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By Solikhah Solikhah

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Comparative study of health (metabolic biomarkers) between owner farmers and farm workers during the COVID-19 pandemic

Dwi Sarwani Sri Rejeki[1], Dwita Darmawati[2], Dyah Susanti[3], Muhammad Zaenuri Syamsu Hidayat[4], Solikhah Solikhah[5]

[1]Department of Public Health, Faculty of Health Sciences, Universitas Jenderal Soedirman, Purwokerto, Indonesia
[2]Department of Management, Faculty of Economic and Business, Universitas Jenderal Soedirman, Purwokerto, Indonesia
[3]Department of Agrotechnology, Faculty of Agriculture, Universitas Jenderal Soedirman, Purwokerto, Indonesia
[4]Department of Medicine, Faculty of Medicine, Universitas Jenderal Soedirman, Purwokerto, Indonesia
[5]Faculty of Public Health, Universitas Ahmad Dahlan, Yogyakarta, Indonesia

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ABSTRACT

Differences of land ownership statuses between farmers who grow their land and workers with a profit-sharing system will result in income disparities. The low income received due to reduced levels of rice productivity affects the health status of farmers. Therefore, this study compares the health status between farmers who are owners and workers during the COVID-19 pandemic. In April 2022, this cross-sectional study was carried out in Banyumas Regency, Central Java, Indonesia. Hb, fasting glucose, low density lipoprotein (LDL) cholesterol, high density lipoprotein (HDL) cholesterol, triglycerides, uric acid, blood pressure, and body mass index (BMI) were all assessed in a total of 100 farmers. Blood samples were taken at 3 cc using an ethylenediaminetetraacetic acid (EDTA) anticoagulant vacutainer tube and 5 cc using a plain vacutainer tube, then analyzed in PRODIA Laboratory. A validated tool was used to check blood pressure and BMI. Furthermore, 74% of the 100 farmers surveyed are farm owners, while 26% are workers. The results show that there is no difference in the health status of owners and workers on metabolic biomarkers including Hb, fasting glucose, LDL cholesterol, HDL cholesterol, triglycerides, uric acid, systolic/systole blood pressure, and BMI. In addition, a number of biomarker indicators, including Hb, fasting glucose, LDL cholesterol, triglycerides, and blood pressure, were found to surpass the threshold. Therefore, farmers need to maintain their health status by performing physical activity, consuming healthy food, and reducing their exposure to insecticides with personal protective equipment (PPE) to prevent metabolic diseases in the future.

Corresponding Author:

Dwi Sarwani Sri Rejeki
Department of Public Health, Faculty of Health Sciences, Universitas Jenderal Soedirman
Suparno Street, Karangwangkal, Purwokerto, Indonesia
Email: dwi.rejeki@unsoed.ac.id

1. INTRODUCTION

Coronavirus disease 19 (COVID-19) is a highly contagious and endemic viral infection that induces an acute respiratory syndrome caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which first appeared in Wuhan, China, and spread worldwide. This disease is transmitted through droplets and close contact [1]. WHO data until August 2021 reported more than 207.7 million cases with 4.37 million deaths [2]. In Indonesia, 3,892,478 positive cases, 120,013 deaths, and 3,414,109 recoveries were reported until August 17, 2021 [3].

The pandemic had a huge impact on the economy and business, education, trade, investment, tourism, as well as general and mental health. The poverty rate in Indonesia has increased, and one in 10 people currently live below the national poverty line. Furthermore, the impact on the agricultural sector cannot be underestimated, such as the disruption of farmers' production in all regions. Due to high fertilizer prices and uncertain selling prices of agricultural products in the long term, agriculture will become an unpromising sector for small scale farmers with very low economic value. The lifestyles of farmers, particularly those who cultivate food crops such as rice, are typically insufficient. Many of them in various areas work only as laborer with inadequate income. Instability in the prices of agricultural products, rising prices for agricultural materials, and health issues are difficult situations faced by farmers during this pandemic [4].

Several studies stated that farmers in various countries are exposed to COVID-19. A study in the United States reported that nearly 10% of them are exposed to this pandemic [5]. Furthermore, a study in Iran showed that the incidence of this virus in farmers was the second largest contributor [6]. According to Washington State research, more farmers exposed to COVID-19 worked indoors and resided in the neighborhood [7].

In Indonesia, as an agricultural country with more than 250 million people, the majority live in rural areas and depend on agriculture for their livelihood [8]. However, many farmers are currently working on other people's farmland [9]. During the pandemic, they are also an economically affected group with limited income to fulfil their daily needs. However, the International Labor Organization (ILO) data shows that one sector has a low risk of exposure since the proportion of workers affected was 29.6% [10].

Studies on farm workers show that prevention of COVID-19 transmission is still low, such as not washing hands with soap, rarely using disinfectants, and still holding eyes, mouth, and nose [11]. Furthermore, a study in Ireland stated that farmers had poor health status: a waist circumference of more than 94 cm, obesity, high cholesterol, and high blood pressure of 140 mmHg [12]. This condition is very vulnerable to being exposed to the pandemic. A study in Jember Regency, Indonesia, also stated that the health status of farmers is low, such as having a thin body, age >60 years, anemia, smoking, hypertension, high salt consumption, and stress [13]. Agriculture is a crucial support for food security during economic crises and pandemics. This is limited to survival and related to people's nutritional intake, which increases body immunity [14].

There are differences in land ownership status in several countries, namely farmers who cultivate their land and those working for other people with a profit-sharing system. These differences will certainly cause disparities in farmers' income. The low income received due to the reduced level of rice productivity affects the magnitude of the poverty rate. According to a prior study conducted in Indonesia, the difference in income between owner farmers and farm workers is quite close to the monthly wage obtained. Additionally, their health is also affected by this behavior [15]. A person's health status may also vary based on their land ownership status in relation to their income. This study aims to compare the health status of farmers who are owners with workers during the COVID-19 pandemic.

2. RESEARCH METHOD

This observational study used a cross-sectional design in which the endemic measurements were carried out simultaneously (point time). In this study, the population consisted of 100 farmers in the study area who matched the inclusion requirements, which included having at least two years of farming experience, fasting before blood tests, and signing an informed permission form. The exclusion criteria were farmers who had sick conditions; hence it was impossible to take and check blood. The variables used included age, gender, education, hemoglobin (Hb), fasting glucose, low density lipoprotein (LDL) cholesterol, high density lipoprotein (HDL) cholesterol, triglycerides, uric acid, blood pressure (systolic and diastolic), and body mass index (BMI). For respondents who agreed to the informed consent, blood samples were taken at 3 cc and 5 cc using an ethylenediaminetetraacetic acid (EDTA) anticoagulant vacutainer and plain vacutainer tubes in a comfortable sitting position. Medical analysts from the PRODIA laboratory carried out blood sampling. Systolic and diastolic blood pressure measurements were conducted using a digital sphygmomanometer. Meanwhile, the nutritional status examination was carried out using BMI by measuring weight and height with an 803 scale with an accuracy of 0.1 kg. Fasting glucose and Hb examinations were obtained using the hexokinase method [16] and portable hemoglobinometer sodium lauryl sulfate-hemoglobin (SLS-Hb) [17]. Direct LDL cholesterol was examined homogeneously, while HDL was analyzed using homogeneous enzymatic colorimetric analysis. The uric acid examination used uricase enzymatic colorimetric, while the fasting blood glucose used the hexokinase method with the ABX pentra-400(A) device. Meanwhile, the age grouping of farmers was categorized into <55 years and ≥55 years [18]. Nutritional status was grouped based on BMI, such as <18.5 for poor nutrition, 18.5–25 for normal, >25.1–27 for overweight, and >27 for obesity. Blood pressure was classified as hypertension above the normal limit of ≥140 mmHg for systolic and ≥90 mmHg for diastolic. Subsequently, data analysis was performed using SPSS version 20.0 software. Ethical approval was given from the ethics committee of the Faculty of Health Sciences, Jenderal Soedirman University No. 677/EC/KEPK/II/2022.

3. RESULTS AND DISCUSSION

The study was conducted in Banyumas Regency, Central Java, Indonesia, in April 2022. Banyumas is one of the regencies on Java Island, which has 27 sub-districts and monsoon climate with rainy and dry seasons of six months. The average rainfall is 1,755 mm per year [19], [20]. The characteristics of farmers are shown in the Table 1. Respondents are farmers who fulfil the criteria and are present at the health check. About 84% of the respondents are male, and the average age is 59.7 years. The majority of farmers are elderly, and some are even more than 80 years old. Furthermore, 72% have low education (no school, elementary school, junior high school) and come from four groups. Even though all farmers fast, 89% fasted for more than eight hours. Farmer status shows that 74% are owners, while 26% are workers, see Table 1. The results of health checks, metabolic biomarkers, on 100 farmers are shown in Table 2.

Table 1. Characteristic of farmer

Variable		n	%
Gender	Male	86	86.0
	Female	14	14.0
Age (year)	<55 years	33	33.0
	≥55 years	67	67.0
	Mean	59.7	59.7
	Min	34	34.0
	Max	84.3	84.3
Educational level	No school	7	7.0
	Elementary school	56	56.0
	Junior high school	9	9.0
	Senior high school	25	25.0
	Undergraduate	3	3.0
Fasting (hour)	<8 hours	11	11.0
	≥8 hours	89	89.0
Farmer status	Owner farmers	74	74.0
	Farm workers	26	26.0

Table 2. Distribution farmer health status

Variable		n	%
Hemoglobin	High	1	1.0
	Low	19	19.0
	Normal	80	80.0
Fasting glucose	High	31	31.0
	Low	0	0
	Normal	69	69.0
LDL cholesterol	High	81	81.0
	Low	0	0
	Normal	19	19.0
HDL cholesterol	High	0	0
	Low	15	15.0
	Normal	85	85.0
Triglyceride	High	25	25.0
	Low	0	0
	Normal	75	75.0
Uric acid	High	20	20.0
	Low	0	0
	Normal	80	80.0
Systole	≥140 mmHg	63	63.0
	<140 mmHg	37	37.0
Diastole	≥90 mmHg	46	46.0
	<90 mmHg	54	54.0
BMI [BW(Kg)/BH(m^2)]	Obesity	21	21
	Fat	10	10
	Thin	5	5
	Normal	64	64

The average Hb level of farmers is 14.1, where 19 people consisting of 19%, have a low Hb level of <13.2 for the adult male group. The average fasting glucose is 100.92 mg/Dl, with a range of 76.2–199.1, see Table 2. Furthermore, as many as 31% have a 100 mg/Dl fasting glucose level. The BMI shows that 65% have normal nutritional status, 31% are overweight and obese, and 5% have poor nutrition. The fasting duration is 2 to 20 hours and is dominated by more than eight hours. The grouping of farmers' health status is shown in the Table 3.

Table 3. Results of metabolic biomarker of farmers

Result	Min	Max	Mean	SD
Hemoglobin (g/dL)	6.9	17.5	14.1	1.48
Fasting glucose (mg/dL)	76.2	199.1	100.92	23.61
Cholesterol LDL	56.0	229.0	130.23	33.96
Cholesterol HDL	30.0	79.1	50.97	9.44
Triglyceride	52.5	546.1	124.43	67.15
Gout (mg/dL)	2.8	9.1	5.77	1.30
Systole (mmHg)	92	209	147.98	25.78
Diastole (mmHg)	49	137	89.09	13.06
Height (cm)	132	170.5	156.98	7.32
Weight (Kg)	42	83.2	57.74	9.63
Fasting (hour)	2	20	11.1	3.15

The health status of farmers during the pandemic in the study location shows that 80% have an average Hb level while 20% have low and high levels. As much as 69% have a fasting glucose level in normal conditions while 31% in elevated situations. Furthermore, 80% have normal uric acid, while 20% have high. As many as 64% of farmers have a normal BMI, while 31% are overweight and obese and 5% are thin, see Table 3. The results show that the median Hb level for men is higher than for women. In general, the characteristics of owner farmers and workers are almost the same: males dominate, have an elementary school education, and are more than 55 years old, as shown in Table 4. The statistical analysis stated that in all the results of metabolic biomarkers, namely Hb, fasting glucose, LDL cholesterol, HDL cholesterol, triglycerides, uric acid, systole, diastole, and BMI, there was no difference in average between the two groups of farmers. However, several metabolic biomarker parameters were still found that were not good/exceeded the threshold required see Table 5.

Table 4. Comparison of characteristics between owner farmers and farm workers

Variable		Owner farmers		Farm workers	
		n	%	n	%
Gender	Male	62	83.8	24	92.3
	Female	12	16.2	2	7.7
Educational level	No school	3	4.1	4	15.4
	Elementary school	43	58.1	13	50.0
	Junior high school	7	9.5	2	7.7
	Senior high school	18	24.3	7	26.9
	Undergraduate	3	4.1	0	0
Age (year)	<55 years	29	39.2	4	15.4
	≥55 years	45	60.8	22	84.6

Table 5. Comparison of the health status (biomarker metabolic) between owner farmers and farm workers

Variable	Owner farmers (74)			Farm workers (26)			p
	Mean	Min	Max	Mean	Min	Max	
Hemoglobin	14.1	11.1	17.5	14.2	6.9	15.9	0.915
Fasting glucose	100.5	76.2	199.1	102.1	77.6	167.7	0.623
Cholesterol LDL	132.0	56.0	229.0	125.2	66.0	210.0	0.645
Cholesterol HDL	51.9	34.7	79.1	48.2	30.0	65.0	0.541
Triglyceride	118.0	52.5	400.4	142.7	67.8	546.1	0.642
Uric acid	5.6	2.8	9.1	6.1	3.3	9.1	0.113
Systole	146.4	92.0	209.0	152.6	120.0	198.0	0.317
Diastole	90.0	68.0	137.0	86.4	49.0	122.0	0.642
BMI	23.5	18.0	31.2	23.3	16.7	30.8	0.844

The results showed that during the COVID-19 pandemic, the health status between owners and farm workers was the same and generally in poor condition. The same average shows this in some indicators such as Hb level, fasting glucose, LDL cholesterol, HDL cholesterol, triglycerides, uric acid, systolic/diastolic blood pressure, and BMI, hence there is no difference. The general condition showed some unfavorable health status. The Hb level was still 19%, with low Hb included in the anemia. A study in Senegal showed more anemia in farmers living in rural areas associated with the risk of being exposed to helminth parasites [21]. Other studies mention that the main cause is iron deficiency related to poor diet, folate deficiency, lack of vitamin B12 and A, malaria parasite infection and helminthiasis [22]. A study on vegetable farmers in Indonesia showed that anemia was 40.9% caused by the incompliance of wearing personal protective equipment [23]. The level of knowledge and understanding of the impact of pesticides is not fully understood. In addition, not wearing proper safety gear while working in the fields might negatively influence health. Farmers may be exposed to

pesticides through their respiratory system or skin-to-skin contact during spraying. Organophosphate and carbamate pesticide poisoning can cause anemia. The finding in this study showed that most farmers have low education, resulting in a lack of understanding to maintain health, especially in agriculture.

There was no difference in fasting glucose between owner farmers and farm workers. Meanwhile, 31% of farmers still had high blood sugar levels, indicating diabetes mellitus. A study shows a relationship between pesticide exposure, especially diabetes mellitus. Organophosphate and organochlorine insecticides can increase the risk by interfering with gluconeogenesis and glycogenolysis mechanisms, leading to insulin resistance through oxidative stress and pro-inflammatory effects [24]. Another study in Uganda did not support the association between exposure to organophosphate and carbamate insecticides and high blood glucose expressed as HbA1C and fasting plasma glucose (FPG) [25]. A survey in Brebes, Center Java, Indonesia, on shallot farmers showed that 13.6% were poisoned with cholinesterase levels <5,320 U/L, influenced by smoking habits when spraying [26].

Furthermore, 20% of farmers had high uric acid levels, indicating hip and leg complaints. A study in China showed that high uric acid increased the risk of knee osteoarthritis which was characterized by the detection of osteophytes in female subjects over 40 years old [27]. The results stated that farmers who consumed foods high in purines had higher uric acid levels [28]. The increase in purine synthesis in the body will accumulate crystals in uric acid in the joint space. High consumption of foods with this compound increases uric acid in the blood. Examples of high-purine foods include offal and coconut milk.

The average LDL level of farmers was 130.23, and 81.0% of farmers had LDL levels that were higher than usual. Compared to sharecroppers, the average LDL level of owner farmers was higher. The average HDL level of farmers was 50.97, and 15% of farmers had HDL values below the normal range. The average HDL level of owner farmers was higher than that of sharecroppers. LDL cholesterol is bad for the body and one of the main causes of atheroma formation. Atheroma is a trigger for heart disease, also known as atherosclerosis or hardening of the arteries. Furthermore, it is a fatty plaque that builds up on the walls of the arteries. The results showed that 81% of farmers had high LDL cholesterol due to unhealthy eating patterns, smoking habits, overweight and stress. A study in Japan stated that men with low education consumed more food with high cholesterol, which was associated with high concentrations of LDL cholesterol [29]. A study on farmers in Thailand stated that the use of herbicides and insecticides when spraying was associated with an increase in systolic and diastolic blood pressure, a decrease in BMI, as well as an increase in LDL and HDL cholesterol levels. These could impact the occurrence of metabolic diseases [30]. Conversely, farmers in America had low total and LDL cholesterol [31]. High blood pressure, LDL cholesterol, and BMI are at risk for heart and blood vessel disease.

The average triglycerides level of farmers was 124.43, and 25.0% of farmers had higher-than-normal triglyceride levels. The average triglyceride level of landowners is higher than that of tenant farmers. Triglycerides are a type of fat in the bloodstream produced by converting unused calories, which are stored as energy reserves. People who consume too many calories with low physical activity will have high triglyceride levels as an energy reserve. In this study, 25% of farmers had high triglycerides. This result is comparable to the number of farmers with a BMI of fat/obese, which is 31%. Obesity is related to the habit of consuming high sugar and carbohydrate foods. The results showed that farmers often consumed rice, noodles, bread, and sweet foods and rarely exercised. Farmers exposed to insecticides experienced increased triglyceride levels by 20% [32]. Lack of physical activity and unhealthy eating patterns lead to a buildup of triglycerides. High triglycerides contribute to the hardening of the arteries or the thickening of the walls, increasing the risk of stroke, heart attack, and heart disease [33].

In addition, 63% of farmers have a systolic blood pressure of more than 140. High blood pressure strongly relates to cardiovascular disease [34] and increased systolic blood pressure is associated with myocardial infarction [35]. A comparative study showed that conventional farmers had higher systolic and diastolic blood pressure related to smoking more and using pesticides [30]. The incidence of hypertension in farmers in Vietnam is 56.4%, associated with age and education [36].

Overweight known as obese people are at high risk for heart disease, diabetes mellitus, and hypertension even though they appear medically healthy. Obesity is related to past exposure to insecticides [37]. In adults, exposure to insecticidal fumigants is also associated with obesity [38]. Pesticides affect the gut microbiome in harvesting energy which can lead to obesity. Long-term exposure affects intestinal microbial homeostasis and induces inflammation, resulting in excess fat accumulation. Residents in rural areas with good nutritional status consumed more bread, sugary foods (such as candy), dairy items (such as cheese and yoghurt), processed meats (such as bacon), eggs (such as hard-boiled eggs), and fat/oil (such as butter) [37]. This pattern for attitude among participants had close to behavior among them. Both owners and workers farmer have poor behavior on physical activity, lack of healthy food, fat, fried meal, lack of fruit consumption and smoking, those are factors affecting their health indicator.

4. CONCLUSION

There was no difference in the health status of owners and workers on metabolic biomarkers. There are still several biomarker parameters that exceed the threshold, such as Hb, fasting glucose, LDL cholesterol, triglycerides, and blood pressure. Farmers need to maintain health conditions by doing physical activity, consuming healthy food, and reducing exposure to insecticides with PPE to prevent metabolic diseases in the future.

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BIOGRAPHIES OF AUTHORS

Dwi Sarwani Sri Rejeki is research and lecturer who works at Department of Public Health, Faculty Health Sciences at Jenderal Soedirman University. She attained her bachelor from Faculty of Public Health at Diponegoro University-Semarang. She did her master degree at Epidemiology, Diponegoro University-Semarang and graduated from PhD program at Gadjah Mada University Yogyakarta. Her research interests include epidemiological research in communicable diseases, spatial epidemiology and community empowerment in public health problems. She can be contacted at email: dwi.rejeki@unsoed.ac.id.

Dwita Darmawati she works in the Management department at Faculty of Economics and Business, Jenderal Soedirman University. She completed her undergraduate studies in the Management study program at Jenderal Soedirman University. She obtains her master of science degree in the Management Science program at Airlangga University and completed her doctoral program at Gadjah Mada University. Her areas of interest are organizational behavior and human resource management. Apart from being a lecturer, she is also a certified coach who provides coaching services to students and the community. She can be contacted at email: dwita.darmawati@unsoed.ac.id.

Dyah Susanti she works as researcher and lecturer at the Faculty of Agriculture, Jenderal Soedirman University who is engaged in plant breeding, especially rice breeding. She graduated from Bachelor of Plant Breeding at the Faculty of Agriculture (2001), Master of Plant Science (2003) and now pursuing a Doctoral degree in the Doctor of Agricultural Sciences study program at Jenderal Soedirman University. In 2007 she attended non-degree training "Gene Expression, from Gene to Protein" at the School of Life Sciences and Technology (SITH), ITB (2007) and at Biocoastal Research Center, Saga University, Japan (2008). Innovations and Intellectual Property Rights that have been produced include superior high protein rice varieties Inpago Unsoed Protani, Inpari Unsoed P20Tangguh, Unsoed PK 7 and Unsoed PK 15. Engage in assembling commercial superior rice varieties and developing integrated agriculture based on superior varieties. She can be contacted at email: dyah.susanti@unsoed.ac.id.

Mumammad Zaenuri Syamsu Hidayat he works as researcher and lecturer at the Faculty of Medicine, Jenderal Soedirman University who is engaged in Forensic and Biomedic. He graduated from Bachelor of Medicine at the Faculty of Medicine, Diponegoro University (1996), and Master of Medical Science, Faculty of Medicine, Diponegoro University (2007). Actively serving as a forensic specialist doctor and being the central board of the Indonesian Forensic Doctors Association. Concern for the health of farmers, the development of healthy agriculture and the improvement of public health and nutrition through Dokter Tani program. He can be contacted at email: muhammad.hidayat@unsoed.ac.id.

Solikhah Solikhah is an associate professor in an epidemiologist/statistician area and working on non-communicable and communicable disease in Faculty of Public Health, Univeristas Ahmad Dahlan. She is interested in exploring quality of life research. She can be contacted at email: solikhah@ikm.uad.ac.id.

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