



# The differences in diet quality and physical activity for COVID-19 survivors and non-survivors in Semarang City

## *Perbedaan kualitas diet dan aktivitas fisik pada kelompok penyintas dan non-penyintas COVID-19 di Kota Semarang*

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## Abstract

The COVID-19 pandemic triggered lifestyle changes, namely diet quality and physical activity, which showed improvements in COVID-19 survivors. This study aimed to analyze the differences in diet quality and physical activity among COVID-19 survivors and non-survivors in the city of Semarang between March and April 2022. The study design was cross-sectional, with as many as 100 Semarang City residents aged 22-45 years (50 survivors and 50 non-survivors of COVID-19) using a purposive sampling technique. Semi-quantitative food frequency questionnaire (SQ-FFQ) interview data were collected, followed by diet quality assessment using the Diet Quality Index-International (DQI-I). Physical activity data were collected using the International Physical Activity Questionnaire-Short Form (IPAQ-SF). Data were analyzed using the Mann-Whitney and Spearman's methods. The diet quality of the two groups showed a difference ( $p=0,012$ ), with the diet quality of the survivor group being better. Variations in dietary quality components showed significant differences ( $p<0,001$ ), including the subcomponents of overall ( $p=0,005$ ) and protein ( $p<0,001$ ). Physical activity in both groups showed no significant difference ( $p=0,639$ ), including heavy, moderate, and walking activities. There was a significant difference in sedentary activity between the two groups ( $p=0,035$ ). Conclusion: The dietary quality of the two groups showed differences, the majority of which was better in the COVID-19 survivor group. Physical activity in both groups showed no difference, but sedentary activity differed between the two groups.

**Keywords:** Activity, COVID-19, dietary quality, survival

## Abstrak

Pandemi COVID-19 telah memicu perubahan gaya hidup, yaitu kualitas diet dan aktivitas fisik yang menunjukkan perbaikan pada penyintas COVID-19. Penelitian bertujuan untuk menganalisis perbedaan kualitas diet dan aktivitas fisik pada kelompok penyintas dan non-penyintas COVID-19 di Kota Semarang bulan Maret-April tahun 2022. Desain studi yaitu cross sectional dengan subjek warga Kota Semarang berusia 22-45 tahun sebanyak 100 subjek (50 penyintas dan 50 non-penyintas COVID-19) dengan teknik purposive sampling. Pengambilan data wawancara Semi Quantitative-Food Frequency Questionnaire (SQ-FFQ), dilanjutkan penilaian kualitas diet menggunakan Diet Quality Index-International (DQI-I). Pengambilan data aktivitas fisik menggunakan International Physical Activity Questionnaire-Short Form (IPAQ-SF). Analisis data menggunakan metode Mann-Whitney dan Spearman's. Kualitas diet kedua kelompok menunjukkan terdapat perbedaan ( $p=0,012$ ), dimana kualitas diet kelompok penyintas secara deskriptif lebih baik. Komponen kualitas diet variasi menunjukkan perbedaan ( $p<0,001$ ), termasuk subkomponen keseluruhan ( $p=0,005$ ) dan protein ( $p<0,001$ ). Aktivitas fisik kedua kelompok tidak menunjukkan perbedaan ( $p=0,639$ ), termasuk pada aktivitas berat, sedang, dan aktivitas jalan kaki. Terdapat perbedaan

aktivitas sedenter pada kedua kelompok ( $p=0,035$ ). Kesimpulan, kualitas diet kedua kelompok menunjukkan perbedaan, mayoritas lebih baik pada kelompok penyintas COVID-19. Aktivitas fisik pada kedua kelompok menunjukkan tidak terdapat perbedaan, namun aktivitas sedenter menunjukkan adanya perbedaan pada kedua kelompok.

**Kata Kunci:** Aktivitas, COVID-19, kualitas diet, penyintas

## Introduction

COVID-19 (Coronavirus Disease 2019) is an acute respiratory syndrome caused by the Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) that emerged in Indonesia in early 2020. (Agustina et al., 2021; Al-Jahdhami et al., 2021; Sukur et al., 2020). The COVID-19 pandemic has caused public awareness of exposure to the virus, triggering changes in lifestyle to become healthier (Atmadja et al., 2020). COVID-19 survivors or someone who has been exposed to COVID-19 is the subject of various studies regarding the impact of COVID-19 on various lines of life. The adult age group can easily experience lifestyle changes because they do not depend on others and have experienced the impact of COVID-19 firsthand. The number of COVID-19 cases that are still often increasing, as well as the possibility of the virus mutating, has triggered people to make lifestyle changes, especially the quality of diet and physical activity.

Diet quality is an indicator of the variety of food groups consumed compared with the recommended dietary guidelines (Dalwood et al., 2020). Good diet quality indicates that the food consumed has met the needs of both macronutrients and micronutrients, so the nutritional status is normal. Low diet quality is indicated by the consumption of foods that are high in energy and fat, low in fiber, and low in micronutrients (Retnaningrum & Dieny, 2015). The types of foods that commonly appear in poor quality diets are salty, sweetened foods, fast foods, and sugary drinks (Tribst et al., 2021). Studies on COVID-19 survivors in Greece mention a change in diet to be healthier and an increase in dietary supplement consumption). (Panagiotakos et al., 2021). Similar studies have shown improvements in diet quality, such as increased vegetable and fruit intake and decreased consumption of alcohol and sugary drinks in adolescents and adults (Silva et al., 2021).

Physical activity is any form of body movement that uses calories, can increase

immunity, and can prevent and overcome diseases such as heart disease, stroke, diabetes, and cancer (Mattioli & Ballerini, 2020; Wicaksono, 2020). Physical activity recommendations by the Indonesian Ministry of Health are 30 min per day or 150 min per week with moderate intensity. During the COVID-19 pandemic, there were restrictions on activities outside the home as a form of self-preservation from the virus, which spread massively. People who have realized the importance of physical activity can certainly overcome these restrictions by continuing to do physical activity indoors (Al Rahmad, 2021). Research in Italy states that during the COVID-19 pandemic, 38,3% of the population has experienced an increase in physical activity (Di Renzo et al., 2020).

COVID-19 survivors with moderate-to-severe symptoms have felt the impact of COVID-19, so they may be anxious about being re-exposed. Semarang City had the highest number of COVID-19 cases in Central Java in September, 2021. In addition, the city has a high mobility of productive age; therefore, the risk of spreading the virus is high. Therefore, it is possible that COVID-19 survivors have better diet quality and physical activity.

The government's COVID-19 vaccination program reached 126,27% for vaccine dose 1, 115,74% for vaccine dose 2, and 50,52% for vaccine dose 3 in Semarang City as of July 6, 2022. In addition, there is discourse that there will be a second booster or dose 4 vaccine that is prioritized for the elderly and health workers (Semarang City Health Office, 2022).

The president's statement on May 17, 2022, regarding the improvement of COVID-19 conditions triggered the relaxation of the mask-wearing policy and the swab obligation for fully vaccinated travelers. These two factors underlie the possibility of COVID-19 survivors and non-survivors having a quality diet and physical activity as usual (Cabinet Secretariat of the Republic of Indonesia, 2022).

Studies analyzing differences in diet quality and physical activity between COVID-19 survivors and non-survivors have not been conducted in Indonesia. This group, especially in adulthood, is vulnerable to lifestyle changes. Previous studies have focused on differences in physical activity and diet quality before and after the pandemic, while differences in the COVID-19 survivor and non-survivor groups have never been examined. Therefore, this study aimed to determine the differences in diet quality and activity between COVID-19 survivors and non-survivors in Semarang City.

## Methods

This was an observational cross-sectional study. The scope of this study was community nutrition conducted offline or online in Semarang City between March and April 2022. Ethical approval was obtained from the Bioethics Commission of the Faculty of Medicine, Sultan Agung University Semarang (number 71/III/2022).

The target population was residents of Semarang City aged 22-45 years old. This age range represents a productive age group with high mobility; therefore, the risk of exposure to COVID-19 is high. In addition, this group was able to change their lifestyles without relying on others. The elderly or survivors with comorbidities have a high risk of exposure to COVID-19 but were not selected for the study because the majority depend on others, making it difficult to obtain accurate data and being a limitation of the researcher.

The sample size was determined using the formula for unpaired categorical-numerical analytical research (Dahlan, 2013). The  $Z_{\alpha}$  value was 1,96, whereas the  $Z_{\beta}$  value was 0,842. The minimum difference considered meaningful ( $X_1 - X_2$ ) was 10. The combined standard deviation ( $S_g$ ) was obtained based on the calculation of the standard deviation value and the sample size of a previous study to obtain a value of 17. Based on the calculation of the sample size, 46 samples were needed plus 10% dropout so that the total sample per group was 51. During the study, there were two sample dropouts because they did not follow data collection until the end of the study. The sampling technique uses the *Purposive Sampling* method, in which the sample is taken based on specified characteristics.

Sampling was obtained by distributing posters where eligible subjects filled out *Google Forms* and *door-to-door* directly so that subject screening could be performed. The final sample was 100, which was divided into two groups with the same number, namely, 50 samples of COVID-19 survivors and 50 samples of COVID-19 non-survivors.

The inclusion criteria were Semarang City residents aged 22-45 years old were willing to become respondents by providing *informed consent*. The special criterion for the COVID-19 non-survivor group is that they have never been confirmed to be positive for COVID-19. The special criteria for the COVID-19 survivor group was confirmed to be positive in July-October 2021 or January-February 2022. The selection of the range was based on the increase in COVID-19 cases, which reached the peak of the second and third waves in Indonesia. Other inclusion criteria for survivors were moderate-to-severe symptoms with clinical symptoms of pneumonia, such as fever, cough, shortness of breath, and rapid breathing. To determine severe or moderate symptoms, one of the following symptoms was added:  $SpO_2 \leq 93\%$  on room air, respiratory distress, or respiratory frequency  $>30x/min$ . The condition at the time of data collection was healthy, not sick, affected by food intake and physical condition, and not in a diet program. Exclusion criteria: subjects who withdrew, could not be contacted, or died.

The independent variable was COVID-19 history, which was categorized into COVID-19 survivors and non-survivors. Data on COVID-19 history were collected by filling out a *Google Form* containing subject screening and filling out *Informed Consent*. Subject screening consisted of history of COVID-19, severity, time of exposure, isolation information, and symptoms experienced. For subjects who met the inclusion criteria, a face-to-face or online interview agreement was made based on their willingness. If the interview is conducted face-to-face, strict health protocols are implemented by being held outside or indoors with the door open and wearing a mask. For those who could not have an in-person interview, it was conducted online using the *Ms. Teams*, *Zoom*, or *Google Meets* platform, depending on the subject's willingness.

The first dependent variable is diet quality, which means that the nutrients consumed are in accordance with the

recommended Indonesian intake, namely the Recommended Dietary Allowance (RDA) 2019 and the General Guidelines for Balanced Nutrition in Indonesia, namely Pedoman Umum Gizi Seimbang (PUGS) (Retnaningrum & Dieny, 2015). Data on food intake for the last 1 month with the SQ-FFQ instrument and Food Photo Book tools made it easier for subjects to determine the amount of food intake. Subsequently, researchers assessed diet quality using the *Diet Quality Index-International* (DQI-I) instrument, which consists of an assessment of variety, adequacy, moderation, and overall balance. The total score of diet quality was assessed by summing the scores of each component so that a score range of 0-100 was obtained. Diet quality was categorized as low if the score was  $\leq 60$  and as high if the score was  $> 60$  (Restutiwati et al. 2019; Retnaningrum & Dieny 2015).

The second dependent variable was physical activity, which is any body movement involving energy expenditure. Assessment of physical activity over the past seven days using the IPAQ-SF instrument. Physical activity assessment included sedentary, walking, moderate, and strenuous physical activity. The IPAQ-SF assessment uses the scoring method with the results if  $< 600$  MET/week is categorized as low,  $600-2999$  MET/week is categorized as moderate, and  $\geq 3000$  MET/week is categorized as high.

The confounding variables included age, income level, education level, and food security obtained through interviews. Age was categorized into 22-29 and 30-45 years based on daily needs, according to the 2019 RDA. Income level is the monthly amount earned in the form of salary, wages, rent, interest, profit, or allowances. Income levels were classified as  $\leq$  Rp. 1.500,000/month, Rp. 1.501,000 - Rp. 3.500,000/month, and  $\geq$  Rp. 3.501.000/month. Education level shows the stage of a person's formal education and is classified based on the last education taken: junior high school, senior high school, diploma, undergraduate (S-1), and postgraduate (S-2 or S-3). Food security measures an individual's level of food insecurity using the Bickel questionnaire, which consists of 18 questions. Food insecurity was defined as whether more than three questions were answered with the following answers: often, sometimes, or yes.

Data analysis was performed using statistical software. Descriptive data were presented as frequency distribution, minimum, maximum, and median. Data normality was analyzed using the Kolmogorov-Smirnov test. Data distribution was found to be abnormal, so the Mann-Whitney test was used to test for differences in diet quality and physical activity in COVID-19 survivors and non-survivors. In addition, analysis to determine the relationship between confounding variables and the dependent variable, namely diet quality and physical activity, was carried out using *Spearman's* test with a confidence interval of 95%.

## Result and Discussion

### Subject Characteristics

This study focused on diet quality and physical activity of productive age groups aged 22-45 years in Semarang City.

Based on Table 1, the sex distribution of the participants was 51 males and 49 females. The educational level in both groups was high. The majority of survivors were students, whereas the majority of non-survivors were civil servants. The majority income level in both groups was  $\leq$  Rp. 1,500,000. The majority of subjects in both groups received the second COVID-19 vaccination and consumed supplements during the COVID-19 pandemic.

The COVID-19 survivors were divided based on moderate or severe symptoms, as shown in Table 2. The majority of survivors with moderate symptoms carried out independent isolation ( $n = 36$ ), while survivors with severe symptoms carried out the majority of isolation in hospitals ( $n = 5$ ). The degree of moderate or severe subject symptoms was determined based on the Decree of the Minister of Health of the Republic of Indonesia Number 4641 of 2021. Moderately symptomatic patients showed clinical signs of pneumonia, such as fever, cough, tachypnea (rapid breathing), without signs of severe pneumonia, and  $SpO_2 > 93\%$  on room air severe.

Patients had clinical signs and symptoms of severe pneumonia such as nasal breathing, cyanosis (bluish skin), subcostal retraction, pneumonia, and one of the following symptoms: respiratory frequency  $> 30x/min$ , severe respiratory distress, and  $SpO_2 < 93\%$  on room air. The majority of the subjects were exposed to COVID-19 in July-October 2021, coinciding with

the increase in the second wave of COVID-19. Symptoms of COVID-19 experienced by subjects included coughing, fever, shortness of breath, rapid breathing, SpO<sub>2</sub> ≤93%, sore throat, and anosmia. Symptoms of respiratory distress are

experienced by survivors with severe symptoms as a manifestation of fluid build-up in the lungs. In addition, most survivors experience nonspecific symptoms of COVID-19, such as runny nose, diarrhea, and muscle pain.

**Table 1.** Subject characteristics based on COVID-19 survivor and non-survivor groups

Variables		Group			
		Survivors		Non-Survivors	
		n	%	n	%
Gender	Male	28	56,0	23	46,0
	Female	22	44,0	27	54,0
Age	22-29 years old	35	70,0	17	34,0
	30-45 years old	15	30,0	33	66,0
Education Level	SMP	0	0	1	2,0
	HIGH SCHOOL	27	54,0	26	52,0
	Diploma	1	2,0	0	0
	Bachelor (S-1)	16	32,0	20	40,0
Type of work	Postgraduate (S-2, S-3)	6	12,0	3	6,0
	Student	27	54,0	7	14,0
	Private	7	14,0	5	10,0
	Self-employed	0	0	8	16,0
	ASN	10	20,0	8	16,0
	Non ASN	5	10	13	26,0
	Not Working	1	2,0	9	18,0
Income Level	≤Rp. 1,500,000	19	38,0	24	48,0
	Rp. 1,500,001-Rp. 3,500,000	18	36,0	13	26,0
	≥Rp. 3,500,001	13	26,0	13	26,0
Food security	Prone	8	16,0	24	48,0
	Not vulnerable	42	84,0	26	52,0
Comorbidities	Available	37	74,0	0	0
	None	13	26,0	50	100,0
Vaccination History	Not yet vaccinated	0	0	1	2,0
	Vaccine 1	0	0	1	2,0
	Vaccine 2	38	76,0	32	64,0
	Vaccine 3 ( <i>Booster</i> )	12	24,0	16	32,0
Physical Activity	<600 MET /week (Low)	9	18,0	9	18,0
	600-2999 MET/week (Medium)	24	48,0	26	52,0
	≥ 3000 METs/week (High)	17	34,0	15	30,0
Take supplements	Yes	39	78,0	27	54,0
	No	11	22,0	23	46,0

\*MET = Metabolic Equivalents

**Table 2.** Characteristics of COVID-19 survivors

Characteristics of Survivors		Categories of COVID-19 Symptoms in Survivors			
		Medium (n = 40)		Weight (n = 10)	
		n	%	n	%
Insulation Description	Self-isolation	36	90,0	3	30,0
	Hospital Isolation	0	0	5	50,0
	Miscellaneous	4	10,0	2	20,0
Exposure time	July to October 2021	22	55,0	7	70,0
	January to February	18	45,0	3	30,0

Characteristics of Survivors		Categories of COVID-19 Symptoms in Survivors			
		Medium (n = 40)		Weight (n = 10)	
		n	%	n	%
		2022			
Symptoms of COVID-19					
Fever	Yes	40	100	10	100,0
	No	0	0	0	0
Cough	Yes	39	97,5	10	100,0
	No	1	2,5	0	0
Shortness of breath	Yes	16	40,0	10	100,0
	No	24	60,0	0	0
Rapid breathing	Yes	29	72,5	8	80,0
	No	11	27,5	2	20,0
SpO <sub>2</sub> ≤93%	Yes	33	82,5	9	90,0
	Not known	7	17,5	1	100,0
Respiratory distress	Yes	1	2,5	5	50,0
	No	39	97,5	5	50,0
Headache	Yes	17	42,5	7	70,0
	No	23	57,5	3	30,0
Diarrhea	Yes	1	2,5	4	40,0
	No	39	97,5	6	60,0
Muscle pain	Yes	27	67,5	10	100,0
	No	13	32,5	0	0
Anosmia	Yes	31	77,5	9	90,0
	No	9	22,5	1	10,0
Throat pain	Yes	32	80,0	9	90,0
	No	8	20,0	1	10,0
Colds	Yes	20	50,0	6	60
	No	20	50,0	4	40,0
Other (acid reflux, nausea, vomiting)	Yes	9	22,5	0	0
	No	31	77,5	10	100,0

The majority of survivors with moderate symptoms carried out independent isolation, while survivors with severe symptoms carried out isolation in the hospital. The number of subjects who carried out independent isolation was quite large because during the increase in the second wave, hospitals were prioritized for elderly COVID-19 patients or adults with comorbidities, so most groups of survivors with moderate symptoms carried out remote monitoring with independent isolation. The period of exposure to COVID-19 was mostly from July to October 2021, coinciding with the second wave of COVID-19 in Indonesia. Symptoms experienced by subjects included fever, cough, shortness of breath, rapid breathing, SpO<sub>2</sub> ≤93%, respiratory distress, headache, anosmia, and sore throat. Most survivors experienced fever, cough, rapid breathing, anosmia, and sore throat. There are several subjects who do not know whether

they experience symptoms of SpO<sub>2</sub> ≤93% because they do not remember or subjects who carry out independent isolation do not check because of limited tools.

**Diet Quality**

Diet quality was assessed in four categories: variety, adequacy, moderation, and overall balance, which were assessed using the *Diet Quality Index-International* (DQI-I) questionnaire with a score range of 0-100. In the survivor group, the majority of diet quality was high (score >60), whereas the non-survivor group had a low score (≤60). High diet quality indicates that a person's food consumption meets both macronutrient and micronutrient needs, while low diet quality indicates food consumption that is high in energy and fat, low in fiber, and low in micronutrients (Gardiarini et al., 2017).

**Table 3.** Diet quality among COVID-19 survivors and non-survivors in Semarang City

Variables		Group			
		Survivors		Non-Survivors	
		n	%	n	%
Diet Quality (score)	High (>60)	30	60,0	16	32,0
	Low ( $\leq$ 60)	20	40,0	34	68,0
Adequacy					
Vegetable group (servings/day)	Good ( $\geq$ 3-5)	13	26,0	2	4,0
	Fair (1,5-<3)	20	40,0	12	24,0
	Less (<1,5)	17	34,0	36	72,0
Fruit group (servings/day)	Good ( $\geq$ 2-3)	6	12,0	3	6,0
	Fair (1-<2)	17	34,0	3	6,0
	Less (<1)	27	54,0	44	88,0
Staple food groups (servings/day)	Good ( $\geq$ 3-8)	34	68,0	25	50,0
	Fair (1,5-<3)	13	26,0	23	46,0
	Less (<1,5)	3	6,0	2	4,0
Fiber (%RDA g/day)	Good ( $\geq$ 100)	3	6,0	5	10,0
	Fair (<100-50)	7	14,0	12	24,0
	Less (<50)	40	80,0	33	66,0
Protein (% energy/day)	Good ( $\geq$ 15)	28	56,0	24	48,0
	Fair (7,5-14)	20	40,0	26	52,0
	Less (<7,5)	2	4,0	0	0
Iron (%RDA mg/day)	Good ( $\geq$ 100)	16	32,0	20	40,0
	Fair (<100-50)	20	40,0	17	34,0
	Less (<50)	14	28,0	13	26,0
Calcium (%RDA mg/day)	Good ( $\geq$ 100)	2	4,0	3	6,0
	Fair (<100-50)	14	28,0	13	26,0
	Less (<50)	34	68,0	34	68,0
Vitamin C (%RDA mg/day)	Good ( $\geq$ 100)	20	40,0	23	46,0
	Fair (<100-50)	15	30,0	12	24,0
	Less (<50)	15	30,0	15	30,0
Moderation					
Total fat (% total energy/day)	Good ( $\leq$ 30)	23	46,0	21	42,0
	More (>30)	27	54,0	29	58,0
Saturated fat (% total energy/day)	Good ( $\leq$ 10)	25	50,0	22	44,0
	More (>10)	25	50,0	28	56,0
Cholesterol (mg/day)	Good ( $\leq$ 300)	29	58,0	25	50,0
	More (>300)	21	42,0	25	50,0
Sodium (mg/day)	Good ( $\leq$ 2400)	44	88,0	44	88,0
	More (>2400)	6	12,0	6	12,0
Foods low in nutrients (%total energy/day)	Good ( $\leq$ 10)	45	90,0	46	92,0
	More (>10)	5	10,0	4	8,0
Overall balance					
Macronutrient ratio ( CH:P:L)	High (55-65:10-15:15-25)	10	20,0	9	18,0
	Medium (52-68:9-16:13-27)	3	6,0	3	6,0
	Low (50-70:8-17:12-30)	37	74,0	38	76,0
fatty acid ratio (PUFA : MUFA : SFA)	High (P/S:1-1,5 M/S:1-1,5)	2	4,0	4	8,0
	Medium (P/S:0,8-1,7;M/S:0,8-1,7)	5	10,0	8	16,0
	Low (Other)	43	86,0	38	76,0

\*Sufficiency table data refers to the RDA

\*CH= Carbohydrates, P=Protein, L=Fat, PUFA= polyunsaturated fatty acids, MUFA = monounsaturated fatty acids, SFA= Saturated fatty acids

The diet quality of the survivor group had a majority score of >60, with a high category of 60% (n=30), while the non-survivor group had a score of ≤60 at 68% (n=34). The consumption of vegetables, fruits, and staple foods in the survivor group was higher than that in the non-survivor group. However, fiber and iron adequacy levels were mostly higher in the non-survivor group. This could be because of the different types of food consumed by the two groups. The levels of calcium and vitamin C adequacy in both groups classified as good to fair were similar based on the consumption of supplements in both the survivor and non-survivor groups. In the moderation component,

The majority of the survivors were categorized as good, including the consumption of total fat, saturated fat, and cholesterol. In the sodium subcomponent, both groups had the majority of subjects who could be categorized as good (≤2400 mg/day), with 44 subjects per group. The low-nutrient food subcomponent in the COVID-19 non-survivor group was better at 46 subjects, but this result was not too far from that of the survivor group at 45 subjects. The overall balance component showed that the macronutrient ratio of the survivor group was mostly categorized as good, whereas the fatty acid ratio of the non-survivor group was mostly categorized as good.

**Table 4.** Differences in diet quality in COVID-19 survivors and non-survivors

Variables	COVID-19 Survivors	COVID-19 Non-Survivors	P-value
	Median (M in- Max)	Median ( Min- Max)	
Diet Quality (score)	61,5 (36-91)	56,5 (39-74)	0,012*
Variation (score)	17 (12-20)	15 (7-20)	<0,001*
Overall (type/day)	4 (3-5)	4 (2-5)	0,005*
Protein (type/day)	3 (1-3)	2 (1-3)	<0,001*
Adequacy (score)	22 (12-40)	20 (10-38)	0,248
Vegetables (servings/day)	2 (1-3)	1 (0-3)	<0,001*
Fruit (servings/day)	1 (0-3)	1 (0-3)	0,001*
Staple Food (servings/day)	3 (1-3)	2,5 (1-3)	0,105
Fiber (g/day)	10 (2,1-55,3)	11,9 (3,4-67,3)	0,099
Protein (g/day)	73,6 (26,7-218)	65,6 (15,9-307,6)	0,823
Iron (mg/day)	9,25 (3,9-35,3)	10,05 (2,2-42,9)	0,617
Calcium (mg/day)	390,05 (180,8-1308,6)	441 (140,3-1407,9)	0,549
Vitamin C (mg/day)	63 (5,5-2335,8)	70,8 (4,8-328,2)	0,772
Moderation (score)	18 (0-30)	18 (0-30)	0,448
Total fat (g/day)	59,45 (25,2-223,2)	65,25 (12-357,4)	0,770
Saturated Fat (g/day)	23,5 (8,5-1486,2)	23 (3,1-100,1)	0,549
Cholesterol (g/day)	266,7 (88-1015,6)	306 (60,4-1550,4)	0,276
Sodium (mg/day)	785,35 (217,4-6638,9)	815 (181,2-7131,9)	0,978
Foods low in nutrients (score)	6 (0-6)	6 (0-6)	0,818
Overall Balance (score)	0 (0-10)	1 (0-10)	0,852
Macronutrient Ratio (score)	0 (0-6)	0 (0-6)	0,466
Fatty Acid Ratio (score)	0 (0-4)	0 (0-4)	0,200
MUFA (mg/day)	15,15 (4,6-51,2)	16,3 (2,9-67,9)	0,649
PUFA (mg/day)	13,75 (4,3-59,5)	15,15 (3,1-111,8)	0,510
Carbohydrate (g/day)	235,1 (80,4-754)	249,3 (115,8-911,8)	0,432
Total energy (kcal)	1861,45 (769,5-4858)	2007,85 (646,4-7866,7)	0,654

min = minimum value; max = maximum value; \*Significant ( $p < 0.05$ ; Mann-Whitney test)

Diet quality showed a significant difference ( $p=0,012$ ) between the two groups, with the majority of COVID-19 survivors classified as good. These results are in line with research on the Greek adult age group, where COVID-19 survivors changed their diet to

healthier and increased supplement consumption during the pandemic. (Panagiotakos et al., 2021). Psychologically, subjects with health complaints find it easier to change their eating habits to avoid reinfection. Previous studies have shown a positive



relationship between a person's psychological state and better diet quality (Panagiotakos et al., 2021). Physiologically, the *behavioral immune system* is active when there is a risk of infection, triggering emotional, cognitive, and behavioral responses to minimize risk. This triggers fear of exposure and the motivation to avoid infection (Troisi, 2020).

The variation component shows the diversity of food consumed with the results of differences between the two groups ( $p < 0,001$ ), including the subcomponents of variation in overall consumption ( $p = 0,005$ ) and variation in protein consumption ( $p < 0,001$ ). The overall consumption variation of both groups showed the majority of daily consumption of staple foods, vegetables, animal-side dishes, and vegetable-side dishes. There was a difference in the survivor group, in which the majority consumed fruits per day, thus increasing the overall variation in the subcomponent score. Research in Canada and Brazil showed that during the COVID-19 pandemic, there was an improvement in diet quality, with an increase in vegetable and fruit consumption (Lamarche et al., 2021; Tribst et al., 2021). In COVID-19 survivors, choosing a varied diet is a form of maintaining the body's immunity to prevent viral reinfection (Rogers et al., 2021). The protein variation of the survivor group mostly reached three types of proteins/day, while the non-survivors mostly reached only two types of proteins/day. The types of protein commonly consumed by both groups were poultry, eggs or vegetable side dishes. However, the survivor group often consumed additional items such as meat or milk. Protein is one of the most important macronutrients, because it is recommended to increase endurance. Therefore, protein consumption levels should be considered in both COVID-19 survivors and non-survivors. Based on the analysis of consumption patterns of overall variation and protein variation, the survivor group was more diverse than the COVID-19 non-survivor group.

The sufficiency component evaluates whether food elements are met in sufficient quantities. The analysis showed no difference ( $p = 0,248$ ), but the subcomponents of adequacy of vegetable ( $p < 0,001$ ) and fruit ( $p = 0,001$ ) consumption differed. The sufficiency levels of vegetables in the survivor group were mostly categorized as moderate to good ( $> 1,5$

servings/day), reaching 66% ( $n = 33$ ), while the non-survivor group was mostly classified as insufficient ( $< 1,5$  servings/day) reaching 72% ( $n = 36$ ). Fruit adequacy in both groups was mostly poor, but survivors who were categorized as adequate to good ( $> 1$  portion/day) were higher at 46% ( $n = 23$ ), whereas the non-survivor group only reached 12% ( $n = 6$ ). Vegetable and fruit adequacy was higher in the survivor group, linearly with the variation in vegetable and fruit consumption, thus increasing the adequacy of consumption. Research in the United States has shown an increase in vegetable and fruit consumption in productive-age groups during the pandemic (Rogers et al., 2021). Research in Indonesia shows differences in vegetable and fruit consumption before and after the pandemic, where there is an increase in consumption (Dieny et al., 2021). (Dieny et al., 2021; Mustakim et al., 2021; Noviasy & Susanti, 2020). Apart from the adequacy of the vegetables and fruits, there were no differences in the other subcomponents. Adequacy of staple food and protein consumption was better in the survivor group. Although the adequacy level of vegetables and fruits was higher in the survivor group, the adequacy of fiber and iron was better in the non-survivor group because of the higher consumption of legumes and their preparations. Calcium and vitamin C adequacy levels in both groups were similar, with the majority categorized as moderate to high.

The moderation component evaluates the intake of foods that may trigger chronic disease. The analysis showed no differences ( $p = 0,448$ ), including all moderation subcomponents. Consumption of total fat, saturated fat, and cholesterol was higher in the non-survivor group; however, the results were not significantly different. Based on the interview results, both groups mostly consumed fried side dishes and snacks. In the survivor group aged  $> 30$  years, the majority said that they started to reduce the consumption of fried foods, as evidenced by the lower frequency and amount of consumption of fried side dishes and snacks than in the non-survivor group. Research in the UK and Saudi Arabia has shown that during the pandemic, there was an increase in the intake of high-fat foods (Alhusseini & Alqahtani, 2020; O'Connell et al., 2022). Research in Indonesia shows the opposite result, namely, a decrease in

fried food consumption (Mustakim et al., 2021; O’Connell et al., 2022). (Mustakim et al., 2021; Noviasy & Susanti, 2020). This study cannot show an increase or decrease during the pandemic, and can only show the consumption pattern. The sodium moderation in both groups showed the same results for subjects who were classified as good with an intake of  $\leq 2400$  mg/day. Based on the interview results, it was found that some participants regularly consumed canned food and sausages, both survivors and non-survivors. The moderation of low-nutrient foods showed similar results, where the majority of subjects in both consumption groups consumed  $\leq 10\%$  of the total energy/day.

The overall balance component shows the balance of the overall intake by energy source and fatty acid composition. The analysis showed no significant differences ( $p=0,852$ ), including all subcomponents. Both the macronutrient and fatty acid ratios in both groups were mostly poor. The macronutrient ratios in both groups were unbalanced because of the majority of excess fat percentage. In addition, the fatty acid ratios were unbalanced, and the majority of saturated fatty acids (SFA) were higher. This was due to the high consumption of fried side dishes and snacks in both the groups. Palm oil in processed fried foods contributes to increased fat content, especially saturated fatty acids. Previous research has shown that one of the sources of saturated fatty acids in Indonesia is processing using *deep frying* techniques that are often performed (Noviasy & Susanti, 2020).

Research on adults in the United States suggests that the quality of one’s diet and physical activity improved after COVID-19 cases declined. This was triggered by the loosening of government restrictions and adaptation following the COVID-19 pandemic (Rogers et al., 2021). The easing of government regulations regarding COVID-19 and the adaptation of new habits allowed dietary quality components such as adequacy, moderation, and overall balance in both groups, with no significant differences. People’s lives are now returning to normal, making it easy to access food and carry out activities as usual.

The majority of COVID-19 survivors and non-survivors were taking supplements during the COVID-19 pandemic. Research in Saudi Arabia suggests that there has been an increase in the use of supplements during the COVID-19 pandemic as a form of prevention and treatment during the COVID-19 pandemic (Radwan et al., 2022). This was triggered by previous studies showing the positive effects of supplement intake in COVID-19 patients. Safe, effective, and early interventions are needed to prevent and reduce severity in the event of exposure to COVID-19, one of which is taking supplements (Feng et al., 2021).

**Physical Activity**

Physical activity refers to any body movement involving energy expenditure. Physical activity over the past 7 days was assessed using the *International Physical Activity Short Form* (IPAQ-SF) instrument.

**Table 5.** Differences in physical activity in COVID-19 survivors and non-survivors

Variables	Survivors	Non-Survivors	P-value
	Median ( Min- Max)	Median ( Min-M aks)	
Total Physical Activity (MET/week)	2132,5 (113-12450)	1414,5 (0-20325)	0,639
Vigorous physical activity (MET/week)	960 (0-7680)	480 (0-16800)	0,841
Moderate physical activity (MET/week)	280 (0-3360)	390 (0-9600)	0,246
Walking activity (MET/week)	346,5 (0-6930)	396 (0-4158)	0,371
Activity sedentary (hours/day)	6 (2-17)	5 (1-12)	0,035*

Min = minimum value; Max = maximum value; \*Significant ( $p < 0,05$ ; Mann-Whitney test)

Based on the results in Table 4, physical activity shows no significant difference, where The majority of both groups were in the moderate physical activity category. COVID-19 survivors with moderate to severe symptoms, the majority experience physical and psychological problems as a result of the severity of symptoms, coupled with community

stigma related to the pandemic and contagious infections (Singh et al., 2020). It is challenging for COVID-19 survivors to recover physically and psychologically, and one of the easiest ways is to engage in physical activity (Kurniawan & Susilo, 2021). Based on interviews conducted with COVID-19 survivors who were over 40 years old and had comorbidities, they

complained that after being exposed to COVID-19, they were easily tired, limiting their engagement in strenuous physical activity.

The components of physical activity, namely, heavy activity, moderate activity, and walking, showed no significant differences. Research in Italy has shown that there is an increase in physical activity in the community as a form of maintaining immunity during a pandemic (Di Renzo et al., 2020). However, at the present time or after the third wave of COVID-19, people are starting to run as usual without physical activity.

Restrictions. This could be one of the reasons why there was no difference in physical activity between COVID-19 survivors and non-survivors.

The sedentary activity component includes sitting to work, relaxing, or lying down but not sleeping. The majority of the COVID-19

survivor group had the type of student occupation (n=27), which included sedentary activities such as online lectures and assignments. In addition, the majority of activities to complete free time are sitting, triggering an increase in sedentary activities. These results are in line with previous research showing an increase in sedentary activities of more than eight hours per day in university students (Short et al., 2021). Interviews with COVID-19 survivors showed that the majority of participants tried to engage in physical activity, especially sports, because they realized that this was a way to maintain health. However, work demands require considerable time for sedentary activities. This shows that COVID-19 survivors do not have more motivation to do more physical activity after being exposed to COVID-19.

### Relationship between variables

**Table 6.** Associations of education level, income level, food security, and comorbidities with diet quality and physical activity

Variables	Survivors				Non-Survivors			
	DQ		PA		DQ		PA	
	r	p	r	p	r	p	r	p
Age	0,153	0,289	-0,023	0,874	0,130	0,367	0,079	0,586
Education level	0,181	0,210	-0,161	0,264	0,022	0,879	0,065	0,653
Income level	0,288*	0,043*	0,035	0,810	0,129	0,373	0,167	0,245
Food security	-0,021	0,886	-	-	-0,026	0,856	-	-

DQ = diet quality; FA = physical activity; \*Significant ( $p < 0,05$ ; Spearman's correlation test)

Table 6 shows the association between age, education level, income level, food security, diet quality, and physical activity. The food security variable was not associated with physical activity because it was not an influential factor. Based on *Spearman's* test, income level was associated with diet quality of COVID-19 survivors ( $p=0043$ ). Education level and food security were not associated with diet quality in either the COVID-19 survivors or non-survivors. Age, educational level, and income level were not associated with physical activity in either group.

*Spearman's* analysis was conducted to determine the association of confounding variables with diet quality and physical activity. Age, education level, income level, and food security were associated with diet quality in both survivors and non-survivors. Income level

was significantly associated with diet quality among COVID-19 survivors ( $p=0,043$ ). Survivors may be motivated to choose healthier foods to maintain immunity. Studies in the UK suggest that after the pandemic, people will continue to cook healthy food (Filimonau et al., 2021). Low income can limit a person's choice of food above their means. Likewise, a high income allows a person to buy the desired food ingredients, although it is not necessarily expensive. This is in line with research on American residents with low income during the pandemic showing low diet quality, characterized by low consumption of vegetables, fruits, and whole grains, and high consumption of ultra-processed food (Wolfson et al., 2022).

Age, educational level, and food security were not associated with diet quality in either group. Age was not associated with diet quality,

indicating that early and late adult subjects do not affect the quality of their diet because they can access food according to their wishes. However, subjects over the age of 40 years stated that they began to pay attention to their diet as a form of maintaining health by reducing the consumption of fried foods because they began to consider cholesterol. Education level is not related to diet quality because during the pandemic, information about food ingredients that can increase immunity amid the COVID-19 pandemic is massively circulated. This is supported by previous studies that showed a weak relationship between nutritional knowledge and healthier eating preferences. (Kapellou et al., 2021). Food security during the COVID-19 pandemic showed that subjects in both groups were not food insecure. Studies in low- and middle-income countries show that the COVID-19 pandemic has reduced diet quality (Picchioni et al., 2021). However, in Semarang City, food access, availability, and diversity are readily available at affordable prices. Income level was not associated with diet quality among COVID-19 non-survivors. The average income of the group was ≤Rp. 1,500,000, still below the minimum wage of Semarang City (Rp.2.835,021), but food is a basic need, so it will still be purchased according to their ability.

Age, education level, and income level were correlated with physical activity in survivors and non-survivors, with all results showing no relationship. The age of the subject, which is categorized as early to late adulthood, shows that it does not affect a person's physical activity, but adults with complaints of severe COVID-19 often feel tired, which becomes a limitation in performing strenuous activities. Education and income level were not associated with physical activity in either group. Previous research shows that people with high levels of education and income can generate motivation to engage in physical activity because they have easy access to sports facilities (Di Renzo et al., 2020). However, this study did not obtain such results.

There are several limitations to this study, namely the *cross-sectional* study design; therefore, researchers cannot guarantee the accuracy of the causal relationship between variables. The age of the subjects in this study was not homogeneous because the survivor group tended to be under 30 years old, whereas

the non-survivor group was over 30 years old. The use of the SQ-FFQ and IPAQ-SF allows for respondent recall bias, which can cause under- or over-estimation. Recall bias can occur due to the distance between data collection and the time the subject suffered from COVID-19 ranging from to 1-6 months.

## Conclusion

The quality of diet in COVID-19 survivors and non-survivors shows that there are differences, with the majority of COVID-19 survivors having a higher quality of diet. There was no difference in the activity of the COVID-19 survivor and non-survivor groups; however, there were differences in sedentary activities between the two groups, where the COVID-19 survivor group was higher.

The advice given to the community is to pay attention to the quality of diet, including consumption of diverse foods, pay attention to fatty food intake, and performing physical activity in accordance with the recommendations of the Indonesian Ministry of Health (30 minutes per day or 150 minutes per week with moderate intensity) to maintain immunity. Suggestions for future research can examine variables that have not been studied in this study, such as the relationship between psychological conditions, nutrition and health knowledge, and food preferences after the COVID-19 pandemic, which may be factors that affect diet quality and physical activity.

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