Jurnal Ilmiah
MEDIA GIZI Indonesia
Accredited by SINTA Indonesia (SINTA 2)
SK DITJEN RISBANG KEMENRISTEKDIKTI RI NO 3/E/KTP/2019
(National Nutrition Journal)

p-ISSN 1693-7228
e-ISSN 2540-8410

Vol. 17 | No. 2 | Page 106 – 223 | May 2022

HUBUNGAN OBESITAS SENTRAL, DURASI TIDUR, DAN TINGKAT KECUKUPAN ENERGI DENGAN KELELAHAN PADA PEKERJA WANITA DI PT GALAXY SURYA PANELINDO

The Relationship between Central Obesity, Sleep Duration, and Energy Adequacy with Fatigue among Female Worker in PT Galaxy Surya Panelindo

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ABSTRAK

Kelelahan kerja merupakan masalah yang sering terjadi pada pekerja wanita. Tingginya risiko kelelahan pada pekerja wanita disebabkan oleh beberapa faktor diantaranya status gizi, tingkat kecukupan energi, dan durasi tidur. Obesitas sentral berkaitan dengan kapasitas konsumsi maksimal oksigen (VO_2 max) sehingga memicu kelelahan kerja. Tidur berkaitan dengan waktu pemulihan organ vital tubuh, sedangkan energi dibutuhkan untuk berbagai metabolisme tubuh. Penelitian ini bertujuan untuk menganalisis hubungan antara obesitas sentral, tingkat kecukupan energi, dan durasi tidur dengan tingkat kelelahan kerja pada pekerja wanita di PT Galaxy Surya Panelindo. Penelitian ini menggunakan desain penelitian cross sectional dengan sampel penelitian 50 pekerja wanita bagian produksi di PT Galaxy Surya Panelindo. Teknik sampling yang digunakan adalah random sampling. Pengumpulan data dilakukan dengan pengukuran lingkar pinggang dan lingkar panggul, kuesioner Semi Quantitative Food Frequency Questionnaire (SQ-FFQ), Subjective Self Rating Test (SRRT), dan jumlah jam tidur. Tidak ada hubungan antara durasi tidur dengan kelelahan kerja (p>0,05), dan ada hubungan antara status gizi obesitas sentral (p=0,001), tingkat kecukupan energi (p=<0,001) dengan tingkat kelelahan kerja. Hasil analisis multivariat menunjukkan bahwa obesitas sentral dapat meningkatkan kelelahan kerja sebesar 2,78 kali, dan tingkat kecukupan energi yang tidak sesuai dengan kebutuhan baik berlebihan maupun kurang dapat meningkatkan risiko kelelahan kerja sebesar 3,14 kali. Status gizi obesitas sentral dan pemenuhan energi yang tidak sesuai baik kelebihan ataupun kekurangan jika dibandingkan dengan kebutuhan dapat meningkatkan kelelahan kerja. Oleh karena itu, pencegahan kelelahan kerja dapat dilakukan dengan menerapkan pola hidup sehat dan mengonsumsi makanan yang seimbang sesuai dengan kebutuhan.

Kata kunci: pekerja wanita, kelelahan kerja, obesitas sentral, tingkat kecukupan energi, durasi tidur

ABSTRACT

Work fatigue is a problem that often occurs in female workers. The higher risk of fatigue among female workers is caused by several factors including nutritional status, energy adequacy level, and sleep duration. Central obesity status is associated with a decrease in the maximal oxygen capacity (VO_2 max) that triggers work fatigue. Sleep is related to the recovery time of the body's vital organs, while energy is needed for various body metabolisms. This research was aimed to analyze the relationship between central obesity, energy adequacy, and sleep duration with work fatigue in female workers at PT Galaxy Surya Panelindo. This study used a cross-sectional research design with a sample of 50 female production workers at PT Galaxy Surya Panelindo. The sampling technique used random sampling method. Data was collected by measuring waist circumference and hip circumference, Semi Quantitative Food Frequency Questionnaire (SQFFQ), Subjective Self Rating Test (SRRT), and sleep duration. There was no relationship between sleep duration and work fatigue (p=0.951). However there was a relationship between central obesity status (p=0.001), energy adequacy level (p=<0.001) and work-nutrition fatigue. Multivariate analysis found that the nutritional status of central obesity increase the risk to experience work fatigue by 2.78 times, where as the level of energy sufficiency that is not in accordance with the needs, both excessive and insufficient, can increases work fatigue by 3.14 times. The nutritional status of central obesity and inadequate energy fulfillment, both excess or deficiency when compared to needs, can increase work fatigue. Therefore, the prevention of work fatigue can be done by implementing a healthy lifestyle and eating a balanced diet as needed.

Keywords: *female workers, work fatigue, central obesity, energy sufficiency level, sleep duration*

 Received 12-08-2021, Accepted 03-11-2021, Published online 30-05-2022.

PENDAHULUAN

Partisipasi perempuan dalam angkatan kerja terus mengalami peningkatan. Pada tahun 2015 Tingkat Partisipasi Angkatan Kerja (TPAK) untuk perempuan secara nasional mencapai 50,9%; di tingkat provinsi Jawa Timur sebesar 52,43%; dan di kabupaten Lumajang sebesar 48,21% (Badan Pusat Statistik Indonesia, 2013; Rahma, 2017). Peningkatan tingkat partisipasi kerja ini seringkali tidak diimbangi dengan upaya perusahaan dalam penerapan Kesehatan dan Keselamatan Kerja (K3) di lingkungan pekerja. Hal ini dapat dilihat dari tingginya angka kecelakaan kerja dikarenakan faktor kelelahan kerja. Menurut *International Labour Organization* (ILO*),* setiap tahunnya diperkirakan 2,78 juta pekerja meninggal karena faktor kelelahan kerja yang memicu penyakit ataupun kecelakaan kerja (International Labor Organization, 2018). Pada tahun 2014, angka kecelakaan kerja sebesar 2.283 kasus (Kementerian Kesehatan RI, 2015).

Kelelahan kerja merupakan kumpulan perasaan lelah yang menimbulkan berbagai dampak baik secara fisik maupun mental yang diakibatkan proses bekerja (Michael and Marie, 2015). Salah satu dampak yang terjadi akibat kelelahan kerja adalah penurunan konsentrasi kerja, yang disertai dengan penurunan efisiensi kerja dan berakibat pada penurunan produktivitas kerja (Atiqoh *et al*., 2014). Kelelahan kerja dapat disebabkan faktor internal maupun faktor eksternal (Suma'mur, 2009; Tarwaka, 2011). Faktor internal merupakan faktor yang berasal dari dalam diri pekerja yang terdiri atas status kesehatan, kualitas tidur, kondisi psikologis pekerja dan status gizi pekerja (Suma'mur, 2009; Tarwaka, 2011). Faktor eksternal adalah faktor yang berasal dari luar diri pekerja meliputi beban pekerjaan, dan lingkungan kerja (Tarwaka, 2011; Suma'mur, 2009).

Pekerja perempuan memiliki risiko kelelahan kerja lebih tinggi jika dibandingkan laki-laki. Hal ini berkaitan dengan tingginya persentase lemak tubuh perempuan. Kondisi ini didukung dengan tingginya prevalensi obesitas sentral pada perempuan, yaitu sebesar 42,1%, sementara laki-laki hanya 11,3% (Badan Penelitian dan Pengembangan Kesehatan, 2013). Persentase lemak tubuh terutama pada bagian perut menyebabkan penurunan nilai VO_2 maks (Nurlim, 2012). VO_2 maks merupakan gambaran tingkat kebugaran jasmani yang dinilai dengan menghitung jumlah oksigen yang digunakan saat beraktivitas (Nurlim, 2012). Tingkat kebugaran jasmani dapat diartikan sebagai kemampuan tubuh untuk mempertahankan kondisi fisik dari kelelahan (Sepriadi, Hardiansyah & Syampurna, 2017). Pada penelitian sebelumnya didapatkan bahwa pekerja dengan status gizi obesitas sentral berisiko lebih tinggi mengalami kelelahan kerja dibandingkan pekerja dengan status gizi normal atau tidak obesitas sentral (Sari & Muniroh, 2017).

Tidur merupakan suatu proses pemulihan kondisi fisiologi tubuh dari kelelahan. Durasi tidur yang cukup dapat mendukung proses pemulihan tubuh secara optimal, sehingga tingkat kebugaran jasmani yang diperoleh juga semakin baik. Pada penelitian yang dilakukan oleh Narpat, *et.al* (2019) dapat diketahui bahwa kelelahan kerja lebih sering dialami oleh pekerja dengan durasi tidur kurang dari kebutuhan (Narpati dan Ekawati 2019). Sementara itu, menurut Kristen *et.al* (2017), perempuan memiliki kecenderungan lebih tinggi mengalami insomnia terutama pada malam hari.

PT. Galaxy Surya Panelindo merupakan salah satu industri perkayuan yang ada di Kabupaten Lumajang. Perusahaan ini menghasilkan produk *finger joint laminated board* (FJLB). FJLB merupakan lembaran papan kayu yang berasal dari solid dan serbuk-serbuk kayu. Perusahaan ini dibagi ke dalam 9 divisi yaitu divisi konstruksi, divisi *payrol*, divisi mekanik, divisi produksi, divisi pemasaran, divisi keuangan, divisi sumber daya manusia, divisi umum, dan divisi satuan pengawasan internal. Pada divisi produksi tenaga kerja dibagi lagi berdasarkan tugas yang diberikan. Tenaga kerja wanita sebagian besar bekerja pada bagian *assembly* dan *finishing*. *Finishing* merupakan langkah terakhir dalam proses pembuatan playwood. *Finishing* terdiri atas *double saw,* amplas, dempul, dan *putty*. Sementara itu, *Assembly* adalah proses pengeleman beberapa lembaran kayu.

Pada bagian *Assembly,* pekerja wanita memiliki tugas untuk menggabungkan beberapa kayu yang telah dilakukan pemotongan sebelumnya dan telah berubah menjadi lembaran kayu tipis yang berukuran kecil ± 20 × 50 cm. Proses penggabungan lembaran kayu ini menggunakan

lem khusus dengan bentuk lembaran. Pekerja wanita yang berada di bagian *Finishing* bertugas untuk melakukan pengecekan dan perbaikan terhadap seluruh produk yang ada pada perusahaan ini sebelum dilakukan pengemasan produk, pada bagian ini biasanya dilakukan perbaikan terkait kekuatan lem apabila dirasa lembaran kayu masih belum menempel dengan sempurna maka akan dilakukan pengeleman tambahan.

Berdasarkan survey pendahuluan yang dilakukan pada 10 orang pekerja wanita bagian produksi di PT Galaxy Surya Panelindo, didapatkan 8 responden dengan obesitas sentral, seluruh responden dengan tingkat kecukupan energi kurang dari 90%, dan 6 responden tidur selama kurang dari 7 jam pada malam hari, serta 3 responden dengan kelelahan kerja kategori tinggi. Penelitian ini bertujuan untuk menganalisis hubungan antara obesitas sentral, tingkat kecukupan energi, dan durasi tidur dengan tingkat kelelahan kerja pada pekerja wanita di PT Galaxy Surya Panelindo.

METODE

Penelitian ini merupakan penelitian observasional dengan desain studi *cross sectional*. Lokasi penelitian adalah PT Galaxy Surya Panelindo, Kabupaten Lumajang, Jawa Timur. Populasi dalam penelitian ini adalah pekerja wanita di PT Galaxy Surya Panelindo yang sebesar 127 orang. Pengambilan sampel dilakukan dengan teknik *random sampling* dengan jumlah responden 50 pekerja wanita bagian produksi di PT Galaxy Surya Panelindo. Kriteria inklusi penelitian termasuk tenaga kerja wanita bagian produksi, tenaga kerja dengan sistem gaji normal/tetap tiap bulan, berusia produktif 15-64 tahun, bersedia menjadi responden dengan menandatangani surat kesediaan menjadi responden (*informed* consent), dan tidak memiliki pekerjaan lain selain pekerjaan dalam perusahaan. Responden dieksklusi dari penelitian apabila sedang hamil, sedang menyusui, dan menderita atau memiliki riwayat penyakit yang menyebabkan *ascites*.

Pengumpulan data dilakukan dengan wawancara dan observasi. Wawancara dilakukan dengan bantuan kuesioner, adapun kuesioner yang digunakan adalah Semi Quantitatif Food Frequency Questionnaire (SQ-FFQ), Subjective Self Rating Test (SSRT), dan kuesioner durasi tidur. Seluruh kuesioner telah dilakukan validasi pada 10 orang wanita pekerja selain yang digunakan sebagai subjek dan didapatkan nilai kappa diatas 0,80 untuk setiap item pertanyaan sehingga dikategorikan valid. Kelelahan kerja diklasifikasikan menjadi 4 tingkat yakni kelelahan rendah (skor 30-52), kelelahan sedang (skor 53-75), kelelahan tinggi (skor 76-98), dan kelelahan sangat tinggi (99-120) berdasarkan kuesioner SSRT (Tarwaka, 2014). Obesitas sentral diukur dengan rasio lingkar pinggang dan panggul menggunakan medline pita ukur, diklasifikasikan menjadi normal (RLPP<0,8) dan obesitas sentral (RLPP ≥ 0,8) (Thamaria, 2017). Tingkat kecukupan energi dinilai dengan SQ-FFQ dalam 6 bulan terakhir. SQ-FFQ berisi 10 item sumber karbohidrat, 16 item sumber protein hewani, 6 item sumber protein nabati, 17 item sumber sayuran, 13 item sumber buah-buahan, dan 15 produk susu, minyak, gula, dan garam. Item makanan yang dimasukkan dalam SQ-FFQ adalah makanan yang sering dikonsumsi oleh responden pada tahap validasi dan dapat dengan mudah ditemukan di pasar atau toko sekitar tempat tinggal dan perusahaan tempat kerja responden. Hasil SQ-FFQ diklasifikasikan menjadi defisit asupan energi (<90%), normal asupan energi (90-119%), dan diatas kecukupan energi (≥120%) (WNPG, 2012). Durasi tidur dinilai dengan kuesioner PSQI (Pittsburgh Sleep Quality Index), dan diklasifikasikan menjadi >7 jam pada malam hari, 6-7 jam pada malam hari, <6 jam pada malam hari (Kemenkes RI, 2018). Pengumpulan data primer dilakukan pada bulan Februari-Juni 2021. Penelitian ini telah disetujui komisi etik Univesitas Airlangga Faculty of Dental Medicine Health Research Ethical Clearance Commission No. 249/HRECC.FODM/V/2021.

Pengolahan data menggunakan bantuan software *IBM SPSS statistics 21*. Pengolahan data dilakukan secara univariat, bivariat, dan multivariat. Analisa bivariat menggunakan uji *chi-square* dengan uji alternatif *Fisher's Exact Test*, dan analisa multivariat menggunakan uji regresi logistik berganda serta dihitung nilai PR (Prevalensi Rasio).

HASIL DAN PEMBAHASAN

Pada penelitian ini karakteristik responden yang diamati adalah usia, jumlah anak usia kurang dari 5 tahun yang menjadi tanggung jawab responden, pendidikan terakhir, lama kerja, kloter istirahat, beban kerja, dan pendapatan rumah tangga per bulan. Variabel *bebas* dalam penelitian ini adalah status gizi obesitas sentral, durasi tidur, dan kecukupan energi, sedangkan variabel *dependent* penelitian ini adalah tingkat kelelahan kerja.

Tabel 1. Distribusi Frekuensi Karakteristik Responden di PT Galaxy Surya Panelindo

Karakteristik	n	%
Usia		
Remaja akhir (17-25 Tahun)	9	18
Dewasa awal (26-35 Tahun)	12	24
Dewasa akhir (36-45 Tahun)	20	40
Lansia awal (46-55 Tahun)	9	18
Jumlah Anak Usia <5 Tahun		
Tidak memiliki anak	40	80
1 anak	9	18
≥ 2 anak	1	2
Lama Kerja		
< 2 tahun	11	22
2 – <5 tahun	22	44
≥ 5 tahun	17	34
Pendidikan Terakhir		
Tamat SD	11	22
Tamat SMP	23	46
Tamat SMA	16	32
Tamat S1	0	0
Pendapatan RT/Bulan		
≤UMR : Rp 1.982.295,10	44	88
>UMR : Rp 1.982.295,10	6	12
Kloter Istirahat		
Ke-1 (10.00-11.00 WIB)	24	48
Ke-2 (11.00-12.00 WIB)	26	52
Beban Kerja Fisik		
Ringan (75-100 x/menit)	50	100
Sedang(101-125 x/menit)	0	0
Berat (126-150 x/menit)	0	0
Tingkat Kelelahan Kerja		
Rendah	21	42
Sedang	28	56
Tinggi	1	2
Obesitas Sentral		
Obesitas Sentral	29	58
Normal	21	42
Durasi Tidur		
< 6 Jam/Hari	22	44
6-7 Jam/Hari	25	50
> 7 Jam/Hari	3	6
Tingkat Kecukupan Energi		
Kurang (<90% AKG)	23	46
Normal (90-119% AKG)	25	50
Kelebihan (≥120% AKG)	2	4

Tabel 1 menunjukkan distribusi responden berdasarkan karakteristiknya. Pada kelompok usia, sebagian besar responden termasuk dalam kelompok usia dewasa akhir (36–45 Tahun) dengan persentase sebesar 40%. Hal tersebut dikarenakan usia dewasa merupakan usia ideal untuk seseorang bekerja, dimana pada usia dewasa seseorang memiliki pola pikir yang lebih matang dibandingkan kelompok usia remaja, dan tenaga fisik usia dewasa lebih baik dibandingkan usia lansia (Ajhuri, 2019). Pada karakteristik jumlah anak usia ≤5 tahun, sebagian besar responden merupakan tenaga kerja wanita yang tidak memiliki anak usia ≤5. Berdasarkan wawancara, pekerja wanita yang memiliki anak usia ≤5 tahun merasa waktu untuk istirahat sangat sedikit, sehingga jika dibandingkan dengan pekerja wanita yang tidak memiliki anak mereka merasa cepat lelah. Pada karakteristik lama kerja, sebagian besar responden sudah bekerja selama 2 sampai kurang dari 5 tahun dengan persentase 44%. Berdasarkan hasil wawancara didapatkan bahwa jarak rumah sebagian besar pekerja dekat dengan perusahaan, sehingga meskipun banyak perusahaan sejenis, mereka memilih untuk setia pada tempat kerja saat ini karena alasan lokasi yang dekat dari rumah. Berdasarkan hasil wawancara tidak ditemukan ada kaitan antara jarak rumah dengan perusahaan dengan durasi kerja. Namun jarak rumah dengan tempat kerja yang dekat dapat menghemat waktu yang dibutuhkan untuk perjalanan sehingga dapat mengurangi tingkat kelelahan. Pada bagian produksi tidak dibutuhkan keahlian khusus sehingga riwayat pendidikan bukan merupakan syarat utama untuk bisa bekerja pada bagian ini. Hal tersebut dapat dilihat dari distribusi responden berdasarkan riwayat pendidikan yang cukup variatif, dimana sebagian besar responden merupakan tamat SMP (46%) dan tidak ada responden dengan riwayat pendidikan tamat S1. Pada perusahaan tempat penelitian waktu

istirahat dibagi ke dalam dua kloter, yaitu kloter pertama istirahat setelah 4 jam kerja dan kloter kedua istirahat setelah 5 jam kerja. Setiap pekerja mendapatkan waktu istirahat kurang lebih 1 jam. Pada karakteristik beban kerja fisik yang diukur dengan menghitung denyut nadi dalam satu menit, seluruh responden memiliki frekuensi denyut nadi di bawah 100 kali/menit sehingga beban kerja fisik yang dirasakan termasuk kategori ringan (100%).

Berdasarkan Tabel 1 dapat diketahui bahwa sebagian besar responden memiliki tingkat kelelahan kerja kategori sedang dengan persentase 56%, status gizi kategori obesitas sentral dengan persentase 58%, tidur selama 6-7 jam/hari dengan persentase 50%, dan tingkat kecukupan energi kategori normal dengan persentase 50%. Pemilihan pengukuran status gizi berdasarkan status obesitas sentral dirasa lebih menggambarkan pengaruh yang lebih signifikan jika dibandingkan dengan pengukuran status gizi terkait nilai Indeks Massa Tubuh (IMT) terhadap tingkat kelelahan kerja responden. Status gizi obesitas sentral menggambarkan penumpukan lemak pada bagian perut yang secara langsung dapat menurunkan asupan oksigen karena adanya penekanan diafragma.

Berdasarkan status gizi, sebagian besar responden dengan status gizi obesitas sentral memiliki tingkat kelelahan kerja sedang (46%). Obesitas sentral merupakan suatu kondisi tubuh yang mengalami penumpukan lemak di bagian abdomen atau perut. Penumpukan ini dikarenakan ketidakseimbangan antara asupan energi dengan pengeluaran energi untuk beraktivitas (WHO Expert Consultation, 2008). Obesitas sentral menyebabkan seseorang lebih mudah mengalami kelelahan daripada orang dengan status gizi tidak obesitas sentral (Yustriani, 2014).

Pada orang dengan kondisi obesitas sentral dimana rasio lingkar pinggang panggul untuk perempuan ≥0,8, terjadi penumpukan lemak dibagian perut atau abdomen (Thamaria, 2017; Sukamti dkk., 2016). Pada kondisi, diafragma mengalami penekanan sehingga proses kontraksi diafragma ketika bernapas atau proses masuknya udara ke dalam paru-paru tidak bisa terjadi secara maksimal. Hal ini kemudian menyebabkan pasokkan oksigen didalam paru-paru mengalami penurunan (Yustriani, Russeng dan Muis, 2014). Rendahnya oksigen dalam paru-paru juga dapat menurunkan ataupun mengganggu proses mekanisme dan metabolisme pada beberapa bagian tubuh, salah satunya pada otot. Rendahnya kadar oksigen ini menyebakan metabolisme energi pada otot terjadi secara anaerob. Proses metabolisme anaerob menghasilkan asam laktat sebagai sisa metabolisme. Asam laktat akan mengalami penumpukan di dalam otot dan peredaran darah (Wiarto, 2012). Penumpukan asam laktat di dalam otot dapat menurunkan fungsi kerja otot, sehingga seseorang lebih mudah mengalami kelelahan (Sepriadi, Hardiansyah dan Syampurna, 2017). Pada hasil penelitian ini, terdapat hubungan yang signifikan antara status gizi obesitas sentral dengan tingkat kelelahan kerja (p=0,001), dan pekerja wanita dengan status gizi obesitas sentral berisiko 2,78 kali lebih besar mengalami tingkat kelelahan kerja yang lebih tinggi jika dibandingkan pekerja

Tabel 2. Hubungan Status Gizi berdasarkan RLPP, Durasi Tidur dan Tingkat Kecukupan Energi dengan Tingkat Kelelahan Kerja Responden di PT Galaxy Surya Panelindo

		Tingkat Kelelahan Kerja (n=50)			*p-value*	PR (CI 95%)
		Rendah (%)	Sedang (%)	Tinggi (%)		
Status Gizi	Obesitas Sentral (RLPP ≥0,8)	12	46	0	0,001*	2,78
	Normal (RLPP <0.,)	30	10	2		
Durasi Tidur	< 6 Jam/Hari	2	4	0	0,951	-
	6-7 Jam/Hari	22	26	2		
	> 7 Jam/Hari	18	26	0		
Tingkat Kecukupan Energi	Kurang (<90% AKG)	6	40	0	<0,001*	3.,4
	Normal (90-119% AKG)	36	12	2		
	Lebih (>120% AKG)	0	4	0		

*signifikan: p-value<0.05

wanita dengan status gizi normal. Hal ini didukung dengan hasil penelitian Pratama & Sutiari (2020) yang menunjukkan bahwa driver ojek online yang mengalami obesitas sentral berisiko 4,37 kali lebih besar mengalami ketidakbugaran tubuh (Pratama & Sutiari, 2020).

Tabel 2 menunjukkan bahwa sebagian besar responden dengan durasi tidur 6-7 jam/hari memiliki tingkat kelelahan kerja kategori sedang (26%). Hasil penelitian ini menunjukkan bahwa tidak ada hubungan yang signifikan antara durasi tidur dengan tingkat kelelahan kerja (p=0,951). Hasil penelitian ini didukung oleh Triana *et al*. (2017) yang menemukan tidak ada hubungan signifikan antara lama tidur dengan tingkat kelelahan kerja. Hasil penelitian ini menunjukkan hubungan yang tidak signifikan antara durasi tidur dan kelelahan kerja.

Faktor lain yang juga memberikan pengaruh terhadap hasil penelitian ini antara lain kualitas tidur responden itu sendiri, dimana pada sebagian orang yang memiliki durasi tidur yang cukup atau sekitar 6-7 jam/hari belum tentu memiliki kualitas tidur yang cukup baik, begitupun sebaliknya untuk seseorang dengan durasi tidur yang kurang belum tentu memiliki kualitas tidur yang buruk. Penilaian kualitas tidur dapat dilakukan melalui kuisioner *Pittsburgh Sleep Quality Index* (PSQI) yang memuat beberapa aspek penilaian yaitu skala kualitas tidur menurut individu, waktu yang digunakan hingga tidur, durasi tidur, efisiensi tidur, gangguan tidur yang dialami baik malam atau/dan siang hari, penggunaan obat tidur (Dietch *et al.* 2016). Berdasarkan banyaknya aspek penilaian kualitas tidur, menyebabkan kualitas tidur memiliki peluang yang lebih besar daripada durasi tidur untuk mempengaruhi tingkat kelelahan kerja seseorang.

Tidur merupakan waktu istirahat bagi tubuh. Pada waktu ini tubuh melakukan proses pemulihan berbagai organ fungsional di dalam tubuh (Hidayat, 2012). Pada satu kali waktu tidur di malam hari terdapat 3 hingga 6 kali siklus, dalam satu kali siklus tidur terdapat dua tahapan yaitu tahap *Non Rapid Eye Movement (*NREM) dan tahap *Rapid Eye Movement* (REM) (Reza *et al*., 2019). *Non Rapid Eye Movement (*NREM) merupakan fase transisi dari keadaan terjaga hingga tidur dengan mata tertutup, pada fase ini seseorang mudah untuk terjaga dan dengan perubahan kondisi fisiologis yang meliputi penurunan tekanan darah, denyut jantung teratur, pernapasan dangkal, dan hampir tidak ada gerakan pada tubuh(Reza *et al*., 2019). Fase tidur *Rapid Eye Movement (*REM) merupakan fase tidur terlelap, pada fase ini seseorang sering mengalami mimpi, pada fase ini otak juga dalam keadaan aktif (Reza *et al.,* 2019). Pada usia 18-60 tahun kebutuhan tidur seseorang berkisar 6-7 jam/hari (Kementerian Kesehatan RI, 2018). Seseorang dengan kualitas tidur yang buruk dapat mengganggu proses pemulihan berbagai fungsional tubuh yang terjadi ketika seseorang tidur. Adanya gangguan dalam proses pemulihan fungsional berbagai organ tubuh dapat meningkatkan resiko kelelahan kerja.

Tabel 2 menunjukkan bahwa sebagian besar responden dengan tingkat kecukupan energi kategori normal memiliki tingkat kelelahan kerja kategori rendah (36%), sedangkan responden dengan tingkat kecukupan energi kategori kurang memilki tingkat kelelahan kerja kategori sedang (40%). Hasil penelitian ini menunjukkan bahwa ada hubungan yang signifikan antara tingkat kecukupan energi dengan tingkat kelelahan kerja (p=<0,001), dan pekerja wanita dengan tingkat kecukupan energi yang kurang ataupun kelebihan berisiko 3,14 kali lebih besar mengalami tingkat kelelahan kerja yang lebih tinggi jika dibandingkan pekerja wanita dengan tingkat kecukupan energi normal atau cukup. Hasil penelitian ini sejalan dengan penelitian Sari dan Muniroh (2017), dimana tingkat kecukupan energi yang kurang akan meningkatkan kelelahan kerja (Sari dan Muniroh, 2017).

Tingkat kecukupan energi merupakan persentase pemenuhan asupan energi dibandingkan dengan kebutuhan energi menurut AKG 2019 dengan memperhatikan berat badan, tinggi badan, dan usia seseorang. Seseorang dengan tingkat kecukupan energi yang kurang dapat menyebabkan penurunan kadar glukosa. Penurunan kadar glukosa menyebabkan tubuh melakukan proses glikogenolisis dan glukoneogenesis. Kedua proses ini menyebabkan simpanan energi pada otot mengalami penurunan yang kemudian berakibat pada penurunan kontraksi otot (Hidayah, 2018). Penurunan kontraksi otot karena rendahnya asupan energi ini akan menyebabkan peningkatan kelelahan

yang dirasakan oleh seseorang (Hidayah, 2018; Yusitriani, Russeng dan Muis, 2014).

Penelitian ini juga melakukan analisa uji hubungan antara status gizi obesitas sentral dengan tingkat kecukupan zat gizi responden, dan didapatkan nilai p. value >0.05 (Pada Tabel 3) atau dapat diartikan bahwa status gizi obesitas sentral tidak berkaitan dengan tingkat kecukupan zat gizi. Hasil penelitian ini sejalan dengan penelitian yang dilakukan oleh Fridawanti (2016) dimana asupan energi, lemak, karbohidrat, dan protein tidak memiliki hubungan yang signifikan dengan status gizi obesitas sentral (Fridawanti, 2016).

Obesitas sentral dapat disebabkan karena tingginya asupan zat gizi terutama asupan energi. Kelebihan asupan ini akan di simpanan di beberapa organ tubuh salah satunya pada lapisan abdomen atau perut dalam bentuk lemak. Penumpukan ini disebut obesitas sentral (Rahmawati, 2015).

Perbedaan hasil penelitian ini dengan teori yang ada dapat dipengaruhi oleh beberapa faktor salah satunya distribusi atau sebaran data terkait tingkat kecukupan zat gizi. Pada penelitian ini didapatkan bahwa sebagian besar responden memiliki tingkat kecukupan zat gizi makro yang kurang dari kebutuhan, dan tingkat kecukupan energi sebagian besar responden termasuk dalam kategori normal atau sesuai dengan kebutuhan. Hal inilah yang kemungkinan dapat menyebabkan perbedaan hasil penelitian dengan teori yang ada. Selain itu, penggunaan instrumen SQFFQ memiliki kelemahan dimana identifikasi pola konsumsi sangat bergantung pada daya ingat responden, dan standar porsi yang tercantum pada kuisioner mungkin tidak merefleksikan apa yang dimakan subyek, sehingga kemungkinan terjadinya under atau *over estimate* dalam penafsiran pola konsumsi. Pada penelitian ini durasi tidur tidak dimasukkan dalam analisa multivariat karena nilai *p-value* untuk durasi tidur >0,05.

Berdasarkan hasil perhitungan PR (Prevalensi Rasio) pada Tabel 2 dapat dilihat bahwa, diantara variabel independent (status gizi obesitas sentral dan tingkat kecukupan energi) terdapat variabel yang memiliki pengaruh yang dominan terhadap tingkat kelelahan kerja responden yaitu variabel tingkat kecukupan energi, dimana tingkat kecukupan energi (CI 95% -0,474 sd -0,044; *p-value*=3,14) memiliki nilai prevalensi rasio (PR) yang lebih tinggi dibandingkan dengan status gizi obesitas sentral (CI 95% -0,674 sd -0,178; *p-value* = 2,78).

KESIMPULAN DAN SARAN

Obesitas sentral dan tingkat kecukupan energi berhubungan signifikan dengan tingkat

Tabel 3. Hasil Uji Hubungan antara Tingkat Kecukupan Zat Gizi (Energi, Protein, Lemak, dan Karbohidrat) dengan Status Gizi Obesitas Sentral

Tingkat Kecukupan Zat Gizi		Status Gizi (n=50)		*p-value*
		Normal (%)	Obesitas Sentral (%)	
Tingkat Kecukupan Energi	Kurang (<90% AKG)	34	12	0,06
	Normal (90-119% AKG)	22	28	
	Lebih (>120% AKG)	2	2	
Tingkat Kecukupan Protein	Kurang (<90% AKG)	54	34	0,23
	Normal (90-119% AKG)	4	8	
	Lebih (>120% AKG)	0	0	
Tingkat Kecukupan Protein	Kurang (<90% AKG)	54	38	1
	Normal (90-119% AKG)	4	4	
	Lebih (>120% AKG)	0	0	
Tingkat Kecukupan Karbohidrat	Kurang (<90% AKG)	22	8	0,27
	Normal (90-119% AKG)	20	14	
	Lebih (>120% AKG)	16	20	

kelelahan kerja. Pada pekerja wanita dengan status gizi obesitas sentral berisiko 2,78 kali lebih besar mengalami tingkat kelelahan kerja yang lebih tinggi. Pada pekerja wanita dengan tingkat kecukupan energi yang kurang berisiko 3,14 kali lebih besar mengalami tingkat kelelahan kerja yang lebih tinggi.

Tingkat konsumsi energi yang sesuai dengan Angka Kecukupan Gizi dan penerapan pola hidup sehat dan seimbang untuk memperoleh nilai rasio lingkar pinggang dan panggul <0,8 dapat dijadikan upaya untuk menurunkan tingkat kelelahan kerja.

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https://doi.org/10.204736/mgi.v17i2.115–121

THE ROLE OF EMOTIONAL EATING A MEDIATOR IN RELATIONSHIP BETWEEN SLEEP DURATION AND QUALITY WITH CARBOHYDRATE INTAKE AMONG PREGNANT WOMEN

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ABSTRACT

Carbohydrate is one of the nutrients that is needed during pregnancy. Increased demand during pregnancy causes pregnant women to consume carbohydrates in excess, which occurs due to emotional eating. The increment of emotional eating is assumed to be triggered by insufficient sleep duration and poor sleep quality. This study was aimed to investigate the role of emotional eating as mediator in relationship between sleep duration and quality with carbohydrate intake among pregnant women. This study applied an analytic survey with cross-sectional design on 105 pregnant women in the second and third trimesters at Bondowoso District were sampled through multistage random sampling technique. In this study, the exogenous variables were sleep duration and quality. Meanwhile, the endogenous variables were carbohydrate intake. Emotional eating was the mediator. Data were collected using the Emotional Eater Questionnaire (EEQ), Pittsburgh Sleep Quality Index (PSQI), and 3×24 hours food recall. Data were analyzed using path analysis. There was a direct relationship between duration and quality of sleep with emotional eating (P <0.001 dan 0.002). Sleep duration and quality were not directly associated to carbohydrate intake (P 0.817 dan 0.z724). A direct relationship was shown by emotional eating and carbohydrate intake variables (P<0.001). It is concluded that emotional eating plays a role in the indirect relationship between sleep duration and quality with carbohydrate intake for pregnant women in the second and third trimesters. Pregnant women should be able to regulate sleep patterns and dietary intake.

Keywords: sleep duration, sleep quality, emotional eating, carbohydrate intake, pregnant women

INTRODUCTION

Carbohydrate is one of nutrients needed during pregnancy. The Recommended Daily Intake for carbohydrate total during pregnancy increases to 400 g/day (Kemenkes RI, 2019). Ritchie and Roser (2013) stated that the highest average carbohydrate consumption in the world was found in Egypt, which was 635.2 g/person/day. Indonesia has an average carbohydrate consumption of 502.3 g/person/day. East Java is one of the provinces with 44.2% of sweet food consumption. Sweet food is one type of high-carbohydrate food because it has a high sugar content (Kemenkes RI, 2018). The results of a preliminary study conducted in Bondowoso District showed that the average consumption of total carbohydrates in second and third trimesters of pregnant women was 457.3 g/day.

Excessive carbohydrate total has an adverse effect on maternal and fetus (Wennberg et al., 2016). Xiang et al. (2019) pointed out that the highest peak of carbohydrate consumption occurs in the second and third trimesters. This is due to excessive sugary and energy-dense foods intake (Teixeira et al., 2018).

Willingness to consume sweet and high-carbohydrate snacks justifies the desire to consume delicious food caused by emotional eating (Blau et al., 2018). People with emotionally eating are unable to distinguish between hunger and a high desire to consume delicious, sweet, and high-carbohydrate foods (Antoniou et al., 2017). Emotional eating also occurs due to an excessive appetite (Kolko et al., 2017).

Insufficient sleep duration (Hill et al., 2020) and poor sleep quality (Geiker et al., 2018) are associated with increased emotional eating. Insufficient sleep duration causes changes in neuroendocrine and metabolic functions that might modify hormone secretion, which is high levels of ghrelin (appetite stimulating hormone) and low levels of leptin (appetite-suppressing hormone) (Balieiro et al., 2019). Poor sleep quality changes

 Received 24-08-2021, Accepted 30-11-2021, Published online 30-05-2022.

in hormone secretion might lead to an increase in subjective eating (Saleh-Ghadimi et al., 2019). Further, the changes of neuroendocrine function and ghrelin can result in emotional eating (Balieiro et al., 2019).

Previous research did not focus on the mediator role of emotional eating in pregnant women, and the variables studied were mostly weigh gain during pregnancy. This study aimed to investigate the role of emotional eating as mediator in relationship between sleep duration and quality with carbohydrate intake for pregnant women.

METHODS

This was an analytic study with a cross-sectional design, conducted in Bondowoso District, East Java. The study population was 2,568 pregnant women in the second and third trimesters. Inclusion criteria included pregnant women who settled in the area as stated in their ID cards, were able to communicate well, and able to read and write. Exclusion criteria included pregnant women with hyperemesis gravidarum, chronic energy deficiency, depression history before pregnancy, Diabetes mellitus, cardiovascular disease, cancer, not living with spouse, already gave birth, and withdrawing from this study.

Subjects in this study were 105 pregnant women who were obtained using a multistage random sampling technique. This research was conducted in 12 sub-districts. The calculation of the size of the research subject using the Lemeshow formula (Dahlan, 2013).

$$n = \frac{Z^2_{1-\alpha/2} \times p\,(1-p) \times N}{d^2\,(N-1) + Z^2_{1-\alpha/2} \times p\,(1-p)}$$

The exogenous variables in this study were sleep duration and quality. Meanwhile, the endogenous variable was carbohydrate intake. The mediator variable was emotional eating. The instruments used in this study were the Emotional Eater Questionnaire (EEQ) adopted from Rachmawati (2019), Pittsburgh Sleep Quality Index (PSQI) adopted from Jumiarni (2018), and a 24-hour food recall form. The questionnaire has been tested for validity and reliability by researchers on the subject of pregnancy in the second and third trimesters. Data on carbohydrate intake, emotional eating, sleep duration and quality, were collected by interview which was conducted through home visits. Carbohydrate intake data were collected three times on non-consecutive days. Data collection was assisted by trained enumerators and uses household size as a measure of food intake. Calculation of carbohydrate intake using *Nutrisurvey software* (2007) and the maximum intake of total carbohydrates for pregnant women is 110% of AKG, or equivalent to 440 grams/day (Gibson, 2005). The score of emotional eating was categorized into non emotional eater, low emotional eater, emotional eater, and very emotional eater (López-Galán and de-Magistris, 2019). The score of sleep duration was categorized into enough and less (<7 hour/night) (Kalmbach et al., 2019), while sleep quality was categorized well and poor (Benloucif et al., 2014).

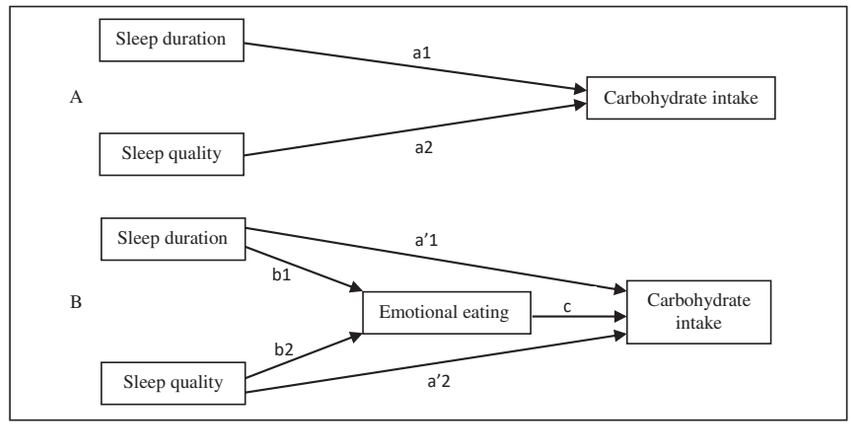

Figure 1. Hypothesized mediation model. (A) Theoretical model of sleep duration, sleep quality, and carbohydrate intake, (B) Theoretical model where emotional eating mediates the relation between sleep duration, sleep quality, and carbohydrate intake.

https://doi.org/10.204736/mgi.v17i2.115–121

Pregnant women who were willing to be respondents signed an informed consent form prior to this study. This research had obtained ethical approval from the Ethics Commission of the Jember State Polytechnic (3571/PL17/PG/2021) and permission from the National Unity and Political Agency of Bondowoso District.

The data were analyzed using path analysis with STATA 14 (Ghodang, 2020). Successive interval method used to change ordinal data to interval data. Normality and multicollinearity tests were carried out as initial conditions for determining path analysis. Path analysis suitability was determined using model identification and model suitability tests.

RESULTS AND DISCUSSION

Most of the samples were third semester pregnant women (51.44%). The percentage is not much different because the highest peak of carbohydrate consumption occurs in the second and third trimesters due to the increased consumption of sweet and energy-dense foods (Xiang *et al.*, 2019). One of the causes of the highest dietary intake is environmental factors (Wesołowska et al., 2019). Someone who lives at home tends to experience an increase in dietary intake due to the availability of food in their environment (Teixeira et al., 2018). This can be related to the occupation of most respondents who were housewives (81.0%).

The percentage of sample with enough sleep duration was 52.4%, and less sleep duration was 47.6%. This is not in accordance with research conducted by Yu et al. (2017) which mentioned that pregnant women in second and third trimesters often experienced sleep disorders therefore, impacting the reduction of sleep duration. The reduction in sleep duration in pregnant women in the second and third trimesters is caused by several factors such as waking up at night, weight gain during pregnancy which causes shortness of breath, fetal movement, and waking up too early (Polo-Kantola et al., 2017).

The majority of samples have experienced poor sleep quality (55.2%). The high-frequency distribution of poor sleep quality was caused by increasing gestational age, especially in the third trimester (Wardani *et al*., 2018). Sleep problems that pregnant women often experience increase along with the gestational age (Yu *et al.*, 2017).

Table 1. Distribution of Sleep Duration, Sleep Quality, Emotional Eating, and Carbohydrate Intake

Variables	Frequency	
	n	%
Gestational Age		
Second trimester	51	48.6
Third trimester	54	51.4
Profession		
Health workers	5	4.8
Teacher	8	7.6
Private employees	5	4.8
Trade	1	1.0
Farmers	1	1.0
Housewives	85	81.0
Sleep Duration		
Enough	55	52.4
Less	50	47.6
Sleep Quality		
Well	47	44.8
Poor	58	55.2
Emotional Eating		
Non emotional eater	19	18.1
Low emotional eater	29	27.6
Emotional eater	45	42.9
Very emotional eater	12	11.4
Carbohydrate Intake		
≤ 440 g/day	37	35.2
> 440 g/day	68	64.8

More than half of the respondents belongs to emotional eater (42.9%) and very emotional eater (11.4%). The high level of emotional eating in pregnant women in the second and third trimesters is due to a response to negative emotions such as anxiety, stress, and depression (Konttinen et al., 2019). This negative response causes individuals to be unable to distinguish hunger feelings (Diggins et al., 2015). This impacts the selection of foods either sweet or high in carbohydrates (Antoniou et al., 2017), which are considered to overcome these negative emotions (Konttinen et al., 2019).

Path analysis in Table 2 shows that there was a direct relationship between sleep duration and quality with emotional eating among pregnant women in the second and third trimesters (respectively, P<0.001; P 0.002 and β=0.51; β=0.34). This was consistent with study by Al-Musharaf (2020) in healthy young a Saudi women,

which demonstrated that poor sleep duration and quality was correlated with the high score of emotional eating. Sleep duration less than normal can cause a changes in neuroendocrine function and high levels of ghrelin (appetite stimulating hormone) (Dashti et al., 2015). Further, the changes of neuroendocrine function and ghrelin can result in emotional eating (Balieiro et al., 2019). In addition, the changes can be caused by poor sleep quality due to psychological dysfunction in pregnant woman (Gao et al., 2019), which leads to an increment in subjective eating (Saleh-Ghadimi et al., 2019). The increment of subjective in eating impacts the uncontrolled timing of meals and the amount of dietary intake (Diggins *et al*., 2015).

Subjective increase in eating based on pathway analysis did not show a direct relationship between sleep quality and carbohydrate intake for pregnant women in the second and third trimesters (P=0.724). This findings was in accordance with the research conducted by van Lee et al. (2017), which found that there was no relationship between poor sleep quality and food intake in pregnant women. Sleep quality undirectly effects to the increase carbohydrate intake, but through unhealthy diet patterns (Lindsay et al., 2017). This mechanism can occur because poor sleep quality causes emotional dysregulation (Geiker et al., 2018). Emotional dysregulation alters physiological systems related to leptin (appetite suppressing hormone) and ghrelin (appetite stimulating hormone) so that it occurs in subjective increase in eating (Saleh-Ghadimi et al., 2019).

Sleep duration did not have a direct relationship with carbohydrate intake for pregnant women in the second and third trimesters (P=0.817,β=-2.90. It is contradicts the other study by van Lee et al. (2017), which stated that less sleep duration increases food intake. The existence of this negative relationship indicates that adequate sleep duration can also lead to increased carbohydrate intake. This can be caused by other factors such as physical activity, socioeconomic and environmental factors. Insufficient sleep duration causes pregnant women to tend to consume sweet and high-carbohydrate foods (Hill et al., 2020).

High intake of carbohydrates is also triggered by emotional eating (Saleh-Ghadimi et al., 2019). Emotional eating was directly related to carbohydrate intake for pregnant women in the second and third trimesters (P<0.001; β=59.73). High emotional eating leads to a person's tendency to consume sweet and high-carbohydrate foods (Saleh-Ghadimi et al., 2019). They cannot distinguish hunger and cause appetite increament (Blau et al., 2018).

Emotional eating plays an indirect role in the relationship between duration and quality of sleep on carbohydrate intake for pregnant women in the second and third trimesters. The strength of the direct relationship between sleep duration and carbohydrate intake (2.90) was smaller than that of the indirect relationship (30.18). The direct relationship of sleep quality to carbohydrate intake (4.24) was smaller than the indirect effect (20.52). The strength of indirect relationship indicated that mediator variable had the role. This study accordance with the research conducted by Weiss et al. (2010), which stated that eating patterns

Table 2. Association between Sleep Duration, Sleep Quality, and Carbohydrate Intake in Second and Third Trimester Pregnancy

Direct and Indirect Effect	β	p-value
Direct Effect		
Sleep duration → emotional eating	0.51	<0.001
Sleep quality → emotional eating	0.34	0.002
Sleep duration → carbohydrate intake	-2.90	0.817
Sleep quality → carbohydrate intake	4.24	0.724
Emotional eating → carbohydrate intake	59.73	<0.001
Indirect Effect		
Sleep duration → emotional eating → carbohydrate intake	30.18	<0.001
Sleep quality → emotional eating → carbohydrate intake	20.52	0.006

act as mediator in the relationship sleep duration carbohydrate consumption. Insufficient sleep duration and poor sleep quality cause emotional dysregulation impacting emotional eating (Saleh-Ghadimi et al., 2019). High emotional eating boosts the desire to consume high-carbohydrate and sweet foods (Quick et al., 2015); therefore, carbohydrate intake becomes excessive (Antoniou et al., 2017). Insufficient sleep duration and poor sleep quality causes an increase in appetite and high carbohydrate intake (Geiker et al., 2018).

CONCLUSION

The study showed a direct relationship between sleep duration and quality with emotional eating. However, it was not directly related to carbohydrate intake. The emotional eating variable also showed a direct relationship with carbohydrate intake. Emotional eating plays a role in the indirect relationship between the duration and quality of sleep with carbohydrate intake of pregnant women in the second and third trimesters. Pregnant women should be able to regulate sleep patterns and the food they eat.

ACKNOWLEDGEMENT

The authors want to convey a gratitude to Aisyah Fariandini in particular for her assistence with the data collection procedure.

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THE PSYCHOLOGICAL DETERMINANTS TOWARD THE VALUE OF HEALTHY FOOD AMONG TYPE 2 DIABETES MELITUS CONSUMERS

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ABSTRACT

Adults and middle-aged food consumers are the most at risk of type 2 diabetes, and these consumers are varied across demographics. While few and fragmented studies are associated with psychological determinants and healthy food value through food choices. Few consumer roles are involved in research for business success. The psychological determinants toward the value of healthy food for type 2 diabetes consumers used consumer behavior and psychological theories of consumer choices. An associative method with purposive sampling was conducted from 165 adults and middle-aged consumers with type 2 diabetes using Structural Equation Modeling/SEM. The finding showed that the belief, attitude, and mood affected the value of healthy food through food choice, but not psychological distress. The attitude had the greatest effect on food choice and toward the value of healthy food, and the causal of the highest result effect of life experiences. The belief was directly affected food choice and value, and the causal for the highest effect of self-consciousness and health maintenance. The mood negatively affected both food choice and value of healthy food mood and the causal for the smallest effect of health maintenance. The food choice affected the values of healthy food. Life experience was the most direct and indirect effect of food choice and self-consciousness was the most direct effect of the value of healthy food. Some highlights of this study were (i) market segmentation and segmentation variable; (ii) social marketing; (iii) mass media campaign by considering attitude, belief, and mood; and (iv) human capital management strategy with targeted audiences.

Keywords: food choice, psychological determinant, value of healthy food, type 2 diabetes, consumer.

INTRODUCTION

Recently, adults and middle-aged food consumers are the most at risk of type 2 diabetes. Diabetes is corresponding to 6.28% of the world's population (Abdul et al., 2020). It is reported as one of the nine leading causes of death (Abdul et al., 2020), and particularly bring substantial economic loss in developing countries (WHO, 2014; WHO, 2016). Nutrition transition (Lucchese et al., 2016), sedentary lifestyle (Basiak-Rasała et al., 2019; Park et al., 2020), and obesity (Bertoglia et al., 2017) are important risk factors that lead to diabetes.

Meanwhile, type 2 diabetes consumers are more diverse in the future (Faerch et al., 2016) and varied across demographics (Cheng et al., 2019), leading to heterogeneity changes in purchasing behavior (Oster, 2018). These heterogeneity changes of consumer behaviors are a market challenge and beneficial for market segmentation (Zanden et al., 2017), and consumer satisfaction–loyalty (Fuentes-Blasco et al., 2014). Besides, there are significant response to diabetes-related products in food items, timing of purchases, combination of purchases, etc. in households food purchase (Oster, 2018).

Furthermore, type 2 diabetes consumers need to make sensible food choices. Understanding individual food choices and healthy food are critical (Chen & Antonelli, 2020) for underlying healthy eating. Informed food choices will promoted healthier consumers (Castres, 2015). Healthy foods are associated with decreament of diabetes case (Nagarajan et al., 2017), and healthy eating help managing long-term health (Swanson & Maltinsky, 2019), even if it is not low cost (Fanzo et al., 2020).

In addition, few studies associated psychological determinants with healthy food values through food choices for type 2 diabetes consumers. Some issues of treatment adherence have been acknowledged for years, which are diverse cost-effectiveness of interventions and a few consumer role research for business success

 Received 13-01-2022, Accepted 04-04-2022, Published online 30-05-2022.

(Roberts et al., 2017; Soler et al., 2018; Khunti et al., 2019; Zhou et al., 2020). While the literature on the value of healthy food to improve diet quality in the population is still fragmented (Heijden et al., 2020).

Diabetes consumers also demand psychological (Swanson & Maltinsky, 2019; American-Diabetes-Association, 2019), and distinctive psychosocial needs (Bhat et al., 2020). Diabetes impacts cognitive, emotional, behavioral, and social factors in psychosocial aspects (Kalra et al., 2018). Hardcastle et al. (2015) show the importance of psychological factors on food choices. While psychological distress, belief, attitude, and mood are a response to eating behavior (Heewon et al., 2018; Wehling & Lusher, 2019; Bartkiene et al., 2019; Bemanian et al., 2021). Personality (Smith, 2020), motive (Poeller, 2021), and attitude (Wu et al., 2021) are essentially driving a person to seek satisfaction.

Meanwhile, values ensure strategic perspective and fundamental behavior of purchasing decision. The valuation of value is a relational process between value and the object to be valued (Himes & Muraca, 2018). The purchasing decisions reflect the values, beliefs, and collective needs of consumers (Yu & Lee, 2019). On the other side, the necessity of type 2 diabetes consumers value generating appropriate psychographic segmentation because of lifestyle changes (Van Huy et al., 2019), and customers loyalty (Gajanova et al., 2019) in the relevant market.

This study tried to build simultaneous relationship between psychological determinant and value of healthy food through food choices using consumer behavior theory (Mowen, 1995) and psychological theory of consumer choice (Hansen, 1976). The perceived health benefits influenced type 2 diabetes consumer behavior (Ali et al., 2018), which make value considerations and show the predictability of consumers behaviors for marketers. While psychological theory of consumers choice characterized by decision making that related to psychological process (Hansen, 1976), focused on the nature of needs and consumers motivations (Gârdan & Gârdan, 2015), and making decision in consumption (Vainikka, 2015).

METHOD

The research used an associative method with purposive sampling from a cross sectional design of 165 adults (aged over 18 years or older) and middle-aged (aged about 45 to 65) food consumers of type 2 diabetes in West Kalimantan Province in 2021 that has continued to increase over the last 6 years (Pramoedyo & Sumarminingsih, 2018; Kemenkes, 2018; Arifin et al., 2019). The participants had been recruited through a non-proportional sampling using semi-structured questionnaire with an in-depth interview to deepen and sharpen the understanding of reason and reflective listening (Brounéus, 2011).

There were two phases of the study. First, identify type 2 diabetes consumer characteristics, which include gender, formal education, occupation, family member, expenditure (Seng et al., 2021), metabolic rate, diabetes status, and period of having diabetes (Caron et al., 2016). Second, to build simultaneous relationship of psychological determinants (Heewon et al., 2018; Wehling & Lusher, 2019; Bartkiene et al., 2019; Bemanian et al., 2021; Smith, 2020; Poeller, 2021; Wu et al., 2021) toward the value of healthy food (Himes & Muraca, 2018) through food choices (Yu & Lee, 2019) using Structural Equation Modelling or SEM (Narimawati & Sarwono, 2017) due to the great flexibility of SEM (Gana & Broc, 2019) with Lisrel software.

The psychological determinants toward food choices were consisted of psychological distress, belief, attitude, and mood. Anxiety, apathy, depression, fatigue, insomnia, and guilty were included in psychological distress (RACGP, 2016; Darwish et al., 2018; Stevanovic et al., 2019; Amankwah-poku & Amankwah-poku, 2020). Religious, cultural, opinion were included in belief (Gorter et al., 2011; Ameyaw & Ameyaw, 2020; Omodaraa et al., 2021). Personality, traveling experience, and perceived constraint were included in attitude (Izadi et al., 2015; Pretty et al., 2016; Adu et al., 2019). Positive mood and negative mood were included in mood (Du et al., 2021).

While food choices were measured on individual measurements, such as self-consciousness, emotional intelligence, and life

stage. Family, life experience, food origin, and health maintenance were included in the value of healthy food (Pathak, 2014; Pamungkas et al., 2017; Fonseca et al., 2018; Idris et al., 2019).

In SEM, there were six key procedural steps (Thakkar, 2020): (i) model specification; (ii) model identification; (iii) model estimation; (iv) model testing; and (v) model modification. The value of healthy food for type 2 diabetes consumers model combine measured and latent variables as predictive variables, both exogenous (i.e. psychological distress, belief, attitude, and mood) and endogenous (i.e. food value and food choice). The measurement model indicates how observed indicators linked to underlying latent variables, while the structural model indicates how the latent variables linked to each other (Gana & Broc, 2019).

The 5-point Likert scale was used to measure indicators of a latent variable (i.e. strongly disagree, disagree, neutral, and strongly agree) without successive interval (MSI) methods because RMSEA (Root Mean Square Error Approximation) value had the same conclusion in the testing model suitability (Pramoedyo & Sumarminingsih, 2018).

RESULT AND DISCUSSION

Characteristics of Type 2 Diabetes Consumers

An overview understanding of consumers characteristics for better comprehending type 2 diabetes consumers' perceived value of healthy food value through food choice, which included gender, formal education, occupation, family members, expenditure, metabolic rate, diabetes status, and period of having diabetes were presented in Table 1.

Table 1 shows that most type 2 diabetes consumers were older adult male with low to moderate formal education, housewive, 3 members of the family, with 2,000,000 - 5,000,000 rupiah of expenditure per month. Most of them were overweight with low BMR for more than 5 years of period. Thus, their diabetes status were uncontrolled condition.

Type 2 diabetes consumers of older adults both men and women are reaching epidemic in many countries (Bradley, 2016) due to increasing rates of overweight and obesity, combined effects

Table 1. The Characteristics of Type 2 Diabetes Consumers

Characteristics	%
Gender	
Male	51.52
Female	48.48
Formal Education (year)	
< 6	1.21
6 - 9	9.09
9 - 12	68.48
> 12	33.33
Occupation	
Farmer	1.82
Government employee	10.91
Private employee	13.94
Entrepreneur	25.45
Retired	9.09
Housewife	38.79
Family Member (people)	
1	3.64
2	9.09
3	44.24
4	32.73
5	13.94
6	5.45
> 9	3.03
Expenditure (rupiah/month)	
< 2,000,000	15.76
2,000,000 - 5,000,000	75.76
> 5,000,000 - 10,000,000	15.15
> 10,000,000	5.45
Body Dimention	
Weight (kg)	
< 50	7.88
50 - 68	38.18
> 68	53.94
Height (cm)	
< 160	9.09
160 - 170	75.76
> 170	15.15
Basal Metabolic Rate/BMR (kcal)	
< 1,400	57.24
1,400 - 1,600	37.88
> 1,600	4.88
Diabetes status	
Uncontrollable	45.45
Moderate controlled	39.39
Very restrained	15.15
Period of having diabetes (year):	
< 5	47.27
≥ 5	52.73

of unhealthy eating habits (Afroz et al., 2019), physical inactivity and poor healthy lifestyles (Galaviz et al., 2018). Besides, the control of type 2 diabetes consumers was inadequate because of smokeless tobacco (Afroz et al., 2019). While low BMR stimulated the risk of insulin resistance metabolism (MacIak et al., 2020). Thus, market segmentation and variables segmentation can be used to form the heterogeneous market into relatively homogenous clusters (Wilhelm, 2015).

Psychological determinants toward the value of healthy food

The validity and reliability test are important in the second phase to build the simultaneous relationship of psychological determinants toward the value of healthy food through food choices using Structural Equation Modelling/SEM as presented in Table 2.

Table 2 shows the quality of research, meaning that the results can be accurately interpreted, and there was a consistency in measuring outcomes (Schumacker & Lomax, 2010). While the goodness of fit-test that described how well the model fits into a set of observations is presented in Table 3.

Table 3 shows that there were eleven criteria in proper conclusions for the interpretation as

Table 2. Construct Reliability (CR) and Variance Extracted (VE)

Criteria	Value of healthy food	Food choices	Psych. distress	Belief	Attitude	Mood
Std. loading factor of VE	0.97	0.69	1.22	0.75	0.85	0.77
Errors of VE	1.01	0.66	0.55	0.78	0,61	0.53
VE	0.51	0.57	0.82	0.65	0.50	0.88
Overall VE			> 0.50			
Std. loading factor of CR	1.44	1.23	1.11	1.12	1.02	1.08
Errors of CR	1.21	0.67	0.81	0.63	0.78	0.80
CR	0.87	0.61	0.69	0.59	0.77	0.99
Overall CR			≥ 0.70			

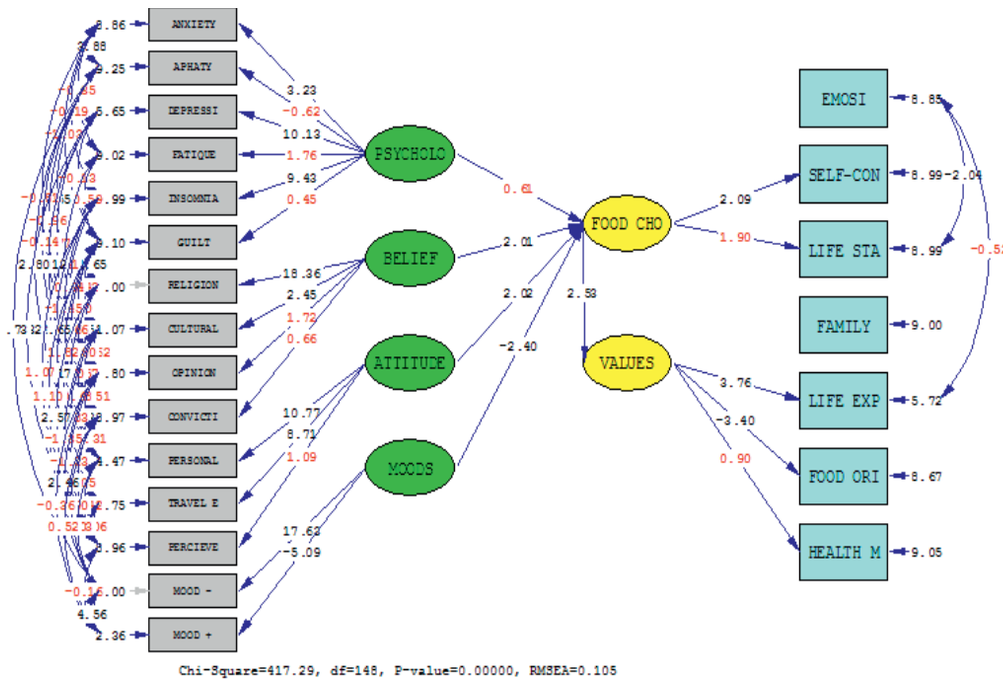
Note: accepted if CR ≥ 0.7 and VE > 0.50

Tabel 3. Goodness of Fit-Test

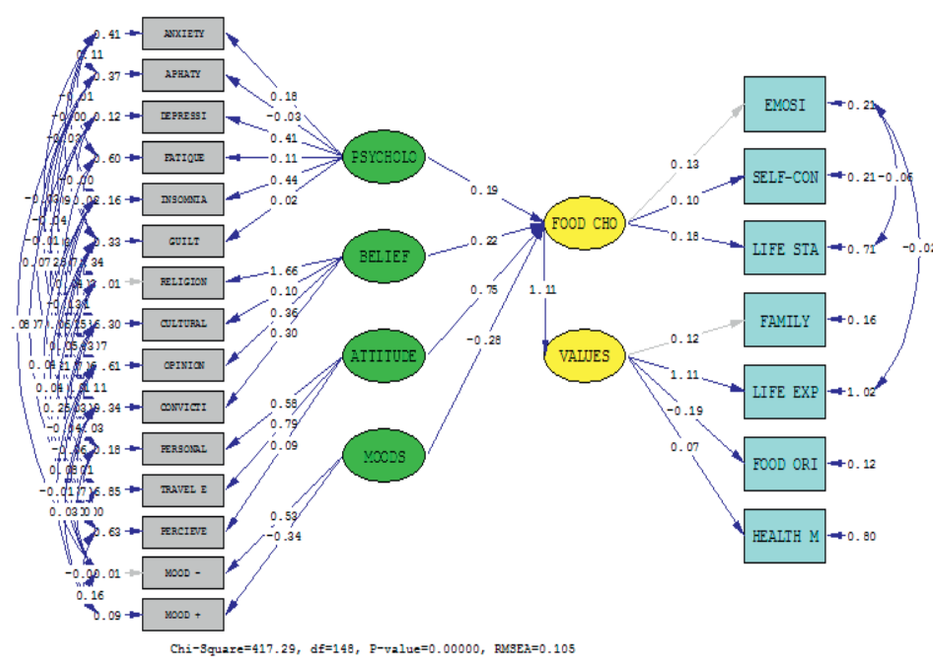
Criteria	Std. value	Initial		Final	
		Estimate	Conclusion	Estimate	Conclusion
Chi-Square /χ^2	Small value	698.07	Poor	474.99	Good
χ^2/DF	1.0 ≥ x ≤ 5.0	3.49	Poor	3.21	Good
NCP	Small value with a narrow interval	455.30 (381.54; 536.65)	Poor	269.29 (212.12); 334.11)	Good
SNCP (NCP/n)	Small value	3.04	Poor	1.79	Good
RMSEA	≤ 0.08	0.12	Poor	0.11	Good
ECVI	Small value and close to saturated ECVI	I=8.87 M=4.64 S=3.09	Poor	I=8.87 M=3.82 S=3.09	Good
AIC	Small value and close to saturated AIC	I=1544.55 M=761.30 S=506.00	Poor	I=1454.22 M=627.29 S=506.00	Good
CAIC	Small value and close to saturated CAIC	I=1544.55 M=978.91 S=1544.8	Poor	I=1544.55 M=1058.4 S=1544.80	Good
PGFI	0-1	0.58	Good	0.48	Good
RMR	≤ 0.05	0.081	Good	0.066	Good

presented in a structural model in Figure 1 and path diagram analysis in Table 4.

Figure 1 shows that each box images are the indicator of latent exogenous variables (observed variables) that correspond to the latent endogenous variables. All covariance of the observed variables described the relationship between observed variable and latent variable. Psychological distress, belief, attitude, and mood explained 73% of food choice and 90% of value of healthy food in a structural model. The finding showed that belief, attitude, and mood affect the value of healthy food through food choice, but not psychological distress



(a) t-value model



(b) estimate coefficient model

Figure 1. Structural model of psychological determinants toward the value of healthy food

due to the healthy food category (Teufel-Shone et al., 2018).

Within belief variables, religion and culture were positively affect the value of healthy food through food choice but not opinion. Consumers with different culture and religion are varied in all aspects of food choice and value of healthy food (Sibal, 2018). While opinions are not related to the potential moral issue of food sources, and low awareness of thoughts related to healthy food (Ronteltap et al., 2012).

Among the attitude measurements, the positive aspects of personality traits affected the value for healthy food through food choice (Najmeh et al., 2021), this research was contrary to El Ansari et al. (2014) due to gender, food insecurity (Leung et al., 2020), and lower socioeconomic status (Spinosa et al., 2019). The value of healthy food has physical and mental health benefit for a long-term investment of well-being (Wahl et al., 2017). While travel experiences are positively related to food choice, affect the value of healthy food because of need and perception (van der Velde et al., 2019), and influence the destination of food experiences (Björk & Kauppinen-Räisänen, 2017).

In mood measurement, the negative and positive emotion were associated with food choices (Ashurst et al., 2018) that lead to eating behavior (Reents et al., 2020) and basis in value of healthy food. A negative mood or low mood leads to indulgent food or unhealthy food over healthy food (Gardner et al., 2014). The improved mood is correlated with more healthy eating (Leeds, 2020). Besides food can serve emotional consolation (Cardoso et al., 2020) and reductions of mood swings (Jenkins et al., 2016) though vary through sociodemographic (Cardoso et al., 2020). While eating healthy food has a positive effect on certain size, composition, expectation, and need (Gibson, 2006).

In the food choice variable, the self-consciousness and emotional intelligence were positively related to food choice and toward the value of healthy food due to the preference in choosing healthy food (Hanspal & Devasagayam, 2017). However, the life stage was not related to food choice and toward value for healthy food because of the sociodemographic characteristic differences (Konttinen et al., 2021), life transitions (Winpenny et al., 2018), and external impact (Chen & Antonelli, 2020).

Value of healthy food are inevitable consequences of the evolving global culture and environment. Consumers reportedly prefer value drivers of health, wellness, and safety over traditional value (i.e. price, taste, and convenience) (Godfray et al., 2010). Thus, life experience and food origin were positively related to the value of healthy food (Farhud, 2015). Life satisfaction, a self-transcendence orientation, and wisdom stimulated life experience for healthy food (Le, 2011). While, food origin is a normative sense of quality and ethnocentrism because of education and income level (Yormirzoev et al., 2019). In addition, family eating habits are dominant factor for healthy food choice and eating behavior due to interaction between individuals in a family (Risti et al., 2021).

Health maintenance was not related to the food choice and toward the value of healthy food which was contrary to Reitmeier (2016) and Jun et al. (2014) because of the sociodemographic characteristic differences (Konttinen et al., 2021) such as formal education, occupation, family members, expenditure, preference changes (Vilaro et al., 2018), and external impact (Chen &

Table 4. Path Diagram Analysis

Path diagram analysis	Estimate coef.	Conclusion	Direct effect	Indirect effect
Psychological distress → Food choice	0.19	Not significant	0.19	-
Belief → Food choice	0.22	Positive significant	0.22	-
Attitude → Food choice	0.75	Positive significant	**0.75**	-
Mood→ Food choice	-0.28	Negative significant	-0.28	-
Psychological distress → Value	0.21	Not significant	0.21	0.21
Belief → Value	0.25	Positive significant	0.25	0.25
Attitude → Value	0.84	Positive significant	**0.84**	0.84
Mood → Value	-0.31	Negative significant	-0.31	-0.31
Food choice → Value	1.11	Positive significant	1.11	-

Antonelli, 2020). Furthermore, there were direct and indirect effect of psychology determinants on value for healthy food through food choice as presented in path diagram analysis in Table 4.

Table 4 shows that the attitude had the strongest direct effect on food choice and toward the value of healthy food, followed by the mood and belief. An increase in 1.0% of attitude led to a direct increase in 0.75% of food choice and 0.84% of the value of healthy food. However, mood negatively affected both food choice and value of healthy food, an increase in 1.0% of mood led to a direct decrease in 0.28% of food choice and 0.31% of the value of healthy food. Belief was directly affected the food choice and value, an increase in 1.0% of belief led to a direct increase in 0.22% of food choice and 0.25% of the value of healthy food. Food choice affected value of healthy food. An increase in 1.0 % of food choice led to a direct increase in 1.11% of values of healthy food. While measurement model is presented in Table 5.

Table 5 shows that life experience, followed by food origin, family, and emotional intelligence had the strongest direct effect of food choice. The life experience, followed by food origin, and family also had the highest positive indirect effect on the food choice. Self-consciousness had the direct effect of the value of healthy food, which is consistent with Souter & Keller (2002) due to the different interactivity of cognitive, affective, and normative aspect (Luomala, 2007). The value of healthy was food positively and directly affected by the attitude and behavioral intention (Jun et al., 2014). In addition, family norm as family identity reduced the food choice conflict (Cong et al., 2013). Table 6 presented the effect of exogenous variables on endogenous indicators.

Tabel 5. Measurement model

Indicator of latent variable	Direct effect		Indirect effect	
	of food choice	of the value of healthy food	of food choice	of the value of healthy food
On food choice				
Emotional intelligence	0.13	-	-	-
Self-consciousness	0.10	-	-	-
On the value of healthy food				
Family	0.13	0.12	0.13	-
Life experience	**1.24**	1.11	1.24	-
Food origin	-0.21	-0.19	-0.21	-

Tabel 6. Effect of belief, attitude, the mood on the indicator of food choice and the value of healthy food

Indicator of latent variable	Belief	Attitude	Mood
On food choice			
Emotional intelligence	0.03	0.10	-0.04
Self-consciousness	0.02	0.08	-0.03
Life stage	0.04	0.14	-0.05
On the value of healthy food			
Family	0.03	0.10	-0.04
Life experience	0.28	0.93	-0.34
Food origin	-0.05	-0.16	0.06
Health maintenance	0.02	0.05	-0.02

Table 6 corroborated the previous result that the highest total effect of psychological determinants is a life experience. The life experience had greater positive indirect effect to food choice due to the difference in interactivity of cognitive, affective, and normative aspect (Luomala, 2007). The highest effect on the food choice and value of healthy food was attitude. The mood had a negative effect on all of the indicators of food choice and value of healthy food, except food origin. In food choice indicators, all psychological determinants had the highest effect on life stage, while the smallest was self-consciousness. In the value of healthy food indicator, all psychological determinants had the highest effect on life experience, while the smallest was health maintenance. The attitude was the causal for the highest result effect on life experience. The belief was the causal for the highest effect on self-consciousness and health maintenance, and the mood was the causal for the smallest effect on health maintenance.

Therefore, some suggestions can be taken into consideration regarding type 2 diabetes consumers as follow. First, social marketing with an emphasis on timely acceptance and usage of attitude, belief, and mood to achieve behavior change (Kalra & Sahay, 2016). Second, mass media campaign to influence consumers' change and make healthy behavior more than the norm by considering attitude, belief, and mood of

type 2 diabetes consumers (WHO, 2016). Third, enhancing value for type 2 diabetes consumers using elements of health care marketing that build consumer satisfaction–loyalty (Fuentes-Blasco et al., 2014; Health et al., 2021). The organization determines differentiation of human potential and its involvement in various organizational processes or human capital management strategies (Toszewska, 2019) with target audience (Wilhelm, 2015).

CONCLUSION

The belief, attitude and mood affected the value of healthy food through the food choice, but not psychological distress. Psychological distress, belief, attitude, and mood explained 73% of food choices and 90% of the value of healthy food. The attitude had the greatest direct effect on the food choice and toward the value of healthy food, followed by the mood and belief. Life experience resulted the biggest direct and indirect effect of the food choice. The self-consciousness had the highest direct effect on the value of healthy food. Some highlights of this study were (i) market segmentation and segmentation variables, (ii) social marketing, (iii) mass media campaigns by considering attitude, belief, and mood, and (iv) human capital management strategy with target audiences.

ACKNOWLEDGMENTS

We would like to express sincere gratitude to the DIPA, Faculty of Agriculture, University of Tanjungpura for funding the research.

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PARENTING PATTERNS AND FAMILY CHARACTERISTICS AMONG STUNTED TODDLERS IN PALEMBANG

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ABSTRACT

Until today, there are still more than 20% children under five years old experiencing stunting due to malnutrition over a long time both in Indonesia and also globally. Therefore, an integrated program is needed to reduce the prevalence of stunting. This study investigated the correlation between parenting patterns and family characteristics with stunting. A matched case-control design was used based on age. Up to 40 cases and 40 controls of mothers having toddlers aged 24-59 months were selected as samples using simple random sampling technique. This study was conducted in Seberang Ulu I Sub-District, Palembang City, from September to October 2020. The data that has been collected were analyzed using univariate and bivariate analysis. The result showed that stunted and normal toddlers were mostly from mothers with poor parenting patterns in terms of feeding (72.5% & 45.0%), hygiene and sanitation (35.0% & 32.5%), and health care (42.5% & 15.0%). In addition, more cases of stunting came from mothers with high school education and below, low-income, at least 4 family members, and having more than 1 toddler. Feeding pattern, health care pattern, and mother's education affect toddlers' growth. The risk of stunting was higher in toddlers raised by mothers with low education, with poor feeding and health care practices than else.

Keywords: family characteristics, parenting patterns, stunting

INTRODUCTION

Stunting is a health problem experienced by toddlers due to chronic malnutrition especially from the womb until they become 23 months old which then affects growth faltering. In the world, the prevalence recorded decreased from 199.5 million (32.4%) in 2000 to 144 million (21.3%) in 2019. However, the highest prevalence is in South Asia (33.2%) and Sub-Saharan Africa (32.7%) (UNICEF, 2020). Indonesia still faces big challenges in preventing stunting and is the second country with the highest prevalence in the Southeast Asia region after Cambodia (Hidayat et al., 2019). The 2018 of *Riset Kesehatan Dasar (Riskesdas)* showed the prevalence among children aged 0-23 and 0-59 months was 29.9% and 30.8%, respectively. Based on the survey carried out in 2019 by the *Survei Status Gizi Balita Terintegrasi* (SSGBI), the prevalence among the 0-59 months age group was 27.67%. Although there has been a decrease, it still remains a public health problem Therefore, the Indonesian Government has set a target for the fulfillment of basic services in the Medium-Term National Development Plan (RPJMN) 2020-2024, to reduce the prevalence of stunting and severe stunting among toddlers by 19.0% in 2024 (Bappenas, 2019).

Based on the results from the SSGBI in 2019 too, the prevalence of stunting among toddlers in the South Sumatra Province was higher compared to the National, namely 28.98%. Moreover, in 2020, Palembang City was selected to become a priority locus for stunting apart from Ogan Ilir, Lahat, and Banyuasin Regency, which have been determined by the Indonesian Government.

The highest prevalence of stunting recorded in this City in 2018 was in Seberang Ulu I Sub-District, specifically at the work area of *Puskesmas 1 Ulu* (26.6%) (Pemerintah Kota Palembang Dinas Kesehatan, 2019). Seberang Ulu I is one of the sub-districts located along the Musi River experiencing environmental problems such as the low proportion of households with clean and healthy lifestyles, access to proper sanitation for the population, and fulfill the health requirements.

One of the possible approaches to prevent stunting is parenting patterns, which covers various aspects, such as feeding, hygiene and sanitation, health care, and psychosocial stimulation. Several results also showed that poor parenting causes

 Received 01-09-2021, Accepted 01-12-2021, Published online 30-05-2022.

toddlers to experience stunting, in terms of feeding (Femidio and Muniroh, 2020; Hijra et al., 2016; Zakaria and Suma, 2020), hygiene and sanitation (Pratiwi and Wahyuningsih, 2018; Rah et al., 2015; Yudianti and Saeni, 2016), health care (Bella et al., 2020; Nasrul et al., 2015; Noftalina et al., 2019), psychosocial stimulation (Noftalina et al., 2019). Furthermore, family characteristics such as maternal education (Abeway et al., 2018; Arbie and Labatjo, 2019; Beal et al., 2018; Ni'mah and Nadhiroh, 2015), monthly income (Islam et al., 2018; Sari et al., 2020), the number of family members (Cruz et al., 2017) and the number of toddlers in the household (Nkurunziza et al., 2017) influence the stunting incidence.

This study aims to determine the differences in parenting patterns, as well as the family characteristics of stunted and normal toddlers in Palembang City. It is also useful for the health office, public health center, and the community in identifying and mapping the real conditions of toddlers, especially nutritional status in the Seberang Ulu I Sub-District. The proposed hypothesis is that parenting patterns and family characteristics affect stunting in toddlers.

METHODS

A quantitative analytic approach with a matched case-control design and age as the matched variable was used. Investigations on stunting using commensurate case-control designs have not been much conducted and with no application of Conditional Logistics Regression analysis yet. Hence, this study provides more value for the academic world. Samples were mothers with children aged 24-59 months living in the Seberang Ulu I Sub-District. Furthermore, they were divided into the case group consisting of stunted toddlers, and the control comprising those having height according to normal age. Meanwhile, the inclusion criteria were single birth and last child, while the exclusion criteria were children with congenital heart disease/Diabetes Mellitus (DM) type 1. The sample size was calculated using the hypothesis test formula for the Odds Ratio (OR) value in both case and control group with an error rate (α) of 5%, power of the test (1-β) of 80%, OR=4.2, P_1=0.75 dan P_2=0.417 (Rahmad and Miko, 2016) and nonresponse (*drop out*) of 10%. Therefore, minimum samples of 40 cases dan 40 age-matched control were obtained. The sampling technique used was simple random sampling with data from e-PPGBM and recording of toddlers carried out by *posyandu* cadres or midwives in three health centers located in Seberang Ulu I Sub-District as a sampling frame.

The calculations of matched case-control samples in this study.

$$M \approx \frac{m}{P_2(1-P_1)+P_1(1-P_2)}$$

$$m = \frac{\left[\frac{\left(z_{1-\frac{\alpha}{2}}\right)}{2} + z_{1-\beta}\sqrt{P(1-P)}\right]^2}{(P-1/2)^2}$$

$$P = \frac{OR}{(1+OR)}$$

Explanation:

M	:	Matched case-control that needed
m	:	Total samples that needed
OR	:	Risk differences
P_2	:	The proportion of exposure subject in control group
P_1	:	The proportion of exposure subject in cases group

The data collected were processed and analyzed with statistical tools, where, univariate analysis was employed to explain the independent and dependent variables Bivariate analysis was carried out using Conditional Logistic Regression by displaying the OR value (95% CI), while the data obtained were presented in narrative and table form. Ethical approval was received from the Health Research Ethics Commission (KEPK) of the Faculty of Public Health, Universitas Sriwijaya, with Number 309/UN9.1.10/KKE/2020.

RESULTS AND DISCUSSIONS

The respondents' characteristics in the case and control groups can be seen in Table 1. The proportion of mothers with less feeding pattern in the case group (stunted) was higher by 27.5% compared to the control (normal), while those with less hygiene and sanitation (2.5%) as well as health

Table 1. Descriptive of Respondents Characteristics

Variables	*Stunting*			
	Yes	%	No	%
Feeding Pattern				
Less (≤80%)	29	72.5	18	45.0
Good (> 80%)	11	27.5	22	55.0
Hygiene and Sanitation Pattern				
Less (≤80%)	14	35.0	13	32.5
Good (> 80%)	26	65.0	27	67.5
Health Care Pattern				
Less (≤80%)	17	42.5	6	15.0
Good (> 80%)	23	57.5	34	85.0
Mother's Educational Level				
Less than SHS	25	62.5	12	30.0
SHS and above	15	37.5	28	70.0
Monthly Family Income				
Less than UMK	39	97.5	37	92.5
UMK and above	1	2.5	3	7.5
Number of Family Members				
Min 4 members	28	70.0	21	52.5
Max 4 members	12	30.0	19	47.5
Number of Toddlers				
2-3 toddlers	14	35.0	7	17.5
1 toddler	26	65.0	33	82.5

Source: Primary Data, 2020

SHS: Senior High School

UMK: *Upah Minimum Kota* (IDR 3,165,519)

care pattern (27.5%) was higher in the case group compared to the control group, respectively.

The proportion of mothers with high school education and below in the case group (stunted) was higher by 32.5% compared to the control (normal). The UMK between the case (97.5%) and the control group (92.5%). The number of family members of at least 4 individuals in the case group was more compared to the control by 17.5%. Meanwhile, the number of toddlers in the case group was 2-3, which was 17.5% more compared to the control.

Table 2 describes the effect of parenting patterns and family characteristics on the incidence of stunting among children aged 24-59 months in Seberang Ulu I Sub-District, Palembang. Variables of feeding pattern, health care pattern, and mother's educational level influence the incidence of stunting in toddlers. Moreover, the results showed mothers with poor feeding pattern were 2.4 times higher risk to having stunted children compared to their counterparts (p= 0.040; 95% CI = 1.04 to 5.42).

The risk of toddlers experiencing stunting is also higher in mothers that are not good at providing suitable health care than their counterpart (p = 0.015; OR = 4.67; 95% CI = 1.34 to 16.24). Meanwhile, the probability of toddlers experiencing stunting was also higher among mothers with high school education and below than mothers with high school education and above (p = 0.009; OR = 4.25; 95% CI = 1.43 to 12.63).

Stunting is a nutritional problem experienced by toddlers in Indonesia and around the world, which has an impact on the quality of Human Resources (HR). It contributes to 1.5 million (15%) toddler deaths globally and also causes 55 million Disability-Adjusted Life Years (DALYs) yearly. Stunting and various forms of nutritional problems are estimated to contribute to the loss of 2-3% of Gross Domestic Product (GDP) each year. Consequently, Indonesia is committed to reducing the cases by enacting Presidential Regulation Number 42 of 2013 concerning the National Movement on the Acceleration of Nutrition Improvement as outlined in the 2015-2019 National Food and Nutrition Action Plan (*RAN-PG*). The government stipulated Presidential Regulation Number 59 of 2017 concerning the Implementation of Achieving the Sustainable Development Goals (SDGs), which establishes stunting as a national priority. The central government also prepared a National Strategy to Accelerate Stunting Prevention from 2018 to 2014 (*Stranas Stunting*) (Bappenas, 2018).

Reduction of stunting is accomplished through two interventions, namely specific and sensitive nutrition interventions, where the initial is an activity generally carried out by the health sector, directly or specifically aimed at certain target groups such as toddlers, pregnant and young women, e.t.c. are. However, specific nutrition only contributes 30% in overcoming nutritional problems, while the remaining 70% is from sensitive nutrition interventions like providing access to clean water and sanitation, perform food fortification, providing access to health and family planning services, providing parenting education to parents (Bappenas, 2018). This is meant to prevent and reduce indirect nutritional problems

Table 2. Effect of Parenting Patterns and Family Characteristics with Stunting in Toddlers in Palembang

Variables	Stunting				OR (95%)	*p-value*
	Yes	%	No	%		
Feeding Pattern						
Less (≤80%)	29	72.5	18	45.0	2.37 (1.04 – 5.42)	0.040*
Good (> 80%)	11	27.5	22	55.0	Reference	
Hygiene and Sanitation Pattern						
Less (≤80%)	14	35.0	13	32.5	1.11 (0.45 – 2.73)	0.819
Good (> 80%)	26	65.0	27	67.5	Reference	
Health Care Pattern						
Less (≤80%)	17	42.5	6	15.0	4.67 (1.34 – 16.24)	0.015*
Good (> 80%)	23	57.5	34	85.0	Reference	
Mother's Educational Level						
Less than Senior High School	25	62.5	12	30.0	4.25 (1.43 – 12.63)	0.009*
Senior High School and above	15	37.5	28	70.0	Reference	
Monthly Family Income						
Less than UMK	39	97.5	37	92.5	3.00 (0.31 – 28.84)	0.341
UMK and above	1	2.5	3	7.5	Reference	
Number of Family Members						
At least 4 members	28	70.0	21	52.5	2.17 (0.82 – 5.70)	0.117
Maximal 4 members	12	30.0	19	47.5	Reference	
Number of Toddlers						
2-3 toddlers	14	35.0	7	17.5	2.00 (0.81 – 4.95)	0.134
1 toddler	26	65.0	33	82.5	Reference	

Source: Primary Data, 2020

* sig < 0.05

and is generally carried out by sectors outside of health (across ministries and institutions) (Rosha et al., 2016).

Parenting is an effort to fulfill the need for love, security, and sustainable welfare in the best interests of the child, provided by parents or families. Commitment, knowledge, and skills are needed by parents or families to implement the best parenting styles. Children need different mental stimulations (*asah*) which is the starting point in the learning process, psychosocial development, skills, intelligence, creativity, independence, morals, personality, and productivity. They also need affection (*asih*) leading to the creation of a close bond and basic trust with the parent. The last is biomedical physical needs (*asuh*) including food, nutrition, and the fulfillment of children's basic needs (Pranawati et al., 2015).

The results showed the incidence of stunting in toddlers was influenced by the feeding pattern. Previous studies by Widyaningsih et al., in 2018 and Bella et al., in 2020 discovered a correlation between feeding pattern and stunting in toddlers ($p< 0.05$) (Bella et al., 2020; Widyaningsih et al., 2018). In this study, up to 32.5% of stunted toddlers did not receive exclusive breastfeeding, 60.0% given early complementary feeding, and 27.5% didn't consume varied foods. The results are in line with previous studies which stated toddlers not provided with exclusive breastfeeding were more at risk of stunting (Campos et al., 2020; Windasari et al., 2020). Abeway et al., 2018 also said toddlers with early complementary feeding had 2.4 times higher risk of stunting compared to the toddlers with timely complementary feeding (95% CI: 1.26 to 4.66) (Abeway et al., 2018). In addition, Widyaningsih et al. stated proportion of stunted toddlers did not consume a variety of foods (85.4%) higher than the normal counterpart (62.7%) and the results were statistically significant ($p= 0.024$) (Widyaningsih et al., 2018).

In addition to feeding pattern, it was discovered that health care pattern also affects stunting such as monitoring child's growth and

development in *posyandu* every month. The results showed up to 17.5% of stunted toddlers did not weigh and measure their height at the *posyandu* and 27.5% had never received deworming medicine. These are in line with a previous study that stated proportion of stunted toddlers (68.8%) received poor health care from mothers higher than the normal counterpart (31.2%) ($p < 0.0001$) (Bella et al., 2020).

Exclusive breastfeeding, complementary feeding, weighing, and measuring height at the *posyandu* are part of priority-specific nutrition interventions for lactating mothers and children aged 0-23 months (target group). Various activities were carried out such as promotion for infant and child feeding (*Pemberian Makan Bayi dan Anak*), counseling for breastfeeding, and growth monitoring activities. Meanwhile, helminthiasis prevention is a priority intervention carried out according to certain conditions (for children aged 24-59 months). Diversity in food consumption is one part of sensitive nutrition interventions, namely increasing access to nutritious food through programs/activities to access non-cash food assistance (*Bantuan Pangan Nontunai*) for underprivileged families (Bappenas, 2018). These various activities are carried out in an integrated manner between specific and sensitive nutrition interventions to ensure stunting reduction efforts are more effective.

Meanwhile, the education of parents, especially mothers, plays an important role in determining the nutritional status of children. The results showed that maternal education is one of the factors influencing the incidence of stunting among toddlers. This result is supported by several previous results (Aguree et al., 2020; Alderman and Headey, 2017; Indriyan et al., 2018; Javid and Pu, 2020; Soekatri et al., 2020). A study in India and Ethiopia showed mothers with higher educational qualifications have lower probability to have a stunted toddler than to those with less educational qualifications (Dhami et al., 2019; Musbah and Worku, 2016). Subsequently, in efforts to prevent stunting among toddlers, mothers play an active role in increasing knowledge through various ways, including seeking information from health workers, *posyandu* or public health centers and mass media (printed or online).

The study carried out in Nigeria showed mother's knowledge about health and nutritional intake were capable of replacing formal education as an effort to reduce nutritional problems for toddlers in conditions of limited access to formal education (Fadare et al., 2019). Meanwhile, the result from West et al. suggested that using various media and services, over 80%, 31.7%, and 16.9% of Indonesian mothers obtain information about stunting from posyandu, public health centers, and internet, respectively. This indicates posyandu is still a facility capable of providing reliable information because it is designed to deliver basic health services to mothers and children, particularly monitoring their developmental process (West et al., 2018). This is in line with several activities in spesific and sensitive nutrition interventions that aim to increase awareness, commitment, parenting and maternal nutrition practices such as providing guidance in increasing community nutrition knowledge, disseminating information through various media, and providing parenting counseling for parents (parenting class) (Bappenas, 2018).

CONCLUSION

Based on the results, it was concluded that toddlers from mothers with high school education and below as well as less feeding and health care patterns tend to experience stunting (*p-value*< 0.05). However, monthly income, total members of the family, number of toddlers born, hygiene, and sanitation practice had no significant effect on stunting. The suggestions provided include parents or families (especially mothers) need to continue doing a good parenting pattern, feeding and health care practices, monitoring children's growth and development regularly through health workers or clinical service facilities (like *posyandu*).

ACKNOWLEDGEMENT

The author expresses gratitude to the respondents, alumni and students of the Public Health Study Program, Faculty of Public Health, Universitas Sriwijaya for their assistance in completing this study on time.

CONFLICT OF INTEREST AND FUNDING DISCLOSURE

All authors have no conflict of interest in this article. This research was funded by Institute for Research and Community Service (LPPM) Universitas Sriwijaya through a Science, Technology and Arts Research Grant in accordance with the Rector's Decree Number: 0684/UN9/SK.BUK.KP/2020 dated 15 July 2020.

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THE EFFECT OF RED DRAGON FRUIT (*Hylocereus polyrhizus*) ON ROS PLASMA OF OVERWEIGHT SPRAGUE DAWLEY RATS

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ABSTRACT

Red dragon fruit (Hylocereus polyrhizus) contains antioxidants, namely vitamin C, flavonoids, phenols, and betacyanins that can reduce or inhibit oxidative stress in the body. Excess body weight condition is associated with an increase in oxidative stress due to a decrease in antioxidants. This study was aimed to analyze the effects of red dragon fruit on the level of ROS (MDA) of overweight Sprague-Dawley rats.It used experimental analysis by using pre- and-posttest design with control group. A total sample of 30 male white Sprague-Dawley rats aged 8-12 weeks old with 150-200g of body weight were divided into 6 groups, namely: normal, negative control (KN), positive control (KP), red dragon fruit juice 3.5 g/200gBW (P1), overweight + dragon fruit juice 7 g/200gBW (P2), overweight + dragon fruit juice 10.5g/200gBW (P3) and were observed for 14 days. ROS levels were measured in the beginning and at the end of the intervention by using MDA markers with TBARs method.The results of MDA level measurements were 3.83 ± 0.13 in the KP group, 7.18 ± 0.27 in the P1 group, 5.30 ± 0.30 in the P2 group, and 4.35 ± 0.42 in the P3 group. The results of one-way ANOVA test showed a significant difference in MDA levels in all intervention groups compared to those of the normal and KN groups (p = 0.05). In conclusion, red dragon fruit intake can reduce ROS levels in overweight Sprague-Dawley rats.

Keywords: Red dragon fruit, ROS, overweight Sprague-Dawley rats

INTRODUCTION

World Obesity Federation stated that obesity is an epidemic which becomes the most important health problem (de Mello et al., 2017). Globally, the prevalence of overweight has tripled, amounting to 1.9 billion of the world's population. In Indonesia, around 13.6% of the population was recorded to be overweight in 2018 (Khadaee and Saidi, 2016; Rebello *et al.,* 2020). The problems of overweight and obesity are the fifth leading causes of global risk of death (Sudargo et al*.,* 2018). An increase in body mass index (BMI) of people aged 25-74 years old over the last five years indicates an increased risk of hypertension by 30% compared to those with normal BMI (Hall et al.,2019).

An increase in body weight can trigger insulin resistance in peripheral tissues through adipose tissue dysfunction or lipotoxicity, inflammation, mitochondrial dysfunction, hyperinsulinemia, and endoplasmic reticulum (ER) stress (Longo et al*.,* 2019). In overweight, there is excessive accumulation of intra-abdominal fat, causing disruption of adipocytokines production including leptin, resistin, adiponectin, monocyte chemoattractant protein-1(MCP-1), tumor necrosis factor-α (TNF-α), and interleukin-6 (IL-6) (Mesquida et al*.,* 2020). Obesity or overweight is associated with an increase in oxidative stress due to an imbalance between pro-oxidants and antioxidants (Yosika et al.,2020). High MDA level can be used as a marker of increased reactive oxidative stress (ROS) (Moazen et al*.,* 2013). Being overweight is an early sign of obesity wihch was has an impact on the emergence of various degenerative diseases such as diabetes mellitus (Muhammad et al*.,* 2019). So that treatment in overweight people is carried out as an early prevention.

The use of fruits to prevent the occurrence of free radicals has been widely studied. The content of bioactive compounds is a source of natural antioxidants. Antioxidants work by inhibiting or preventing ROS or as chain breakers of free radical reactions (Saklayen et al*.,* 2018). In addition, antioxidants can also be obtained from chemical

 Received 10-09-2021, Accepted 02-12-2021, Published online 30-05-2022.

synthesis. Synthetic antioxidants have several side effects, ranging from inflammation to liver damage and are carcinogenic if consumed in the long term (Parwata, 2016). Natural sources of antioxidants can be found in spices, whole grains, cereals, fruits, and vegetables.

Red dragon fruit (*Hylocereus polyrhizus*) has natural antioxidants such as betacyanins, flavonoids, polyphenols, lycopene, vitamin C, vitamin B1, vitamin B3, vitamin B12, beta-carotene, fiber and mineral phosphorus. The antioxidant activity of red dragon fruit is 67.45 ppm. It should be noted that a compound is said to have good antioxidant activity if the IC value is IC_{50}<200 ppm (Kim et al*.,* 2017).

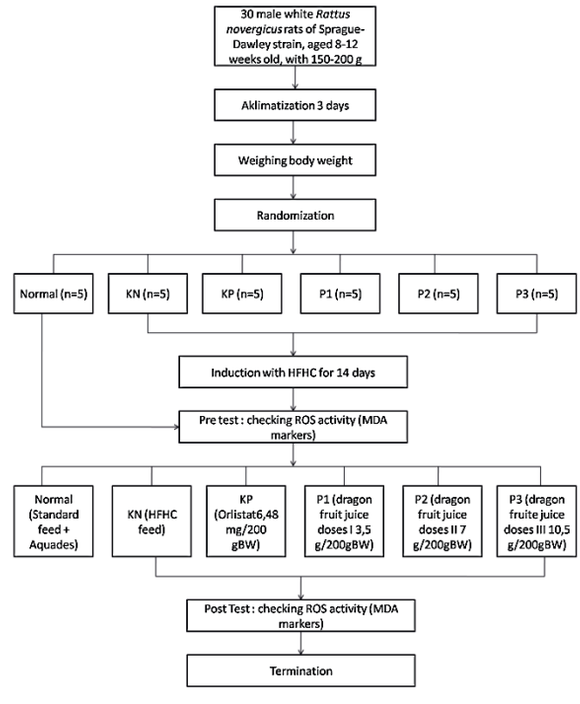
METHODS

This research used a randomized control trial with pre- and post-test control group design. Samples in this study were male white Sprague-Dawleystrain, aged 8-12 weeks old, with 150-200 g body weight, and in good health (normal activity, willing to eat, no anatomical abnormalities). The samples were never used in a scientific study and obtained from the Nutrition Laboratory of the Center for Food and Nutrition Studies of Inter-University Center (PAU), Gajah Mada University, Yogyakarta. The number of samples was calculated by using the Federer formula. Based on this formula, the number of samples was determined to be 5 rats in each group. To prevent drop-out, the number of samples was added by 20% so that the total number of samples obtained was 30 samples.

The samples were determined by simple random sampling and divided into 6 groups with 5 rats each, namely the normal weight group with standard feed, negative control (KN) group of overweight rats with intake of high fat high carbohydrate diet (HFHC), positive control group (KP) of overweight rats with intake of Orlistat 6.48 mg/200g of body weight, overweightrats group with red dragon fruit juice intake of 3.5 g/200g body weight (P1), overweight rats group with red dragon fruit juice intake of 7 g/200g body weight (P2), and overweight rat group with red dragon fruit juice intake of 10.5g/200g body weight (P3) (Picture 1). The standard Comfeed feed was AD II *ad libitum*. Each 100 g of standard AD-II feed contains 12% water, 7% ash, 15% crude protein, 3-7% crude fat, 0.9-11% calcium, 0.6-0.9% phosphorus, antibiotics, and up to 20 mg/day coccidiostats.

Modelling of overweight rats was carried out by giving them high-fat, high-carbohydrate (HFHC) diet. The composition of HFHC included 5% cheese, 10% egg yolk, 15% beef fat, 5% oil, 45% rice, and 20% standard feed (Ardiansyah et al*.,* 2018). HFHC was given for 14 days *ad libitum*.

The dose of red dragon fruit was given by using therapeutic doses that have been tested on humans, namely 200 ml of fruit juice obtained from 100 grams of fruit (Nisa et al*.,* 2019). The maximum volume of fluid administration for rats weighing 200 grams is 5 ml. The dose given refered to the dose in previous studies, namely 7.2 grams of dragon fruit which was reduced to 7 grams to see the effectiveness of giving dragon fruit at lower doses. The first dose was calculated by 0.5 x 7grams = 3.5 grams/200 grams. The second dose was 1 x 7 grams, and the third dose was 1.5 x 7 grams = 10.5 grams.



Picture 1. Samples Grouping and Intervention Flow

The overweight status in each rat was measured by using Lee index, which compares between the rat's height and its weight (Lee et al, 2011). Rats were determined overweight if their Lee index value was > 300. Rat weight was measured with a scale, while their height was measured with a ruler.

Malondyaldehyde (MDA) levels were measured by using spectrophotometry with 532 nm wavelength. Blood samples used were plasma blood taken 2 times after overweight modeling on the 15thday post-administration of red dragon fruit juice.MDA levels were checked using the TBARS reagent kit method. Take 3 cc of venous blood and put it into a centrifuge tube that has been given EDTA. And than blood samples were centrifuged at 3000 rpm for 30 minutes, 200 L supernatant was put into an empty centrifuge tube. Add 2 ml of 15% TCA solution. Add 0.37% TBA solution in 0.25 N . HCL. Heat in a water bath at 80^{o}C for 60 minutes. Centrifuge for 15 minutes at 3000 rpm. Take the supernatant and put it in the cuvette. Read the absorbance of the supernatant with a spectrophotometer at a wavelength of 532 nm with blanks in the form of TCA and TBA. MDA levels are obtained using the

$$\text{MDA (µmol/L)} = \frac{0{,}2422 + absorbansi}{0{,}0241}$$

The datas were analyzed with SPSS Version 16.0 and represented by the mean and standard deviation values. Before analyzed and first tested in terms of normality and homogeneity. To determine the effect of dragon fruit juice, it was analyzed with one-way ANOVA. The test results were considered statistically significant if the p value was less than 0.05.

This research has been approved by the Health Research Ethics Commission, Faculty of Medicine, Universitas Sebelas Maret Surakarta (KEPK UNS) No. 23/UN27.06.6.1/KEP/EC/2021.

RESULTS AND DISCUSSION

Table 1 shows the general difference in the average body weight of rats in all groups before and after HFHC induction. The results showed that there was no significant difference in weight at the beginning of the study (p=0.785). It indicated that the initial conditions of the rats were similar, before the treatment was given. The difference in the mean body weight of rats in all treatment groups induced by HFHC feed both on the 7th and 14th days showed a significant difference when compared to the normal rats group (p<0.001). The highest mean weight gain occurred in group P1 (213.6 ± 4.62) and the lowest was in group P3 (210.0 ± 5.70). The results of the average body weight of rats are shown in Table 1.

The results were in line with the of research by Wong (2018) which stated that administration of HFHC diet for 6 weeks could increase the body weight of obese rats. Another study on Sprague-Dawley rats showed that feeding a high-fat diet as much as 61% for 8 weeks could lead to obesity and increase visceral fat mass (Udomkasemsab and Prangthip, 2019). The presence of excess free fatty acids in adipose tissue increases the intracellular accumulation of acetyl-co-enzyme-A including diglycerides, triglycerides, monoglycerides, and ceramides which causes dephosphorylation

Table 1. Average on Body Weight After HFHC Induction

Group	Body Weight (g)		Δ (+)	Δ (%)	P
	Pre-test (Average ± SD)	Post-test (Average ± SD)			
Normal	183.2 ± 3.70	193.0 ± 2.92	376.2	205.3	<0.001[a]
KN	184.2 ± 3.77	210.6 ± 3.36	394.8	214.3	<0.001[a]
KP	186.4 ± 3.78	212.4 ± 4.45	398.8	213.9	<0.001[a]
P1	187.0 ± 3.54	213.6 ± 4.62	400.6	214.2	<0.001[a]
P2	184.8 ± 6.22	210.4 ± 7.23	395.2	213.8	<0.001[a]
P3	184.2 ± 6.10	210.0 ± 5.70	394.2	214.0	<0.001[a]
P	0.785[b]	<0.001[b]			

Source: Primary Data (2021). Data are presented in Average± SD.
a) Paired t Test. b) one-way Anova was significant if the p-value was less than 0.05

of protein kinase B/Akt. This process would trigger glucose transport to the tissues by glucose transporter-4 (GLUT-4). The occurrence of*protein kinase B*/*Akt* (PKB/Akt) dephosphorylation can inhibit the process of lipolysis and gluconeogenesis, causing an increase in body mass (Nissa and Madjid, 2016). Foods high in carbohydrates, animal protein, and fat can contribute to increased oxidative stress and the emergence of inflammation through theformation of white adipose tissue that secretes proinflammatory factors (Tan et al*.,* 2018; Tan and Norhaizan, 2019). A marker of excess fat accumulation in ectopic tissue is an increase of intra-abdominal visceral fat, which is associated with abdominal obesity (Tchernof et al*.,* 2013).

Furthermore, excessive intake of fat and carbohydrates can change oxygen metabolism which caused oxidation reactions. Excessive intake will cause enlargement of adipose tissue through adipocyte hypertrophy and hyperplasia. The imbalance between ROS and antioxidants causes an increase in oxidative stress, causing systemic inflammation. High ROS in the body will oxidize lipids and go through three phases including initiation, propagation, and termination. The initiation phase is marked by the removal of hydrogen atom from the lipid carbon which will then form lipid radicals. Propagation phase is marked by the rapid reaction of lipid radicals with oxygen to form lipid peroxyl radicals by taking hydrogen from other lipid molecules to produce new lipid radicals and form a chain reaction. Meanwhile, in the termination phase, the hydrogen atoms that have been lost will form lipid

Malondyaldehide MDA levels are the result of lipid peroxidation which is a marker of oxidative stress in the body (Susantiningsih, 2015). Lipid peroxidation is processed by withdrawing one electron from the PUFA double bond for the formation of radicals. Carbon lipid radicals will adapt themselves by rearranging the intra-molecular environment so that they can react quickly to form lipid peroxyl radicals. The presence of lipid peroxyl radicals will attract hydrogen atoms from other PUFA double bonds to form other lipid radicals. The reaction between lipid peroxyl radicals and hydrogen atoms will form lipid peroxidation (Thadeus et al*.,* 2018).

Effect of Dragon Fruit Juice on Plasma ROS (Reactive Oxygen Species)

The results of one-way ANOVA showed that there were a difference in the ROS among the groups with red dragon fruit juice treatment ($p<0.001$). The results of this study were in line with a research by Ma'arif et al (2020) which stated that administration of 200 g of red dragon fruit for 14 days could reduce ROS levels by 0.645 nmol/ml in smokers.The intervention of red dragon fruit juice for 14 days at three doses decreased the ROS plasma in all intervention groups. The highest decrease was found in the group of rats given dragon fruit juice at a dose of 10.5 g/200 gBW (51.07%). This study were in line with Zahra et al (2019), which showed that the administration of red dragon fruit juice to hypercholesterolemic rats could significantly reduce MDA levels.

Table 2 shows that that there was a decrease in MDA levels in all intervention groups. The most significant decrease in MDA was found in the KP group. The results showed that the use of Orlistat in overweight rats after 6 months could significantly reduce body weight, total cholesterol, LDL, and triglyceride levels, due to the reduction of the absorption of dietary fat. Orlistat inactivates gastrointestinal lipase. The lower the activity of enzymes produced by the intestine would result in, the less the reduction of the fat absorbed from. The weight loss was caused by Orlistat inhibiting the lipase enzyme which rendered the fatsnon-absorbable by the body and caused them to be excreted through feces. However, in addition to providing a good reduction effect, Orlistat has a high rate of side effects in the gastrointestinal tract (Ioannides-Demos *et al.,* 2011).

Weight loss is associated with a reduced levels of ROS. Red dragon fruit contains higher vitamin C white dragon fruit. In addition, the fiber content of red dragon fruit (3.2g/100g) also greater than white dragon fruit (1.1g/100g) (Choo and Yong, 2011; Mahattanatawee et al*.,* 2006). The presence of this nutrient can induce the hydrolyzation of the formation of bile salts andbind the bilesalts. The increased of bile salts can cause the increased of cholesterol excretio. Water-soluble dietary fiber is more easily fermented by intestinal bacteria to produce short chain fatty acids (SCFA) (Hapsari

Table 2. Average MDA levels in Rats

Group	MDA (nmol/ml)		Δ (+)	Δ (%)	P
	Pre-test (Average ± SD)	Post-test (Average ± SD)			
Normal	1.51± 0.26	1.81 ± 0.22	0.3	19.9	<0.001[a]
KN	9.02 ± 0.58	9.75 ± 0.44	0.73	8.09	<0.001[a]
KP	9.02 ± 0.74	3.83 ± 0.13	-5.19	-57.54	<0.001[a]
P1	8.84 ± 0.42	7.18 ± 0.27	-1.66	-18.78	<0.001[a]
P2	9.24 ± 0.27	5.30 ± 0.30	-3.94	-42.64	<0.001[a]
P3	8.89 ± 0.21	4.35 ± 0.42	-4.54	-51.07	<0.001[a]
p	0.718[b]	<0.001[b]			

Source: Primary Data (2021). Data are presented inAverage±SD. K= Normal group. KN= Negative group. KP= Positive control group with Orlistat of 6.48 mg/200grBB. P1= Red dragon fruit with the dose of 3.5 gr/200gBB. P2= Red dragon fruit with the dose of7 gr/200grBB. P3= Red dragon fruit with the dose of 10.5 gr/200grBB. The difference between pre-and-posttests used a) *paired t-test*. The difference between group tests used b) in which one-way ANOVA was significant if the p-value was less than 0.05.

and Kusumastuti, 2014; Pareira, 2010). SCFA has an effect on lowering cholesterol by inhibiting the HMG-CoA reductase enzyme.

The antioxidant activity of red dragon fruit is 134.1 ± 30.1 g GA/g. The phenol content is 24.22 ± 0.95 mg GA/100g. Phenol compounds play a role in counteracting free radicals and radil peroxide which are effective in inhibiting lipid oxidation (Susanti and Panunggal, 2015).

In addition, antioxidant compounds in the form of flavonoids in red dragon fruit play a role in preventing cell damage due to oxidative stress by donating hydrogen ions and thereby reducing the toxic effects of free radicals. The content of antioxidants such as flavonoids, phenols, vitamin C, and betacyanin in dragon fruit plays a role in warding off free radicals and lowering cholesterol levels. The way flavonoids work in inhibiting radicals is by donating hydrogen ions to stabilize free radicals and indirectly stimulate the expression of antioxidant genes and can increase bile secretion which can reduce cholesterol levels in the body (Thadeus et al.,2018). This is in line with research by Karimah et al(2014) showing that giving red dragon fruit juice can reduce cholesterol levels in hpypercholesterolemic rats. In addition, research conducted by Titrlolobi et al(2020) showed that giving red dragon fruit juice could significantly reduce blood sugar levels in people with diabetes mellitus.

CONCLUSION

The administration of red dragon fruit juice can reduce the ROS levels compare. The highest decrease was found at a doses 10,5 g/200 gBW. Red dragon fruit juice can be used as an alternative beverage that contains a source of antioxidants to tackle oxidative stress in people with overweight conditions. Further research on the antioxidant content of fruit juices and whole fruit is needed to see the difference in antioxidant activity by the different food processing. In addition, further research on the bioactive content in dragon fruit that plays a role in controlling and reducing oxidative stress.

ACKNOWLEDGEMENTS

We would like to thank all staffs ofthe Nutrition Laboratory of the Center for Food and Nutrition Studies of Inter-University Center (PAU), Gajah Mada University, Yogyakarta for the support in rearing the rats during this study.

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https://doi.org/10.204736/mgi.v17i2.151–158

ELEVATED GROWOL FLOUR REDUCE FASTING BLOOD GLUCOSE, HOMA-IR AND INCREASE INSULIN LEVEL IN RAT MODEL WITH TYPE 2 DIABETES MELLITUS

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ABSTRACT

The rise of glucose levels in the blood of patients with type-2 diabetes mellitus (T2DM) is attributed to the decrease of insulin secretion and the interruption of insulin activity. Growol is a fermented product made from cassava that has the potential to lower blood glucose levels in patients with T2DM. This study was aimed to evaluate the effects of oral administration of growol flour on the levels of blood glucose, insulin, and HOMA-IR. A total of 40 male Wistar rats were divided into 5 groups i.e., negative control group, positive control group taking metformin, and 3 treatment groups taking growol flour of 3.1, 6.2, and 9.3 (g/200gBW), respectively, for 2 weeks. Blood glucose levels were measured using Enzymatic Photometric Method GOD-PAP, insulin using the ELISA kit, and HOMA-IR using the formula. The Shapiro Wilk test was used to determine the normality of the data followed by the One-Way ANOVA test and Posthoc Tukey HSD test. The Paired T-test was used to see the difference of pre- and post-treatment levels of blood glucose, insulin, and HOMA-IR. There was a decrease ($p<0.05$) in blood glucose levels and HOMA-IR after the administration of low, moderate, and high doses of growol flour. In contrast, the levels of insulin increased ($p<0.05$) after the administration of low, moderate, and high doses. In conclusion, growol flour contributes to the maintenance of T2DM by lowering the levels of fasting blood glucose levels, as well as HOMA-IR, and increasing the levels of insulin in rats.

Keywords: fasting blood glucose, insulin, HOMA-IR, growol flour

INTRODUCTION

The prevalence of diabetes mellitus (DM) increases in both developed and developing countries, affecting 425 million people or 8.8% of the world adult population aged 20-79 years. It has been predicted that in 2045, the numbers will increase to 693 million people aged 18-99 years or 629 million people aged 20-79 years (IDF, 2019). Among Indonesian adults, the prevalence of DM in 2018 was 10.9% (Riskesdas, 2018). Type-2 diabetes mellitus (T2DM) is the most prevalent type of DM, accounting for 88-91% of the total cases (IDF, 2019). The World Health Organization (WHO) also states that 90-95% of diabetes cases are T2DM (WHO, 2019).

T2DM is characterized by hyperglycemia due to disruption of insulin activity and decreased insulin secretion, resulting in insulin resistance and dysfunction of pancreatic β cells (Fatimah, 2015; PERKENI, 2019). The insulin resistance that occurs in T2DM can be measured by using the Homeostatic Model Assessment of Insulin Resistance (HOMA-IR) method (Tjokroprawiro, 2017). According to the Indonesian Endocrinology Society (PERKENI) (2019), the treatment of T2DM includes pharmacological and non-pharmacological therapies. Pharmacological therapy involves consuming antidiabetes drugs while non-pharmacological therapy is an alternative treatment such as lifestyle management which includes physical activity, nutritional therapy, counseling of smoking habits and alcohol consumption, reducing salt consumption, increasing fruit and vegetable consumption, and consuming natural foods, one of which is growol (ADA, 2019).

Growol, a product of fermented cassava, originates from Kulon Progo, Yogyakarta, Indonesia. This local food has the potential as a functional food because it contains active components that can provide health benefits and is part of the daily consumption with acceptable sensory properties (Suter, 2013). The fermentation

 Received 16-10-2021, Accepted 07-12-2021, Published online 30-05-2022.

process that occurs during growol production hydrolyzes carbohydrate compounds such as starch, cellulose, and pectin into organic acids. In addition, amylolytic lactic acid secreted by the bacteria during the process of fermentation will naturally produce extracellular enzymes, namely amylase and pullulanase, which can then hydrolyze some of the natural starch into simple sugars, other oligosaccharides, or dextrins as well as some undigested resistant starch (Oktaviana et al., 2014; Astriani, 2015; Sari and Puspaningtyas, 2019). A previous study reported that growol contains 13.17 g/100 g of fiber (Puspaningtyas et al., 2019). In general, high dietary fiber content contributes to a low Glycemic Index (GI) value. The whole fiber can act as a physical barrier to digestion. In addition, fiber can also slow the rate of food in the digestive tract and inhibit enzyme activity so that the digestive process, especially starch, becomes slower and the blood glucose response will be lower. Thus, the GI tends to be lower (Rimbawan, 2004; Arief et al., 2013).

Dietary fiber has been shown to have an important role in glycemic control in patients with DM (Weickert and Pfeiffer, 2018). A meta-analysis of randomized clinical trials reported by Silva et al. (2013) showed that a high-fiber diet (42.5 g/day) or taking fiber supplements (15 g/day) decreased the levels of HbA1C and fasting plasma glucose in adults with T2DM. To our knowledge, there has been no research about the role of growol in T2DM. This study aimed to determine the effect of growol flour on fasting blood glucose, insulin, and HOMA-IR levels in vivo on a rat model of T2DM.

METHODS

This is an experimental laboratory study with Pre-Test and Post Test Control Group Design. The research was conducted in July 2021 at the Central Laboratory of Food and Nutrition Studies, Gadjah Mada University, Yogyakarta.

The materials used in this study included growol obtained from Kokap, Kulon Progo, Yogyakarta (growol has been steamed), growol flour (60 mesh), Wistar rats (male, aged 8 weeks, weighs 150-200 grams), aquadest, metformin tablet, a buffer solution, reagent GOD-PAP (Glucose Oxidase Phenol 4-Aminoantipyrine), standard feed, Streptozotocin (STZ), and Nicotinamide (Na). The instruments used were cabinet dryer, grinder, 60-mesh filter, gastric sonde, 1 set of experimental animal cages, gloves, analytical scales, animal scales, syringes, spectrophotometer (SP-300: Optima, Japan), and Rat Elisa Insulin Kit (Zenix-520 Automated Elisa Processor; PT Sumifin, Indonesia).

The growol flour is obtained by adding the growol steamed into a cabinet drum dryer for ± 6 hours at 80 ^{0}C. The drying process is aimed to reduce the pathogenic microorganisms and the moisture content of the material. The dried growol flour was then milled using a grinder. Then, it was sieved using a 60-mesh sieve to produce flour of the same size (Puspaningtyas et al., 2019).

A total of forty male Wistar rats with a bodyweight of 150-200 g/kgBW and aged 8 weeks were divided into 5 groups (Table 1). The rats were obtained from the Central Laboratory of Food and Nutrition Studies, Gadjah Mada University, Yogyakarta. The sample size was determined according to the guidelines from the Institutional Animal Care & Use Committee (IACUC) in which each group consisted of a minimum of 6 rats, 20% of which were added for substituting the dropout cases so that each group consisted of 8 rats.

Table 1. Experimental Design

Treatment Group	Intervention
Negative Group	DM Rats + Comfeed Standard Feed
Positive Group	DM Rats + Metformin
P1 Group	DM Rats + Growol Flour Low Dosage (3.1 g/200gBW)
P2 Group	DM Rats + Growol Flour Medium Dosage (6.2 g/200gBW)
P3 Group	DM Rats + Growol Flour High Dosage (9.3 g/200gBW)

Before the intervention, the animals were acclimatized for 7 days and fasted the night before diabetic inducement using a single dose of STZ 65 mg/kg + NA 230 mg/kgBW. After being induced, the rats were re-acclimatized for 72 hours. They were considered diabetic if their blood glucose levels were > 200 mg/dL (Anwer, 2014).

The dosage of dietary fiber administration was based on the daily health needs in T2DM patients, which is 20-35 g/kgBW (PERKENI, 2019). The determination of each dose was formulated based

on the daily dietary fiber requirement in humans, so after being converted according to the needs of the rats, the required dose of growol flour was 3.1 g/200 gBW (low dose), 6.2 g/200gBW (moderate dose), and 9.3 g/200 gBW (high dose).

The dose of metformin was based on the effect of lowering blood glucose by 500 mg/kgBW a day (Wells et al., 2008), so it was converted to 9 mg/200 gBW in rats. The intervention was given for 14 days. Growol flour is feeding in the morning two times. After being given growol flour sonde, the rats were given Comfeed standard feed and aquadest.

Fasting blood glucose examination was carried out 3 times i.e., before STZ-NA induction, pre-intervention (after STZ-NA induction), and post-intervention. Fasting blood glucose levels were determined using the Enzymatic Photometric Method GOD-PAP (Glucose Oxidase-Phenol 4-Aminoantipyrine). The samples examined were rat blood serum taken through the retro-orbital flexus. The rats' blood glucose levels were determined by spectrophotometry. Firstly, 1000-µL reagent glucose standard was mixed with 10-µl rat serum. Secondly, the solution was incubated for 10 minutes at 37 ^{0}C. Following the incubation, the rats' blood glucose levels were evaluated by using a spectrophotometer (SP-300: Optima, Japan) at 510-nm wavelength (Ramadhani, 2019).

The levels of blood insulin were measured twice i.e., pre-intervention and post-intervention. A total of 3-mL blood samples were collected from the retro-orbital flexus and then centrifuged at 3000 rpm for 7 minutes. The supernatant was taken and stored at -20 ^{0}C before use. The levels of fasting insulin were measured using a rat insulin ELISA kit (Zenix-520 Automated Elisa Processor; PT. Sumifin, Indonesia) according to the manufacturer's instruction. Briefly, the tubes were filled with rats' plasma obtained from each study group, and the standard reagents and enzymes were added into the tubes. The tubes were then incubated at -25 ^{0}C for 30 minutes. Following the incubation, 100-L solution A (buffer solution containing H_2O_2 next solution B [tetramethylbenzidine]) was added, and the mixture was re-incubated for 15 minutes. In the final step, 50 L of stop solution was added, and then the optical densities were read at a 450-nm wavelength. The HOMA-IR measurement uses the formula (Tjokroprawiro, 2017):

HOMA-IR =

$$\frac{fasting\ blood\ glucose\ \left(\frac{mg}{dL}\right) x\ fasting\ insulin\ levels\ \left(\mu\frac{U}{ml}\right)}{405}$$

The data were analyzed by using Statistical Product and Service Solutions (SPSS) version 17. The Shapiro Wilk test was used to determine the data distribution. Normally distributed data were tested using the One-Way ANOVA test followed by the Tukey HSD test if the data were homogeneous. If the data were not homogeneous, the Games Howell test was used to analyze. The data that were not normally distributed were tested using the Kruskal-Wallis test, followed by the Man-Whitney test. Differences in the levels of fasting blood glucose, insulin, and HOMA-IR before and after the treatment in all groups were tested by Paired T-Test if the data were normally distributed. If the data were not normally distributed, the analysis was performed using the Wilcoxon test. The protocol of this study has been approved by the research ethics committee of the Faculty of Medicine, Sebelas Maret University (reference number: 48/UN27.06.6.1/KEP/EC/2021).

RESULT AND DISCUSSION

The Levels of Fasting Blood Glucose

Table 2 shows the levels of fasting blood glucose before induction, after induction (pre-intervention), and post-intervention. There was a significant decrease ($p<0.05$) of fasting blood glucose in the G (+), P1, P2, and P3 groups. The greatest decrease (61.32%) in blood glucose occurred in the G (+) group. The levels of blood glucose after the consumption of growol flour in the P1—P3 groups decreased by 36.89%, 52.13%, and 57.49%, respectively. The results of the ANOVA test show no significant difference in the levels of blood glucose between the groups before the intervention ($p>0.05$); after the intervention for 14 days, there was a significant difference ($p<0.05$) in the levels of blood glucose among the 5 treatment groups.

Table 2. The Average Levels of Fasting Blood Glucose After 14 Days of Intervention

Group	Average Fasting Blood Glucose (mg/dL)			Rate Change	
	Day-0 (mean ± SD) mg/dL	Day-14 (mean ± SD) mg/dL	p[a]	Δ Fasting Blood Glucose (mg/dL)	%
Negative Group	262.22±5.02	263.21±4.99	0.595	0.99±-0.03	0.38
Positive Group	264.66±8.36	102.36±2.24	0.001*	-162.3±-6.12	61.32
P1 Group	268.72±3.79	169.60±1.28	0.001*	-99.12±-2.51	36.89
P2 Group	267.22±5.18	127.91±0.89	0.001*	-139.31±-4.29	52.13
P3 Group	264.83±3.05	112.59±1.98	0.001*	-152.24±-1.07	57.49
***p*[b]**	0.166	0.001*			

*) There is a significant difference
[a]) (p<0.05) Paired T-test
[b]) (p<0.05) One Way Anova Test

Table 3 shows that after 14 days of growol consumption, there was a significant difference ($p < 0.05$) in the levels of fasting blood glucose between the control groups and the treatment groups (P1, P2, and P3).

Table 3. Post Hoc Analysis of Fasting Blood Glucose Levels Before and After Intervention

Measurement Time		Negatif Control	Control (+)	P1 Group	P2 Group
D14[b]	P1 Group	0.001*	0.001*		0.001*
	P2 Group	0.001*	0.001*	0.001*	
	P3 Group	0.001*	0.001*	0.001*	0.001*

*) There is a significant difference
[b]) (p<0.05) Games Howell Test

Our study shows that the levels of fasting blood glucose decreased significantly after the consumption of growol flour at a low dose (3.1 g/200 gBW), medium dose (6.2 g/200 gBW), and high dose (9.3 g/200 gBW). The decrease of fasting blood glucose in the treatment groups was similar to that in the positive group given metformin (p<0,05). In addition, the decrease in the levels of blood glucose in rats consuming high doses of growol flour was close to that in rats consuming metformin. We assume that the decrease in blood glucose is influenced by the presence of dietary fiber within growol flour.

The results of table 3 show that the average difference in fasting blood glucose (FBG) levels in the negative group and the administration of growol flour with the three doses was statistically significant. This shows that growol flour can reduce FBG levels in rats with DMT2 model so that growol has the potential to become functional food for people with DMT2. In addition, if the P1, P2, and P3 groups were compared with the positive group, it was statistically significant, indicating that the administration of growol flour with three doses has not been able to replace the drug metformin in reducing FBG levels in T2DM rats.

Dietary fiber is beneficial for health and could reduce the risk of developing T2DM (Weickert and Pfeiffer, 2018). A previous study conducted by Puspaningtyas et al. (2019) stated that the dietary fiber in growol plays a role in controlling blood glucose. The positive effect of fiber on T2DM patients is that it can reduce blood glucose absorption by increasing the viscosity of macromolecules in the digestive tract, decreasing the levels of blood glucose (Yofanda and Estiasih, 2016). Furthermore, dietary fiber is also able to prevent hyperglycemia by inhibiting the absorption of glucose into the bloodstream (Saputro and Estiasih, 2015). Dietary fiber also increases food viscosity or facilitates gel formation, slowing down the process of gastric emptying and food digestion. As a result, there will be an increase in satiety, insulin secretion to increase, and absorption of nutrients including decreased glucose (Chen et al., 2016).

Insulin Levels

Impaired insulin secretion by pancreatic cells and the inability of insulin-sensitive tissue to respond to insulin are the main pathogenesis of T2DM (Roden and Shulman, 2019). Oxidative stress also contributes to T2DM by inducing insulin resistance in peripheral tissues and damaging

https://doi.org/10.204736/mgi.v17i2.151–158

insulin secretion from pancreatic cells (Triandita et al., 2016).

Table 4 shows significant differences ($p<0.05$) in insulin levels between the control groups and treatment groups. The results of the ANOVA test show no significant difference ($p>0.05$) in insulin levels between groups before the intervention was given. However, significant differences ($p<0.05$) in insulin levels were seen among the groups after 14 days of intervention.

Table 5 shows that after the intervention was given for 14 days, there was a significant difference ($p < 0.05$) in insulin levels between the negative control group and the treatment groups (P1, P2, and P3). In addition, there were significant differences in insulin levels between the positive control group and P1, P2, and P3, P1 and P2, P1 and P3 as well as between P2 and P3.

The increased levels of insulin that were seen in the group of rats consuming metformin (25.42%), were also observed in the treatment groups consuming low, medium, and high doses of growol flour i.e., 7.54%, 14.13%, and 20.57%, respectively. The increased insulin levels in this study were caused by insoluble fiber intake (8.06 in 100 grams of growol flour) which has been shown to increase insulin sensitivity through short-chain fatty acids produced by fiber fermentation in the intestine so that insulin resistance was reduced (Robertson et al., 2012; Chen et al., 2016; Feder and Foncesa, 2017).

A high dietary fiber contributes to a low glycemic index so that it can improve insulin sensitivity. This improvement is caused by a reduction in insulin requirements, decreased glucotoxicity effects due to reduced pancreatic-cell activity, cell dysfunction, and prolonged suppression of free fatty acid release (Visuthranukul et al., 2015). In addition to fiber, flavonoids contained in growol—flour can increase insulin sensitivity and reduce gluconeogenesis and oxidative stress (Vinayagam and Xu, 2015). Flavonoids can stimulate the release of insulin from pancreatic beta cells. In addition, flavonoids are also able to stimulate glucose uptake in peripheral tissues. The activity of the enzymes involved is regulated during carbohydrate metabolism and can also act like insulin by influencing insulin signaling (Warditiani et al., 2015).

Table 5. Post Hoc Analysis of Insulin Levels Before and After Intervention

Measurement Time		Control (-)	Control (+)	P1 Group	P2 Group
D14[a]	P1 Group	0.001*	0.001*		0.001*
	P2 Group	0.001*	0.001*	0.001*	
	P3 Group	0.001*	0.001*	0.001*	0.001*

*) There is a significant difference
[a]) ($p<0.05$) Tukey HSD Test

Insulin Resistance (HOMA-IR)

Insulin resistance is defined as a condition in which the biologic response of tissues (liver, muscle, and adipose tissue) is impaired by insulin stimulation. The condition of insulin resistance results in decreased pancreatic cell function. This is due to a compensatory increase in cell insulin production and hyperinsulinemia (Brown et al., 2019; Deacon, 2019; Seong et al., 2019). Insulin resistance can be assessed using HOMA-IR which is the gold standard in measuring insulin resistance (Freeman et al., 2019).

Table 4. The Average Levels of insulin 14 Days of Intervention

Group	Average Insulin (pg/mL)			Rate Change	
	Day-0 (*mean* ± *SD*) pg/mL	Day-14 (*mean* ± *SD*) pg/mL	*p*[a]	Δ Insulin (pg/mL)	%
Negative Group	425.15±4.69	416.70±6.97	0.001*	-8.45±2.28	1.99
Positive Group	425.43±5.03	533.56±6.93	0.001*	108.13±1.90	25.42
P1 Group	425.01±4.23	457.04±4.70	0.001*	32.03±0.47	7.54
P2 Group	424.88±4.77	484.90±5.33	0.001*	60.02±0.56	14.13
P3 Group	421.96±4.25	508.75±3.99	0.001*	86.79±-0.26	20.57
p[b]	0.555	0.001*			

*) There is a significant difference
[a]) ($p<0.05$) Paired T-test
[b]) ($p<0.05$) One Way Anova Test

Table 6 shows a significant difference (p<0.05) in HOMA-IR in G (+), P1, P2, and P3 groups. However, there was no significant difference (p>0.05) in HOMA-IR in the negative control group. The results of the ANOVA test show no significant change (p>0.05) in HOMA-IR between groups before the intervention. However, after 14 days of intervention, the results of the Kruskal Wallis test showed a significant change (p<0.05) in HOMA-IR between the treatment groups. Furthermore, the results of the Mann-Whitney test show significant differences (p<0.05) in HOMA-IR between all treatment groups after 14 days of intervention (Table 7).

The HOMA-IR value decreased remarkably (51.50%) in the positive control group. Our study shows that there was a decrease in the HOMA-IR values in P1, P2, and P3 by 32.15%, 45.36%, and 48.73%, respectively. High dietary fiber in the diet is associated with a reduction in insulin resistance (Indrasari, 2019). In patients with T2DM, insulin resistance occurs in the liver, skeletal, muscle, and adipose tissue (Prakash et al., 2015). Insulin resistance impairs glycogen synthesis, fails to suppress glucose production, increases lipogenesis, and increases protein synthesis such as proinflammatory in the liver (Galicia-Garcia et al., 2020). The high value of HOMA-IR causes the uptake and use of glucose by body cells to be disrupted, increasing blood glucose levels (Nurhidajah and Nurrahman, 2017).

Table 7 shows that the average difference in HOMA-IR between the negative group and the group (P1, P2, and P3) statistically significant. This shows that the administration of growol flour with these three doses can reduce the HOMA-IR value in DMT2 model rats. In addition, the difference in the mean HOMA-IR scores between the metformin group and the P1, P2, and P3 groups was statistically significant (p<0.05), while the difference in the decrease in the HOMA-IR scores in the positive group was higher when compared to the treatment group. This shows that the administration of growol flour has not been able to replace the drug metformin in reducing the HOMA-IR value.

Table 7. Post Hoc Analysis of HOMA-IR Before and After Intervention

Measurement Time		Control (-)	Control (+)	P1 Group	P2 Group
D14b	P1 Group	0.001*	0.001*		0.001*
	P2 Group	0.001*	0.001*	0.001*	
	P3 Group	0.001*	0.007*	0.001*	0.001*

*) There is a significant difference
b) (p<0.05) Mann Whitney Test

The strength of our research is that growol flour with the lowest dose and the highest dose can reduce fasting blood glucose levels, HOMA-IR, and increase insulin levels in rat model with type 2 diabetes mellitus. Meanwhile, the limitations of this study are that the flavonoid content examined is still not specific and has not been studied in vitro, it is still limited to in vivo research.

CONCLUSIONS

The growol flour can significantly reduce the levels of fasting blood glucose and HOMA-IR and can increase insulin levels in T2DM rats. Growol flour has the potential to be a functional food for people with T2DM, and further clinical studies can be carried out in humans.

Table 6. The Average HOMA-IR After 14 Days of Intervention

Group	Average HOMA-IR			Rate Change	
	Day-0 (*mean* ± *SD*)	Day-14 (*mean* ± *SD*)	p	Δ HOMA-IR	%
Negative Group	8.26±0.15	8.12±0.25	0.113[a]	-0.14±0,10	1.70
Positive Group	8.33±0.20	4.04±0.13	0.001[a]	-4.29±0,07	51.50
P1 Group	8.46±0.15	5.74±0.12	0.001[a]	-2.72±0,03	32.15
P2 Group	8.40±0.13	4.59±0.05	0.001[a]	-3.81±-0,08	45.36
P3 Group	8.27±0.12	4.24±0.08	0.012[c]	-4.03±-0,04	48.73
p	0.085[b]	0.001[d]			

[a]) (p<0.05) Paired T-test
[b]) (p<0.05) One Way Anova Test
[c]) (p<0.05) Wilcoxon Test
[d]) (p<0.05) Kruskal Walis Test

ACKNOWLEDGEMENT

We would like to thank Mr. Yuli as a laboratory assistant who helped in the research process at the Central Laboratory of Food and Nutrition Studies, Gadjah Mada University, Yogyakarta, Indonesia.

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PERBEDAAN KADAR ZAT BESI BERDASARKAN WAKTU PEMASAKAN DAN METODE YANG DITERAPKAN PADA TEMPE DAN HATI SAPI: SEBUAH STUDI EKSPERIMENTAL

The Difference of Iron Level Based on the Cooking Time and Methods Applied on the Tempeh and Beef Liver: An Experimental Study

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ABSTRAK

Defisiensi zat besi merupakan penyebab umum terjadinya anemia secara global sehingga diperlukan konsumsi makanan sumber zat besi yang cukup untuk mencegah terjadinya anemia. Salah satu cara yang dapat digunakan untuk mencukupi asupan zat besi adalah dengan meminimalisir hilangnya zat besi pada proses pemasakan bahan makanan sumber zat besi. Hati sapi dan tempe adalah bahan makanan sumber zat besi yang mudah ditemui di Indonesia. Tujuan dari penelitian ini adalah untuk menganalisis pengaruh teknik dan waktu pemasakan terhadap kadar zat besi hati sapi dan tempe. Penelitian ini merupakan penelitian ekperimental murni dimana terdapat tiga teknik memasak yang digunakan, yaitu merebus, merebus+pengadukan, dan mengukus, serta menggunakan 2 waktu memasak, yaitu selama 10 dan 15 menit. Setelah proses pemasakan, kadar zat besi pada bahan makanan diukur menggunakan metode *Atomic Absorption Spectroscopy* (AAS). Hasil dari penelitian ini menunjukkan terjadi penurunan kadar zat besi sebesar 22,43 – 34,61% pada proses merebus, 42,24 – 49,64% pada proses merebus+pengadukan, dan 11,93 – 19,09% pada proses mengukus. Selain itu, berdasarkan waktu pengolahan menunjukkan penurunan kadar zat besi yang lebih tinggi pada pemasakan selama 15 menit dibandingkan pemasakan selama 10 menit. Hasil dari penelitian ini menunjukkan bahwa teknik pengolahan dan lama waktu pengolahan berhubungan secara signifikan dengan kadar zat besi pada tempe dan hati sapi dimana mengukus selama 10 menit memiliki kadar zat besi paling tinggi.

Kata kunci: teknik memasak, waktu memasak, hati sapi, tempe, kadar besi

ABSTRACT

Iron deficiency is a common cause of anemia, so it is necessary to consume adequate food sources of iron to prevent anemia. One way that can be used to fulfill iron intake is by minimize the loss of iron in the cooking process. Beef liver and tempeh are the common iron food sources in Indonesia. This study aimed to analyze the effect of cooking methods and cooking times on the iron levels of beef liver and tempeh. This study was an experimental. There are three cooking methods used in this study: boiling, boiling + stirring, and steaming, and two cooking times were applied for each treatment: 10 and 15 minutes. We were measured the iron level using the Atomic Absorption Spectroscopy (AAS) method. The study results showed that boiling decreased the iron content of tempeh and beef liver by a range of 22.43-34.61%, boiling+stirring decreased the iron content by a range of 42.24-49.64%, and steaming decreased the iron content by a range of 11.93-19.09%. Based on cooking time, cooking for 15 minutes showed a higher reduction in iron content than cooking for 10 minutes. However, cooking methods and cooking times significantly affect the iron level of beef liver and tempeh while steaming for 10 minutes has the highest iron level.

Keywords: *cooking method, cooking time, beef liver, tempeh, iron level*

PENDAHULUAN

Anemia adalah kondisi dimana konsentrasi hemoglobin (Hb) dan jumlah sel darah merah tidak mencukupi atau kurang dari angka normal untuk dapat memenuhi kebutuhan fisiologis tubuh (WHO, 2011; Chaparro dan Suchdev, 2019). Masalah gizi ini dapat menyebabkan beberapa tanda pada penderitanya, diantaranya mudah lelah, sesak napas, jantung berdebar-debar, kulit pucat, penurunan daya tahan tubuh dan penurunan daya pikir (Chaparro dan Suchdev, 2019; Kemenkes,

 Received 29-04-2021, Accepted 06-08-2021, Published online 30-01-2022.

2016). Di Indonesia terjadi peningkatan prevalensi anemia berdasarkan Riskesdas 2018 jika dibandingkan dengan tahun 2013 sebesar 11,8%. Adanya peningkatan tersebut menjadikan masalah anemia perlu menjadi sorotan untuk segera diatasi dengan mengetahui penyebab terjadinya anemia.

Defisiensi zat besi merupakan penyebab utama anemia secara global (Suryani *et al*., 2015). Zat besi (Fe) merupakan mineral mikro yang paling banyak terdapat dalam tubuh, yaitu sebesar 3 – 5 gram pada tubuh orang dewasa (Almatsier, 2010). Zat besi juga merupakan mineral yang diperlukan dalam proses pembentukan hemoglobin (Hb) (Almatsier, 2010).

Penelitian yang telah ada sebelumnya menunjukkan proses pemasakan dapat meningkatkan penyerapan zat besi dalam tubuh (Fabbri & Crosby, 2015). Hal ini karena pemasakan cenderung menurunkan kadar faktor penghambat penyerapan zat besi seperti asam fitat, oksalat, dan tanin sehingga zat besi dapat lebih mudah diserap (Issa *et al.,* 2019). Namun dalam beberapa penelitian lain dipadatkan bahwa kadar zat besi pada makanan dapat menurun pada berbagai jenis proses pemasakan dan lama waktu pemasakan (Kusnadi *et al*., 2016; Purwaningsih *et al*., 2011; Ekafitri *et al*., 2019; Kurnia, 2011; Bastias *et al.,* 2017). Hasil dari penelitian sebelumnya menunjukkan terdapat perbedaan kadar zat besi pada ikan salmon dan ikan makarel yang diolah dengan teknik dan waktu yang sama. Penelitian tersebut didapatkan bahwa ikan salmon yang dimasak dengan oven selama 20 menit dan dilanjutkan pengovenan selama 5 menit menyebabkan penurunan kadar xat besi, sedangkan kadar zat besi pada ikan makarel yang dimasak dengan teknik dan waktu yang sama menunjukkan peningkatan (Bastias *et al.,* 2017).

Jenis teknik yang digunakan dalam proses pemasakan juga menjadi salah satu faktor penentu kadar zat besi pada makanan. Penelitian Purwaningsih *et al.* (2011), menyatakan bahwa proses pengukusan menyebabkan kehilangan kadar zat besi pada bahan makanan lebih sedikit dari pada proses perebusan. Hal ini diperkuat oleh Kusnadi *et al* (2016), bahwa jenis mineral pada umumnya tahan terhadap proses pemanasan, tetapi rentan terhadap proses pengolahan yang menggunakan air sehingga bahan makanan yang diolah dan bersentuhan dengan air secara langsung memiliki kemungkinan kehilangan zat besi lebih tinggi. Namun penelitian Khosroshahi (2016) menyatakan bahwa proses perebusan tidak menyebabkan hilangnya zat besi pada makanan.

Selain jenis teknik pemasakan, pengadukan merupakan salah satu faktor yang dapat mempengaruhi kelarutan suatu zat dalam pelarut (Sinala, 2016). Hal ini dibuktikan dalam penelitian Thanuja *et al.,* (2019) bahwa adanya proses pengadukan pada saat menggoreng (menumis) dan merebus dapat menyebabkan turunnya kadar TPC (*Total Phenolic Content*) dan TFC (*Total Flavonoid Content*) pada tomat. Hasil penelitian tersebut juga diperkuat oleh penelitian Dewi (2010) yang menunjukkan bahwa lama pengadukan dapat meningkatkan kelarutan testosteron pada proses ekstraksi teripang pasir. Peningkatan kelarutan dari beberapa zat tersebut karena adanya pengadukan juga bisa terjadi pada zat besi karena zat besi merupakan jenis mineral yang rentan terhadap pengolahan dengan air (Kusnadi *et al.*, 2016). Akan tetapi juga terdapat hasil penelitian yang bertolak belakang yaitu pengadukan saat menggoreng (menumis) tidak berpengaruh pada kadar glukosinolat kubis China dan pakchoi (Nugrahedi *et al.,* 2017). Hasil penelitian pada kelarutan terkait pengadukan yang berbeda pada berbagai zat gizi menjadikan pentingnya dilakukan penelitian pada zat gizi lainnya, salah satunya zat besi. Tidak hanya terkait pengadukan, perbedaan hasil dari penelitian sebelumnya terkait jenis teknik dan lama waktu pemasakan menjadikan perlunya dilakukan penelitian terkait hal tersebut.

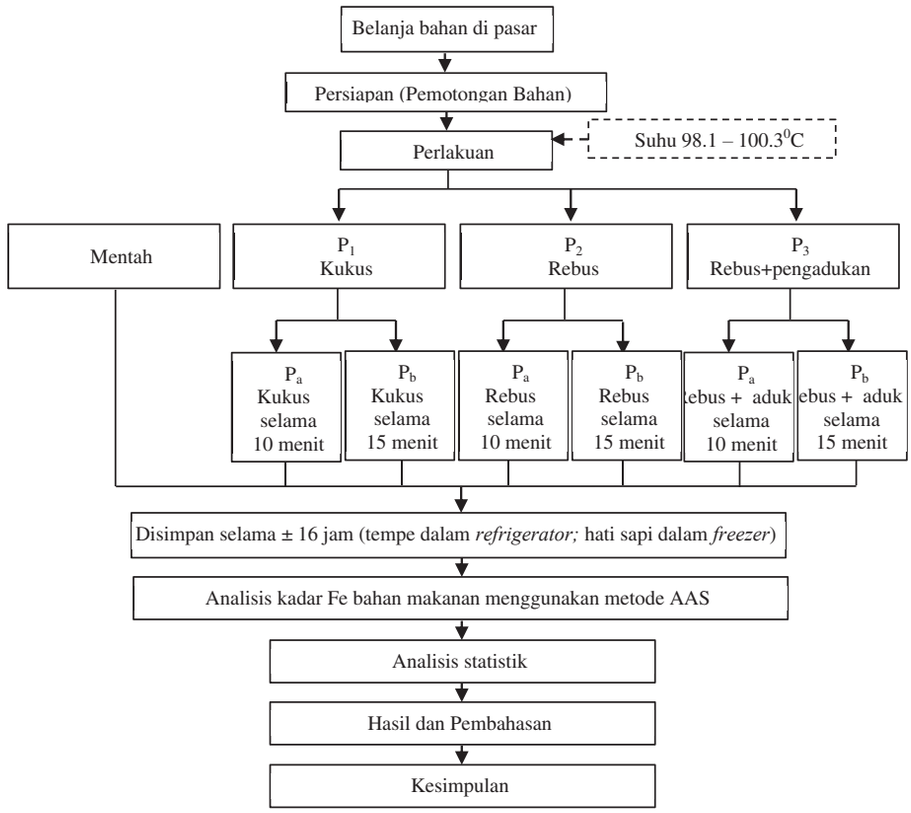
Hasil dari penelitian terdahulu menjadikan dasar dilakukan penelitian ini dengan tujuan untuk menganalisis pengaruh teknik dan waktu pemasakan terhadap kadar zat besi pada bahan makanan sumber zat besi. Bahan makanan sumber zat besi yang digunakan dalam penelitian ini adalah tempe dan hati sapi yang merupakan perwakilan dari bahan makanan nabati dan hewani yang cukup sering menjadi bahan makanan masyarakat Indonesia.

METODE PENELITIAN

Penelitian ini merupakan penelitian eksperimental murni dengan melakukan pemasakan

menggunakan teknik pemasakan yang berbeda (pengukusan, perebusan dengan pengadukan, perebusan tanpa pengadukan), serta dilakukan dalam dua lama waktu pengolahan (10 dan 15 menit) pada bahan makanan sumber zat besi, baik nabati (tempe) maupun hewani (hati sapi). Rancangan percobaan yang digunakan adalah rancangan acak lengkap. Penelitian ini dilakukan di dapur peneliti dikarenakan adanya pandemi dengan tetap memperhatikan berbagai variabel perancu pada Agustus 2020. Variabel perancu yang diperhatikan dalam menjalankan penelitian ini adalah jenis bahan pada alat memasak dan diameter dari alat tersebut. Dandang dan panci yang digunakan dalam penelitian ini berbahan dasar *stainless steel.* Alat masak dengan ini dipilih karena tahan panas dan api, lebih tahan korosi, mudah dibersihkan dari sisa makanan, serta tidak bereaksi terhadap makanan yang dimasak (Schmidt *et al.,* 2012; Armila, 2017). Panci yang digunakan juga memiliki diameter yang sama sehingga jumlah air yang diperlukan hingga semua bahan makanan terendam dapat dikontrol.

Terdapat beberapa variabel kontrol yang diperhatikan dalam penelitian ini, diantaranya adalah jenis dan jumlah air pemasakan, suhu pemasakan, serta penyimpanan. Volume air yang digunakan untuk penelitian ini sebanyak 320 mL untuk masing-masing perlakuan. Volume tersebut disesuaikan dengan jumlah bahan makanan yang dimasak dan diameter alat memasak yang digunakan sehingga bahan makanan dapat terendam air seluruhnya saat direbus. Perlakuan tersebut disesuaikan dengan syarat merebus dimana volume air melebihi bahan makanan (Lubis dan Sutejo, 2013). Berdasarkan volume air yang diperlukan dalam setiap perlakuan sehingga dapat diperoleh total air yang diperlukan adalah 15,36 liter. Jumlah air tersebut dapat dipenuhi dengan menggunakan satu galon air mineral yang sama. Bahan makanan dalam penelitian ini dimasak dengan menggunakan kompor gas dengan suhu berkisar pada 98,1–100,3^{0}C yang diukur menggunakan *thermometer* digital. Rentang suhu tersebut berlaku untuk ketiga teknik pemasakan yang digunakan. Fluktuasi suhu dalam penelitian ini diatur dengan membesarkan atau mengecilkan



Gambar 1. Diagram Alir Penelitian

api pada kompor sehingga didapatkan kisaran suhu proses pemasakan yang sama.

Sebelum dilakukan pemasakan, bahan makanan tidak melalui proses penyimpanan. Penyimpanan dilakukan setelah pemasakan untuk menunggu dilakukannya analisa kadar zat besi. Proses penyimpanan ini berlangsung selama ± 16 jam. Penyimpanan tempe dilakukan dalam *refrigerator* dengan suhu 4^0C, sedangkan hati sapi disimpan dalam *freezer.* Suhu penyimpanan yang digunakan tersebut sudah disesuaikan dengan ketentuan dari Kemenkes (Bakri *et al.,* 2018; Purwanto dan Weliana, 2018). Berikut adalah diagram alir penelitian disajikan dalam **Gambar 1.**

Jumlah sampel penelitian berjumlah 24 untuk masing-masing bahan makanan yang didapatkan dari rumus Federer [(t – 1) (n – 1) ≥ 15] dimana t adalah jumlah perlakuan sampel dan n adalah jumlah pengulangan (Charan & Kantharia, 2013). Berikut adalah hitungan besaran sampel.

$$\begin{aligned} (t-1)(n-1) &\geq 15 \\ (6-1)(n-1) &\geq 15 \\ 5(n-1) &\geq 15 \\ n-1 &\geq 3 \\ n &\geq 4 \end{aligned}$$

Alat yang dibutuhkan dalam penelitian ini adalah *cutting board,* piring, pisau, timbangan makanan digital, kompor, dandang *stainless*, panci *stainless*, spatula, penjapit makanan, dan alat pengukur suhu (*thermometer*) digital. Bahan yang digunakan adalah tempe, hati sapi, dan air mineral. Sebelum dilakukan pemasakan, kedua jenis bahan makanan akan dipotong dalam bentuk dan ukuran yang sama, yaitu dipotong dalam bentuk dadu dengan panjang sisi ± 2 cm.

Analisis kimia yang dilakukan pada sampel adalah analisis kandungan zat besi yang dilakukan di Laboratorium Gizi Fakultas Kesehatan Masyarakat Universitas Airlangga dengan menggunakan metode *Atomic Absorption Spectroscopy* (AAS).

Uji statistik yang digunakan dalam penelitian ini adalah uji *Kolmogorof-Smirnov* untuk menguji normalitas dan uji *Levene* untuk menguji homogenitas. Setelah diketahui data tersebut berdistribusi normal dan homogen, analisis dilanjutkan dengan menggunakan uji *Two Way ANOVA (Analisys Of Variance)* dan dilanjutkan dengan uji *Post Hoc Tukey* setelah diketahui bahwa H_0 ditolak. Analisis statistik ini dilakukan dengan menggunakan *IBM SPSS Statistic 21*.

HASIL DAN PEMBAHASAN

Terdapat dua bahan makanan yang digunakan dalam penelitian ini, yaitu tempe dan hati sapi. Tempe yang digunakan dalam penelitian ini merupakan tempe kedelai murni yang dibeli di Pasar Pacar Keling Surabaya, berasal dari satu produsen yang sama, serta diproduksi pada hari yang sama. Sedangkan, hati sapi yang digunakan merupakan hati sapi yang berasal dari satu sapi.

Sebelum dilakukan pemasakan, tempe dan hati sapi dipotong terlebih dahulu dalam bentuk dadu dengan panjang sisi masing-masing potongan sepanjang 2 cm, serta berat sebesar 5 gram untuk tempe dan 10 gram untuk hati sapi. Pemotongan ini bertujuan untuk mendapatkan ukuran dan luas penampang yang sama karena ukuran dan luas penampang dapat mempengaruhi kelarutan suatu zat (Sinala, 2016). Setelah dipotong, kedua bahan makanan tersebut memasak dengan tiga teknik yang berbeda (merebus, merebus+pengadukan, mengukus) dan dalam dua lama waktu pemasakan (10 dan 15 menit). Setiap perlakuan tersebut dilakukan pengulangan sebanyak 4 kali sehingga terdapat 24 sampel untuk masing-masing bahan makanan. Setelah masing-masing sampel diberikan perlakuan kemudian dilakukan uji laboratorium terhadap kadar zat besi menggunakan metode *AAS.* Uji kadar zat besi dengan metode ini memerlukan sampel minimal sebanyak 25 gram sebagai antisipasi jika diperlukan pengulangan uji laboratorium pada sampel sehingga diperlukan 5 potong tempe dan 3 potong hati sapi dalam satu kali pemasakan. Berikut adalah hasil analisa kadar zat besi pada tempe dan hati sapi yang telah disajikan dalam **Tabel 1**.

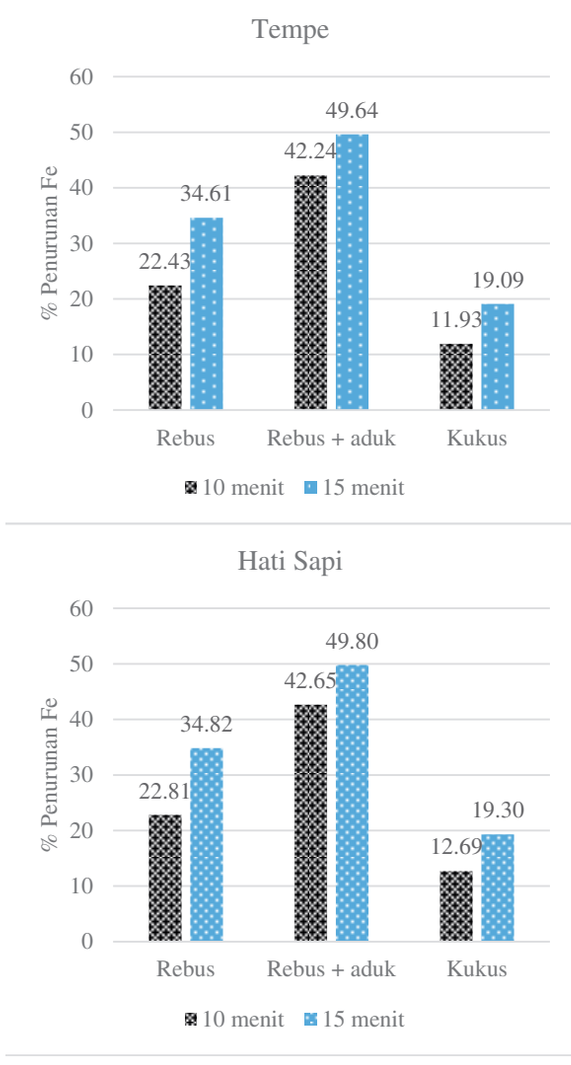
Berdasarkan data tersebut dapat dilakukan perhitungan lanjutan untuk mengetahui selisih antara kelompok perlakuan dan kontrol. Data selisih tersebut juga bisa disebut sebagai jumlah penurunan kadar zat besi setelah proses pemasakan. Berikut adalah persentase penurunan kadar zat besi pada tempe dan hati sapi setelah proses pemasakan yang telah disajikan dalam **Gambar 2.**

https://doi.org/10.204736/mgi.v17i2.159–167

Tabel 1. Analisis Kadar Zat Besi pada Tempe dan Hati Sapi: rata-rata ± SD (*Standard Deviation; n = 4*)

Waktu Memasak	Teknik Memasak	Kadar Rata-Rata Zat Besi (mg/100g) ± SD	
		Tempe	Hati Sapi
Kontrol	Kontrol	4,19*	7,41*
10 menit	Rebus	3,25 ± 0,03	5,72 ± 0,02
	Rebus + Pengadukan	2,42 ± 0,02	4,25 ± 0,01
	Kukus	3,69 ± 0,13	6,47 ± 0,02
15 menit	Rebus	2,74 ± 0,02	4,83 ± 0,01
	Rebus + Pengadukan	2,11 ± 0,01	3,71 ± 0,01
	Kukus	3,39 ± 0,02	5,98 ± 0,01

**n = 1*



Gambar 2. Persen Penurunan Kadar Zat Besi Pada Tempe dan Hati Sapi Setelah Proses Pemasakan

Berdasarkan teori yang telah ada sebelumnya, tempe dan hati sapi yang terpapar langsung dengan oksigen sebelum proses pemasakan dapat menyebabkan zat besi *ferro* (Fe^{2+}) yang terkandung dalam bahan makanan tersebut teroksidasi menjadi zat besi *ferri* (Fe^{3+}) sehingga sulit untuk larut dengan air (Asmaningrum, 2016). Namun, penggunaan air tanah dalam penelitian ini menyebabkan proses reduksi sehingga terjadi penurunan kadar zat besi pada tempe dan hati sapi seperti yang tertera dalam gambar 1. Dari hasil pengukuran kadar zat besi pada tempe dan hati sapi dengan metode *AAS,* diketahui terjadinya penurunan kadar zat besi yang bervariasi antara berbagai teknik pemasakan yang digunakan. Penurunan kadar zat besi tertinggi pada kedua bahan makanan tersebut terjadi setelah proses pemasakan dengan teknik merebus+pengadukan, kadar zat besi setelah proses merebus menempati tempat kedua, dan mengukus menempati tempat ketiga. Hal ini disebabkan oleh frekuensi kontak antara bahan makanan dengan air sebagai zat pelarut pada metode memasak mengukus lebih sedikit jika dibandingkan dengan metode merebus maupun merebus dengan adanya pengadukan, serta adanya pengadukan pada saat merebus juga dapat meningkatkan frekuensi kontak bahan makanan dengan zat pelarut. Semakin banyak kontak antara zat pelarut dan terlarut, maka kelarutan akan semakin tinggi (Dewi *et al.,* 2010; Sinala, 2016).

Secara umum, berdasarkan analisis statistik diketahui bahwa adanya pengaruh antara teknik pemasakan dan lama waktu pemasakan terhadap kadar zat besi pada tempe dan hati sapi ($p<0,001$). Walaupun berpengaruh terhadap kadar zat besi, pemasakan tetap penting untuk dilakukan karena dapat meningkatkan daya absorpsi zat besi yang ada pada bahan makanan ke dalam tubuh (Fabbri & Crosby, 2015). Oleh karena itu, pentingnya memilih jenis teknik pemasakan dengan tetap

Tabel 2. Analisis Kadar Zat Besi pada Tempe dan Hati Sapi setelah Proses Pemasakan Menggunakan Teknik yang Berbeda: rata-rata ± SD (*Standard Deviation; n = 8*)

Teknik Memasak	Kadar Rata-Rata Zat Besi (mg/100g) ± SD	
	Tempe	Hati Sapi
Rebus	2,99 ± 0,27	5,28 ± 0,48
Rebus + Pengadukan	2,26 ± 0,17	3,98 ± 0,29
Kukus	3,54 ± 0,16	6,23 ± 0,26

Keterangan: rata-rata dihitung baik berdasarkan waktu memasak selama 10 menit maupun 15 menit

Tabel 3. Analisis Kadar Zat Besi pada Tempe dan Hati Sapi setelah Proses Pemasakan Menggunakan Dua Lama Waktu Pengolahan yang Berbeda: rata-rata ± SE (*Standard Error; n=12*)

Waktu Memasak	Kadar Rata-Rata Zat Besi (mg/100g) ± SD	
	Tempe	Hati Sapi
10 Menit	3,12 ± 0,55	5,48 ± 0,96
15 Menit	2,75 ± 0,55	4,84 ± 0,97

Keterangan: rata-rata dihitung berdasarkan ketiga jenis teknik pemasakan yang digunakan

Tabel 4. Hasil Uji *Two Way Anova* pada Tempe dan Hati Sapi

Perlakuan	*p value*	
	Tempe	Hati Sapi
Waktu Pemasakan	< 0,001*	< 0,001*
Teknik Pemasakan	< 0,001*	< 0,001*
Waktu*Teknik Pemasakan	< 0,001*	< 0,001*

*Signifikan jika p ≤ 0,05

Tabel 5. Hasil Uji Lanjut *Tukey*

Pasangan Perlakuan	*P value*	
	Tempe	Hati Sapi
A – B	< 0,001*	< 0,001*
A – C	< 0,001*	< 0,001*
B – C	< 0,001*	< 0,001*

Keterangan : * Signifikan jika p ≤ 0,05
A = rebus
B = rebus rebus + kukus
C = kukus

mempertimbangkan jenis makanan, tekstur dan rasa makanan yang diinginkan.

Berdasakan hasil uji *two way anova* tersebut, maka diperlukan uji lanjut karena terdapat tiga jenis teknik pemasakan yang digunakan. Berikut adalah hasil uji lanjut *tukey* terhadap teknik pemasakan yang disajikan dalam **tabel 5**.

Rebus

Perebusan merupakan salah satu teknik memasak makanan dalam air mendidih (100^{o} C) dimana volume air melebihi makanan yang dimasak sehingga makanan dapat terendam seluruhnya (Lubis dan Sutejo, 2013). Digunakan sebanyak 320 ml air untuk dapat merendam seluruh bahan makanan yang diolah dalam penelitian ini. Hasil dari penelitian ini didapatkan bahwa merebus berpengaruh terhadap kadar zat besi pada tempe dan hati sapi (p<0,001) (tabel 1). Hasil dari penelitian ini diperkuat oleh penelitian lain yang menyatakan bahwa proses perebusan dapat menurunkan kandungan zat besi pada keong matah merah sebagai contoh kasus dari bahan makanan hewani, serta daun ubi, daun Moringa olifera, daun

jute mallow, ubi, dan irish potato sebagai contoh kasus dari bahan makanan nabati (Purwaningsih *et al.,* 2011; Ikanone dan Oyekan, 2014; Issa *et al.,* 2020). Namun, terdapat perbedaan hasil penelitian dengan penelitian yang dilakukan pada *rainbow trout* yang menyatakan bahwa proses perebusan tidak memiliki efek signifikan terhadap kadar zat besi (Khosroshahi *et al.*, 2016). Perbedaan dari penelitian ini dengan penelitian yang dilakukan oleh Khosroshahi *et al.* (2016) adalah lama waktu yang digunakan untuk merebus bahan makanan. Dalam penelitian Khosroshahi*, et al.* (2016) dilakukan perebusan selama 5 menit, sedangkan dalam penelitian ini dilakukan perebusan selama 10 dan 15 menit sehingga dapat dikatakan penyebab perbedaan hasil dari kedua penelitian tersebut adalah lama waktu perebusan yang berbeda.

Rebus + Aduk

Mengaduk merupakan salah satu proses yang bertujuan untuk mencampur suatu cairan atau zat lain dengan cara menggerakkan benda seperti sendok secara melingkar (*Cambridge Dictionary*, 2020). Dalam proses memasak mengaduk penting untuk dapat mencampur semua bahan yang digunakan. Namun, proses pengadukan dapat meningkatkan kelarutan zat besi dalam air rebusan (Sinala, 2016). Pengadukan dapat menyebabkan lapisan difusi semakin menipis sehingga meningkatkan kelarutan suatu zat dalam pelarut (Harahap, 2019). Pengadukan juga dapat memperbanyak frekuensi kontak antara zat pelarut dan terlarut sehingga kelarutan dapat meningkat (Dewi *et al.,* 2010). Hal tersebut sesuai dengan hasil penelitian ini yang menyatakan adanya pengadukan dapat meningkatkan penurunan kadar zat besi pada tempe dan hati sapi saat proses merebus (gambar 2).

Kukus

Mengukus atau *steaming* merupakan teknik pengolahan yang menggunakan uap air mendidih (100^{o} C) dalam wadah yang tertutup (Lubis dan Sutejo, 2013). Penggunaan air dalam proses mengukus dapat berpengaruh terhadap kadar zat besi yang rentan dengan pengolahan menggunakan air (Kusnadi, 2016). Kebenaran teori tersebut dibuktikan dalam penelitian ini bahwa mengukus berpengaruh secara signifikan terhadap kadar zat besi pada tempe dan hati sapi ($p<0,001$) (tabel 1).

Penurunan kadar zat besi pada saat mengukus lebih rendah jika dibandingkan merebus. Hal ini berhubungan dengan frekuensi kontak antara tempe dan hati sapi dengan air sebagai zat pelarut berbeda antara mengukus dan merebus (Sinala, 2016). Hasil penelitian ini diperkuat oleh penelitian lain pada remis dan keong matah merah dimana penurunan kadar zat besi pada proses merebus lebih tinggi jika dibandingkan dengan mengukus (Kurnia, 2011; Purwaningsih *et al.,* 2011).

Lama Waktu Pemasakan

Teori terkait frekuensi kontak antara zat terlarut dan zat pelarut yang telah dibahas sebelumnya juga berlaku pada lama waktu yang digunakan dalam memasak (Tabel 2), semakin lama waktu pengolahan bahan makanan, maka semakin banyak frekuensi kontak dengan zat terlarut sehingga kelarutan zat gizi pada pelarut akan meningkat (Dewi *et al.*, 2010). Oleh karena itu, mempersingkat waktu pemasakan sangat diperlukan untuk memimimalisir zat besi yang hilang selama proses pemasakan menggunakan air. Waktu pemasakan dapat diminimalisir dengan menaikkan suhu yang digunakan dalam memasak (Karina dan Amrihari, 2017).

Interaksi Ketiga Teknik Memasak dengan Lama Waktu Memasak

Ketiga teknik pemasakan yang digunakan sama-sama menunjukkan hasil yang signifikan. Walaupun begitu, hasil dari interaksi antara teknik pemasakan dan lama waktu pemasakan yang dilakukan menunjukkan bahwa teknik mengukus dan penggunaan waktu pemasakan selama 10 menit memiliki rata-rata kadar zat besi yang lebih baik dari perlakuan lainnya. Sebaliknya, teknik memasak merebus dengan adanya pengadukan selama 15 menit memiliki rata-rata kadar zat besi yang paling rendah jika dibandingkan dengan perlakuan lainnya. Hal ini berhubungan dengan zat besi yang merupakan jenis mineral yang cukup tahan terhadap pemanasan, namun rentan terhadap pengolahan dengan air (Kusnadi, 2016). Berdasarkan teori tersebut menyebabkan frekuensi kontak antara zat besi dengan air berpengaruh

terhadap kandungan zat besi dalam makanan. Terkait hal tersebut, mengukus dan menggunakan waktu pemasakan selama 10 menit memiliki frekuensi kontak dengan air yang lebih sedikit dari perlakuan pemasakan lain yang digunakan dalam penelitian ini sehingga kadar zat besi pada perlakuan mengukus dan penggunaan waktu pemasakan selama 10 menit juga lebih tinggi. Hasil penelitian ini sesuai dengan hasil penelitian lain yang menunjukkan bahwa lama proses pemasakan berpengaruh pada kandungan zat besi pada *banana flakes,* serta kandungan zat besi setelah proses mengukus lebih tinggi dari merebus pada remis dan keong matah merah (Qodriah, 2016; Kurnia, 2011; Purwaningsih *et al.,* 2011).

Di samping hasil yang telah diperoleh dari penelitian ini, terdapat beberapa kelebihan maupun kekurangan dalam penelitian yang harus diperhatikan. Adapun kelebihan dari penelitian ini adalah sampel yang digunakan dipotong dengan bentuk dan ukuran yang sama untuk meminimalisir bias, digunakan alat ukur digital yang dapat meningkatkan ketelitian hasil pengukuran, serta kandungan zat besi dianalisa oleh laboran yang sudah berpengalaman sehingga hasil lebih akurat. Sedangkan, kekurangan dari penelitian ini adalah sampel penelitian yang terbatas hanya pada tempe dan hati sapi, serta hanya terdapat tiga teknik memasak dan dua lama waktu memasak yang digunakan.

KESIMPULAN DAN SARAN

Dari hasil penelitian ini diketahui bahwa teknik pengolahan dan lama waktu pengolahan berhubungan secara signifikan dengan kadar zat besi pada tempe dan hati sapi. Kadar zat besi lebih tinggi terdapat pada teknik pemasakan mengukus dan lama waktu pemasakan 10 menit. Oleh karena itu, untuk dapat meminimalisir hilangnya zat besi dalam proses pemasakan dapat dilakukan dengan memilih jenis teknik pemasakan yang sesuai dan mempersingkat lama waktu pengolahan. Berdasarkan hasil dan keterbatasan penelitian, maka diperlukan penelitian lanjutan pada bahan makanan, serta teknik dan waktu pemasakan lainnya.

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UNHEALTHY DIET AND STRESS ARE CORRELATED WITH PREMENSTRUAL SYNDROME IN ADOLESCENT GIRLS IN TANGERANG

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ABSTRACT

Adolescent girls is one of the age groups that are vulnerable to menstrual disorders, especially in the first year after menarche. Premenstrual syndrome (PMS) is a group of physical and emotional symptoms that emerge 7 to 14 days before menstruation and diminish once menstruation starts. This study was aimed to analyze the correlation between unhealthy diets and stress on premenstrual syndrome in adolescent girls. This study employed an observational study with a cross-sectional approach. The population of this study was all adolescent girls at State Junior High Schools in Tangerang City who aged 13-15 years. The sampling technique used cluster random sampling, consisting of 120 respondents. The data was collected through validated questionnaires, namely Food Frequency Questionnaire (FFQ), Perceived Stress Scale (PSS-10), and Shortened Premenstrual Assessment Form (SPAF). The obtained data were analyzed using Spearman statistical test. The results showed that there was a significant correlation between sweet foods ($p = 0.039$; $r = 0.188$), sweet drinks ($p = 0.006$; $r = 0.247$), salty foods ($p = 0.026$; $r = 0.203$), fatty foods ($p = 0.000$; $r = 0.366$) and fast food ($p = 0.001$; $r = 0.313$) and stress ($p = 0.000$; $r = 0.564$) on PMS. In conclusion, maintaining healthy diet and controlling stress is important to prevent and manage PMS among female adolescent.

Keywords: adolescent girls, premenstrual syndrome, stress, unhealthy diets

INTRODUCTION

Premenstrual syndrome (PMS) is a collection of physical and psychological symptoms during the luteal phase of the menstrual cycle. Generally, PMS occurs one or two weeks before menstruation and disappears at the start of menstruation until a few days after menstruation ends (Gnanasambanthan & Datta, 2019). The most common physical and psychological symptoms associated with PMS are headache, breast tenderness, muscle aches, fatigue, depression, hypersensitivity, and mood changes (Katzinger et al., 2020). PMS begins to become an issue in adolescence that can affect productivity, health-related quality of life, interpersonal relationships, and daily activities (Goker et al., 2015).

The American College of Obstetrics and Gynecologists reports that 85% of women experience one or more premenstrual symptoms (American College of Obstetricians and Gynecologists, 2001). A meta-analysis involving 17 studies showed that the prevalence of PMS worldwide was 47.8% with Asia being the continent with the highest prevalence of PMS (Direkvand-Moghadam et al., 2014). A study of 1,379 adolescent girls in Iran found about 99.5% of students reported at least one premenstrual symptom. Of these, 66.3% were mild, 31.4% were moderate, and 2.3% were severe (Delara et al., 2013).

Lifestyle factor is one of the predictor factors that affect the severity of PMS. Currently, the lifestyle of adolescents is changing. One of which is a change in diets that is high in risky foods (foods high in salt, sugar, and fat), low consumption of fruit and vegetables, and high consumption of energy-dense but low-nutrition foods (Keats et al., 2018). A recent study reported that young women with a western diet (fast food, soft drinks, processed foods with preservatives, high-salt foods, sugar-sweet desserts) had a 1.77 times greater risk of developing PMS than adolescents with traditional and healthy diets (Moradifili et al., 2020). Foods that are high in calories, fat, sugar, salt, and low in fiber that are consumed continuously can increase estrogen

 Received 01-10-2021, Accepted 14-01-2022, Published online 30-05-2022.

levels in the blood. High levels of estrogen cause fluid retention in the body which results in swelling and pain (Bertone-Johnson et al., 2005).

Psychological disorders such as stress have a significant influence on PMS. A study reported that stress in adolescent girls was associated with the severity of PMS. Symptoms of severe PMS were found in adolescent girls who experience moderate or severe stress (Rasheed & Al-Sowielem, 2003).

The research on correlation between unhealthy diets and stress with PMS in adolescent girls are still limited and show varying results. Adolescents are the largest age group in Indonesia's population structure as the focus of intervention for human resource development (Soeroso, 2016). Reproductive health problems are one of the important indicators in determining the health of adolescent girls (Šaffa et al., 2019). Thus, this study was aimed to analyze the correlation between unhealthy diets and stress with premenstrual syndrome in adolescent girls in Tangerang.

METHODS

This study was an analytic observational study with a cross-sectional approach, which was conducted in June and July 2021 at State Junior High Schools in Tangerang City Education Office's operational region in Banten Province. The population of this study was all adolescent girls at State Junior High Schools in Tangerang City, aged 13-15 years.

The sampling method employed was cluster random sampling, where schools were randomly selected obtaining 3 State Junior High schools from 28 State Junior High Schools in Tangerang City. The sample size was counted by Slovin formulas and resulted 120 adolescents girls aged 13 – 15 years who met the inclusion and exclusion criterias as the sample. The inclusion criterias in this study were adolescents girls aged 13-15 years, had begun menstruation and were able to communicate online. The exclusion criterias were adolescent girls who took hormonal drugs and painkillers during menstruation.

The study was conducted online using a Google Form due to the COVID-19 pandemic. The respondents who participated in this study had previously signed informed consent as evidence of their willingness to participate in the study. This study obtained ethical approval from the Health Research Ethics Committee of Politeknik Kesehatan Kementerian Kesehatan Jakarta II (KEPK-PKJ II) LB.02.01/I/KE/00/554/ 2021.

Data of unhealthy diet was obtained by using the Food Frequency Questionnaire (FFQ), where the types of unhealthy foods attached were adopted from The Indonesioan Basic Health Research in 2018 (RISKESDAS). The FFQ was used to identify the type and frequency of food/beverage consumption in the previous month which includes a list of sweet foods/drinks, fatty foods, salty foods, and fast foods. Furthermore, the FFQ was rated using a score calculation based on the Likert scale. The score was categorized as 6 for consuming foods >1 time a day, 5 for 1 time a day, 4 for 3-6 times a week, 3 for 1-2 times a week, 2 for 1-3 times a month, and 1 for never. After the coding, the scores were added up and the average score was calculated. The score of more than equal to mean was categorized often and the score of less than to mean was categorized as rare (Sirajuddin et al., 2018)

The stress data were obtained from the Perceived Stress Scale (PSS-10) questionnaire which had been previously validated with a Chronbach Alpha coefficient of 0.96 (Pin, 2011). PSS-10 questionnaire consisted of 10 questions with 6 negative questions and 4 positive questions and rated based on five Likert scales. On the negative questions, the score was categorized as 0 for never, 1 for almost never, 2 for sometimes, 3 for often and 4 for very often. The score of positive questions are reversed. Furthermore, the scores were added up and categorized into mild stress (1 – 14), moderate (15 – 26), and severe (>26). Premenstrual syndrome data were obtained from the SPAF (Shortened Premenstrual Assessment Form) questionnaire. The SPAF questionnaire in Indonesian was declared valid and reliable with a Chronbach Alpha coefficient of 0.84 (Damayanti & Samaria, 2021). The SPAF questionnaire is an assessment instrument that contains 10 question items collected on a four Likert scales related to complaints of premenstrual symptoms. The score is added up categorized into normal (0 – 14), mild (15 – 34), moderate (35 – 44), and severe (45 – 60).

The data was analyzed descriptively univariately and presented in a frequency distribution table. Because the data scale of the variables is numerical, bivariate analysis was conducted using Spearman's test to analyze the correlation between unhealthy diets and stress with PMS in adolescent girls. The data analysis was performed using IBM SPSS Statistics 23 software.

RESULTS AND DISCUSSION

The characteristics of respondents in this study including age, unhealthy diet (sweet foods, sweet drinks, salty foods, fatty foods and fast food), stress and premenstrual syndrome. Table 1 shows 45.0% of respondents were 14 years old. This age group is generally prone to menstrual disorders, especially in the first year after menarche (Islamy & Farida, 2019). Menstrual disorders that commonly occur in adolescent girls are dysmenorrhea, PMS, and menstrual cycle irregularities (Negi et al., 2018).

Table 1. Distribution of Age, Unhealthy Diet (Sweet foods/drinks, Fatty foods, Salty foods, and Fast foods), Stress, and Premenstrual syndrome

Characteristics	n	%
Age (years)		
13	41	34.2
14	54	45.0
15	25	20.8
Sweet Foods		
Rarely	71	59.2
Frequently	49	40.8
Sweet Drinks		
Rarely	68	56.7
Frequently	52	43.3
Fatty Foods		
Rarely	53	44.2
Frequently	67	55.8
Salty Foods		
Rarely	56	46.7
Frequently	64	53.3
Fast Foods		
Rarely	63	52.5
Frequently	57	47.5
Stress		
Mild	41	34.2
Moderate	64	53.3
Severe	15	12.5
PMS		
Normal	7	5.8
Mild	60	50.0
Moderate	44	36.7
Severe	9	7.5

The results of the study showed that 59.2% of respondents consumed sweet foods in the rare category. Meanwhile, some other respondents consumed fatty and salty foods in the frequent category (respectively 55.8% and 53.3%). This indicates that adolescent girls tended to consume the food that high in salt, sugar, and fat. The excessive unhealthy food consumption can pose a risk to health problems and trigger various chronic diseases, such as obesity, heart disease, stroke, cancer, type 2 diabetes mellitus, and osteoporosis (Croll et al., 2001).

This result supported the Basic Health Research in 2018 which showed that almost half of teenagers consumed risky foods. There were 50.4% of adolescents aged 10-14 years who consume sweet foods ≥ once a day; 31.4% salty foods; 44.2% fatty/fried foods; 8.8% processed foods with preservatives; 78.5% foods flavored; and 61.9% sweet drinks (Kementrian Kesehatan RI, 2018).

The distribution of respondents based on stress levels shows that almost half of the respondents had stress levels in the moderate category (53.3%). All the samples reported to experience stress from time to time, at least academic-related stress. The excessive worries about academic achievement can lead to stress symptoms such as changes in appetite,anxiety, insomnia, and mood swings (Bhargava & Trivedi, 2018).

PMS is a collection of physical and emotional symptoms that occur during the days leading up to the menstrual period (American Psychiatric Association, 2014). Almost every girl experiences one or more menstrual disorders in her life,. It was reported that 75% of girls experience some problems related to menstruation (Slap, 2003). Table 1 presents that almost all respondents experienced premenstrual syndrome (94.2%), where 50.0% having mild symptoms. This is supported by a study conducted in India which reported that 94.8% of girls had at least one PMS

https://doi.org/10.204736/mgi.v17i1.168–173

symptom with 65.7% having moderate to severe symptoms (Chowdhury & Chakraborty, 2017).

Based on table 2, there was a correlation between sweet foods (p = 0.039), sweet drinks (p = 0.006), fatty foods (p = 0.000), salty foods (p = 0.026), and fast food (0.001) on PMS in adolescent girls. The Spearman correlation value indicated a positive correlation direction. The more frequent consumption of sweet foods, sweet drinks, fatty foods, salty foods, and fast food, the higher the severity of PMS.

A study on Arab adolescents found a correlation between high-calorie/fatty/ sweet/salty food consumption and physical and psychological symptoms of PMS (Hashim et al., 2019). The consumption of fast food, fatty, salty and sugary foods increase the risk of PMS related to inflammation induction. There is an imbalance of the oxidant or antioxidant system caused by the consumption of unhealthy foods, thereby increasing PMS symptoms (Duvan et al., 2011).

Another study in Indonesia reported that adolescents with unhealthy food consumption had a 2.3 times greater risk of premenstrual syndrome (Nurmiaty et al., 2011). Unhealthy food such as fast food contains high saturated fatty acids which can cause several health problems related to menstruation (Shinde et al., 2017). Dietary fat and saturated fatty acids have been shown to be pro-inflammatory factor that increase the concentration of C-Reactive Protein (CRP) (Santos et al., 2013). High CRP concentrations and other inflammatory cytokine levels are associated with PMS symptoms (Ronnenberg et al., 2014).

Foods high in calories, sugar, salt, fat, and low in fiber that consumed frequently can increase blood levels of estrogen, triggering PMS symptoms. Dietary modification is necessary to minimize the severity of PMS. Fruits and vegetables are foods that are high in fiber, bioactive phytochemicals, and antioxidants. Daily consumption of non-starchy fruits and vegetables has been reported to help reduce the severity of PMS by converting estrogen to its inactive form (Hashim et al., 2019).

Table 2 shows a correlation between stress and premenstrual syndrome in adolescent girls (P = 0.000). The Spearman correlation value of 0.564 indicates a positive correlation with a moderate correlation strength. A possible explanation is that

Table 2. The Correlation between Unhealthy Diet (Sweet foods/drinks, Fatty foods, Salty foods, and Fast foods) stress and Premenstrual Syndrome in Adolescent Girls

Variable	Premenstrual Syndrome										p-value	r
	Normal		Mild		Moderate		Severe		Total			
	n	%	n	%	n	%	n	%	n	%		
Sweet Foods												
Rarely	7	100.0	38	63.3	23	52.3	3	33.3	71	59.2	0.039*	0.188
Frequently	0	0	22	36.7	21	47.7	6	66.7	49	40.8		
Sweet Drinks												
Rarely	6	85.7	39	65.0	18	40.9	5	55.6	68	56.7	0.006*	0.247
Frequently	1	14.3	21	35.0	26	59.1	4	44.4	52	43.3		
Fatty Foods												
Rarely	5	71.4	36	60.0	11	25.0	1	11.1	53	44.2	0.000*	0.366
Frequently	2	28.6	24	40.0	33	75.0	8	88.9	67	55.8		
Salty Foods												
Rarely	6	85.7	30	50.0	15	34.1	5	55.6	56	46.7	0.026*	0.203
Frequently	1	14.3	30	50.0	29	65.9	4	44.4	64	53.3		
Fast Food												
Rarely	6	85.7	38	63.3	18	40.9	1	11.1	63	52.5	0.001*	0.313
Frequently	1	14.3	22	36.7	26	59.1	8	88.9	57	47.5		
Stress												
Mild	5	71.4	30	50.8	5	11.1	1	11.1	41	34.2		
Moderate	2	28.6	28	47.5	32	71.1	2	22.2	64	53.3	0.000*	0.564
Severe	0	0.0	1	1.7	8	17.8	6	66.7	15	12.5		

the higher the stress level, the higher the severity of PMS.

Based on this study, it can be seen that 66.7% of respondents who had severe stress tend to experience severe PMS. A study showed a correlation between stress and PMS (Walton et al., 2018). A case-control study on women in Spanish reported that psychological factors in the form of stress were positively associated with the incidence of PMS (Regueira-me et al., 2019). Various forms of stressors can trigger stress in adolescents, namely academic demands, finances, time, and relationships. It has been associated with negative health outcomes including physical, psychological, and emotional problems. Stress can exacerbate PMS symptoms as a result of disruption of the body's hormonal balance (Zaddana, 2018).

This study was one of the study which measured multifactorial aspects of PMS determinant, including nutritional and psychological. Thus, the factors complement each other in determining PMS in adolescent girls. The limitation of the study is that this study cannot measure unhealthy diets in terms of the portion consumed, but focuses on the frequency of consumption qualitatively. Also, the online data collection may resulted some bias because the researchers cannot monitor the respondents directly.

CONCLUSIONS

The results of this study showed that unhealthy diet and stress were associated with PMS in adolescent girls. Respondents who often eat unhealthy foods (sweet foods, sugary drinks, fatty foods, salty foods, and fast food) and have severe stress tend to experience PMS in the severe category. Lifestyle modification is needed by reducing the consumption of foods high in calories/fat/sugar/salt and controlling stress as an effort to minimize the severity of PMS.

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CHARACTERISTICS ENERGY, AND PROTEIN INTAKE OF PREGNANT WOMEN DURING THE COVID-19 PANDEMIC AND ITS RELATION WITH INFANT BIRTH WEIGHT

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ABSTRACT

The COVID-19 pandemic is an outbreak that has a risk of a food crisis and changes in diet that have an impact on the nutritional status of pregnant women and babies. This study was aimed to analyze the relationship between the characteristics of pregnant women in the third trimester and food intake during the COVID-19 pandemic with birth weight. This research used cross-sectional method with a sample of 91 third trimester pregnant women at the Pundong and Bantul 1 Community Health Centers, Bantul Regency, Yogyakarta, which were randomly selected. The data was collected using a questionnaire. The nutritional status was measured based on MUAC (Mid Upper Arm Circumference), food consumption was measured using SQFF (Semi-Quantitative Food Frequency) questionnaire, and birth weight was measured using a digital weight scale with an accuracy of 0.1 kg. Bivariate analysis was done using Fisher-Exact with 95% CI. The results showed that the characteristics of pregnant women in the third trimester such as education, income, occupation, and disease history had no relationship with birth weight; gestational age ($p = 0.007$) and nutritional status ($p = 0.002$) had a relationship with birth weight; energy intake had no relationship while protein had a relationship with birth weight ($p = 0.001$). The conclusion is that gestational age, nutritional status, and protein intake have a relationship with birth weight during the COVID-19 pandemic. Therefore, pregnant women should always pay attention to food intake and carry out regular pregnancy checks to health services to detect early abnormalities to prevent low birth weight.

Keywords: gestational age, nutritional status, protein, birth weight, COVID-19

INTRODUCTION

The COVID-19 pandemic has significantly increased food insecurity in the community which causes serious nutritional problems (Pedroso et al., 2020). As a result, there is a change in individual eating patterns and poor nutritional status (Naja & Hamadeh, 2020). This pandemic is projected to severely impact food security, nutrition, and health, especially for vulnerable groups including children, pregnant, and lactating mothers (Roberton et al., 2020). During the COVID-19 pandemic, the health of pregnant women, newborns, and children is a major concern as they are at a high risk of health problems (Roberton et al., 2020).

Changes in nutritional status during the pandemic in pregnant women can occur such as mid-upper arm circumference (MUAC) indicator (Huizar et al., 2021; Mehta, 2020). MUAC presents the state of muscle tissue and fat layer under the skin and reflects the growth of fat tissue and muscle. It is used for screening chronic energy shortage in pregnant women with the risk of low birth weight (LBW) (Harjatmo et al., 2017).

Nutritional status can be influenced by nutritional intake; if it is not balanced, there will be a nutritional deficiency, which will result in poor nutritional status (Khasanah 2020). LBW in infants can occur because of a lack of energy and protein intake during pregnancy (Irbianto & Wahyuningsih, 2012).

Protein functions in the formation of enzymes in metabolic processes and maintains cells and body tissues (Amrang et al., 2020). If there is a lack of protein and energy intake during pregnancy, it will affect fetal growth and development (Kartikasari et al., 2011) and the mother is at risk of disease complications such as anemia, bleeding, infectious diseases, and LBW (Rukmana & Kartasurya, 2014).

According to The Indonesian Basic Health Survey (RISKESDAS) data, the prevalence of LBW in 2013 was 5.7% and increased in 2018

 Received 09-11-2021, Accepted 12-01-2022, Published online 30-05-2022.

https://doi.org/10.204736/mgi.v17i1.174–182

to 6.2% (Kemenkes, 2013; Kemenkes, 2018). In 184 countries, preterm births range from 5% to 18% of babies born. In Indonesia, premature birth is ranked 5th worldwide (WHO, 2012). It is estimated that around 15 million babies are born prematurely with one million deaths per year due to complications of preterm birth. This incidence accounts for 80% in between 32 and 37 weeks of gestation (Lawn et al., 2013). In 2015, about 5 - 9 million deaths of children under 5 years, and about 2--7 million occurred in the neonatal period. Babies born prematurely are at a high risk of infection and death (Liu et al., 2016).

Based on the data from the Bantul Health Office in 2019, there were infant deaths due to LBW. The highest death cases in Bantul Regency were 110 while maternal death in 2019 accounted for 13 cases (Dinas kesehatan Kabupaten Bantul, 2020; Profil Kesehatan DIY, 2020). A study revealed that babies with low weight are 6.16 times more at risk of stunting (Supriyanto et al., 2017).

The importance of this research is to determine the relationship between the characteristics of third-trimester pregnant women and food intake during the COVID-19 pandemic with LBW, and it is expected to provide the latest information on health and nutrition developments in several regions in Indonesia during the COVID-19 pandemic.

METHODS

This study used a cross-sectional design, conducted in two working areas of Pundong and Bantul 1 Community Health Centers, Bantul Regency, Yogyakarta. The population in this study was 12,983 pregnant women in Bantul Regency and obtained from each of two Community Health Centers, namely 130 pregnant women in the third trimester.

The minimum sample calculated using Lemeshow's formula (1997) was 83 respondents added by 10%, resulting in 91 respondents. Furthermore, the respondents were divided according to the proportions for each community health center using proportional random sampling to determine each sample representing two health centers. The minimum sample size was calculated using Lemeshow's formula.

$$n = \frac{Z^{2}\,1-\alpha/2xp(1-P)xN}{d^{2}\,(N-1)+Z^{2}\,1-\alpha/2xp\,(1-P)}$$

Remark:
n = Number of subjects
N = Number of populations
P = Proportion from previous research
Z^2 = Degree of confidence of 95% and Z = 1.96
D = Desired precision of 10%

The respondents were pregnant women in the third trimester with births during the COVID-19 pandemic. The characteristics of maternal income was categorized based on national income, which is, high economy (> Rp2,017,664) and low economy (< Rp2,017,664). The occupation was divided into working and not working. The birth age was divided into two categories, ≥ 37 weeks and < 37 weeks, and maternal disease history was divided into with disease history and without disease history. The data was obtained by using questionnaires or structured interviews. Furthermore, the nutritional status of pregnant women was determined based on MUAC (Mid-Upper Arm Circumference) using the MUAC tape with the categories of normal (≥ 23.5 cm) and low (< 23.5 cm); food consumption data were collected using the SQFF (Semi-Quantitative Food Frequency) by asking 10 questions about their food intake for the past 3 consisting of staple foods, animal side dishes, vegetable side dishes, vegetables, fruits, oils, processed foods, beverages, supplements and more. The data were then categorized into the good intake (80--100% RDA), less intake (< 80% RDA), and excess intake (> 110% RDA) using interviews. Birth weight data was obtained by measuring the baby's weight using a digital scale with an accuracy of 0.1 kg with a normal category of ≥ 2,500 and low < 2,500. All datas were tested using univariate and bivariate tests before being analyzed descriptively and statistically. Univariate analysis was conducted to determine the frequency distribution of the variables while bivariate analysis was used to determine the relationships between research variables using Fisher-Exact analysis with 95% CI and 0.05 alpha. This study has received approval from the Ethics Commission of Universitas Alma Ata Yogyakarta, which was issued on May 5, 2021, number KE/AA/V/0442/EC/2021.

RESULTS AND DISCUSSION

The characteristics of pregnant women in the third trimester include general conditions including education, income, occupation, disease history, and gestational age.

Table 1 shows that, from the education category, the research subjects are mostly high-educated, 64% of whom have low income, and 60.4% of the respondents are not working. 30.8% of the respondents had a disease history, and most of them (91.2%) were at term. Of 91 newborns, 11 babies (12.1%) had LBW.

Table 2 shows that, of the 91 research respondents, 10 (13.2%) had less energy intake, 69 (75.8%) had sufficient energy intake, and 10 (11%) had more energy intake, while 11 (12.1%) had a lack of protein intake. 69 respondents (75.8%) had adequate protein intake, and 11 respondents (12.2%) had more protein intake.

Table 3 shows that maternal education does not have a relationship with birth weight (p = 0.297). This depends on the form of awareness to carry out pregnancy checks, facilities, and health workers. Although mothers with low education also receive services and are more likely to have curiosity, they still need education to overcome the problems that arise. Therefore, there is no fundamental difference between mothers who have high education and those with low education (Afrida 2019). The level of education is correlated with a person's knowledge. People with higher education can have better knowledge about health (Notoatmodjo, 2012). However, based on the literature, maternal educational level is not

Table 2. Energy and Protein Intake of Third-Trimester Pregnant Women

Nutritional Intake	Nutrients			
	Energy		Protein	
	n	%	n	%
Insufficient Intake	12	13.2	11	12.1
Sufficient Intake	69	75.8	69	75.8
Excessive Intake	10	11	11	12.1
Total	91	100	91	100

Table 1. Characteristics of Research Variables

Characteristics of	Subjects (n=91)	
	n	%
Education		
Low (not studying, elementary school, junior high school)	9	9.9
High (Senior High School, College)	82	90.1
Income		
Low Rp2,017,664	32	35.2
High Rp2,017,664	59	64.8
Occupation		
Not Working	55	60.4
Working	36	39.6
Disease History		
No	63	69.2
Yes	28	30.8
Gestational age		
Insufficient Month (< 37 weeks)	8	8.8
Sufficient Month (≥ 37 weeks)	83	91.2
Nutritional status		
Low (UAC < 23.5 cm)	20	22
Normal (UAC ≥ 23.5 cm)	71	78
Birth weight		
Low <2500	11	12.1
Normal ≥ 2500	80	87.9

Table 3. Relationship Between Maternal Characteristics and Birth Weight

Characteristics	Birth Weight		p-value	OR
	Low	Normal		
Education				
Low (not studying, elementary school, junior high school)	2 (22.2%)	7 (77.8%)	0.297	2,317
High (Senior High School, College)	9 (11%)	73 (89%)		
Income				
Low Rp2,017,664	4 (12.5%)	28 (87.5%)	1.000	1.061
high Rp2,017,664	7 (11.9%)	52 (88.1%)		
Occupation				
Not Working	5 (9.1%)	50 (90.9%)	0.223	0.500
working	6 (16.7%)	30 (83.3%)		
Disease History				
No	7 (11.1%)	56 (88.9%)	0.454	0.750
Yes	4 (14.3%)	24 (85.7%)		
Gestational age				
Insufficient Month (< 37 weeks)	4 (50%)	4 (50%)	0.007	10,857
Sufficient Month (≥ 37 weeks)	7 (8.4%)	76 (91.6%)		
Nutritional status				
Low (UAC < 23.5 cm)	7 (35%)	13 (65%)	0.002	9.019
Normal (UAC ≥ 23.5 cm)	4 (5.6%)	67 (94.4%)		

necessarily correlated with birth weight because it does not always imply good knowledge about health (Mahayana et al., 2015). This study is not in line with the research conducted by Gage et al. (2013) which suggested that the educational level of Mexican pregnant women influenced their births**.** Lack of nutritional behavior in pregnant women tended to result in poor eating patterns during pregnancy (Sumiyarsi et al., 2018).

Family income can affect the nutritional status of children at birth (Mahmoodi et al., 2013). Family income showed no relationship with birth weight (p = 1.000). This study was in line with the research of Aghadiati et al. (2019) which concluded that there was no relationship between income and birth weight, but this result contradicts the results of Illahi (2017), research which stated that there was a relationship between family income and infant nutritional status. Low income is one of the risk factors for stunting due to LBW (Chandra, 2013). The quality and quantity of the food we eat, including access to good quality food, is supported by income as a determining factor. Food insecurity in the family occurs due to low income, making them unable to access safe food in terms of quality and quantity (Fikawati, 2013). The COVID-19 pandemic has changed the world's socioeconomic order, starting from the education, health, food, and income sectors (Nicola et al., 2020). Low income in a household affects the ability to obtain food (Pechey & Monsivais, 2016). A study conducted by Chiwona-Karltun *et al.* (2021) from qualitative data collected from 12 countries in South Sahara revealed that the lockdown policy during the COVID-19 pandemic resulted in decreased income, disturbed household food security, and other health problems.

In this study, the occupation did not have a relationship with birth weight (p = 0.223). This result was in line with Salawati, (2012) research that there was no significant relationship between the work of pregnant women and LBW because there are several factors that are not considered, such as the type of mother's work without considering the mother's daily physical activity. Like mothers who have working hours, the intensity of the mother's work during pregnancy can cause stress and cannot rest which ultimately affects her fetus (Kouis et al., 2018), leading to LBW (Mahmoodi et al., 2015).

In this study, there was no relationship between maternal history and birth weight (p = 0.454). Disease history such as high blood pressure, diabetes mellitus, and anemia can occur

in pregnant women, but it may be influenced by health care factors after delivery, income, and nutritional intake. This is as explained in a study conducted by Maulinda et al., (2021) that women who are of sufficient age, good nutritional status, optimal nutritional intake, and routine antenatal care (ANC) visits are very likely to give birth to normal babies even though they have childbirth complications. Pregnant women who always carry out prenatal care are very good at preventing complications and detecting complications early so that they can be prevented to avoid the impact on the fetus and pregnant women (Manurung dan Helda 2020). This study is contrary to what was done by Indrasari, (2012). Her analysis showed a relationship between disease history and the incidence of low birth weight (LBW). Maternal disease history and other disease factors can influence the occurrence of LBW babies (Hashash and Kane, 2015; Wahyuningrum et al., 2016). Several diseases such as anemia, hypertension, preeclampsia, eclampsia, bladder infections, and colitis during pregnancy can cause LBW in infants (Hashash and Kane, 2015; Wahyuningrum et al., 2016).

The nutritional status of pregnant women based on MUAC showed that there was a relationship with birth weight (p = 0.002). This result was supported by a research conducted by Maulidiyah (2012), who found that nutritional status based on UAC has a significant relationship with birth weight. Pregnant women who experience PED (Protein Energy Deficiency) will be more at risk of giving birth to an abnormal weight baby and, vice versa, If the nutritional status is good, they will give birth to babies of normal weight (Rukmana & Kartasurya, 2014).

The nutritional status of pregnant women plays an important role in fetal growth and development as the result of the metabolism of food consumed, absorbed, both from macronutrients and micronutrients. In other words, nutritional status determines the quality of babies born (Kartikasari et al., 2011). The poor nutritional status of the mother before and during pregnancy may lead to LBW (Sinta et al., 2017). Therefore, pregnant women who experience PED will be more at risk of giving birth to obese babies (Rukmana & Kartasurya, 2014).

The COVID-19 pandemic has the potential to increase the prevalence of malnutrition in pregnant women which will have an impact on the health status of the fetus (UNICEF, 2020).

Table 4 shows that there is no relationship between energy intake during the COVID-19 pandemic and birth weight (p = 0.872). Pregnant women have low energy intake with LBW 2 (16.7%) and sufficient energy intake with LBW 8 (11.6%). This study is the same as the research conducted by Pratiwi, Rahfiludin, and Aruben, (2017) who have similar results. This is caused by many factors including the physiological changes of pregnancy, pathological conditions, nutritional needs, and physical activity of the mother during pregnancy (Tzanetakou 2011). The other factors are low socioeconomic, low education levels, and changes in increasing adherence to dietary patterns during pregnancy (Usrina et al. 2021). However, these results are not in line with the research conducted by Irbianto & Wahyuningsih, (2012) showing a relationship between energy intake and birth weight. Insufficient energy intake during pregnancy can inhibit fetal growth and pose a risk for LBW. Nutrients are energy sources that

Table 4. The Relationship Between Energy and Protein Intake With Birth Weight

Variable	Birth Weight		Total	p-value
	Low	Normal		
Energy Intake				
Insufficient Intake	2 (16.7%)	10 (83.3%)		
Sufficient Intake	8 (11.6%)	61 (60.7)	100%	0.872
Excessive Intake	1 (10%)	9 (90%)		
Protein intake				
Insufficient Intake	6 (54.5%)	5 (45.5%)		
Sufficient Intake	3 (4.3%)	66 (95.7%)	100%	0.001
Excessive Intake	2 (18.2%)	9 (81.8%)		

act as a circulator and protein synthesizers that support physical activity and body metabolism (Mahayana, Chundrayetti dan Yulistini, 2015). Based on the research of Abadi & Putri, (2020), there was a lack of macronutrient intake during the COVID-19 pandemic.

Protein intake in pregnant women during the COVID-19 pandemic had a relationship with LBW (p = 0.001). Pregnant women with low protein intake are at risk of LBW 6 (54.5%) while those with adequate protein intake may experience LBW 3 (4.3%). The results of this study were proven by Najpaverova et al. (2020) who explained that protein intake during pregnancy provides benefits for fetal growth and development. Protein intake is very helpful in the process of fetal growth during pregnancy. Deficit of protein intake during pregnancy results in stunted fetal growth leading to LBW as well as excess nutrition because energy and protein intake can also inhibit the placenta and increase the risk of fetal death (Fenton et al., 2020).

Protein is a major determinant in the survival, growth, and development of the embryo. Protein functions in pregnant women are important for metabolism, cell function, and fetal formation, altering gene expression in the fetal genome and being precursors for the synthesis of molecules (e.g., nitric oxide, polyamines, and creatine) with cell signaling and metabolic function. L-arginine (Arg) is important during pregnancy for the growth and development of the conceptus (Herring et al. 2018). In addition, the baby's birth weight is also influenced by the hypertrophy and maturation phase. The baby's body becomes 2 times longer, and his weight increases to 3-4 times from the previous weight (Manuaba, 2010)

CONCLUSION

This study found that several factors, including birth age, maternal nutritional status, and protein intake of third trimester pregnant women has a correlation with child birth weight. Mother who had insufficient gestational age (<37 weeks), low MUAC, and low protein intake has a higher risk to have low birth weight infant.

Pregnant women should always pay attention to food intake and carry out regular prenatal check-ups to health services for early detection of abnormalities so that they can be addressed as quickly as possible to prevent the occurrence of LBW. It is also hoped that various parties across sectors and health services will continue to pay attention to the health of pregnant women during the COVID-19 pandemic so that maternal and child health problems can be overcome.

ACKNOWLEDGMENTS

We would like to thank the parties who have permitted us to conduct research, especially at the Bantul 1 and the Pundong Community Health Centers, Bantul Regency, Yogyakarta.

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PENGARUH PENDIDIKAN GIZI *LIFT THE FLAP BOOK* TERHADAP PENGETAHUAN DAN SIKAP ANAK USIA SEKOLAH 10-12 TAHUN TENTANG VITAMIN LARUT LEMAK

The Effect of Lift The Flap Book About Fat-Soluble Vitamins on Knowledge and Attitude of School-Age Children 10-12 Years

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ABSTRAK

Anak usia sekolah merupakan salah satu kelompok yang berisiko mengalami defisiensi vitamin larut lemak. Akibat yang dapat ditimbulkan seperti pertumbuhan tulang dan gigi yang tidak optimal, sehingga akan berpengaruh pada masa tumbuh kembang anak. Salah satu hal yang dapat menyebabkan kondisi tersebut adalah kurangnya pengetahuan anak tentang vitamin larut lemak. Upaya yang dapat dilakukan dalam meningkatkan pengetahuan tentang vitamin larut lemak adalah dengan menggunakan media interaktif seperti *Lift The Flap Book* sebagai media pembelajaran. Tujuan penelitian ini adalah mengetahui pengaruh media *Lift The Flap Book* terhadap pengetahuan dan sikap anak usia sekolah tentang pentingnya vitamin larut lemak pada makanan. Penelitian ini merupakan studi kuasi eksperimental dengan jumlah sampel 33 anak berusia 10-12 tahun dengan rancangan desain *one group pre-test* dan *post-test.* Hasil penelitian ini adalah rata-rata skor pengetahuan vitamin larut lemak dengan intervensi media *Lift The Flap Book* saat *pre-test*, *post-test* 1, *post-test* 2 adalah 62,00; 81,99; dan 78,14. Kemudian pada sikap vitamin larut lemak adalah 64.83, 77.48 dan 76.95. Hal ini menunjukkan *Lift The Flap Book* dapat meningkatkan pengetahuan dan sikap vitamin larut lemak (p=0,0001) pada anak usia sekolah 10-12 tahun.

Kata kunci: *lift the flap book*, pengetahuan, sikap, vitamin larut lemak.

ABSTRACT

School-age children are one of the at risk groups for fat-soluble vitamin deficiencies. The consequence that could be experienced is the unoptimal growth of bones and teeth. In addition, it can affect the child's growth and development. One of the things that can cause this condition is a child's lack of knowledge about fat-soluble vitamins. The efforts that can be made to increase knowledge about fat-soluble vitamins is by using interactive media such as Lift The Flap Book as a learning medium. The purpose of this research was to the measure the influence of Lift The Flap Book on the knowledge and attitudes of school-age children about the importance of fat-soluble vitamins in food. This research was a quasi-experimental study with a sample of 33 children aged 10-12 years with a one group pre-test and post-test design. The results of this study are the average knowledge score of fat-soluble vitamins with media interventions Lift The Flap Book during the pre-test, post-test 1, and post-test 2 was 62.00; 81.99; and 78.14. Then, the attitude of fat-soluble vitamins was 64.83; 77.4;, and 76.95. This result showed that the Lift The Flap Book media can increase the knowledge and attitudes about fat-soluble vitamins (p=0.000) among school-age children 10-12 years.

Keywords*: attitude, fat-soluble vitamin, knowledge, lift the flap book.*

PENDAHULUAN

Kelompok anak usia sekolah (6-12 tahun) merupakan kelompok anak yang sedang mengalami tumbuh kembang yang pesat sehingga pada saat itu anak membutuhkan kebutuhan gizi yang optimal untuk menunjang tumbuh kembangnya. Anak usia sekolah merupakan salah satu kelompok yang rawan terhadap masalah gizi (Kurniasari, 2020). Kesehatan yang optimal akan menghasilkan pertumbuhan yang optimal juga. Sehingga untuk memenuhi kesehatan anak maka diperlukannya asupan gizi, karena zat gizi sangat memengaruhi

 Received 15-09-2021, Accepted 24-01-2022, Published online 30-05-2022.

tumbuh kembang anak (Pritasari, Damayanti, & Tri Lestari, 2017).

Menurut Sitoayu *et al* (2020), pertumbuhan dan perkembangan anak bergantung pada pemberian zat gizi yang cukup dan berkualitas. Per harinya anak membutuhkan asupan zat gizi yang dapat diperoleh melalui makanan baik zat gizi makro maupun mikro. Menurut Sight dan Life (2012), zat gizi yang sangat penting selain zat gizi makro adalah zat gizi mikro, salah satunya adalah vitamin. Hal ini karena kekurangan vitamin dapat merugikan kesehatan dengan terhambatnya pertumbuhan dan perkembangan serta penurunan kekebalan tubuh (Alfthan *et al.,* 2010).

Salah satu permasalahan gizi yang terjadi pada anak usia sekolah adalah kurangnya asupan vitamin. Berdasarkan penelitian Marliyati & Nugraha (2014) status vitamin A pada anak sekolah dasar menunjukkan kategori sedang (54,8%) dan rendah (58,1%). Penelitian Ernawati & Budiman (2015) yang menggunakan analisis data anak usia 2-12 tahun dari *South East Asian Nutrition Surve*y menyatakan bahwa walaupun persentase defisiensi vitamin D pada anak di Indonesia belum terlihat, tetapi anak Indonesia mengalami *insufficient* dan *inadequate* paling tinggi yaitu sebesar 45,1% dan 49,3%. Menurut penelitian Mai *et al.* (2003), anak usia sekolah tepatnya di Vietnam selatan juga masih mengalami kekurangan vitamin E, baik itu di pedesaan maupun di perkotaan walaupun belum ditemukannya kekurangan pada anak usia sekolah, tetapi menurut Kalkwarf *et al.* (2004), menyebutkan perlunya mencegah kekurangan Vitamin K pada anak. Vitamin K mempunyai peran dalam metabolisme tulang anak dan diperlukan untuk memaksimalkan pertumbuhan tulang selama masa pertumbuhannya.

Salah satu yang menyebabkan terjadinya permasalahan gizi pada anak usia sekolah adalah kurangnya pengetahuan gizi tersebut. Karena pada dasarnya pengetahuan adalah tingkatan terendah dalam perubahan sikap dan perilaku (Kurniasari, 2020).

Menurut Pramono et al., (2014) berkurangnya pengetahuan akan mengurangi kemampuan seseorang untuk menerapkan informasi gizi dalam kehidupan sehari-hari, sehingga untuk meningkatkan pengetahuan seseorang maka diperlukannya memberikan pendidikan gizi sedini mungkin.

Pendidikan gizi pada anak usia sekolah dapat diberikan melalui penyuluhan, pemberian poster, leaflet ataupun booklet (Pramono et al., 2014). Hal ini juga diutarakan oleh Healthy People 2010 dalam Pramono et al. (2014) bahwa pengaruh pendidikan gizi akan lebih efektif jika targetnya adalah anak sekolah.

Hal ini dibuktikan berdasarkan hasil penelitian Azadirachta & Sumarmi (2018) yang menyatakan bahwa Pendidikan gizi pada anak usia sekolah dapat memberikan peningkatan pengetahuan dan praktik pentingnya makan buah dan sayur.

Dalam proses pembelajaran melalui pendidikan gizi, dibutuhkan media untuk membantu pengajar dalam menyampaikannya, serta memudahkan anak dalam menyerap informasi yang disampaikan. Penggunaan media seperti *pop up book*, PGS *card*, dan *leaflet* memudahkan anak dalam menyerap informasi dan efektif meningkatkan pengetahuan (Kurdanti *et al*., 2019).

Salah satu alternatif media yang dapat digunakan adalah *Lift The Flap Book*. *Lift The Flap Book* memiliki bentuk khusus yaitu menggunakan desain warna yang menarik serta gambar yang dilengkapi dengan jendela sehingga dapat dibuka ke atas, ke bawah, ke kanan dan ke kiri serta memiliki keterangan di baliknya (Efendhi & Susilowibowo, 2013). Penggunaan *Lift The Flap Book* ini akan membuat proses pembelajaran tidak membosankan karena adanya variasi antara membaca teks dengan melihat gambar menggunakan lipatan-lipatan (Ardhana, 2016). Media *Lift The Flap Book* pada penelitian ini bertemakan tentang vitamin larut lemak yaitu di dalam masing-masing halamannya terdapat definisi masing-masing vitamin, manfaat, sumber, akibat dari kekurangan dan kebutuhan dari masing-masing vitamin. Penelitian ini memiliki tujuan untuk mengetahui pengaruh media *Lift The Flap Book* terhadap pengetahuan dan sikap anak usia sekolah 10-12 tahun tentang pentingnya vitamin larut lemak.

METODE

Jenis penelitian yang digunakan adalah Kuasi Eksperimental. Desain yang digunakan adalah

https://doi.org/10.204736/mgi.v17i2.183–190

one group pretest – posttest, artinya penelitian ini dilakukan observasi pertama terlebih dahulu kemudian diberikan intervensi dengan pemberian media pendidikan gizi *Lift The Flap Book*. Pada penelitian ini tidak menggunakan kelompok pembanding.

Penelitian ini berlangsung mulai dari bulan Januari – Agustus 2021. Lokasi penelitian bertempat di Rusun Bumi Cengkareng Indah, Kecamatan Cengakreng dan Pemukiman Gaga Rawa Kompeni, Kecamatan Kalideres, Kota Administrasi Jakarta Barat, DKI Jakarta. Populasi dalam penelitian ini tidak dapat diketahui karena wilayah penelitian tersebar di dua kecamatan yang berbeda. Pemilihan sampel di dua kecamatan yang berbeda ini dilakukan karena saat pengambilan data penelitian, sedang diberlakukannya Pemberlakuan Pembatasan Kegiatan Masyarakat (PPKM) akibat pandemi Covid-19.

Pemilihan lokasi penelitian ini juga didukung berdasarkan observasi awal yang dilakukan oleh peneliti, menunjukkan bahwa di dua lokasi tersebut masih terdapat anak usia sekolah 10-12 tahun yang belum mengetahui dan mendapatkan informasi tentang pentingnya vitamin larut lemak dengan media *Lift The Flap Book* Pengambilan sampel penelitian ini dilakukan dengan pertimbangan yang ditentukan oleh peneliti (*Purposive Sampling*), berdasarkan kriteria inklusi.

Adapun kriteria inklusi sampel pada penelitian ini adalah anak usia 10-12 tahun, diberikan izin oleh orang tua/wali, bersedia menjadi sampel dan sehat jasmani maupun rohani. Sedangkan untuk kriteria eksklusi sampel yaitu anak yang tidak mengikuti proses penelitian menyeluruh dan sedang dalam keadaan sakit. Perhitungan sampel menggunakan rumus di bawah ini (Singh P, 2012).

$$n = \frac{\sigma^2 [Z_{1-\frac{\alpha}{2}} + Z_{1-\beta}]^2}{(\mu_1 - \mu_2)^2}$$

Berdasarkan perhitungan sampel, diperoleh jumlah minimal sampel sebanyak 31 anak. Saat pengambilan data, sampel yang digunakan dalam penelitian ini dari dua wilayah sebanyak 33 anak menggunakan teknik *purposive sampling*.

Pengambilan data pada penelitian ini dilakukan secara *door to door* melalui beberapa tahap dengan rincian yaitu peneliti mengajukan perizinan kepada RT/RW setempat untuk melakukan penelitian. Kemudian sebelum dilakukan *pre-test,* anak dibantu oleh orang tua/wali yang didampingi enumerator untuk mengisi *informed consent* terlebih dahulu setelah itu dilakukannya *pre-test* selama kurang lebih 15 menit. Setelah dilakukan *pre-test*, diberikan jeda waktu selama tujuh hari, kemudian dilakukannya intervensi menggunakan media *Lift The Flap Book* tentang pentingnya vitamin larut lemak pada makanan kurang lebih 30 menit dan *post-test* 1 dilakukan sesaat setelah intervensi selama 15 menit. Tahap akhir dilakukannya kembali *post-test* 2 dengan jeda waktu selama tujuh hari.

Media *Lift The Flap Book* dibuat secara independent oleh tim peneliti. Peneliti juga melakukan uji daya terima media melalui kuesioner. Hal ini bertujuan untuk melihat bagaimana penerimaan media oleh responden. Kuesioner berisi tujuh pertanyaan mengenai kesan responden terhadap media, isi materi, penggunaan bahasa, pemilihan warna, gambar/ilustrasi, hingga manfaat media.

Kuesioner penelitian *pre-test* dan *post-test* sudah diuji validitas dengan menggunakan analisis *corrected item-total correlation*. Terdapat 15 pertanyaan pengetahuan dan 17 pertanyaan sikap yang valid. Pilihan jawaban pada pertanyaan pengetahuan terdiri dari “benar” dan “salah”. Skor 1 diberikan kepada responden yang menjawab dengan benar dan skor 0 jika tidak menjawab dengan benar.

Pilihan jawaban pada pertanyaan sikap terdiri dari “setuju” dan “tidak setuju”. Kuesioner dibuat dengan pernyataan positif dan negatif. Pada pernyataan positif, responden akan mendapatkan skor 1 jika memilih “setuju” dan skor 0 jika memilih “tidak setuju”. Sedangkan pada pernyataan negatif, responden akan mendapatkan skor 0 jika memilih “setuju” dan skor 1 jika memilih “tidak setuju”

Analisis data yang dilakukan adalah dengan menguji normalitas data terlebih dahulu. Pada penelitian ini data berdistribusi normal sehingga pada uji bivariat menggunakan uji *Paired Sample T-test* untuk melihat perbedaan pengetahuan dan sikap antara sebelum dan sesudah diberikan intervensi. Penelitian in telah memperoleh

persetujuan dari Komisi Etik Fakultas Ilmu – ilmu Kesehatan Universitas Esa Unggul dengan Nomor: 0181-21.181/DPKE-KEP/FINAL-EA/UEU/VII/2021.

HASIL DAN PEMBAHASAN

Karakteristik Responden

Penelitian ini menggunakan anak usia sekolah dengan rentang usia 10-12 tahun berjumlah 33 anak. Berdasarkan hasil data yang diperoleh dapat dilihat bahwa responden didominasi dengan yang berjenis kelamin perempuan berjumlah (54,5%).

Berdasarkan karakteristik usia dapat dilihat bahwa sebagian besar responden berada pada usia 10 tahun sebanyak 19 anak (57,6%). Pemilihan usia anak 10-12 tahun karena menurut Teori Piaget dalam Ibda (2015), anak pada usia 6-12 tahun telah memasuki tahap operasional konkrit dimana anak cukup matang untuk menggunakan pemikiran logika.

Tabel 1. Karakteristik Responden

Karakteristik Responden	n	%
Jenis Kelamin		
Laki – laki	15	45,5
Perempuan	18	54,5
Usia		
10 Tahun	19	57,6
11 Tahun	7	21,2
12 Tahun	7	21,2
Total	33	100,0

Tabel 2. Distribusi Kategori Pengetahuan

Kategori Pengetahuan	*Pre-test*	*Post-test* 1	*Post-test* 2
Kurang (≤55)	11 (33,3%)	0	0
Cukup (56-75)	19 (57,6%)	11 (33,3%)	13 (39,4%)
Baik (76-100)	3 (9,1%)	22 (66,7%)	20 (60,6%)

Tabel 3. Distribusi Skor Pengetahuan Sebelum dan Sesudah Intervensi

	***Mean* ± SD**	Δ	*p value*
Pre-test	62,00 ± 11,48	19,99	0,0001*
Post-test 1	81,99 ± 10,60		
Pre-test	62,00 ± 11,48	16,44	0,0001*
Post-test 2	78,00 ± 9,16		

*terdapat perbedaan yang signifikan (p<0.05)

Pengetahuan Sebelum dan Sesudah Intervensi

Pengetahuan yang diuji dalam penelitian ini adalah pengetahuan mengenai pentingnya vitamin larut lemak dengan menggunakan intervensi media berupa media cetak *Lift The Flap Book.* Media tersebut berisikan materi tentang masing-masing vitamin larut lemak mulai dari definisi, manfaat, sumber, akibat kekurangan, hingga kebutuhan dari masing-masing vitamin larut lemak itu sendiri.

Pengetahuan gizi merupakan komponen yang penting untuk terjadinya perubahan sikap gizi. Jika pengetahuan gizi baik, maka akan mendorong anak-anak untuk mengubah sikap mereka (Winandar, 2018). Penelitian ini dilakukan untuk mengetahui peningkatan pengetahuan anak usia 10 – 12 tahun mengenai pentingnya vitamin larut lemak pada makanan.

Pengambilan data *pre-test* pada penelitian ini dilakukan untuk mengetahui pengetahuan awal responden mengenai pentingnya vitamin larut lemak pada makanan. Tingkat pengetahuan responden mengenai vitamin larut lemak dinilai dalam menjawab pernyataan dalam kuesioner.

Hasil *pre-test* menunjukkan pengetahuan tentang vitamin larut lemak sebagian besar responden tergolong cukup (57,6%). Walaupun demikian, masih terdapat responden dengan tingkat pengetahuan kurang (33,3%).

Setelah pemberian edukasi gizi, diketahui terjadi peningkatan pengetahuan pada responden. Hal ini diketahui dari hasil post-test yang menunjukkan mayoritas responden (66,7%) telah memiliki pengetahuan gizi yang tergolong baik.

Tabel 3 menggambarkan perubahan pengetahuan sebelum dan sesudah edukasi gizi diberikan. Hasil analisis menunjukkan terdapat perubahan signifikan pada pengukuran post-test pertama (p=0,001) maupun post-test kedua (p=0,001). Peningkatan terbesar terlihat pada post-test pertama (Δ =19,99). Lebih lanjut, walaupun terdapat penurunan pada post-test kedua, namun skor post-test kedua masih lebih tinggi dibandingkan pre-test (Δ =16,44). Hal ini sejalan dengan penelitian Nugroho (2018) di sekolah dasar kota Bandar Lampung yang menunjukkan terdapat perbedaan yang signifikan antara pengetahuan sebelum dan sesudah intervensi dengan media gizi komik. Adapun terjadi meningkatnya pengetahuan seseorang ini merupakan hasil dari berhasilnya

sebuah proses belajar yang dipengaruhi oleh faktor-faktor di dalamnya di mana salah satunya adalah dengan menggunakan media pendidikan (Wahyuningsih *et al.*, 2015).

Post-test 2, menunjukkan adanya perbedaan yang signifikan dibandingkan skor pengetahuan *pre-test*. Terjadinya peningkatan pengetahuan subjek dipengaruhi oleh memori baik itu jangka panjang maupun jangka pendek. Menurut Jayani & Hastjarjo, (2011) setiap individu yang menerima informasi terlebih dahulu melalui memori sensoris dan bertahan dalam jangka waktu yang singkat. Memori jangka pendek hanya menyimpan informasi kurang lebih 15-30 detik. Apabila informasi yang diterima masih terus diingat maka akan dilanjutkan menuju memori jangka panjang. Kemudian pada memori jangka panjang, informasi akan dipilah dan dipadatkan sehingga memudahkan untuk disusun. Walaupun terjadinya peningkatan, pada penelitian ini juga terjadi penurunan pengetahuan antara *post-test* 1 ke *post-test* 2. Penurunan ini dapat saja terjadi dikarenakan pengaruh dari daya ingat responden dan intervensi yang hanya dilakukan satu kali. Menurut Afifaturrohma & Purnasari (2020) dalam penelitiannya, tidak sedikit subjek yang mudah lupa terhadap materi yang telah diberikan. Hal ini dapat terjadi karena materi tidak disimpan pada *long term memory* melainkan hanya disimpan pada *short term memory*. Hal ini didukung dengan masih terdapat beberapa pernyataan yang belum dijawab dengan benar yaitu pada pengetahuan tentang vitamin D dan pemorsian untuk mencukupi vitamin D.

Sikap Sebelum dan Sesudah Intervensi

Sikap merupakan suatu respons yang tertutup terhadap objek tertentu yang melibatkan pendapat dan emosi yang bersangkutan. Sikap secara nyata menunjukkan adanya kesesuaian antara reaksi terhadap stimulus tertentu di kehidupan sehari-hari. Sikap belum merupakan suatu tindakan atau aktivitas akan tetapi merupakan predisposisi tindakan suatu perilaku (Notoatmodjo, 2007 dalam Retnaningsih, 2016).

Hasil penelitian menunjukkan sebelum edukasi diberikan, vitamin larut lemak tergolong cukup (60,6%). Setelah pemberian edukasi terdapat peningkatan sikap pada pengukuran post-test 1 dan 2. Sebagian bear responden memiliki sikap yang tergolong baik pada post-test 1 dan 2 (berturut-turut 72,7% dan 66,7%).

Berdasarkan kategori sikap pada Tabel 4 masih terdapat sikap dengan kategori kurang sebesar 3% pada *post-test* 1. Hal ini dapat disebabkan terdapat beberapa pernyataan yang belum dijawab dengan benar, yaitu pada sikap mengenai pemorsian sayur dan buah. Hal ini dapat terjadi dikarenakan ketika diberikan intervensi responden sulit memahami materi pemorsian pada sayur dan buah sehingga peningkatan yang terjadi belum terlalu besar. Namun ketika pada *post-test* 2, kategori sikap mengalami peningkatan yang ditandai dengan sudah tidak ada lagi responden yang termasuk ke dalam kategori sikap yang kurang. Kenaikan ini dapat terjadi karena anak mencoba mengingat kembali informasi yang disampaikan sehingga pada kategori sikap *post-test* 2 tidak terdapat lagi kategori kurang. Peningkatan sikap ini, nantinya diharapkan mampu membentuk perilaku yang semakin baik pula.

Berdasarkan hasil *pre-test* sikap yang dilakukan, diketahui bahwa rata-rata skor adalah 64,83 ± 11,24. Hal ini sejalan dengan penelitian Pramono *et al.* (2014) yang mana nilai sikap sebelum intervensi adalah sebesar 70.31. Rendahnya sikap mengenai vitamin larut lemak ini saat *pre-test* dapat disebabkan oleh beberapa faktor. Salah satu faktornya adalah kurangnya sosialisasi mengenai vitamin larut lemak baik di masyarakat maupun di sekolah.

Setelah *pre-test* kemudian dilakukannya intervensi dan *post-test* 1. Tujuan diberikannya

Tabel 4. Distribusi Kategori Sikap

Kategori Pengetahuan	*Pre-test*	*Post-test* 1	*Post-test* 2
Kurang (≤55)	8 (24,2%)	1 (3%)	0
Cukup (56-75)	20 (60,6%)	8 (24,2%)	11 (33,3%)
Baik (76-100)	5 (15,2%)	24 (72,7%)	22 (66,7%)

Tabel 5. Distribusi Skor Sikap Sebelum dan Sesudah

	***Mean* ± SD**	Δ	***P-value***
Pre-test	64,83 ± 11,24	12,65	0,0001*
Post-test 1	77,48 ± 10,02		
Pre-test	64,83 ± 11,24	12,12	0,0001*
Post-test 2	76,95 ± 10,12		

*signifikan: (p<0,05)

intervensi melalui media *Lift The Flap Book* ini untuk memberikan informasi mengenai vitamin larut lemak. Selain dapat meningkatkan pengetahuan, intervensi ini juga diharapkan dapat memengaruhi perubahan sikap menjadi lebih baik.

Berdasarkan hasil *post-test* 1 didapatkan rata-rata skor sikap adalah 77,48±10,02, dimana terjadinya peningkatan rata-rata skor sikap sebesar 12,65. Terdapatnya perbedaan yang signifikan antara skor sikap *pre-test* dan *post-test* 1 (p=0,0001). Terjadinya peningkatan pada sikap anak tentang gizi dapat disebabkan oleh terjadinya peningkatan pengetahuan anak melalui pendidikan gizi (Pramono *et al.,* 2014).

Pada *post-test* 2, diketahui rata-rata skor sikap adalah 76,95±10,12, dimana adanya peningkatan rata-rata skor dari *pre-test* ke *post-test* 2 sebesar 12,12. Hasil analisis *paired sample t-test* menunjukkan nilai *p-value* 0,0001 (p<0.05), yang menandakan bahwa terdapat perbedaan yang signifikan antara *pre-test* dan *post-test* 2 (p=0,001).

Berdasarkan hasil penelitian terlihat adanya peningkatan namun peningkatan skor sikap ini tidak terlalu jauh jika dibandingkan dengan peningkatan pengetahuan. Menurut Bakri *et al.* (2013), sikap merupakan respons yang masih tertutup terhadap suatu objek, sehingga manifestasinya tidak dapat dilihat, tetapi hanya dapat diinterpretasikan karena sikap berasal dari dalam diri masing-masing individu.

Daya Terima Media

Kuesioner daya terima digunakan untuk mengukur seberapa besar daya terima responden terhadap media *Lift The Flap Book*. Terdapat tujuh aspek yang digunakan dalam melihat daya terima responden terhadap *media Lift The Flap Book* yaitu, kesan, penjelasan materi, cara penyampaian materi, penggunaan bahasa, pemilihan warna, gambar/ilustrasi, dan manfaat media. Hasil daya terima *media Lift The Flap Book* disajikan pada Tabel 6.

Berdasarkan Tabel 6 bahwa kesan responden terhadap *Lift The Flap Book* sebagian besar responden (90,9%) menyatakan bahwa media ini sangat menarik. Mayoritas responden (63,6%) menyatakan bahwa materi yang diberikan sangat mudah dipahami.

Tabel 6. Distribusi Frekuensi Daya Terima Media *Lift The Flap Book*

Isi Materi	n = 33 (%)
Kesan	
Sangat Menarik	30 (90,9)
Cukup Menarik	3 (9,1)
Penjelasan Materi	
Sangat Mudah Dipahami	21 (63,6)
Cukup Mudah Dipahami	12 (36,4)
Cara Penyampaian Materi	
Sangat Menarik	30 (90,9)
Cukup Menarik	3 (9,1)
Penggunaan Bahasa	
Sangat Mudah Dipahami	23 (69,7)
Cukup Mudah Dipahami	10 (30,3)
Pemilihan Warna	
Sangat Menarik	25 (75,8)
Cukup Menarik	8 (24,2)
Pemilihan Gambar/Ilustrasi	
Sangat Menarik	29 (87,9)
Cukup Menarik	4 (12,1)
Manfaat	
Ya	33 (100)

Berdasarkan daya terima mengenai cara penyampaian materi pada *Lift The Flap Book* diketahui 90,9% responden menyatakan sangat menarik. Pada daya terima dalam penggunaan bahasa dalam *Lift The Flap Book* diketahui 69,7% responden menyatakan sangat mudah dipahami. Sebagian besar responden menyatakan pemilihan warna dalam media sangat menarik.

Daya terima mengenai pemilihan gambar/ ilustrasi yang digunakan dalam *Lift The Flap* dianggap sangat menarik oleh mayoritas responden (87,9%). Selain itu, seluruh responden (100%) responden menyatakan bahwa media ini bermanfaat. Berdasarkan uji daya terima ini, dapat dikatakan bahwa media *Lift The Flap Book* dapat diterima dengan baik dann mudah dipahami. Menurut Susilana & Riyana (2009), penggunaan media visual yang disertai dengan gambar dan warna yang menarik, akan menarik minat kelompok sasaran untuk mempelajari materi yang diberikan.

KESIMPULAN

Media *Lift The Flap Book* mampu meningkatkan pengetahuan dan sikap anak terkait dengan vitamin larut lemak pada makanan. Media ini dapat dikembangkan menjadi media interaktif yang dapat digunakan untuk mengedukasi siswa di sekolah. Hal ini akan mendukung tercapainya perbaikan status gizi dan kesehatan pada anak usia sekolah.

UCAPAN TERIMA KASIH

Penelitian ini dapat dilaksanakan dengan baik berkat dari berbagai pihak, untuk itu peneliti mengucapkan terima kasih kepada seluruh responden, dosen pembimbing, dan penguji. Penulisan ilmiah ini telah diikutkan pada Scientific Article Writing Training (SAWT) Batch V Program Kerja GREAT 4.1.e, Program Studi S1 Gizi, FIKES, Universitas Esa Unggul dengan dukungan fasilitator: Dudung Angkasa, S.Gz., M.Gizi, RD; Khairizkita Citra Palupi, S.Gz., M.S; beserta tim dosen lainnya di Program Studi Ilmu Gizi Universitas Esa Unggul.

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THE POTENTIAL OF PHYTOCHEMICALS LYCOPENE IN PREVENTION OF BONE LOSS DUE TO DECREASED ESTROGEN HORMONE IN HUMANS AND EXPERIMENTAL ANIMALS

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ABSTRACT

Osteoporosis is a condition of decreased bone mass and disruption of bone microarchitecture that often occurs in the elderly. One of the causes of osteoporosis is menopause as reduced estrogen secretion increases bone resorption by osteoclasts activity, and the body's oxidative stress. Currently, osteoporosis is still a major cause of morbidity and mortality in the elderly. Prevention is vital in reducing this disease. Recent studies have shown a reduction in bone loss with lycopene consumption. High serum lycopene is also reported to be associated with decreased protein oxidation and bone resorption in postmenopausal women. This literature aimed to examine and analyze the research results related to the potential of lycopene on bone loss based on molecular and clinical research evidence in preventing osteoporosis in elderly women. Literature review on published papers in English in the last 10 years (2011 – 2021) was conducted using electronic database. Reviewed experimental and cohort studies on elderly women and experimental animals showed influence and effect of lycopene on bone loss. Lycopene may contribute in reduction of oxidative stress caused by reduced secretion of estrogen.

Keywords: estrogen, lycopene, osteoporosis, bone loss, antioxidant

INTRODUCTION

Osteoporosis is one of the major health problems among the elderly. It is a condition of decreased bone mass and changes in bone microstructure that make bones to be brittle and weak and increases risk of factures (Sözen et al., 2017). The 2005-2006 NHANES study stated that at the age of ≥50 years, 10% of women and 2% of men are at risk to get osteoporosis (Looker et al., 2010). In Indonesia, in 2013, osteoporosis in women in 2013 was 23% for 50-70 years old and 53% for those over 70 years (Kemenkes, 2020). These data showed that women aged ≥50 years are four times more likely to have osteoporosis and at fracture risk for 5-10 years earlier than men (Alswat, 2017).

Risk factors for osteoporosis that cannot be controlled include a fall history, old age, gender, race or ethnicity, family osteoporosis history (Pouresmaeili et al., 2018), and menopause (Thulkar et al., 2016). Menopause is the permanent cessation of menstruation due to the loss of activity and the last sign of ovarian follicles in female reproduction (Messier et al., 2011). Menopause usually occurs in the mid-40s, begin with periods of irregular menstrual cycles known as the menopausal transition or perimenopause. The menopausal transition period begins with hormonal changes due to a decrease in the number of ovarian follicles (Burger et al., 2007). In this period the hypothalamus-pituitary insensitivity decreases estrogen secretion (Weiss et al., 2004). It is triggers an increase in luteinizing hormone (LH) levels in perimenopausal women (Weiss et al., 2004), and a significant increase in follicle stimulating hormone (FSH) (Burger et al., 2007). High levels of LH and FSH due to the absence of negative feedback from the ovaries make the menstrual cycle irregular in menopausal women.

A low level of estrogen is one of the main causes of post-menopausal osteoporosis (Shihab et al., 2018). Low level of estrogen interferes stimulation of osteoblast activity (Callaway & Jiang, 2015) and also management of oxidative stress (Geng et al., 2019). Oxidative stress can stimulate differentiation and bone resorption by osteoclasts (Domazetovic et al., 2017) and may increase risk of osteoporosis (Emmanuelle et al., 2021). Most of the osteoporosis complications are fractures of the hip, spine, and distal forearm,

 Received 22-09-2021, Accepted 28-01-2022, Published online 30-05-2022.

which are currently still one of the main risks of death among elderly (Rao & Rao, 2015). In general, one of three women aged ≥50 years is likely to have an osteoporosis fracture (Kemenkes, 2020). So, it shows that osteoporosis is a significant cause of morbidity and mortality in the elderly. Osteoporosis and related health consequences increases medical costs and economic burden of the society, especially those with high life expectancy (Mithal et al., 2014).

While menopause cannot be controlled, a risk of developing osteoporosis can be reduced through management of oxidative stress, alcohol consumption, smoking, physical activity level, and diet (Nawrat-Szołtysik et al., 2020). Antioxidants have been reported to be capable of decreasing the risk of osteoporosis and several studies reported that regular consumption of carotenoids from vegetables and fruits is effective in helping bone mineralization (Domazetovic et al., 2017; Sugiura et al., 2011).

Lycopene is a plant carotenoid pigment that produces a yellow or orange color in fruits and vegetables (Imran et al., 2020). Lycopene is fat-soluble with all-trans and cis isomers in nature, often found in tomatoes and processed products (Mohamed & Iikay, 2019). It has some characteristics such as not easily crystallize, easily soluble in oil, easily absorbed by the intestine, and easily transported in cells, so that it makes the cis-isomer concentration high in plasma and tissues (Cooperstone et al., 2016). The process of cooking and processing food with the oil addition can increase the release of carotenoids from the food matrix, so the absorption will be increased (Bhowmik et al., 2012). While tomatoes are known to have the highest lycopene content, processed tomatoes such as tomato paste, tomato sauce, soup, and juice have a higher content than raw tomatoes (Burton-Freeman & Reimers, 2011).

Lycopene has the highest ability to quench singlet oxygen (Islamian & Mehrali, 2015). Recent in-vivo and in-vitro studies have shown a reduction in bone loss with tomato/lycopene consumption. High serum lycopene is also reported to be associated with decreased protein oxidation and bone resorption in postmenopausal women (Rao et al., 2007). Since lycopene is suggested to stimulate the growth and differentiation of osteoblasts and inhibit the formation and resorption activity of osteoclasts (Rao et al., 2003), it has a potential to reduce the risk of osteoporosis (Walallawita et al., 2020).

However, studies discussing beneficial effects of lycopene on bone loss in post-menopausal women are still limited. This paper is therefore aimed to review relevant literatures to summarize the effect of lycopene on bone loss based on molecular and clinical research evidence.

METHODS

This study used a literature review design by searching scientific articles published in the last ten years (2011-2021). Figure 1 shows a protocol of literature search. Literature search was conducted through electronic databases (i.e. PubMed, Science Direct, and SpringerLink). Published papers in English were searched using keywords “osteoporosis” or “bone loss” and “lycopene”.

Identified scientific articles were then selected according to inclusion criteria that show the roles and effects of lycopene on bone loss (decreased protein oxidation and bone resorption, differentiation of osteoblasts) both in humans and experimental animals. Research subjects with comorbidities such as diabetes mellitus and cancer were excluded from this study. In addition, scientific articles with a literature review design, systematic review, meta-analysis, and research with cross-sectional studies were excluded from this study. Selected articles were obtained and studied in-depth and analyzed. From a total of 1307 studies found from several database, 1280 are go through the screening process, but only 128 study included in further process based on exclusion criteria. After reviewing the full text and deep analysis of method, only 9 studies match with the review criteria.

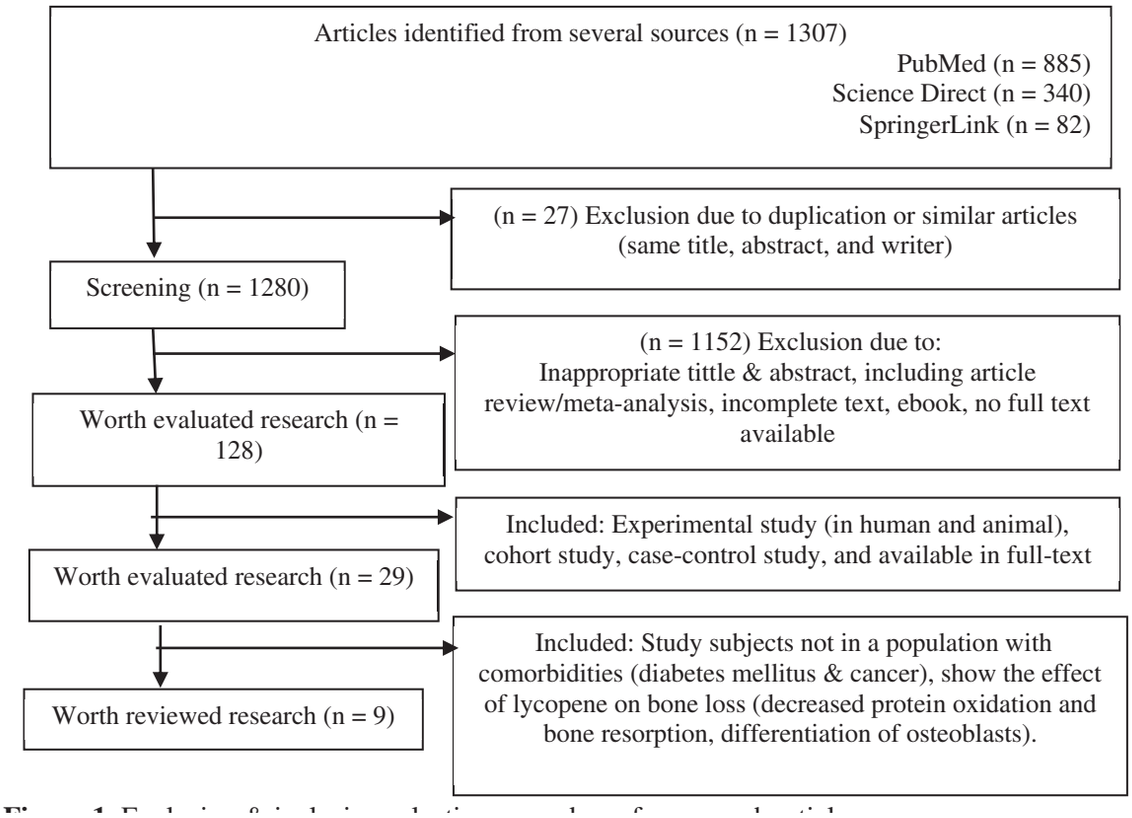

Figure 1. Exclusion & inclusion selection procedures for research articles**.**

Table 1. Effects of Lycopene on Osteoporosis in Post-Menopausal Women

Study Design	Methods	Dosage	Duration	Results	Reference
Cohort Study Subjects: (n = 60) 50-60 years old women who have been postmenopausal for at least 1 year.	Postmenopausal women were divided into 4 groups: (1) regular tomato juice, (2) lycopene-rich tomato juice, (3) tomato Lyc-O-Mato lycopene capsules, or (4) placebo capsules, twice daily for total lycopene intakes	Lycopene supplementation 30 mg/day (regular tomato juice), 70 mg/ day (lycopene-fortified tomato juice), 30 mg/ day (Lyc-O Mato capsules)	4 months	Lycopene supplementation at least for 4 months significantly increased serum lycopene compared to placebo ($p<0.001$) Giving lycopene in of juice or supplements in postmenopausal women of at least 30 mg/day significantly ($p<0.001$) reduced bone resorption and oxidative stress. Oxidative stress parameters such as lipid peroxidation, protein oxidation, and N-telopeptide (NTx) were significantly different from the corresponding changes resulting from placebo supplementation ($p<0.05$, $p<0.005$, and $p<0.02$, respectively)	MacKinnon et al., (2011a)

Continued Table 1. Effects of Lycopene on Osteoporosis in Post-Menopausal Women

Study Design	Methods	Dosage	Duration	Results	Reference
Cohort Study Subjects: (n = 23) Healthy postmenopausal women, 50-60 years old.	Participants were instructed to reduce consumption of food sources containing lycopene (according to the list of foods provided) and supplements. Measuring food intake with 7-day dietary records. Blood samples were measured. Provided blood samples at baseline and following a one-month lycopene-depletion period.	Limitation of lycopene intake to 3.5 mg/day initially and 0.13 mg/day after 1 month	1 month	Dietary lycopene restriction resulted in significant decrease of serum lycopene ($p<0.0001$) and glutathione peroxidase (GPx) ($p<0.01$) There was a significant increase ($p<0.05$) in bone resorption (NTx increased) The level of lipid and protein were not significantly increased. Significant increase in GPx ($p<0.01$) significant decrease in antioxidant levels of superoxide dismutase (SOD) ($p<0.005$) and catalase (CAT) ($p<0.005$) were observed.	Mackinnon et al., (2011b)
A pilot prospective clinical study Subjects: (n = 39) Post-menopausal women aged 63 or ± 70 years	There are 2 groups consisting of a treatment group and a control group. The treatment group was treated by consuming 150 ml/day of tomato sauce.	Tomato sauce 150 ml/day or lycopene content was 3,9 mg/day as tomato sauce	3 months	No significant difference (p = 0.97) bone mineral density (BMD) in postmenopausal women who consumed tomato sauce with the control group. There was a significant decrease in bone alkaline phosphatase (BAP) in women who consumed tomato sauce compared to the control group.	Russo et al., (2020)

Table 2. Effects of Lycopene on Osteoporosis in Experimental Animals

Study	Method	Dosage	Duration	Results	Reference
An experimental study Subjects: (n = 264) 6 months old female Wistar rats with ovariectomized (OVX) and SHAM surgery	Wistar rats were divided into 6 groups: (1) The SHAM group received oral vehicle only, (2) lycopene serum to OVX rats 0 mg/kg BW/day (control), (3) lycopene serum to OVX rats 15 mg/kg BW/day, (4) lycopene serum to OVX rats 30 mg/kg BW/day, (5) lycopene serum to OVX rats 45 mg/kg BW/day, (6) one group receiving alendronate (ALN) (2 µg/kg body weight per day)	Lycopene serum 15, 30, 45 mg/kg BW per day	12 weeks.	Lycopene in ovariectomized (OVX) rats reduced the risk of increased bone turnover (increased bone mineral density (BMD) & bone mineral content (BMC)) and decreased bone reabsorption compared to control OVX rats. Lycopene (30 or 45 mg/kg BW/day) in OVX rats significantly ($p<0.001$) increased bone formation and decreased bone reabsorption. The OVX control group had significantly lower ($p<0.05$) plasma GPx activity as compared with the sham surgery (SHAM) group but lycopene treatment significantly increased GPx activity (30.6–57.2%) compared to the OVX control ($p<0.001$ in each case). Lycopene treatment significantly prevented OVX induced bone loss with marked increases in both BMC and BMD in the lumbar spine ($p<0.001$) and humerus ($p<0.05$) compared with the OVX control group.	Ardawi et al., (2016)

Continued Table 2. Effects of Lycopene on Osteoporosis in Experimental Animals

Study	Method	Dosage	Duration	Results	Reference
An experimental study Subjects: Wistar rats were ovariectomized (n = 18) and paired with sham animals (n = 18)	Wistar rats were ovariectomized and paired with sham animals. In vitro evaluations were performed after 60 days of surgery, when cells were cultured in osteogenic medium and divided in control (C), ovariectomized (OVX) and ovariectomized+1 µmol/L lycopene (OVXL) groups	Lycopene 10 mg/kg BW/ day	10 mg/ kg BW/ day for 4 weeks for pre-OVX and 8 weeks for post-OVX.	Lycopene intake reduced bone loss in the epiphyseal femur in OVX Lycopene rats compared to control OVX. Cell proliferation had a significant increase after 10 days for OVX and OVXL experimental groups ($p<0.0001$), with a subsequent decrease at 14 days culture for all groups ($p<0.0001$)	Ribeiro et al. (2019)
An experimental study Subjects: Female Sprague–Dawley 6-week-old rats with OVX	Ovariectomized rats were grouped into 4 groups according to the lycopene content of their diet: 0, 50, 100, and 200 ppm. Lycopene was incorporated into the diet as a tomato extract containing 6 % lycopene (Lyc-O-Mato 6 %, LycoRed Ltd., Israel)	Lycopene to OVX rats 0, 50, 100, and 200 mg lycopene/kg diet	9 weeks.	Lycopene (100 mg/kg BW) in OVX can increase the BDM of the lumbar spine and decrease bone resorption compared to the control OVX. No significant difference in the levels of oxidative stress in all OVX groups.	Iimura et al., (2015)
An experimental study Subjects: (n = 24) 6 week old Sprangue-Dawley	24 rats were grouped into 3 groups according to the lycopene content in their diet: 0, 50, 100 mg/kg dose lycopene. Lycopene was incorporated into the diet as a tomato extract containing 6 % lycopene (Lyc-O-Mato 6 %, LycoRed Ltd., Israel)	Giving lycopene to OVX rats 0, 50, 100 mg lycopene/kg diet	9 weeks.	Giving lycopene (100 mg/kg) can increase the BMD of the lumbar spine and proximal tibial metaphysis compared to the control OVX. The tibial proximal metaphyseal BMD in the 100 ppm groups was also significantly higher than in 50 ppm group ($p<0.05$) No significant differences or trends in BMD of tibial diaphysis were observed in among the groups. No significant difference in the serum oxidative stress level among the 3 groups.	Iimura et al., (2014)
An experimental study Subjects: (n = 50) 2 month female Wistar rats with OVX and sham	Fifty female Wistar rats were grouped into 5 groups: (1) Sham, (2) OVX, (3) OVX + 20 mg/ kg bw, (4) OVX + 30 mg/ kg body weight, (5) OVX + 40 mg/kg body weight. This study investigated the beneficial effect of lycopene on bone biomarkers in ovariectomized (OVX) rats	Lycopene 20, 30, 40 mg/kg BW	8 weeks.	Giving lycopene at 30 and 40 mg/ kg BW can increase BMD ($p<0.05$) and BMC ($p<0.01$) in OVX rats compared to the control OVX group. Serum estrogen level was markedly ($p<0.01$) decreased compared with sham control. Interleukin 6 (IL-6), Bone Gla Protein (BGP), and Collagen Type 1-C-Tellopeptide (CTx) levels were significantly decreased in OVX + lycopene. IL6 plays a role in stimulating bone resorption.	Liang et al., (2012)

Table 3. The Effect of Lycopene on the Osteoclasts and Osteoblasts Development

Study	Method	Dosage	Duration	Results	Reference
An experimental study using osteoblastic culture (human mesenchymal stem cells bone marrow) and osteoclastic culture (human peripheral blood mononuclear cells) in humans aged 25-35 years old.	Osteoblastic and osteoclastic culture were maintained for 21 days in the absence (base medium, BM). Cell cultures were incubated in a 5% CO2 humidified atmosphere at 37°C, and culture medium was replaced once a week. Culture cell will treated with lycopene. Then observed apoptosis, expression of several culture cell and involvement of several intracellular pathways in cell response. Cultures were assessed at days 14 and 21 as described below.	Lycopene concentrations of 5 nM to 50 µM in cell culture	21 days.	Giving lycopene (≥500 nM) helped the proliferation and differentiation of osteoblast (osteoblastogenesis) and inhibit the differentiation of osteoclast (osteoclastogenesis) so it does not affect bone density. Giving lycopene (≥500 nM) can promote a significantly decreased Tartrate-Resistant Acid Phospatase (TRAP) (~20%-46%) on osteoclastic culture. TRAP concentration in serum is utilized as a biochemical marker of osteoclast function and degree of bone resorption. Cell density in osteoblasts was seen based on the total protein value that could be seen with the dexamethasone (-dex or +dex) content. The results showed that lycopene supplementation (≥500 nM) can significantly increase the content of dexamethasone (~18%–22% and ~19%–25% in −dex and +dex conditions, respectively).	Costa-Rodrigues et al., (2021)
An in vitro investigation using Human osteoblast cells (Saos-2) in the American Type Culture Collection (ATCC)	Cell cultures were incubated at 37 °C in 5% CO2. The cell cultures were incubated with dexamethasone 10 nM to obtain a more differentiated cell line. For the evaluation of cell proliferation, Saos-2 cells were seeded at a density of 200,000 cells/ well in 6-well dishes. Cells were incubated with lycopene (≥98%), from tomato (Sigma Aldrich, St. Louis MO, USA), 5 and 10µM or vehicle Tetrahydrofuran, THF (Sigma Aldrich, St. Louis MO, USA) in serum free medium for 24 hours.	Lycopene to cells with a concentration of 5 and 10 µM	24 hours	Lycopene incubation at the dose of 10µM resulted in higher phERK1/2 protein expression levels than the respective vehicle ($p = 0.006$). Lycopene in tomatoes can suppress bone resorption as indicated by decreased Receptor activator of NF-κB ligand (RANKL) expression. Lycopene helps suppress Alkaline Phospatase (ALP) stimulation thereby indicating the occurrence of bone mineralization. The ALP activity was significantly increased with lycopene 5 and 10µ ($p<0.001$) in comparison to their vehicles ($p = 0.02$)	Russo et al., (2020)

Continued Table 3. The Effect of Lycopene on the Osteoclasts and Osteoblasts Development

Study	Method	Dosage	Duration	Results	Reference
An experimental study using osteoblast cells from the medullary femur of OVX female Wistar rats	The cultured cells are grouped into 3 parts: Control (C), ovariectomized (OVX) and ovariectomized with lycopene (OVXL). The lycopene (Sigma-Aldrich®, St. Louis, Missouri, USA) was presented in powder form and mixed in the above-mentioned culture medium to reach a concentration of 1 μmol/L. Cell proliferation was assessed by MTT assay at 7, 10, and 14 days	1μmol/L lycopene in cell culture	14 days	Lycopene can increase the metabolism of osteoblastic cells for 3-10 days for OVX and OVXL ($p<0.0001$). On day 10 ALP activity was still slow in the OVXL group ($p = 0.755$), but on day 14 ALP activity increased in the OVX group compared to the control group ($p = 0.0024$).	Ribeiro et al., (2019)

RESULTS AND DISCUSSIONS

One of the main causes of post-menopausal osteoporosis is low level of estrogen secretion which functions to regulate bone turnover with osteocytes, osteoclasts, and osteoblast formation (Brennan et al., 2014). Under condition of a low estrogen secretion, greater osteoclast activity compared with osteoblast activity that will affect bone formation and increases risk of post-menopausal osteoporosis. Based on epidemiological studies, low estrogen secretion also triggers a decrease in antioxidants and therefore increases oxidative stress, one of the risk factors of osteoporosis (Geng et al., 2019).

Oxidative stress, such as lipid peroxidation, is formed due to an imbalance between of Reactive Oxygen Species (ROS) production and the intravital antioxidant capacity. ROS are formed due to cellular respiration, mitochondrial enzymatic activities, and cellular responses to cytokines due to external stimuli (Birben et al., 2012). ROS are associated with aging and the pathogenesis of various inflammatory and degenerative diseases (Cervellati & Bergamini, 2016), including osteoporosis (Bonaccorsi et al., 2018). The reactive oxygen and free radical contents in ROS oxidize lipids and proteins. As ROS damage cells and deteriorate its function, ROS in bone suppress osteoblast differentiation and significantly help osteoclast differentiation (Callaway & Jiang, 2015) that accelerates bone resorption and cause bone fragility because it increases proinflammatory cytokines, especially tumor necrosis factor (TNF-α) (Domazetovic et al., 2017). Until today the correlation between proinflammatory cytokines with bone fragility and bone deformation and its correlation with estrogen level in menopause women still have no clear explanation.

The results from the present literature review was in line with a study by Azab et al., (2019) that showed antioxidant intake effectively reduced the body's oxidative stress by reducing the production of ROS and proinflammatory cytokines, as well as increasing endogenous antioxidants. Based on the literature search, nine relevant pieces of literature studied benefits of lycopene for bone health based on experimental animal studies, cell culture, and epidemiological/clinical research. The following are the literature review results listed in Table 1-3 with the context of osteoporosis in low estrogen secretion/menopause.

Epidemiological and Clinical Research

An increase in oxidative stress in post-menopausal women is characterized by an increase in serum lipid peroxide and a lower Total Antioxidant Capacity (TAC), as indicated by a decrease in glutathione peroxidase activity compared to reproductive women (Montoya-estrada et al., 2020). In the form of superoxidation, oxidative stress triggers increased osteoclastic in osteoporosis (Zhao et al., 2021).

Postmenopausal women experience a decrease in antioxidants due to increased lipid peroxidation

due to a low estrogen level (Kolesnikova et al., 2015). The results of the Framingham Osteoporosis Study for 4 years showed that the intake of antioxidants in carotenoids had a protective effect on bone by increasing the Bone Mineral Density (BMD) value of the male trochanter and female lumbar spine (Sahni et al., 2009). The results of a 17-year follow-up study showed that a high intake of lycopene could reduce the risk of hip fracture ($p = 0.01$) and nonvertebral bone ($p = 0.002$) (Sahni et al., 2009). This study design demonstrated the positive impact of lycopene on bone health, as mentioned in Table 1.

Experimental Research using Animals

Experiments using female Wistar rats may be considered most appropriate to determine the effect of lycopene on bone health because ovariectomy (OVX) can describe hormonal and postmenopausal conditions similar to humans. In OVX bone turnover was not too fast and similar to the control group of SHAM surgery procedure without the ovaries (Calciolari et al., 2017). Several studies related to the bone density with experimental rats have also been conducted with various interventions such as the provision of certain diets (Fischer et al., 2017), hormones (Yan & Ye, 2015), and immobilization (Horge et al., 2016) which showed major influence on bone loss.

Research on the bone marrow of OVX rats with low estrogen secretionshowed an increase in ROS, activities of enzymes such as glutathione reductase, and increased plasma lipid peroxidation compared to SHAM rats (de Oliveira et al., 2018). These are all associated with bone metabolism and the observed differences suggests OVX rats were more prone to bone loss. Research by Nirmala et al., (2020) also showed that giving green tomato extract to OXV rats can reduce bone loss by increasing the regulation of bone homeostasis. Overall, animal studies using OVX rats have shown positive effects of lycopene administration on bone protection (Table 2).

Research in Bone Cell Culture

High concentrations of ROS can inhibit osteoblast activation through H_2O_2 from ROS that can activate NFκB so that it inhibits osteoblast differentiation and increases bone resorption by osteoclasts (Hubert et al., 2014). It is known that carotenoid group antioxidants play a role in regulating both NFkB and cytokine activities (Linnewiel-Hermoni et al., 2014). Intake of antioxidants is therefore important in reducing ROS production and remodeling of bones by inhibiting osteocyte apoptosis. It also takes part in reducing osteoclast differentiation, increasing osteoblast activity, inducing osteogenesis, and reducing inflammation (Domazetovic et al., 2017). Recent studies have shown that lycopene affect osteoblast and osteoclast (Table 3).

Lycopene is known to have the highest antioxidant potential compared to astaxanthin and it plays an important role in lowering singlet oxygen levels, twice better than β-carotene and ten times better than α-tocopherol (Przybylska, 2020). At the cellular level, lycopene has shown its role in stimulating the growth and differentiation of osteoblasts. It can also inhibit bone formation and resorption by osteoclasts by producing Tartrate-Resistant Acid Phosphatase (TRAP) as well as ROS secretion (Bonaccorsi et al., 2018).

A cohort study on postmenopausal women using various types of carotenoids was carried out by Sugiura et al., (2012). The study showed no significant relationship between lycopene and bone health. It also showed that the carotenoids β-cryptoxanthin and β-carotene played more important roles in increasing BMD. This may be influenced by low lycopene intake in subjects. Meanwhile, Hayhoe et al., (2017) showed that intake of various types of carotenoids, including lycopene, had a positive effect on bone health by increasing bone density and reducing the fracture risk in elderly men and women in Europe. In addition, a review by Walallawita et al., (2020) stated that the intake of lycopene mainly sourced from tomatoes and their processed products has a protective effect on bone loss. However, the role of certain tomato varieties in protecting bone loss is not certainly known. As in lycopene and β-cryptoxanthin which play an important role in preventing bone loss (Quilliot et al., 2010), increased consumption of fruits and vegetables rich in carotenoids and antioxidants contributes improvement of bone health, especially in the elderly.

Currently, there is no recommendation for the amount of lycopene ideal for bone health. Research by MacKinnon et al., (2011a) has shown that a lycopene intake of at least 30 mg/day can significantly reduce bone loss and oxidative stress. As for the lycopene half-life in plasma about 6 days, based on intake of 20 mg of lycopene for 8 consecutive days (Moran et al., 2013). However, it seems that the lycopene dose and half-life in the body vary for various health purposes. Based on the results of several epidemiological studies, a daily intake of lycopene 2-20 mg/day can improve bone? health by reducing oxidative stress (Saini et al., 2020). These recommendations can be met by consuming processed tomato products which increase lycopene intake to about 20 mg/day (Marques et al., 2015). Besides, research by Nishimura et al., (2019) stated that a high intake of lycopene (sources from raw tomatoes) did not cause specific side effects on the body with a safe dose of 200 g/day raw tomatoes. Nine studies from the present study showed that an intervention using lycopene reduces a risk of osteoporosis in women with low estrogen secretion. All studies included in the present study used experimental and cohort designs as these study designs better explained the effectiveness of specific intervention. These studies suggested that lycopene reduces a level of oxidative stress in the body and bone resorption by osteoclasts as well as stimulation of growth and differentiation of osteoblasts.

The present study has some limitations to be acknowledged. This study only consists of nine studies. This is because studies focused on effects of lycopene, especially in relation to bone health is still limited. Since there is a lesser number of studies compared with animal studies, there is a need for further research using human subjects. In addition, it is necessary to consider tomato varieties and doses in assessing the effectiveness of the effect of lycopene on bone loss in humans.

CONCLUSION AND SUGGESTION

Based on the review result on nine studies, lycopene was found to have beneficial effects on bone loss. The results from epidemiological studies suggested that lycopene intake of 2-20 mg/day may contribute as an antioxidant to maintain bone health. Consumption of lycopene such as from tomatoes and their processed products can increase the intake of lycopene for bone protection. The bioavailability of lycopene in tomatoes can be increased through cooking techniques with the oil addition and processing it into tomato sauce and paste. In order to increase lycopene consumption in the Public, delivery of nutritional information as well as cooking skills is recommended.

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FACTORS AFFECTING THE CHOICES OF HEALTHY DIET AMONG ADOLESCENTS IN RURAL AREAS

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ABSTRACT

Many adolescents tend to pick unhealthy diets with high amount of sugar, salt and fat, while the number of adolescents who consume vegetables and fruit is relatively low. As adolescents begin to pick their own diets by themselves, there are certain reasons behind each of their preferences in foods. This study was aimed to analyze the factors affecting the choices of healthy diet among adolescents in rural areas. This was quantitative research with analytical and observational research method with a cross sectional design. The data sampling method used in this study was a multistage random sampling method. This research was conducted to 160 respondents with a population of 1,143 from 10 different high schools. The sample size was calculated using the OpenEpi software. The data on factors or reasons behind the choice of healthy diet was taken using the Food Choice Questionnaire (FCQ), while the data on the choices of healthy foods was taken using a structured questionnaire, both of which had been tested for validity and reliability. The collected data were analyzed using the Spearman Rank test. The main reasons that can influence adolescents to pick healthy diets in rural area were for healthiness concerns, the natural contents of the foods, and body weight control (BW) (p=<0.005). It is recommended for adolescents to optimize their knowledge and skills in food selection, especially healthy food.

Keywords: rural area, adolescents, food choices, healthy diet.

INTRODUCTION

Adolescence is a stage between childhood and adulthood between the age of 10 to 19 years old. Adolescents experience rapid physical, cognitive and psychosocial growth, which affects their feeling, decision-making and their way of interaction. As each age group is facing different health risk, adolescent are also vulnerable to certain risks. Children aged 10-14 years old are vulnerable to risks related to water, hygiene, and sanitation, while for children aged 15-19 years old, the risks are often associated with unhealthy habits, such as alcohol abuse, poor diet, and minimum amount of physical exercises (World Health Organization, 2021).

The COVID-19 pandemic has affected every line of life, including food consumption patterns. Unfortunately, the changes that occur can lead to both positive and negative eating patterns. Maintaining a balanced diet during a pandemic is crucial to support the body's immune system against viruses, bacteria and disease organisms. Changes in conditions during the COVID-19 pandemic should require people to adopt a healthier and more diverse diet. Unfortunately, the impact of the COVID-19 pandemic on diet can lead to both positive and negative behavior (Amaliyah et al., 2021; Di Renzo et al., 2020; Mustakim et al., 2021; Tampatty et al., 2020).

Healthy lifestyles need to be applied from the beginning to generate positive impact on the body. Adolescent, consciously or not, may have developed unhealthy lifestyle habits. Inactiveness and low physical exercises, fast food consumption, unhealthy sleep schedule, and overworking are some of the example (Albert et al., 2018). Aside of the daily intake of fruit; vegetable, physical activity, and micronutrient intake in rural area are still relatively low. A research conducted by (Davidson et al., 2018). found that the quality of the density of micronutrient intake such as intake of calcium, iron, vitamin A, and vitamin C in rural area is still low. The low density of micronutrient intake in preschooler can be caused by the high consumption of snacks and other foods that are high in energy, but low in micronutrient quality. The nutritional density of food for rural preschool-

 Received 17-11-2021, Accepted 11-02-2022, Published online 30-05-2022.

aged children is still relatively low. More than half the respondents are exposed to the risk of high morbidity rate.

Fulfillment of nutritional intake in adolescence shall be taken seriously due to the increasing amount of need for nutrients at this stage to support physical and psychological growth and development. The lifestyle and diet of adolescent are also important aspects to watch because those can affect each persons' percentage of nutritional intake (Hardinsyah & Supariasa, 2016).

Indonesian people are already at very high risk of sugar, salt, and fat consumption (SSF). The combination of these SSF consumptions shows that Indonesia have entered an alert situation, where thirty percent of the population (equivalent to approximately 77 million people) consume more than the recommended intake per day. Policies to reduce the national sugar, salt, and fat intake shall be implemented immediately to anticipate the increase of population with the risk of non-communicable diseases (Atmarita et al., 2016).

The amount of sodium intakes among the population aged over five years old is more than 2000 mg/person/day. This number has exceeded the intake limit set in the Regulation of the Minister of Health No. 30 of 2013. The number of population who consumes sodium for more than 2000 mg per day, or the equivalent of 5 gram of salt, is seen to be highest among the population between 13-18 years old—which are the nation younger generation. This situation need to be taken into concern to prevent rises on the amount of non-communicable diseases in the future (Sri et al., 2016).

Sugary foods with high amount of fat are more popular than healthy foods, such as green vegetables, among children. The accessibility, good taste, low price, or even good marketing strategies, and peer influence are contributing to the popularity of unhealthy junk food among children and adolescent. A study found a high prevalence of junk food consumption (36%) among students in rural area of Himachal Pradesh India. High junk food consumption has been observed among the people from both urban and rural area due to easy accessibility and increased family income. Consumption of junk food in high frequency and in high amount will eventually risk adverse impacts on the body, one of which is obesity. Additionally, a study stated that urbanization is also found to be connected with increasing body weight among adolescent in Ontario, Canada. That study showed that the percentage of overweight and obese respondents from rural areas was significantly higher than in urban area (Aakriti et al., 2018; Ismailov & Leatherdale, 2010; Jaya et al., 2011).

Choosing a diet plan is generally a complex process that may be influenced by family, mass media and environment. In addition, globalization can erode people preferences for traditional food while providing a wider choice and availability of food, therefore it is also a factor that influences people dietary choices (Aulia & Yuliati, 2018). There is no difference in food choices between adolescent living in rural and urban area, but there are differences in terms of factors that influence healthy food choices.

Nearly 35% of students aged between 9-13 years old in the rural area in Poland consume sweets frequently, while 40% of the students do not consume vegetable and consume fruit at least once a day. Adolescent diet is usually known by low intake of fruit and vegetable with the consumption of foods with high calories and low nutrients. This includes sweet and savory foods, sugary drinks with extra amount of sugar, and also fast foods (Akseer et al., 2017; Keats et al., 2018; Witold et al., 2011).

Picking diet is defined as the degree of preferences in foods which will affect each individual diet. There are several factors that may affect this preference. Previous studies regarding factors that can impact individual diet choices are still showing varied results, thus it is necessary to do more research on factors that affect the selection of healthy diets among adolescents in rural areas. Based on the previous explanation, the researcher tried to analyze factors associated with the choice of these foods. Previous studies explained that lifestyle and characteristics or habits of adolescents who live in urban and rural area of course have a difference. (Setyawati & Setyowati, 2015).

METHODS

This research was conducted in quantitative methods of analytical and observational research

with cross sectional research design. The total population in this study amounted to 1143 people, sample size of this study was calculated using a computer program called OpenEpi, with the following criteria: aged between 14-19 years old, adolescent living in rural area, and willing to be research subject. Based on these criteria, the number of sample in this study was 160 respondents. Each of the research samples had stated their agreement to participate in this study by signing the informed consent agreement. This research was conducted from May to June 2021.

The data used in this study were obtained from two sources: the first was the primary data, which were obtained directly from the food choice questionnaires and healthy food selection questionnaire filled out by the respondents. The questionnaire contained lists of questions on factors affecting healthy diets and on healthy food selection. The second was secondary data, which were obtained from existing sources, which in the form of the total number of students whom were used as research sample and obtained from the Central Statistics Agency.

The sampling method used in this study was a multistage random sampling method, which was conducted on regional level. The first stage was to determine which sub-districts were considered and met the criteria as rural area. Tulang Bawang is one of the regencies in Lampung with 15 sub-districts, and 12 of which are rural area. Fifty percent of the 12 rural areas were picked as the determined sampling area. The selection of the 6 districts was conducted randomly via Microsoft excel. The selected sub-districts are: Gedung Aji, Meraksa Aji, Penawar Aji, Rawa Pitu, Penawar Tama, and Gedung Aji Baru sub-districts. The second step was to determine the schools that would be used as research locations. From the selected 6 sub-districts, there were 21 high schools/ equivalent schools registered. We picked 50% of that amount randomly, which would be used as the research locations. The school selection was done by random sampling using Microsoft Excel with the rand between formulas.

Data on reasons or aspects affecting individual choice of diet were obtained from the FCQ (Food Choice Questionnaire) questionnaire. There were 36 questions representing nine major aspects affecting choices of diet, including health condition, emotion, convenience, sensory appeal towards food, food natural content, food price range, weight control, familiarity towards certain flavours or foods, and ethical values. This questionnaire was developed by Steptoe et al., 1995, to identify the major aspect taken by a person in picking their diet by adding up the scores on each answer according to categories. The three most picked aspects would be considered as the most impactful aspects affecting the respondents in picking their diet.

The second questionnaire was the healthy diet selection questionnaire. As what has been described above, the selection of healthy diet is a process of determining which nutritious, healthy, and safe food should consumed by a person. This questionnaire was carried out by referring to the Balanced Nutrition Guidelines, published by the Ministry of Health of the Republic of Indonesia in 2014. Respondents were asked to express their opinion whether they: strongly disagree (STS), disagree (TS), undecided (RG), agree (S), or strongly agree (ST) against the statements in the questionnaire. Both questionnaires had been tested for validity and reliability with a sample of 30 respondents.

The data were analysed using the Spearman Rank test, since the particular data were not normally-distributed data. This research had obtained ethical approval from the Health Research Ethical Commission. (KEPK) Sebelas Maret University Number 30/UN27.06.6.1/KEP/ EC/2021.

RESULT AND DISCUSSION

Respondents Characteristics

Half of the respondents, approximately 55% of the total respondents, participating in this study are high school students from the older adolescence age group. Seventy-five percent of the research subjects are female. Forty nine percent of the subjects have pocket money less than Rp. 10,000 a day. While the average amount of pocket money is Rp. 5,000 a day. Characteristics of respondents can be seen thoroughly on Table 1.

Tabel 1. Characteristics of The Respondents (n=160)

Variable	n	%
Age Group (Age)		
Younger Adolescence (11-13)	-	
Middle Adolescence (14-16)	72	45%
Older Adolescence (17-20)	88	55%
Gender		
Female	121	76%
Male	39	24%
Pocket Money (in Rupiah)		
Low (< 10.000)	78	49%
Average (10.000-15.000)	74	46%
High (>15.000)	8	5%

Source: primary data (2021).

Factors Affecting Adolescent Choice of Healthy Diet

The analysis in this study was conducted using the Spearman Rank test, which aimed to see the correlation between two variables. The variables used in this research are: health aspects, emotional conditions, convenience, sensory appeal towards certain foods, food's natural content, price range of foods, body weight control, familiarity, and ethical values. The dependent variable in the research is the adolescent choices of healthy diet.

Identifying factors that influence healthy food choices can be done by looking at the reasons or motives of respondents in choosing healthy foods using the FCQ (Food Choice Questionnaire). Based on the results obtained, the main factors of respondents in determining the choice of food were health (4.49 ± 0.79), natural content (4.34 ± 0.97), and weight control (4.14 ± 0.94). The results of this study were in accordance with the research of Puspadewi & Briawan, (2015), which states that health is one of the factors that influence the choice of healthy food, where the main reason for choosing food is the natural content in food (score 6.25±0.69), and health (score 6.15±0.68).

The statistic result showed that there was a correlation between factors of health concerns, body weight control, and food's natural contents behind healthy diets among adolescents in rural areas ($p<0.005$). This showed that respondents prioritize health as the main reason in determining the food to be consumed. This can be concluded that adolescent understand that consuming unhealthy foods can affect their health.

Based on the results of the study, most of the respondents were female. Usually the choice of eating between men and women is different. A person's gender can affect their preference of food. A research conducted by Choiriyah et al., (2019), states that there was a relationship between diet and gender, because gender is a factor that can differentiate pattern of food consumption among children. Male adolescent generally have a pattern of eating more food than female adolescent. In addition, the preference of food between men and women tend to be different as well. Men tend to enjoy more unhealthy foods such as foods with high amount of fat, carbohydrate, protein, sugar, and alcohol; while women prefer much healthier

Table 2. The Relation between Affecting Factors and Adolescent's Choice of Healthy Diets

Affecting Factors	Choice of Healthy Diets		
	Mean ± SD	Correlation Coefficiency (ρ)	p
Health Factor	4.49 ± 0.79	0.353	0.000**
Food's Natural Content	4.34 ± 0.97	0.293	0.000**
Body Weight Control	4.14 ± 0.94	0.318	0.000**
Price Range	4.10 ± 0.98	0.041	0.610
Convenience	4.00 ± 0.99	0.043	0.586
Emotional Condition	3.96 ± 1.11	0.107	0.178
Sensory Appeals	3.87 ± 1.11	0.033	0.679
Familiarity	3.68 ± 1.06	0.000	0.999
Ethical Values	3.23 ± 1.26	0.045	0.573
Pearson test, $p < 0.05$			

Source: primary data (2021).
**correlation is significant at the 0,01 level (2-tailed)

choice of foods such as fruit, vegetable and low-fat product (Barriee et al., 2015).

Pocket money is the amount of money given from the parents to their children as part of the allocation of family income to the children which can be used for snacks or other purposes preferred by the student (Zainuddin et al., 2018). Most of the respondents have less than Rp. 10,000 per day. The amount of pocket money given to the students can affect student's choice of diet. A research conducted by Widyoningsih et al, (2016) stated that the students with lesser amount of pocket money had 18 times bigger chance to choose healthy snacks compared to students with higher amount of pocket money.

A province consisted of an urban area and a rural area. Adolescents who live in these two regions certainly have different sets of characters. Research conducted by Anggraeni et al, (2020), showed that there was a difference in the frequency of consumption of packaged snacks containing MSG in urban and sub-urban youth. Percentage of sub-urban youth with consumption frequency of 7 times per week was 34.0% higher than urban youth, which was 27.7%. Research conducted by Setyawati & Setyowati (2015) showed that both adolescent in rural and urban area did not have unhealthy eating behavior according to the general message of balanced nutrition. Not good eating behavior that many adolescents often do include: not having breakfast, the tendency for eating snacks, confectionery and soft drinks. In addition, research conducted by Wesley & Joseph, (2011) found that adults from rural areas had lower amount of fruit and vegetable intake than the people in urban area.

The result from the questionnaires in this study showed that there were three main factors affecting adolescent in choosing healthy foods. Those factors are: health factors, food's natural contents, and body weight control. Respondents majorly picked health factors as the reason for them to choose healthy foods. The health factors in question are foods that are high in fiber, nutritious foods, foods with good amounts of vitamin and mineral, foods that are high in protein, as well as foods that are good for their health, and their body. This result showed that the nutritional knowledge of respondents who live in rural area are relatively good. The more familiar a person is to facts and information regarding food's nutritional content, the higher chance for them to pick healthier choice of foods, and vice versa. The more a person understands about the nutritional information on foods, the higher chance for them to watch out the foods they consume. A person's level of nutritional knowledge affects their attitude and behavior in picking their diet (Setyawati & Setyowati, 2015; Syafira, 2015).

In 2017, a study stated that the people's awareness on the importance of a healthy lifestyle had increased, where health became one of the top three most important factors behind the people's food preferences after the factors of taste and price (Ho & Song, 2017). In the last two decades, there have been significant changes in the people's food selection and consumption (Küster & Vila, 2017).

Accessibility of information makes it easy for teenager to get the information they want. In this context, the information regarding nutritional aspects of foods. The rapid technological advancement has changed the lives of people in all regions. The increasingly sophisticated technology offers various conveniences and choices of lifestyle that sometimes may even substitute the old and traditional ways. Human nowadays depend on TV, radio, newspaper, internet, and other mass communication media as the source of information. Every adolescent, both in rural and urban area, has easy access to information through social media. Social media is a vehicle for communication or exchange of information in the community. Social media, in some ways, also demands physical involvement of the individual in the communication process. Social media provides easy access of face-to-face communication in the form of interpersonal communication and collective communication. Social media is described as cheap, easy, promoting equal access to information, culturally-appropriate, legitimate, entertaining, and trusted by the rural communities. Various kinds of social media are increasing every year with different advantages and disadvantages (Setyawati & Setyowati, 2015).

The respondents also picked food's natural content factor as the second main factors they consider in picking their foods. The natural content in question may include the consideration of

whether the food contains additive substances or not, whether the food contains any natural ingredients or not, and whether the food contains any artificial chemicals or not. This illustrates that the overall respondents were already informed that foods with artificial chemicals are not good for their health. This is what makes foods' natural ingredients as one of the main reasons of the respondents in considering and choosing their food. Diseases that might be caused by the long-term consumption of artificial food ingredients include cancer, kidney damage, and many others. It is stated in the Regulation of the Minister of Health of the Republic of Indonesia Number 033 of 2012 concerning Food Additives. The use of *rhodamine B* may cause respiratory tract irritation and is a carcinogenic substance which may cause cancer (Deny, 2015).

The next main reason considered by the respondents before choosing their diets was the effort in keeping their body weight within a healthy number. The aspect of weight control in question was the respondents' consideration whether the food is low in calories, low in fat, and is good for body weight control or not. Body weight control is closely related to the public perception of body shapes. Many adolescent idolizing public idols with good body shape, which contributed in creating the ambition among adolescents to get that particular body type. One helpful way to shape the body is by watching the amount of the daily calories intake, limiting the consumption of certain types of food, or planning healthy diets. However, adolescents with positive body image tend to not set any particular limits to their food consumption (Asnudin & Sanjaya, 2018).

In addition to the three factors above, there were several other factors affecting adolescents in choosing healthy diets, such as emotional condition, convenience, sensory appeal, price range, familiarity and ethical values. The 4th major factor considered by the respondents in choosing a healthy diet is the price of food. The respondents generally (4.10 ± 0.98) consider the importance of price in picking their foods. Respondents prefer the cheaper and more affordable option for their foods. Of the 160 respondents, 78 respondents have less than Rp. 10.000, pocket money, which was a relatively low amount. Consequently, respondents were bound to consider the cheaper options for their choice of food. According to research done by Pamelia, (2018), price and taste are some of the main factors that can trigger the consumption of unhealthy foods in adolescent, for example: fast foods.

The 5th priority is convenience. The average of respondents (4.00 ± 0.99) considered convenience as one of the important things in choosing healthy food. Convenience means that the food is easy to prepare, and easy to find in shop/market nearby. The availability of food nearby their houses is one of the most influential factors towards the frequency of eating and the quality of the diet (Febrina et al., 2020).

In the aspect of mood or emotional conditions, the average value was 3.96 ± 1.11, this showed that respondents do not consider the emotional condition too much in choosing healthy foods. Emotional aspect was ranked at the 6th factor. The mood aspect in this study was measured in terms of whether they pick a food because it helps cheering them up, easing their stress, keeping them awake, helping the body relax, or feeling better. Some people consume certain foods to relieve stress or help the body to relax. A research conducted by Claresta & Purwoko, (2017) stated that there was a decrease on the anxiety level of a group of college students before tests who consume chocolate and an increase on the anxiety levels of the group who do not.

The 7th affecting factor was sensory appeal. The sensory appeal aspect in this study consisted of the condition of foods that is appealing to the human's senses, such as: good tastes, nice smell, pleasant texture, and nice plating. The average of the (3.87 ± 1.11) respondents did not pick sensory appeal as the top affecting factors behind adolescent's choice of healthy food. A study showed that most adolescents in Padang consider the taste, color, portion, aroma, texture, and price of the food before they pick their foods (Azrimaidaliza & Purnakarya, 2011).

The next factor affecting choice of healthy food among adolescents is familiarity. This aspect might include foods consumed in childhood, familiar foods, and foods that are consumed daily. This factor is on the 8th priority for respondents in choosing the healthy diets with an average value of 3.68 ± 1.06.

The last factor affecting choice of healthy food was ethical values. Ethical values behind a person's choice of foods might include: preference towards foods with environmental-friendly packaging, foods from a certain country, or foods with clear information regarding the source. The aspect of ethical values is not a major aspect behind the respondent's choice of healthy food. It is placed within the lowest average value of 3.23 ± 1.26. Ethical values are the last reason for choosing their meal. This is because ethical values are factors that are not considered important by respondents. as research conducted by Markovina et al., (2015), showed the result that ethical values were consistently ranked as the least important in nine countries, namely Germany, Greece, Ireland, Poland, Portugal, Spain, the Netherlands, the UK, and Norway.

CONCLUSION

Based on the analysis, it can be concluded that among the nine possible aspects which affect a person's choice of healthy diets, there were three major aspects used by adolescents in rural area in picking their healthy diets. These aspects include health factors, food's natural content, and weight control. There was a correlation found between the aspects of health, food's natural content, and weight control behind the healthy diet choices among adolescents in rural areas ($p<0.005$). Food selection in adolescents was quite good. It is recommended for adolescents to optimize their knowledge and skills in food selection, especially healthy food.

ACKNOWLEDGEMENT

The authors would like to express our gratitude towards all parties who have contributed to this research, including the lecturers and all school principals who have allowed the author to conduct the research in the particular school, which are: SMKN 01 Gedung Aji, SMAN 01 Gedung Aji, MAS Al Fadlu, SMAN 01 Meraksa Aji, SMAN 01 Rawa Pitu, SMAN 01 Penawar Aji, MAS Nurul Iman, SMKS Kosgoro, SMKN 01 Penawar Tama, and SMAN 01 Gedung Aji Baru.

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FAKTOR YANG MEMENGARUHI KEPUTUSAN PEMBELIAN KONSUMEN TERHADAP KATERING SEHAT

Factors Affecting Consumer Purchasing Decisions on Healthy Catering

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ABSTRAK

Semakin tinggi kesadaran masyarakat terhadap makanan sehat berbanding lurus dengan pertumbuhan eksistensi atau katering sehat yang membuat persaingan usaha semakin kompetitif. Tujuan penelitian untuk mengetahui faktor yang mempengaruhi keputusan pembelian di katering sehat dan kaitannya dengan dampak pandemi *Covid-19*. Penelitian ini menggunakan metode *literature review* dengan seleksi studi mengacu pada *Preferred Reporting Items for Systematic Reviews and Meta-Analysis Statement* dan dipilih studi kuantitatif. Hasil telaah didapatkan 23 studi yang disertakan. Terdapat faktor yang mempengaruhi keputusan pembelian pada konsumen, baik secara internal maupun eksternal. Faktor internal meliputi jenis kelamin, riwayat sosial ekonomi, pengetahuan, usia, serta faktor kepercayaan terhadap suatu produk. Faktor eksternal yaitu harga, kualitas produk, pemasaran produk, atribut produk, *cultural background* suatu negara, kualitas pelayanan, dan pengaruh produk terhadap kesehatan. Selama pandemi *Covid-19* terjadi perubahan pada faktor yang mempengaruhi keputusan pembelian konsumen. Mayoritas responden menyatakan bahwa lebih menerapkan perilaku makan sehat, namun di negara lain kesulitan dalam menemukan produk segar, sehingga beralih pada pembelian makanan beku dan makanan kaleng.

Kata kunci: Katering sehat, Keputusan pembelian konsumen, *Covid-19*

ABSTRACT

The higher public awareness of healthy food the more increase of the existence of healthy catering which makes the healthy catering business more competitive. The objective of this research to find out what factors influence consumer purchasing decisions in healthy catering and its relation to the impact of Covid-19. This study uses a literature review method by selecting studies that refer to the Preferred Reporting Items for Systematic Review and Meta-Analyses Statement and selected quantitative studies. For the final result, 23 studies were included. There are factors that influence purchasing decisions on consumers, both internally and externally. Internal factors include gender, social economic history, knowledge, and the trust factor for a product. For external factors like price, product quality, product marketing, product attributes, cultural background, quality service, and the health effect. During Covid-19 pandemic, there have been changes in the factors that influence consumer purchasing decisions. Respondents stated that they prefer to adopt healthy eating behavior, but in other countries is difficult to find fresh products, so they tend to buy frozen and canned food.

Keywords: *Healthy catering, Purchasing decision, Covid-19.*

PENDAHULUAN

Saat ini, masalah gizi ganda masih menjadi masalah yang belum teratasi di Indonesia. Berdasarkan data Riskesdas 2018 prevalensi berat badan lebih (IMT ≥25 s/d 27) sebesar 13,6% dan prevalensi obesitas (IMT ≥27) sebesar 21.8% (Kemenkes RI, 2018). Hal ini dikarenakan pola makan (diet) sehari-hari yang tidak seimbang .

Perubahan gaya hidup khususnya terkait pola makan sehat semakin dinamis dari tahun ke tahun. Hal tersebut beriringan dengan meningkatnya jam kerja, perubahan demografi, perubahan ekonomi yang berkontribusi pada meningkatnya minat terhadap penggunaan jasa katering. Pada gilirannya nanti, jasa katering harus senantiasa beradaptasi untuk memenuhi kebutuhan pelanggan yang senantiasa berubah dengan berbagai jenis

 Received 17-12-2021, Accepted 25-03-2022, Published online 30-05-2022.

pelanggan (Trafialek *et al., 20*20). Hal tersebut diupayakan agar katering makanan sehat dapat terus bertahan dan berkembang mengikuti tuntutan perubahan pola hidup sehat.

Penyelenggaraan jasa boga kesehatan merupakan salah satu inovasi dalam bisnis industri jasa boga yang menyediakan pemenuhan kebutuhan makanan sehat harian (Anjasari *et al., 20*14). Adapun jenis katering yang akan dibahas dalam penelitian ini adalah katering sehat yang memiliki karaketristik produk yang berbeda dengan katering umum. Dalam penyelenggaraan katering sehat diperlukan pengetahuan gizi yang mumpuni untuk menyusun beragam menu gizi seimbang yang sesuai dengan kebutuhan pelanggan.

Semakin tinggi kesadaran masyarakat terhadap makanan sehat berbanding lurus dengan pertumbuhan katering sehat yang membuat persaingan usaha semakin kompetitif. Guna tetap mempertahankan eksistensi dan memenangkan persaingan, maka dibutuhkan strategi yang tepat dalam menarik minat calon konsumen. Strategi tersebut dirancang untuk meningkatkan minat konsumen dalam memberikan keputusan pembelian. Keputusan pembelian merupakan tindakan dari konsumen untuk mau membeli atau tidak terhadap suatu produk, dari berbagai faktor yang mempengaruhi konsumen dalam melakukan pembelian suatu produk atau jasa (Kurniawan & Mashariono, 2021)

Perilaku pembelian konsumen menunjukkan tindakan konsumen dalam memilih, membeli, dan mengonsumsi barang dan jasa untuk memenuhi kebutuhannya. Mengetahui perilaku pembelian konsumen sangat diperlukan bagi pengelola usaha katering untuk menyelaraskan rencana mereka dengan harapan konsumen (Liew *et al., 20*21). Perlu disadari bahwa konsumen adalah manusia yang memiliki kebutuhan tak terbatas dengan selera yang berbeda. Hal tersebut melatarbelakangi peneliti untuk mengetahui faktor-faktor yang dapat mempengaruhi keputusan pembelian konsumen di katering sehat. Selain itu peneliti juga ingin mengetahui sejauh mana dampak pandemi *Covid-19* dalam mempengaruhi keputusan pembelian di katering sehat.

Adapun manfaat dari penelitian ini adalah untuk memberikan gambaran atau masukan kepada pihak pengelola katering sehat khususnya untuk mengetahui faktor apa saja yang menjadi penentu konsumen dalam memilih katering sehat. Harapannya dengan mengetahui faktor tersebut, pihak pengelola katering dapat melakukan perbaikan atau peningkatan kualitas pelayanan agar konsumen dapat tertarik membeli produk dari katering sehat tersebut.

METODE

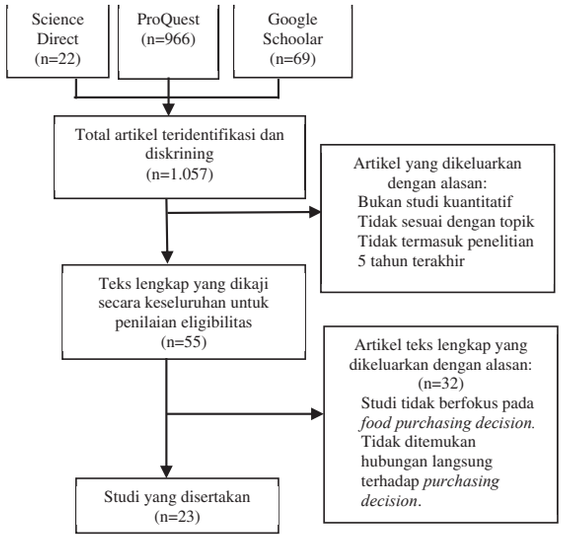
Penelitian ini menggunakan metode *literature review*. Seleksi studi yang dilakukan mengacu pada *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA) *Statement* yang memetakan jumlah catatan yang diidentifikasi, disertakan, dan dikecualikan, serta alasan pengecualian (Page *et al., 20*21).

Topik penelitian terkait dengan faktor keputusan pembelian di katering sehat merupakan salah satu kriteria inklusi penelitian ini. Pencarian *literature* dilakukan dengan menggunakan 3 database elektronik meliputi *ScienceDirect, ProQuest dan Google Scholar* dengan menggunakan *boolean operators 'AND', 'OR'* dan '*NOT*' yang digunakan untuk mengombinasikan istilah pencarian atau *keyword*.

Adapun *keywords* yang digunakan adalah "*Factors of purchasing decision and healthy catering and quantitative studies*" yang dicari melalui *ScienceDirect* dan *ProQuest,* didapatkan artikel jurnal sebanyak 22 dan 966. Sedangkan untuk *Google Scholar* digunakan keywords "Faktor keputusan pembelian dan katering sehat atau dan studi kuantitatif" dan didapatkan sebanyak 69 artikel.

Kriteria inklusi yang digunakan adalah artikel jurnal yang dipublikasikan dalam kurun waktu 5 tahun terakhir (2017-2021), *free access*, *full text*, menggunakan bahasa Indonesia atau bahasa Inggris, jenis penelitian adalah kuantitatif yang bertujuan agar penulis mendapatkan gambaran nyata apakah faktor yang ditemukan berpengaruh signifikan terhadap keputusan pembelian konsumen.

Dari 1.057 artikel jurnal yang didapat, selanjutnya diskrining berdasarkan judul dan abstrak yang berkaitan dengan topik, didapatkan 55 artikel. Artikel yang lolos pada tahap skrining, selanjutnya dibaca untuk dikaji keseluruhan



Gambar 1. Diagram alir PRISMA

teksnya (*full text screened for eligibility*). Artikel yang tidak relevan dikeluarkan (*excluded*). Untuk hasil akhir didapatkan 23 studi yang disertakan (*studies included*) dalam *literature review* ini. Proses seleksi literatur telah diringkas pada Gambar 1.

HASIL DAN PEMBAHASAN

Keputusan pembelian merupakan kegiatan individu yang secara langsung terlibat dalam pengambilan keputusan untuk melakukan pembelian. Keputusan pembelian dipengaruhi oleh faktor internal seperti umur, jabatan, sosial ekonomi, gaya hidup, kepribadian dan konsep diri pembeli, serta faktor psikologi mengenai perilaku konsumen pada seseorang (Rizkiansah *et al.,* 2018).

Berdasarkan Tabel 1, terdapat 11 faktor yang memiliki pengaruh terhadap keputusan pembelian, salah satunya adalah faktor harga. Dengan metode analisa yang berbeda dari setiap penelitian, didapatkan hasil yang sama mengenai keterkaitan harga yang berpengaruh kuat terhadap keputusan pembelian. Semakin meningkatnya harga akan diikuti dengan meningkatnya harapan terhadap kualitas dari makanan itu. Faktor ekonomi (pendapatan) merupakan faktor yang paling tinggi mempengaruhi keputusan pembelian (Rizkiansah *et al., 20*18).

Tabel 1. Faktor yang Memengaruhi Keputusan Pembelian

Variabel	Judul Penelitian (Tahun)	Hasil
Harga	Pengaruh *Word Of Mouth*, Kualitas Produk dan Harga Terhadap Keputusan Pembelian Zahra Catering (Kurniawan & Masharionо, 2021)	Harga memiliki pengaruh signifikan dan positif terhadap keputusan pembelian (0,012)
	Pengaruh Label Halal, Kualitas Produk dan Harga Terhadap Keputusan Pembelian Produk Kemasan dan Dampaknya Pada Loyalitas Mahasiswa Fakultas Ekonomi Universitas Islam Riau (Saleh *et al., 20*20)	Harga berpengaruh signifikan dan positif terhadap keputusan pembelian (α =0,439)
	Evaluasi Multidimensi Restoran Mengenai Kualitas Makanan, Layanan, dan Praktik Berkelanjutan: Studi Kasus Lintas Nasional, Polandia dan Lituania (Trafialek *et al., 20*20)	Di Lithuania (67,5%) menilai harga dan kualitas makanan sebagai faktor yang paling berpengaruh, dan di Polandia (63,2%) menilai kelezatan dan kualitas makanan, harga, lokasi restoran, dan rekomendasi teman-teman sebagai faktor yang mempengaruhi dalam menentukan pilihan Restaurant
	Faktor Sosial Ekonomi, Lingkungan Pangan dan Pembelian Makan Siang oleh Remaja di Sekolah Menengah (Wills *et al., 20*19)	Harga merupakan faktor terpenting yang dinilai oleh 88,9% responden.
	Eksplorasi Faktor-Faktor Kunci Yang Mempengaruhi Perilaku Pembelian Konsumen Terhadap Produk Makanan Instan: Studi Kasus Kota Bharu (Liew *et al., 20*21)	Faktor harga 7,469% dari total faktor, kedua terbesar setelah faktor pemasaran.
	Analisis Faktor- Faktor Pribadi dan Psikologi Pada Proses Keputusan Pembelian Sayuran Hidroponik di Kota Pontianak (Studi Kasus Merek Sayok Kite) (Rizkiansah *et al., 20*18)	Pendapatan dan harga merupakan faktor yang paling tinggi mempengaruhi keputusan pembelian sayuran hidroponik di Kota Pontianak

Lanjutan Tabel 1. Faktor yang Memengaruhi Keputusan Pembelian

Variabel	Judul Penelitian (Tahun)	Hasil
Kualitas Produk	Pengaruh Kualitas Produk, Promosi dan Kualitas Pelayanan Terhadap Keputusan Pembelian di Katering Yvonne's (Hatma, 2021)	Kualitas produk berpengaruh signifikan terhadap keputusan pembelian di Katering Yvonne's (t=0,014)
	Pengaruh *Word Of Mouth*, Kualitas Produk dan Harga Terhadap Keputusan Pembelian Zahra Catering (Kurniawan & Mashariono, 2021)	Variabel kualitas produk memiliki pengaruh signifikan (0,248) dan positif terhadap keputusan pembelian
	Evaluasi Multidimensi Restoran Mengenai Kualitas Makanan, Layanan, dan Praktik Berkelanjutan: Studi Kasus Lintas Nasional, Polandia dan Lituania (Trafialek *et al., 20*20)	Di Lithuania (67,5%) menilai harga dan kualitas makanan sebagai faktor yang paling berpengaruh, dan di Polandia (63,2%) menilai kelezatan dan kualitas makanan, harga, lokasi restoran, dan rekomendasi teman-teman sebagai faktor yang mempengaruhi dalam menentukan pilihan Restaurant
		Perbedaan statistik yang signifikan (p=0,00) dalam komentar konsumen tentang kualitas layanan restoran terkait dengan penemuan benda asing, sakit perut setelah makan, dan rasa aneh lebih sering dinyatakan di Polandia daripada di Lithuania.
	Analisis Faktor- Faktor Pribadi dan Psikologi Pada Proses Keputusan Pembelian Sayuran Hidroponik di Kota Pontianak (Studi Kasus Merek Sayok Kite) (Rizkiansah *et al., 20*18)	Higienitas dan kesegaran, kepedulian kemasan, kesadaran manfaat dan kesesuaian harga, mempengaruhi keputusan pembelian sayuran hidroponik di Kota Pontianak
	Faktor-Faktor Penting yang Mempengaruhi dan Keputusan dalam Pembelian Makanan Organik di Hongaria (Nagy-Pércsi & Fogarassy, 2019)	Kesegaran merupakan faktor utama penentu pembelian makanan organik di Hongaria**.**
		Rasa merupakan faktor terpenting penentu pembelian makanan organik di Hongaria**.**
	Faktor Sosial Ekonomi, Lingkungan Pangan dan Pembelian Makan Siang oleh Remaja di Sekolah Menengah (Wills *et al., 20*19)	Rasa merupakan faktor terpenting yang dinilai oleh 97,5% responden
Jenis Kelamin	Faktor-Faktor Penting yang Mempengaruhi dan Keputusan dalam Pembelian Makanan Organik di Hongaria (Nagy-Pércsi & Fogarassy, 2019)	60% konsumen makanan organik adalah wanita
	Pengaruh Pelabelan Nutrisi Pada Menu Restoran di Perguruan Tinggi Terhadap Perilaku Makan Sehat Mahasiswa (Roseman *et al., 20*17)	Ditemukan dampak yang signifikan dari jenis kelamin terhadap keputusan pembelian; responden wanita menunjukkan niat yang lebih tinggi secara signifikan untuk memilih item menu yang berkalori rendah daripada responden pria
	Kepercayaan Konsumen terhadap Kualitas dan Keamanan Produk Pangan di Siberia Barat (Skripnuk *et al., 20*21)	Perilaku konsumen dalam memilih gerai sangat tergantung pada jenis kelamin, utamanya wanita
Sosial Ekonomi	Faktor-Faktor Penting Yang Mempengaruhi dan Keputusan dalam Pembelian Makanan Organik di Hongaria (Nagy-Pércsi & Fogarassy, 2019)	86 % konsumen makanan organik memiliki tingkat pendapatan tinggi.
Pengetahuan	Pengaruh Pelabelan Nutrisi Pada Menu Restoran di Perguruan Tinggi Terhadap Perilaku Makan Sehat Mahasiswa (Roseman *et al., 20*17)	Tingkat pengetahuan subjektif terkait gizi berdampak signifikan ($\beta = 0.37$, $P < 0.001$) terhadap keputusan pembelian makanan rendah kalori
	Membangun Pengetahuan dan Perilaku Makan Sehat: Evaluasi Pendidikan Gizi dalam Keterampilan Kursus Pelatihan untuk Pegawai Konstruksi Magang (Chung *et al., 20*19)	Pendidikan gizi secara signifikan (p<0,05) meningkatkan perilaku makan sehat dari awal hingga pasca intervensi, dan dari pasca intervensi hingga tiga bulan setelah intervensi.
	Persepsi Lansia tentang Pangan Fungsional terkait Kesehatan Dibandingkan Kelompok Umur Lainnya (Szakos *et al., 20*20)	Lansia >60 tahun memiliki persepsi pangan fungsional lebih positif dibanding kelompok umur lain yaitu bahwa diet sehat penting bagi dirinya.

Lanjutan Tabel 1. Faktor yang Memengaruhi Keputusan Pembelian

Variabel	Judul Penelitian (Tahun)	Hasil
Pemasaran	Pengaruh Kualitas Produk, Promosi dan Kualitas Pelayanan Terhadap Keputusan Pembelian di Katering Yvonne's (Hatma, 2021)	Hasil uji t untuk variabel promosi diperoleh nilai signifikansi 0,001, promosi berpengaruh secara nyata terhadap keputusan pembelian di Katering Yvonne's
	Evaluasi Multidimensi Restoran Mengenai Kualitas Makanan, Layanan, dan Praktik Berkelanjutan: Studi Kasus Lintas Nasional, Polandia dan Lituania (Trafialek *et al., 20*20)	Warga Lituania secara signifikan menggunakan media sosial untuk memilih restoran (p=0,00)
	Eksplorasi faktor-faktor kunci yang mempengaruhi perilaku pembelian konsumen terhadap produk makanan instan: Studi kasus Kota Bharu (Liew *et al., 20*21)	Responden memilih ketersediaan produk di pasaran menjadi faktor yang mempengaruhi pembelian. Responden mengatakan bahwa pemasaran dan branding, sangat kuat dalam mempengaruhi kebiasaan membeli konsumen.
	Analisis Faktor- Faktor Pribadi Dan Psikologi Pada Proses Keputusan Pembelian Sayuran Hidroponik di Kota Pontianak (Studi Kasus Merek Sayok Kite) (Rizkiansah *et al., 20*18)	Informasi mengenai produk dan kemudahan dalam memperoleh produk berpengaruh terhadap keputusan pembelian
	Faktor Sosial Ekonomi, Lingkungan Pangan dan Pembelian Makan Siang oleh Remaja di Sekolah Menengah (Wills *et al., 20*19)	Penawaran dan diskon merupakan faktor terpenting yang dinilai oleh responden
Atribut Produk	Pengaruh Label Halal, Kualitas Produk Dan Harga Terhadap Keputusan Pembelian Produk Kemasan Dan Dampaknya Pada Loyalitas Mahasiswa Fakultas Ekonomi Universitas Islam Riau (Saleh *et al., 20*20)	Label halal berpengaruh positif dan signifikan (α=0,217) terhadap keputusan pembelian.
	Eksplorasi Faktor-Faktor Kunci Yang Mempengaruhi Perilaku Pembelian Konsumen Terhadap Produk Makanan Instan: Studi Kasus Kota Bharu (Liew *et al., 20*21)	Responden menyatakan bahwa penampilan produk dengan warna yang tegas berkontribusi pada pengalaman pembelian
		Responden memilih keamanan pangan sebagai faktor yang berpengaruh terhadap perilaku pembelian makanan instant.
	Pengaruh Pelabelan Nutrisi Pada Menu Restoran di Perguruan Tinggi Terhadap Perilaku Makan Sehat Mahasiswa (Roseman *et al., 20*17)	Responden yang diberikan informasi kalori memiliki niat yang jauh lebih tinggi untuk memilih makanan berkalori rendah daripada mereka yang tidak diberikan informasi kalori
	Efek Dari Menu Labelling Berbasis Ikon Terhadap Pemilihan Makanan Konsumen (Kerins *et al., 20*17)	Terjadi peningkatan penjualan pada menu yang telah diberi label
Trust	Penelitian tentang Perilaku Makanan di Rumania Ditinjau dari Perspektif dalam Mendukung Kebiasaan Makan Sehat (Voinea *et al., 20*19)	Terdapat hubungan positif antara kepercayaan pada sumber pemasaran dengan kriteria pilihan makanan sehat.
	Faktor-Faktor yang Mempengaruhi Sikap Konsumen Muda Dewasa Terhadap Konsumsi Makanan Sehat dan Niat Pembelian (Januardi & Windasari, 2019)	Keyakinan terhadap kesehatan memiliki pengaruh yang signifikan (t=5,215) terhadap sikap konsumen terhadap makanan sehat.
Cultural Background	Pengaruh Religiusitas Terhadap Minat Pembelian Produk Halal (Ibnunas *et al., 20*21)	Religiusitas berpengaruh positif terhadap minat pembelian
	Kebiasaan Diet sebelum dan selama Epidemi *COVID-19* di Negara Eropa Terpilih (Skotnicka *et al., 20*21)	Polandia melaporkan makan di luar sebelum pandemi lebih sedikit daripada orang Austria atau Inggris

Lanjutan Tabel 1. Faktor yang Memengaruhi Keputusan Pembelian

Variabel	Judul Penelitian (Tahun)	Hasil
Kualitas Pelayanan	Pengaruh Kualitas Produk, Promosi Dan Kualitas Pelayanan Terhadap Keputusan Pembelian Di Katering Yvonne's (Hatma, 2021)	Kualitas pelayanan berpengaruh terhadap keputusan pembelian di Katering Yvonne's.
	Evaluasi Multidimensi Restoran Mengenai Kualitas Makanan, Layanan, dan Praktik Berkelanjutan: Studi Kasus Lintas Nasional, Polandia dan Lituania (Trafialek *et al., 20*20)	Di Polandia, kesalahan pemesanan disebutkan secara signifikan lebih sering daripada di Lithuania
	Analisis Faktor- Faktor Pribadi Dan Psikologi Pada Proses Keputusan Pembelian Sayuran Hidroponik di Kota Pontianak (Studi Kasus Merek Sayok Kite) (Rizkiansah *et al., 20*18)	Keunggulan produk, ketelitian dalam memilih sayuran, dan ketenangan dalam melakukan pembelian mempengaruhi keputusan pembelian sayuran hidroponik di Kota Pontianak
Kesehatan	Faktor-Faktor Penting yang Mempengaruhi dan Keputusan dalam Pembelian Makanan Organik di Hongaria (Nagy-Pércsi & Fogarassy, 2019)	Dampak kesehatan yang positif merupakan faktor terpenting sebagai penentu pembelian makanan organik di Hongaria.
	Faktor-Faktor yang Mempengaruhi Sikap Konsumen Muda Dewasa Terhadap Konsumsi Makanan Sehat dan Niat Pembelian (Januardi & Windasari, 2019)	Pencegahan penyakit berpengaruh signifikan (p-value = 0,001) terhadap sikap konsumen terhadap makanan sehat
	Analisis Faktor- Faktor Pribadi Dan Psikologi Pada Proses Keputusan Pembelian Sayuran Hidroponik di Kota Pontianak (Studi Kasus Merek Sayok Kite) (Rizkiansah *et al., 20*18)	Tingginya kesadaran konsumen akan manfaat sayuran hidroponik sebagai sumber serat baik, kandungan vitamin dan mineral utuh serta menjaga fungsi tubuh
	Penelitian tentang Perilaku Makanan di Rumania Ditinjau dari Perspektif dalam Mendukung Kebiasaan Makan Sehat (Voinea *et al., 20*19)	Kriteria yang digunakan konsumen untuk pemilihan makanan sehat berpengaruh positif terhadap perkembangan kebiasaan makan yang sehat.

Variabel kedua yaitu mengenai kualitas produk. Kualitas produk berpengaruh signifikan terhadap keputusan pembelian di Katering Yvonne's (Hatma, 2021). Pada penelitian lain, higienitas dan kesegaran; kemasan produk; manfaat dan kesesuaian harga; yang kesemuanya merupakan atribut nilai dari kualitas produk juga mempengaruhi keputusan pembelian (Rizkiansah *et al., 20*18). Rasa dan kesegaran sebagai bagian dari keandalan kualitas produk pun juga merupakan faktor utama penentu keputusan pembelian (Nagy-Pércsi & Fogarassy, 2019). Hal ini diperkuat oleh Wills *et al., (2*019) yang menyatakan bahwa rasa sebagai kualitas produk adalah prioritas terpenting dalam keputusan pembelian.

Variabel ketiga yaitu mengenai jenis kelamin. Berdasarkan penelitian yang dilakukan oleh Nagy-Pércsi & Fogarassy (2019) menyatakan bahwa 60% konsumen makanan sehat adalah wanita. Penelitian lain dari Roseman *et al. (20*17) menemukan hubungan yang signifikan dari jenis kelamin terhadap keputusan pembelian. Responden wanita menunjukkan niatan yang lebih tinggi secara signifikan dalam memilih menu berkalori rendah. Skripnuk *et al. (20*21) pun menyatakan bahwa jenis kelamin berkaitan erat dengan pemilihan gerai makanan.

Variabel keempat adalah mengenai status ekonomi yang berkaitan dengan keputusan pembelian makanan sehat. Penelitian Nagy-Pércsi & Fogarassy (2019) mendapatkan hasil bahwa 86% konsumen memiliki tingkat pendapatan yang tinggi. Variabel kelima adalah pengetahuan yang berhubungan secara signifikan terhadap keputusan pembelian makanan sehat. Penelitian Roseman *et al. (20*17) memberikan hasil bahwa tingkat pengetahuan subjektif terkait gizi memiliki dampak yang signifikan terhadap keputusan pembelian makanan rendah kalori. Jika seseorang yakin tentang pengetahuan gizi, mereka cenderung peduli dengan apa yang mereka makan. Chung *et al. (20*19) menyatakan bahwa pendidikan gizi yang diberikan pada peserta magang secara signifikan dapat meningkatkan perilaku makan sehat dari awal hingga tiga bulan setelah intervensi. Selain itu dari penelitian Szakos *et al. (20*20) memberikan hasil bahwa lansia >60 tahun memiliki persepsi lebih positif dibanding kelompok umur lain tentang

penilaian diet sehat yang memiliki peranan penting bagi kesehatan. Hal ini disebabkan karena lansia adalah kelompok umur yang lebih memperhatikan diet sehat dengan pola makan teratur, termasuk mengutamakan sarapan dibandingkan kelompok umur lain.

Variabel yang keenam terkait pengaruh dari pemasaran yang berkaitan dengan keputusan pembelian konsumen. Variabel pemasaran tersebut terdiri dari ketersediaan produk, kemudahan dalam memperoleh produk, pemasaran melalui sosial media, adanya penawaran promosi dan diskon, yang semuanya memiliki pengaruh signifikan terhadap keputusan pembelian konsumen. Produk dengan daya tahan yang tinggi dan banyak tersedia di toko juga akan meningkatkan penerimaan konsumen terhadap suatu produk. Selain itu, pemasaran melalui media sosial dapat membangun hubungan yang menguntungkan dengan pelanggan, meningkatkan kepuasan pelanggan, menciptakan informasi positif dari mulut ke mulut (*word of mouth*) Liew *et al. (20*21). *Word of Mouth* menjadi salah satu strategi yang berpengaruh didalam keputusan konsumen untuk menggunakan produk atau jasa serta dapat membangun rasa kepercayaan para pelanggan.

Variabel yang ketujuh adalah pengaruh atribut produk terhadap keputusan pembelian konsumen. Atribut produk seperti informasi zat gizi, warna kemasan, label halal, klaim kesehatan terbukti berpengaruh signifikan terhadap keputusan pembelian konsumen. Keamanan pangan dari produk tersebut (tanggal produksi dan kadaluwarsa) sangat penting bagi konsumen untuk mendapatkan informasi tentang makanan sebelum membeli. Sebagaimana dikemukakan dalam Liew *et al. (20*21), konsumen cenderung membaca informasi pada label produk sambil mengamati grafik, warna, ukuran, atau bentuknya pada awal proses pembelian. Kemasan yang inovatif disertai dengan penambahan label informasi sangatlah penting dalam mempengaruhi keputusan pembelian konsumen, karena atribut ini dapat menghilangkan kebingungan dan membangun reputasi merek pada konsumen. Pelabelan makanan memungkinkan konsumen untuk membuat pilihan makanan sehat selama konsumen memperhatikan, memahami dan mempercayai label tersebut.

Variabel yang kedelapan adalah faktor *trust* terhadap keputusan pembelian konsumen. Penelitian yang dilakukan oleh Januardi & Windasari (2019) mengatakan bahwa dengan adanya kepercayaan terhadap manfaat kesehatan dari jasa katering, maka konsumen akan semakin tertarik untuk memilih jasa katering tersebut. Pada penelitian sebelumnya oleh Anjasari *et al. (20*15), mengatakan bahwa dalam penyelenggaraan jasa boga khususnya di bidang kesehatan, pengetahuan gizi sangat diperlukan dalam menyusun menu sehat dan seimbang yang disesuaikan dengan kondisi kesehatan konsumen. Pada penelitian yang dilakukan oleh Voinea *et al. (20*19) menggarisbawahi bahwa kepercayaan pada sumber pemasaran dapat mempengaruhi penggunaan kriteria tertentu dalam pemilihan makanan sehat. Oleh karena itu, pembeli yang mendapatkan lebih banyak informasi dari label produk dan media sosial menjadi lebih berpengetahuan tentang makanan dan lebih selektif memilih makanan sehat. Beberapa penelitian sebelumnya menyebutkan bahwa adanya kecenderungan menurunnya kepercayaan konsumen terhadap suatu merek yang disebabkan karena *review* dari konsumen lain. Sehingga, keputusan konsumen untuk membeli dapat dipengaruhi secara signifikan oleh pendapat dan pengalaman konsumen lain yang dibagikan di media virtual seperti blog, situs media sosial, dll (Voinea *et al., 20*19).

Variabel berikutnya yang kesembilan menyatakan bahwa adanya pengaruh dari *Cultural Background* terhadap keputusan pembelian konsumen. *Cultural Background* disini terdiri dari religiusitas dan kebiasaan makan di luar pada negara tersebut. Menurut Ibnunas *et al. (20*21) menjelaskan bahwa religiusitas merupakan perpaduan yang kompleks dari pengetahuan agama, perasaan, dan juga tindakan yang mencerminkan ajaran agama. Selain itu, perbedaan yang signifikan secara statistik terlihat dalam frekuensi makan di luar. Jumlah pembeli mungkin berbeda secara signifikan tergantung pada latar belakang budaya, tingkat pendapatan dan ketakutan akan virus *Covid-19* tersebut.

Variabel berikutnya yang kesepuluh menyatakan bahwa adanya pengaruh dari kualitas pelayanan terhadap keputusan pembelian konsumen. Semakin baik kualitas pelayanan yang

diberikan akan berpengaruh terhadap keputusan pembelian konsumen. Hal tersebut didukung dengan teori bahwa kualitas pelayanan bukan hanya ditentukan oleh pihak yang melayani, tetapi lebih banyak ditentukan oleh pihak yang dilayani, karena merekalah yang menikmati layanan sehingga dapat mengukur kualitas pelayanan berdasarkan harapan mereka dalam memenuhi kepuasannya (Hatma, 2021). Berdasarkan penelitian yang dilakukan oleh Rizkiansah *et al. (20*18), sayuran hidroponik yang segar, berwarna cerah dan utuh serta keramahan dari penjual telah memotivasi konsumen untuk memutuskan membeli sayuran hidroponik tersebut.

Variabel berikutnya yang kesebelas menyatakan bahwa adanya pengaruh dari faktor kesehatan terhadap keputusan pembelian konsumen. Pada penelitian yang dilakukan di Hongaria oleh Nagy-Pércsi & Fogarassy (2019) menyebutkan bahwa responden memutuskan untuk melakukan pembelian pangan organik karena memiliki dampak positif terhadap kesehatan. Pada penelitian yang dilakukan oleh Januardi & Windasari (2019) menunjukkan bahwa orang yang percaya pada kemungkinan semakin memburuknya kesehatan yang disebabkan oleh perilaku makan tidak sehat akan cenderung memilih menu sehat. Penelitian ini menyarankan bahwa pencegahan penyakit dapat mempengaruhi sikap individu terhadap makanan sehat.

Hasil analisis menunjukkan bahwa keyakinan terhadap kesehatan dan pencegahan penyakit merupakan faktor yang signifikan mempengaruhi konsumen untuk memilih makanan sehat. Hal ini menunjukkan bahwa penting bagi bisnis katering makanan untuk mempromosikan produk mereka dengan memberikan lebih banyak informasi mengenai keuntungan kesehatan dan risiko penyakit kronis dalam strategi pemasaran makanan mereka. Dengan demikian konsumen akan merasakan manfaat dari pembelian makanan di katering sehat sesuai dengan tujuan yang ingin dicapai. Jadi, jika konsumen memiliki sikap positif terhadap makanan sehat, mereka akan membeli makanan dari katering sehat karena merasa katering sehat dapat membantu mereka mencapai tujuan yaitu meningkatkan kesehatan secara keseluruhan dan mencegah risiko penyakit.

Tabel 2. Keputusan Pembelian Selama Covid-19

Peneliti	Hasil
Perubahan Kebiasaan Makan dan Aktivitas Fisik Sebelum dan Selama *COVID-19* Pandemi di Hong Kong: Cross-Sectional Melalui Survei Telepon Acak (Wang *et al., 20*21)	Penurunan frekuensi makan di luar yang signifikan selama masa pandemi *COVID-19* (Δ = -1,26 kali makan per minggu, p < 0,001), frekuensi rata-rata mingguan memasak di rumah (Δ = 1,06 makanan per minggu, p<0,001) serta memesan makanan untuk dibawa pulang (Δ = 0,48 makanan per minggu, p <0,001)
Perubahan Perilaku Terkait Makanan Pada Konsumen di Italia selama Pandemi *COVID-19* (Fanelli, 2019)	Selama *lockdown*, keinginan untuk memasak lebih meningkat. 43% peserta menyatakan sangat kesulitan menemukan produk tertentu (seperti produk segar) dan 6,4% mengalami kenaikan harga untuk produk yang sama.
Faktor-Faktor yang Mempengaruhi Niat Pelanggan Makan di Luar Selama *COVID-19*, Periode Pembukaan Kembali: Peran Moderasi Dampak Negara Asal (Wei *et al., 20*21)	Keterlibatan makan memiliki pengaruh yang signifikan positif berhubungan dengan niatan makan malam diluar (0,14, P <0,05)
Keamanan Pangan dan Evaluasi Niatan Makan di Luar dengan Aman Selama *COVID-19*: Studi Cross Sectional di Indonesia dan Malaysia (Soon *et al., 20*21)	Variasi dipengaruhi oleh sikap, norma subjektif dan kontrol perilaku yang dirasakan dalam praktik niatan makan diluar yang aman di Indonesia dan Malaysia (p<0,05)
Faktor-Faktor yang Mempengaruhi Niat Pelanggan Untuk Menggunakan Layanan Pesan-Antar Makanan Online Sebelum dan Selama Pandemi *COVID-19* (Hong *et al., 20*21)	Pelanggan Gen Y/Z (18-35 tahun) lebih bersedia menggunakan OFD dibandingkan generasi lebih tua. Selain itu, kegunaan yang dirasakan, kepercayaan, penghematan harga, dan penghematan waktu berhubungan signifikan dengan niatan untuk menggunakan layanan pesan-antar makanan online (β = 0,07, p < 0,05).
Motivasi Mengunjungi Restoran Kelas Atas Selama *COVID-19* Pandemi: Peran Persepsi Risiko dan Kepercayaan Pada Pemerintah (Dedeoğlu & Boğan, 2021)	*Sociability* dan pengaruh regulasi berpengaruh positif terhadap niat berkunjung ke restoran kelas atas (β = 0,23; t = 5,702; p < 0,001)

Pandemi Covid-19 telah mengubah kebiasaan makan konsumen. Penduduk dewasa di Amerika Utara, Australia, Irlandia dan Inggris dilaporkan lebih sering memasak di rumah dan lebih jarang makan di luar selama pandemi (Soon *et al., 20*21). Walaupun makanan bukanlah media penularan virus, coronavirus dapat mencemari makanan atau pengemasan makanan melalui orang yang terinfeksi dan mengenai produk makanan tersebut. Perubahan kebiasaan perilaku makan ditunjukkan oleh penelitian Wang *et al. (20*21) bahwa dampak pandemi dapat meningkatkan secara signifikan frekuensi memasak di rumah, membeli makanan untuk dimakan di rumah, serta konsumsi buah dan sayur. Peningkatan kebiasaan memasak di rumah selama lockdown juga diakui oleh 34% responden (Fanelli, 2019).

Dengan demikian, pandemi *Covid-19* berpengaruh terhadap menurunnya daya beli konsumen pada produk katering sehat, karena konsumen lebih memilih untuk membeli bahan makanan dan memasak sendiri di rumah untuk menghindari penularan *Covid-19*. Berbeda dengan penelitian Wang *et al. (20*21), konsumen di Italia (43%) mengaku kesulitan dalam menemukan produk segar selama pandemi seperti buah dan sayur karena terhambatnya pasokan produk segar yang mengakibatkan kenaikan harga. Dengan demikian mereka lebih beralih pada pembelian makanan beku (70%), bahan mentah (93,2%), makanan kaleng (67%), jajanan manis dan gurih (65%), dan minuman beralkohol (49%).

Keputusan makan di luar juga mengalami perubahan sebagai dampak pandemi *Covid-19*. Terjadi penurunan frekuensi makan di luar yang signifikan (Wang *et al., 20*21). Fasilitas cuci tangan yang tidak memadai di restoran akan menurunkan keputusan konsumen untuk makan di luar (83,8%). Kontrol perilaku merupakan tindakan yang diterapkan di restoran seperti pembatasan kapasitas tempat duduk, jarak sosial, sanitasi peralatan dan perlengkapan makan, penggunaan pelindung wajah setiap saat kecuali saat makan (Soon *et al., 20*21). Restoran yang tidak menerapkan kontrol perilaku akan menurunkan daya kunjung konsumen sebesar 77,4%.

Bentuk lain dari keputusan pembelian selama pandemi yang diteliti dalam penelitian ini yaitu *Online Food Delivery* (OFD). Penelitian Hong *et al. (20*21) mengungkapkan bahwa jumlah pesanan OFD melonjak 67% pada Maret 2020 (saat pandemi) dibandingkan Maret 2019. Konsumen memanfaatkan layanan OFD untuk menghindari kontak dengan karyawan restoran dan pelanggan lain selama pandemi *Covid-19*. Gen Y/Z (18-35 tahun) secara signifikan lebih sering menggunakan OFD dibandingkan kelompok usia lain.

KESIMPULAN DAN SARAN

Terdapat beberapa faktor yang dapat mempengaruhi keputusan pembelian konsumen, baik secara internal (dari diri responden), maupun faktor eksternal (pengaruh dari luar). Faktor internal yang dapat mempengaruhi keputusan pembelian konsumen adalah jenis kelamin, riwayat sosial ekonomi, pengetahuan, serta kepercayaan terhadap suatu produk. Untuk faktor eksternal yaitu mengenai harga, kualitas produk, pemasaran produk, atribut produk, *cultural background*, kualitas pelayanan, dan pengaruh produk terhadap kesehatan.

Walaupun makanan bukanlah media penularan virus, *coronavirus* dapat mencemari makanan atau pengemasan melalui paparan virus dari orang yang terinfeksi. Keputusan pembelian yang diteliti dalam jurnal *Covid-19*, merupakan manifestasi dari perilaku makan, keputusan untuk makan diluar dan keputusan pembelian melalui *Online Food Delivery* (OFD).

Terbatasnya jurnal penelitian tentang keputusan pembelian pada katering sehat dan kaitannya dengan dampak *Covid-19* di Indonesia menjadi kekurangan pada *literatur review* kami, sehingga kami tidak bisa mendapatkan gambaran secara nyata mengenai keputusan pembelian katering sehat di Indonesia. Saran untuk penelitian berikutnya agar dapat meneliti mengenai keputusan pembelian makanan sehat dikaitkan dengan pandemi *Covid-19* di Indonesia yang merupakan isu terkini secara global. Saran yang dapat diberikan untuk pemilik katering sehat adalah memperhatikan faktor eksternal yang dapat mempengaruhi pembelian konsumen, seperti meningkatkan dan mempertahankan kualitas produk; melakukan pemasaran produk lebih sering dan lebih luas; mencantumkan atribut seperti nilai informasi gizi, logo halal, klaim manfaat

terhadap kesehatan pada kemasan produk; dan meningkatkan serta mempertahankan kualitas pelayanan.

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