVID-19 pneumonia – a systematic review, meta-analysis, and meta-regression. *Diabetes Metab Syndr Clin Res Rev.* 2020; 14 (4): 395-403.
- World Health Organization. Report of the WHO-China joint mission on coronavirus disease 2019 (COVID-19). 2020.
- Kementerian Kesehatan Republik Indonesia. Hasil utama riset kesehatan dasar tahun 2018. *Kementrian Kesehat Republik Indones;* 2018.
- Gugus Penanganan COVID-19. Peta sebaran COVID-19. *Gugus Tugas Percepatan Penanganan COVID 19;* 2020.
- Harbuwono DS, Handayani DOTL, Wahyuningsih ES, Suprptowati N, Ananda, Kurniawan F, et al. Impact of diabetes mellitus on COVID-19 clinical symptoms and mortality: Jakarta's COVID-19 epidemiological registry. *Prim Care Diabetes.* 2022; 16 (1): 65-8.
- Karyono DR, Wicaksana AL. Current prevalence, characteristics, and comorbidities of patients with COVID-19 in Indonesia. *J Community Empower Heal.* 2020; 3 (2): 77-84.
- Muniyappa R, Gubbi S. COVID-19 Pandemic, coronaviruses, and diabetes mellitus. *Am J Physiol Endocrinol Metab.* 2020; 318: 736-41.
- DKI Jakarta Provincial Health Officer. COVID-19 data reporting, March-August 2021; 2021.
- Rothman KJ. *Epidemiology: an Introduction.* 2nd ed. New York: Oxford University Press; 2012.
- Zhang Y, Cui Y, Shen M, Zhang J, Liu B, Dai M, et al. Association of diabetes mellitus with disease severity and prognosis in COVID-19: a retrospective cohort study. *Diabetes Res Clin Pract.* 2020; 165: 108227.
- Surendra H, Elyazar IRF, Djaafara BA, Ekawati LL, Saraswati K, Adrian V, et al. Clinical characteristics and mortality associated with COVID-19 in Jakarta, Indonesia: a hospital-based retrospective cohort study. *The Lancet Regional Health - Western Pacific.* 2021; 9: 1-9.
- Abu-Farha M, Al-Mulla F, Thanaraj TA, Kavalakatt S, Ali H, Ghani MA, et al. Impact of diabetes in patients diagnosed with COVID-19. *Front Immunol.* 2020; 11.
- Kornum JB, Thomsen RW, Riis A, Lervang HH, Schönheyder HC, Sørensen HT. Type 2 diabetes and pneumonia outcomes: a population-based cohort study. *Diabetes Care.* 2007; 30 (9): 2251-7.
- Wan Y, Shang J, Graham R, Baric RS, Li F. Receptor recognition by the novel coronavirus from Wuhan: an analysis based on decade-long structural studies of SARS Coronavirus. *J Virol.* 2020; 94 (7).
- Satria RMA, Tutupoho RV, Chalidyanto D. Analisis faktor risiko kematian dengan penyakit komorbid Covid-19. *J Keperawatan Silampari.* 2020; 4 (1): 48-55.
- Shang J, Wang Q, Zhang H, Wang X, Wan J, Yan Y, et al. The relationship between diabetes mellitus and covid-19 prognosis: a retrospective cohort study in Wuhan, China. *Am J Med.* 2021; 134 (1): e6-e14.
- Byeon KH, Kim DW, Kim J, Choi BY, Choi B, Cho KD. Factors affecting the survival of early COVID-19 patients in South Korea: an observational study based on the Korean National Health Insurance big data. *Int J Infect Dis.* 2021; 105: 588-94.
- Kun'ain UIA, Rahardjo SS, Tamtomo DG. Meta-analysis: the effect of diabetes mellitus comorbidity on the risk of death in Covid-19 patients. *Indones J Med.* 2020; 5 (4): 368-77.
- Grasselli G, Greco M, Zanella A, Albano G, Antonelli M, Bellani G, et al. Risk factors associated with mortality among patients with COVID-19 in intensive care units in Lombardy, Italy. *JAMA Intern Med.* 2020; 180(10): 1345-55.

29. Kshanti IA, Aji G, Eprilliawati M, Mokoagow Md-I, Nasarudin J, Magfira N, et al. Clinical presentation and outcome of covid-19 infection in type 2 diabetes mellitus: a preliminary data from a tertiary hospital in Jakarta during the early days of the pandemic. *Bali Med J.* 2020; 9 (3): 663-9.
30. Ganesan SK, Venkatratnam P, Mahendra J, Devarajan N. Increased mortality of COVID-19 infected diabetes patients: role of furin proteases. *Int J Obes.* 2020; 44: 2486-8.
31. Huang J, Zhu L, Bai X, Jia X, Lu Y, Deng A, et al. Multidimensional analysis of risk factors for the severity and mortality of patients with COVID-19 and diabetes. *Infect Dis Ther.* 2020; 9 (4): 981-1002.
32. Rajpal A, Rahimi L, Ismail-Beigi F. Factors leading to high morbidity and mortality of COVID-19 in patients with type 2 diabetes. *J Diabetes.* 2020; 12 (12): 895-908.
33. Giovannelli J, Trouiller P, Hulo S, Cherot-Kornobis N, Ciuchete A, Edme J-L, et al. Low-grade systemic inflammation: a partial mediator of the relationship between diabetes and lung function. *Ann Epidemiol.* 2018; 28 (1): 26-32.
34. Bornstein SR, Dalan R, Hopkins D, Mingrone G, Boehm BO. Endocrine and metabolic link to coronavirus infection. *Nat Rev Endocrinol.* 2020; 16: 297-8.
35. Bindom SM, Lazartigues E. The sweeter side of ACE2: physiological evidence for a role in diabetes. *Mol Cell Endocrinol.* 2009; 302 (2): 193-202.
36. Morigi M, Angioletti S, Imberti B, et al. Leukocyte-endothelial interaction is augmented by high glucose concentrations and hyperglycemia in an NF- $\kappa$ B-dependent fashion. *J Clin Invest;* 1998.
37. Roncon L, Zuin M, Rigatelli G, Zuliani G. Diabetic patients with COVID-19 infection are at higher risk of ICU admission and poor short-term outcome. *J Clin Virol.* 2020; 127: 104354.
38. Guan WJ, Liang WH, Zhao Y, Liang H, Chen Z, Li Y, et al. Comorbidity and its impact on 1,590 patients with COVID-19 in China: a nationwide analysis. *MedRxiv;* 2020.
39. Parohan M, Yaghoubi S, Seraji A, Javanbakht MH, Sarraf P, Djalali M. Risk factors for mortality in patients with Coronavirus disease 2019 (COVID-19) infection: a systematic review and meta-analysis of observational studies. *Aging Male.* 2020; 23(5): 1416-24.
40. Kandi V, Thungaturthi S, Vadakedath S, Gundu R, Mohapatra RK. Mortality rates of coronavirus disease 2019 (COVID-19) caused by the novel severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2). *Cureus.* 2021; 13 (5): e14081.
41. Kang SJ, Jung SI. Age-related morbidity and mortality among patients with COVID-19. *Infect Chemother.* 2020; 52 (2): 154-64.
42. Freund A, Orjalo AV, Desprez PY, Campisi J. Inflammatory networks during cellular senescence: causes and consequences. *Trends Mol Med.* 2010; 16 (5): 238-46.

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