



## The Relationship of Vitamin C Intake and Nutritional Status with Stress Levels in T2DM Patients during the COVID Pandemic

Qothrunnadaa Fajr Rooiqoh<sup>1\*)</sup>; Didik Gunawan Tamtomo<sup>2</sup>; Risyia Cilmiaty<sup>3</sup>

<sup>1\*)</sup> Master Program of Nutrition Sciences, School of Posgraduate, Sebelas Maret University, Surakarta

<sup>2</sup> Department of Anatomy Faculty of Medicine, Sebelas Maret University, Surakarta

<sup>3</sup> Department of Dental and Oral Disease Faculty of Medicine, Sebelas Maret University, Surakarta

### ARTICLE INFO

#### Article history:

Received 15 March 2022

Accepted 21 April 2022

Published 10 June 2022

#### Keyword:

Nutritional status

Vitamin C

Stress

Type 2 diabetes mellitus

### ABSTRACT

Diabetes mellitus develops when the insulin hormone's secretion or work activity is reduced, resulting in an increase in blood glucose levels. Diabetes mellitus is one of the comorbid disease associated with COVID-19. Coronavirus Disease-19 is causing concern among DM patients since it has the potential to harm their psychological health. People with diabetes may suffer stress, which might affect their blood glucose management. Increased blood glucose levels alter food intake, resulting in weight loss. During the COVID-19 pandemic, the study to know relationship vitamin C intake and nutritional status with stress levels in T2DM patients. With a total of 105 respondents, the study was done cross-sectional in three health centers: Bantul 1 Health Center, Bambanglipuro Health Center, and Pajangan Health Center. Respondents involved were T2DM patients who were members of the Chronic Disease Management Program. BMI was used to measure nutritional status, while the Semi Quantitative - Food Frequency Questionnaire (SQ-FFQ) and the Perceived Stress Scale (PSS-10) were used to determine vitamin C intake and stress levels. The Chi-Square test was used to analyze data in SPSS. This study's nutritional status ( $p: 0.183$ ) and vitamin C intake ( $p: 0.055$ ) have a Chi-Square value, indicating that  $p > 0.05$ . The conclusion there was no relationship between nutritional status and vitamin C intake and stress levels in T2DM patients

This open access article is under the CC-BY-SA license.



### Kata kunci:

Status Gizi

Vitamin C

Stres

Diabetes melitus tipe 2

*\*) corresponding author*

Qothrunnadaa Fajr Rooiqoh

Master Program of Nutrition Sciences,  
School of Posgraduate, Sebelas Maret  
University, Surakarta, Indonesia

Email: roiqohnada95@gmail.com

DOI: 10.30604/jika.v7i2.976

Copyright @author(s)

### ABSTRAK

Diabetes melitus terjadi apabila ada kenaikan kadar glukosa darah yang diakibatkan dari penurunan sekresi atau aktivitas kerja hormon insulin. Salah satu penyakit yang komorbid terhadap COVID-19 yaitu diabetes melitus. Penderita DM memiliki kekhawatiran terhadap COVID-19 karena akan dapat berakibat pada kesehatan psikososial. Stres yang dialami oleh penyandang DM dapat berdampak pada gangguan pengontrolan glukosa darah. Adanya peningkatan kadar glukosa darah akan mengubah asupan makanan dan terjadi penurunan berat badan. Penelitian ini bertujuan untuk mengetahui hubungan status gizi dan asupan vitamin C terhadap tingkat stres pada penderita DMT2 selama pandemi COVID-19. Penelitian cross-sectional dilakukan di tiga Puskesmas yaitu Puskesmas Bantul 1, Puskesmas Bambanglipuro, dan Puskesmas Pajangan dengan total responden 105 orang. Responden yang terlibat adalah penderita DMT2 anggota Program Manajemen Penyakit Kronis. Status gizi dihitung dengan IMT, asupan vitamin C dapat diketahui dengan *Semi Quantitative-Food Frequency Questionnaire* (SQ-FFQ) dan tingkat stress dengan kuesioner *Perceived Stress Scale* (PSS-10). Analisis data menggunakan SPSS dengan uji *Chi-Square*. Hasil penelitian ini mempunyai nilai Chi-Square ( $p: 0.183$ ) pada

status gizi dan asupan vitamin C ( $p:0.055$ ), sehingga  $p>0.05$ . Kesimpulan menunjukkan tidak adanya hubungan status gizi dan asupan vitamin C dengan tingkat stress pada penderita DMT2.



This open access article is under the CC-BY-SA license.

## INTRODUCTION

The number of COVID-19 cases in June 2021 worldwide is estimated at 180,817,269 active cases, including the death of around 3,923,238, with 223 confirmed cases of this disease (World Health Organization, 2021). Based on the results of the data recap of the Covid-19 task force dated June 25, 2021, the total number of Covid-19 cases in Indonesia was 2,072,867 and 50.5% of the total had a history of comorbid hypertension and was followed by DM 36.7% and heart disease 17.5%. Based on death data from Covid-19 patients, a history of DM is a comorbid disease with the highest percentage of death at 9.6%, followed by hypertension 9.3% and followed by heart disease at 5.4% (Satgas Penanganan COVID 19, 2021).

Diabetes mellitus develops when the hormone insulin's secretion or work activity is reduced, leading in an increase in blood glucose levels. Insulin is a hormone generated by the pancreas that transports glucose from the bloodstream to the body's cells, where it is used as an energy source (IDF, 2019). Insulin secretion has a major effect on Type 2 Diabetes Mellitus (T2DM), which is accompanied by insulin resistance (PERKENI, 2019). Diabetes Mellitus Type 2 is one of the disorders that is comorbid with COVID-19. Severe Acute Respiratory Syndrome (SARS) is a life-threatening respiratory condition. Coronavirus has been shown to attach to Angiotensin Converting Enzyme 2 (ACE2) in the pancreas, damaging it and causing rapid hyperglycemia, both of which lead to high fatality rates (Yang, Lin, Ji, & Guo, 2010).

A pandemic that lasts for a long period can cause a person to become stressed. The study of Grabia *et al* (2020) found that at the start of the COVID-19 pandemic, there was a surge in psychiatric problems, with high stress categories increasing from 14% to 29% and extremely high stress categories increasing from 0% to 32%. Coronavirus-19 Disease and Diabetes Mellitus (DM), which result in poorer psychosocial health, were of particular concern to people with T2DM.

During territorial constraints, psychological variables have a significant impact on eating patterns. Food cravings in T2DM patients might be triggered by a variety of mental health problems such as stress, social isolation, or a lack of physical activity (Naja & Hamadeh, 2020; Watson *et al.*, 2018). Stress that isn't managed can lead to leptin resistance and an increase in food consumption (Sugiyanto, 2017). Overeating and obesity can result from uncontrolled food intake. Psychological factors (including stress), physical exercise, and eating behavior are all complicated elements that might be connected (Nurrahmawati & Fatmaningrum, 2018). Persons with diabetes were twice as vulnerable to stress as people without DM (Utami, Jamaludin, & Agus, 2016). People with T2DM may suffer stress, which might affect their glucose management. When you're stressed, your body produces more cortisol, a hormone that can counteract the effects of insulin and cause high blood glucose levels (Strandberg, Graue, Wentzel-Larsen, Peyro, & Rokne, 2014).

One of the most common endocrine illnesses, T2DM, is linked to a high level of oxidative stress. In T2DM patients, anxiety, stress, and sadness were prevalent neuropsychiatric

symptoms. To help lower glucose levels, hyperglycemia generates an increase in oxidative stress, which necessitates reducing the requirement for antioxidants (Mazloom, Ekramzadeh, & Hejazi, 2013). Antioxidants work by removing free radicals or blocking other oxidation events to lessen or stop chain reactions (Azab, Adwas, & Elsayed, 2019). Vitamin C is one of the antioxidants. In persons with T2DM, vitamin C can help reduce free radicals in the body and manage blood sugar levels. In persons with T2DM, consuming vitamin C-rich foods can boost immunity and reduce COVID-19 illness.

## METHODS

### *Study Design*

A cross-sectional study

### *Sampling*

The sample technique employed in this investigation was multi-stage random sampling. Stratified random sampling with multiple stages. The first step is chosen three health center with random from a total of 27 health facilities in Bantul Regency (Bantul Health Center, Bambanglipuro Health Center, and Pajangan Health Center). The research sample size was obtained using the Kothari formula for estimating the number of samples, with total sample size of 105 respondents (Murti, 2013). The respondents were members of Chronic Disease Management Program. The second step involves using proportional random sampling to sample T2DM patients each health center. A total of 40 respondents were gathered from Bantul Health Center, 35 respondents from Bambanglipuro Health Center, and 30 respondents from Pajangan Health Center for this study.

### *Instrument*

The information gathered is primary information. By recording the food consumed in the previous month, the Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ) can be used to determine vitamin C intake. The BMI is used to assess nutritional health, whereas the Perceived Stress Scale (PSS)-10 is used to assess stress levels. The Perceived Stress Scale-10 is a ten-item self-report tool that claims to measure "how unpredictable, unmanageable, and overcrowded respondents' lives are." Each PSS-10 point is scored on a 5-point Likert scale, from 0 (never) to 4 (always) (very often). PSS-10 has six positive points (1, 2, 3, 6, 9, and 10: positive factors) and four negative points (4, 5, 7, and 8: negative factors). During the analysis, any points that worked negatively were recorded. The total score ranges from 0 to 40, with higher scores indicating higher degrees of stress perception. Low stress is defined as a score between 0 and 13, moderate stress is defined as 14 to 26, and severe stress is defined as a

score between 27 and 40 (Maroufizadeh, Foroudifard, Navid, Ezabadi, & Sobati, 2018).

### Procedure

Data was gathered at three health sites in Bantul, Yogyakarta (Bantul Health Center, Bambanglipuro Health Center, and Pajangan Health Center), from May to June 2021. The health department has granted this study an ethical license and authorization. Written and verbal consent were sought prior to data collection. Patients have the right to refuse to participate in the trial at any time. A nutritionist conducted each interview. For roughly 15 to 30 minutes, an inspection and survey is conducted.

### Statistical analysis

SPSS (IBM SPSS Statistics for Windows, Version 16). The relationship between nutritional status and vitamin C intake with stress levels was determined using the chi-square test with significance level ( $p < 0,05$ ).

## RESULTS AND DISCUSSION

The characteristics of participants can be described as follows:

**Table 1.**  
**The Characteristics of Participants**

Characteristics	n (%)
Sex	
a. Female	67 (63.8)
b. Male	38 (36.2)
Age	
a. 26-45 years old	6 (5.7)
b. 46-65 years old	70 (66.7)
c. >65 years old	29 (27.6)
Fasting Blood Glucose Level	
a. Normal	47 (44.8)
b. Not Normal	58 (55.2)
Total	105 (100)

Table 1. reveals that women the majority of the responders (63.8%) and 46-65 years old group (66.7%). Over the age of 40 years old, the risk of noncommunicable diseases and other chronic diseases increases. As a result, T2DM patients over the age of 40 were likely to be more health-conscious, eating a balanced diet, exercising regularly, and beginning to avoid high-sugar, high-salt, and high-fat meals (Yunieswati, Marliyati, & Setiawan, 2020). The fasting blood sugar levels of many T2DM participants were abnormal (55.2%). Coronavirus Disease-19 severity and mortality appear to be linked to the presence of T2DM and the degree of hyperglycemia in an individual (Holman et al., 2020).

The nutritional condition in Table 2 shows the majority of them are either normal (48.6%) or have a BMI of 18.5-22.9 kg/m<sup>2</sup>. In contrast to Ruiz-Roso *et al.*, (2020)'s study, the majority of persons with T2DM were obese (63%). The optimal management of T2DM, particularly during the Covid-19 pandemic, is emphasized through the management of modifiable factors, particularly living a healthy lifestyle that includes efforts to achieve and maintain normal nutritional status to prevent obesity, apply a balanced diet

based on nutrition principles, and engage in regular physical activity according to age (Rohani & Ardenny, 2019).

**Table 2.**  
**Nutritional Status, Vitamin C Intake, and Stress Level**

Variable	n(%)
Nutritional Status	
a. Underweight	44(41.9)
b. Normal	51(48.6)
c. Overweight	8 (7.6)
d. Obesities I	2(1.9)
Vitamin C Intake	
a. Deficient	46(43.8)
b. Adequate	38(36.2)
c. Surplus	21(20.0)
Stress Level	
a. Low	46(43.8)
b. Medium	35(33.8)
c. High	24(22.4)
Total	105

Vitamin C intake in T2DM patients was divided into three categories: less (43.8%), good (36.2%), and more (20%). Fruits high in vitamin C, such as oranges, papaya, bananas, apples, pears, and guava, provide a good source of vitamin C and other nutrients to T2DM sufferers. According to the SQ-FFQ data, the typical fruit consumption was 3-5 times per week. Orange jember, papaya, and kapok banana were the most popular fruits. Oranges (49mg/100gr), papaya (78mg/100gr), and kapok bananas (9mg/100gr) all have high vitamin C levels (PERSAGI, 2017). Vitamin C requirements for men aged 19 to 80 years old are 90 mg per day and 75 mg per day for women aged 19 to 80 years old (Kemenkes RI, 2019).

Type two diabetes mellitus patients have low stress levels (43.8%), moderate stress (33.8%), and high stress (22.9%). According to a study Ruissen *et al.*, (2021), T2DM suffered up to 35.1% stress throughout the area quarantine. Quarantine has been linked to higher levels of mental discomfort and anxiety in previous studies (Brooks et al., 2020; Hossain, Sultana, & Purohit, 2020). Excessive stress can disrupt diabetes self-management and glucose control by causing changes in everyday behavior (Faulenbach et al., 2012).

Table 3. reveals that 14 people with a low T2DM intake have a high stress level (13.3%). In T2DM, which has a low stress level of 26 people, the nutritional state reveals normal nutritional status (24.8%). The association between stress and nutritional status was not established in this study. This occurs because emotional overeating as a coping mechanism for stress is insufficient to influence food intake, hence it is unrelated to nutritional status (Sukianto, Marjan, & Fauziyah, 2020). Relationship with no tension other things that were more connected to nutritional status, such as energy, carbohydrate, and protein intake, cause nutritional status. Other studies have found that stress has no bearing on one's nutritional health (Nicholas, 2016).

There was no correlation between nutritional status and vitamin C intake with stress level ( $p > 0.05$ ). On the intake of vitamin C, 23 persons had a low stress level and a good intake of T2DM (21.9%). Interestingly, ascorbic acid has been shown in multiple clinical investigations to reduce stress hormone levels and subjective impressions of stressful situations. For example, ascorbic acid (3 g/day for 5 days) can block the increase in cortisol levels caused by exogenous Adrenocorticotrophic Hormone (ACTH) (Moritz, Schmitz, Rodrigues, Dafre, & Cunha, 2020).

**Tabel 3.**  
**The Relationship Nutritional Status and Vitamin C Intake with Stress Level**

Variable	Stress Level						Total		p
	Low		Medium		High		n	%	
	n	%	n	%	n	%			
<b>Nutritional Status</b>									
Normal	26	24.8	17	16.2	8	7.6	51	48.6	0.183*
Not Normal	20	19.0	18	17.1	16	15.2	54	51.4	
<b>Vitamin C</b>									
Deficient	15	14.3	17	16.2	14	13.3	46	43.8	0.055*
Adequate	23	21.9	8	7.6	7	6.7	38	36.2	
Surplus	8	7.6	10	9.5	3	2.9	21	20.0	

\*Chi Square Test, p>0.05

The emotional strain faced by responders with T2DM is a concern. Because of the huge number of concomitant COVID-19 mortality cases, someone with T2DM may experience strong emotions during this pandemic. This is becoming more prevalent in the population, particularly in rural regions. So many people, especially during the COVID-19 epidemic, have emotional difficulty dealing with their condition (Shinan-Altman & Levkovich, 2022). Furthermore, unfavorable opinions about health personnel are affected by the media during the COVID-19 epidemic. Health personnel must utilize comprehensive personal protection equipment when treating COVID-19. When a person with T2DM is receiving treatment at a health institution, this produces anxiety and fear, as well as psychological issues (Manik, Natalia, & Theresia, 2021). A person with mental difficulties' interpersonal relationships would be affected as well. Withdrawal, social isolation, and a lack of self-activities are all symptoms. A person with mental difficulties has an impact on many parts of their life, including medication adherence, which leads to illness recurrence (Febrianita, Alfianto, & Muntaha, 2021).

In Alfianto, Ulfa, Kurniyanti, & Wicaksono (2021)'s research, they discuss the description of stress in people with DMT2 in rural areas. The average result of the respondent's stress level is moderate. During the COVID-19 pandemic, the issue that becomes a priority is mental health. The cortisol hormone caused by negative feelings of anxiety or stress can cause physical health problems, especially problems with non-communicable diseases such as the heart. The cortisol hormone caused by anxiety problems is influenced by a person's negative thoughts due to the COVID-19 pandemic. This feeling arises from information about COVID-19 in the mass media or social media, death, illness, to mental health problems due to COVID-19. Village people on average have a less understanding of a disease. Lack of access to information about the COVID-19 pandemic has made rural communities ignore health protocols. But on the other hand, the community is very concerned about the problems of the COVID-19 pandemic, such as the stigma against people who are exposed to COVID-19, the stigma on health workers by assuming that if they visit and check with the puskesmas or health services, they will be infected. This reduces the number of visits to health services for self-examination. The decrease can be from non-communicable disease services such as checking for diabetes, hypertension, auric acid and cholesterol. So that the cause of mental health problems in someone with a non-communicable disease or such as DM is a stigma factor (negative thoughts) that can cause anxiety and stress in a person and have an impact on psychosocial problems in someone with DM.

It was not related in this study because T2DM respondents were members of Chronic Disease Management

Program members who received routine treatment at the Health Center, implying that T2DM patients received treatment and education directly from the on-duty doctor. Several prolanis operations, including as counseling and Posbindu PTM, were halted during the COVID-19 pandemic. According to prior study, T2DM patients who have routine health checks, monitor their drugs and nutrition, and participate in activities can help T2DM patients adjust to their surroundings so that they don't feel stressed while undergoing therapy (Wahyu Lestarina, 2018).

#### LIMITATION OF THE STUDY

Researchers did not examine the stress coping of T2DM patients. Methods or problem-solving strategies (coping) used by diabetics are also strongly related to the problem of stress in diabetes. The use of SQ-FFQ also has drawbacks because T2DM patients have to remember food habits in the past month, so many patients experience forgetfulness.

#### CONCLUSIONS AND SUGGESTIONS

Nutritional status and vitamin C did not have a significant relationship with stress levels in T2DM patients. Further research is needed to determine the factors that influence stress levels in T2DM patients during the COVID-19 pandemic.

#### ETHICAL CONSIDERATIONS

The Research Ethics Committee of the Faculty of Medicine, Universitas Sebelas Maret (No: 34/UN27.06.6.1/KEP/EC/2021).

#### Funding Statement

No funding was received for conducting this study

#### Conflict of Interest Statement

None declared

#### REFERENCES

Alfianto, A. G., Ulfa, M., Kurniyanti, M. A., & Wicaksono, K. E. (2021). Tingkat Stres Penderita Diabetes Mellitus Tipe 2 di Wilayah Pedesaan Selama Pandemi Covid-19 Dalam

- Melakukan Manajemen Perawatan Diri. *Jurnal Kesehatan Komunitas*, 7(3), 354–359. <https://doi.org/10.25311/keskom.vol7.iss3.975>
- Azab, A. E., Adwas, A. A., & Elsayed, A. S. I. (2019). Oxidative stress and antioxidant mechanisms in human body Toxicological effects of Propoxur View project Antidyslipidemic and Antiatherogenic Effects of Some Natural Products View project. *Journal of Applied Biotechnology & Bioengineering*, 6(1), 43–47. <https://doi.org/10.15406/jabb.2019.06.00173>
- Brooks, S. K., Webster, R. K., Smith, L. E., Woodland, L., Wessely, S., Greenberg, N., & Rubin, G. J. (2020). Rapid Review The psychological impact of quarantine and how to reduce it : rapid review of the evidence. *The Lancet*, 395(10227), 912–920. [https://doi.org/10.1016/S0140-6736\(20\)30460-8](https://doi.org/10.1016/S0140-6736(20)30460-8)
- Faulenbach, M., Uthoff, H., Schwegler, K., Spinass, G. A., Schmid, C., & Wiesli, P. (2012). Effect of psychological stress on glucose control in patients with Type 2 diabetes. *Diabetic Medicine*, 29, 128–131. <https://doi.org/https://doi.org/10.1111/j.1464-5491.2011.03431.x>
- Febrianita, D. A., Alfianto, A. G., & Muntaha, M. (2021). Gambaran Kepatuhan Minum Obat pada Penderita Gangguan Bipolar di Masa Pandemi Covid-19. *Media Husada Journal Of Nursing Science*, 2(2), 1–5. <https://doi.org/10.33475/mhjns.v2i2.38>
- Grabia, M., Zukowska, R. M., Pu, A., Bielecka, J., Nowakowski, P., Gromkowska-k, K., & Mielcarek, K. (2020). nutrients The Nutritional and Health Effects of the COVID-19 Pandemic on Patients with Diabetes Mellitus. *Nutrients*, 15(June), 1–15. <https://doi.org/doi:10.3390/nu12103013>
- Holman, N., Knighton, P., Kar, P., O'Keefe, J., Curley, M., Weaver, A., ... Valabhji, J. (2020). Risk factors for COVID-19-related mortality in people with type 1 and type 2 diabetes in England: a population-based cohort study. *The Lancet Diabetes and Endocrinology*, 8(10), 823–833. [https://doi.org/10.1016/S2213-8587\(20\)30271-0](https://doi.org/10.1016/S2213-8587(20)30271-0)
- Hossain, M. M., Sultana, A., & Purohit, N. (2020). Mental health outcomes of quarantine and isolation for infection prevention: a systematic umbrella review of the global evidence. *Epidemiology and Health*, 42. <https://doi.org/10.4178/epih.e2020038>
- IDF. (2019). *Diabetes Atlas* (NINTH). UK: International Diabetes Federation.
- Kemkes RI. (2019). *Tabel Angka Kecukupan Gizi*. Jakarta.
- Manik, M. J., Natalia, S., & Theresia. (2021). Social stigma towards nurses taking care of patients with COVID-19 in Indonesia: A mixed-methods study. *Belitung Nursing Journal*, 7(2), 98–106. <https://doi.org/10.33546/bnj.1322>
- Maroufizadeh, S., Foroudfard, F., Navid, B., Ezabadi, Z., & Sobati, B. (2018). The Perceived Stress Scale ( PSS-10 ) in women experiencing infertility: A reliability and validity study. *Middle East Fertility Society Journal*, 23(4), 456–459. <https://doi.org/10.1016/j.mefs.2018.02.003>
- Mazloom, Z., Ekramzadeh, M., & Hejazi, N. (2013). Efficacy of supplementary vitamins C and E on anxiety, depression and stress in type 2 diabetic patients: A randomized, single-blind, placebo-controlled trial. *Pakistan Journal of Biological Sciences*, 16(22), 1597–1600. <https://doi.org/10.3923/pjbs.2013.1597.1600>
- Moritz, B., Schmitz, A. E., Rodrigues, A. L. S., Dafre, A. L., & Cunha, M. P. (2020). The role of vitamin C in stress-related disorders. *Journal of Nutritional Biochemistry*, 85, 108459. <https://doi.org/10.1016/j.jnutbio.2020.108459>
- Murti, B. (2013). *Desain dan Ukuran Sampel untuk Penelitian Kuantitatif dan Kualitatif di Bidang Kesehatan* (ketiga). Yogyakarta: Gadjah Mada University Press.
- Naja, F., & Hamadeh, R. (2020). Nutrition amid the COVID-19 pandemic: a multi-level framework for action. *European Journal of Clinical Nutrition*, 74(8), 1117–1121. <https://doi.org/10.1038/s41430-020-0634-3>
- Nicholas, S. E. (2016). The Effect of Stress on Undergraduate College Students in Relation to Eating Out Behaviors and Weight Status. *Journal of Medicine and Health Sciences Commons Syracuse University*, (May). Retrieve from: <https://surface.syr.edu/etd/480/>
- Nurrahmawati, F., & Fatmaningrum, W. (2018). Hubungan Usia, Stres, dan Asupan Zat Gizi Makro dengan Kejadian Obesitas Abdominal pada Ibu Rumah Tangga di Kelurahan Sidotopo, Surabaya. *Amerta Nutrition*, 2(3), 254. <https://doi.org/10.20473/amnt.v2i3.2018.254-264>
- PERKENI. (2019). *Consensus and Prevention of Type 2 Diabetes Mellitus in Indonesia*. JAKARTA.
- PERSAGI. (2017). *Tabel Komposisi Pangan Indonesia* (4th ed.). Jakarta: Elex Media Komputindo.
- Rohani, R., & Ardenny, A. (2019). Analisis Faktor Yang Berhubungan Dengan Kepatuhan Diet Penderita Diabetes Melitus. *Jurnal Proteksi Kesehatan*, 7(2), 61–67. <https://doi.org/10.36929/jpk.v7i2.132>
- Ruissen, M. M., Regeer, H., Landstra, C. P., Schroijen, M., Jazet, I., Nijhoff, M. F., ... De Koning, E. J. P. (2021). Increased stress, weight gain and less exercise in relation to glycemic control in people with type 1 and type 2 diabetes during the COVID-19 pandemic. *BMJ Open Diabetes Research and Care*, 9(1), 1–7. <https://doi.org/10.1136/bmjdr-2020-002035>
- Ruiz-Roso, M. B., Knott-Torcal, C., Matilla-Escalante, D. C., Garcimartín, A., Sampedro-Nuñez, M. A., Dávalos, A., & Marazuela, M. (2020). Covid-19 lockdown and changes of the dietary pattern and physical activity habits in a cohort of patients with type 2 diabetes mellitus. *Nutrients*, 12(8), 1–16. <https://doi.org/10.3390/nu12082327>
- Satgas Penanganan COVID 19. (2021). *Infografis COVID 19*. Indonesia. Retrieve from: <https://covid19.go.id/>
- Shinan-Altman, S., & Levkovich, I. (2022). Emotional reactions towards COVID-19 among persons with diabetes. *International Health*, 14(2), 170–175. <https://doi.org/10.1093/inthealth/ihab024>
- Strandberg, R. B., Graue, M., Wentzel-Larsen, T., Peyro, M., & Rokne, B. (2014). Relationships of diabetes-specific emotional distress, depression, anxiety, and overall well-being with HbA1c in adult persons with type 1 diabetes. *Journal of Psychosomatic Research*, 77, 174–179. <https://doi.org/10.1016/j.jpsychores.2014.06.015>
- Sugiyanto, N. A. (2017). *Hubungan kebiasaan konsumsi lemak dan aktifitas fisik terhadap status gizi pada pegawai di Fakultas Matematika dan Ilmu Pengetahuan Alam (FMIPA)*. Universitas Muhammadiyah Surakarta. Retrieve from: <http://eprints.ums.ac.id/54456/>
- Sukianto, R. E., Marjan, A. Q., & Fauziah, A. (2020). Hubungan tingkat stres, emotional eating, aktivitas fisik, dan persen lemak tubuh dengan status gizi pegawai Universitas Pembangunan Nasional Jakarta. *Ilmu Gizi Indonesia*, 3(2), 113. <https://doi.org/10.35842/ilgi.v3i2.135>
- Utami, A. P., Jamaludin, & Agus, Y. (2016). *Gambaran Mekanisme Koping Stres pada Pasien Diabetes Mellitus di Wilayah Kerja Puskesmas Sambit Ponorogo Jawa Timur*. UIN Syarif Hidayatullah. Retrieve from:

<https://repository.uinjkt.ac.id/dspace/bitstream/123456789/32412/1/Astuti%20Puji%20Utami-flkik.pdf>

- Wahyu Lestarina, N. N. (2018). Tingkat Stres Penderita Diabetes Melitus Di Panti Werda Santu Yosef Surabaya. *Jurnal Keperawatan*, 7(1), 22–25. <https://doi.org/10.47560/kep.v7i1.111>
- Watson, N. A., Dyer, K. A., Buckley, J. D., Brinkworth, G. D., Coates, A. M., Parfitt, G., ... Murphy, K. J. (2018). Reductions in food cravings are similar with low-fat weight loss diets differing in protein and carbohydrate in overweight and obese adults with type 2 diabetes: A randomized clinical trial. *Nutrition Research*, 57, 56–66. <https://doi.org/10.1016/j.nutres.2018.05.005>
- World Health Organization. (2021). Coronavirus (COVID-19) Dashboard. Retrieved from <https://covid19.who.int/>
- Yang, J. K., Lin, S. S., Ji, X. J., & Guo, L. M. (2010). Binding of SARS coronavirus to its receptor damages islets and causes acute diabetes. *Acta Diabetologica*, 47(3), 193–199. <https://doi.org/10.1007/s00592-009-0109-4>
- Yunieswati, W., Marliyati, S. A., & Setiawan, B. (2020). Nutritional Status, Health Status, and Work Productivity of Cocoa Farmers in Polewali Mandar, Indonesia. *Jurnal Gizi Dan Pangan*, 15(3), 169–174. <https://doi.org/10.25182/jgp.2020.15.3.169-174>