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The effect of dietary antioxidant on lung function in pedicab during the COVID-19 pandemic

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Abstract

Rickshaw drivers have a high risk of respiratory disease, especially in the COVID-19 pandemic which is very risky to the respiratory system. The purpose was to determine the effect of antioxidant intake in food on the lung function of pedicab drivers in Surabaya. This study was a cross-sectional design, in May-July 2019. The variables of this study were lung function value and intake of foods containing antioxidants (vitamins A, C, and E). The research respondents were pedicab drivers in the Surabaya area. The method used a structured interview method, used the 24-hour recall method. The chi-square test was used to determine whether there was a difference between the value of lung function and the classification of intake of vitamins A, C, and E. The respondents of this study were 62 people with decreased lung function, and 62 people without decreased lung function. there were only 6 respondents who had vitamin A intake per day, while as many as 108 respondents had less level of vitamin A intake per day (87.10%). While the intake of vitamins C and E was still at a lower level in all respondents (100%). The average intake of vitamins A, D, and E on holidays was higher than on weekdays. Vitamin A intake has been shown to affect lung function. There was had significant relationship between dietary vitamin A intake and lung function in FEV1/FVC value. In addition, further research is needed to determine other dietary factors and other lifestyles to be able to maintain the quality of lung health for pedicab drivers.

1. Introduction

Surabaya is the second largest city in Indonesia. The increase in the volume of vehicles which is quite high every year not only causes a positive impact but also has a negative impact on the community, namely an increase in exhaust emissions produced by these motorized vehicles. The exhaust gas emissions produced are incomplete combustion residues and contain substances that are harmful to the human body (Surya *et al.*, 2020; Santoso *et al.*, 2020). Air pollution is one of the main factors causing respiratory diseases such as acute respiratory infections, asthma, bronchitis, lung cancer and chronic obstructive pulmonary disease (COPD) (Kim *et al.*, 2018). Air pollution can cause inflammation of the respiratory tract epithelium which cells will release cytokines (neutrophils, macrophages, lymphocytes, leukotrienes, interleukins) which can cause muscle weakness, weight loss, and normal endogenous antiprotease inhibition. Inflammation of the patient's airways can be amplified by chronic irritation from inhaled air and cigarette smoke (Chakraborti *et al.*, 2017). People who do daily activities on the highway have a higher risk of feeling the negative impact of air pollution, such as motorcyclists, especially people who work around highways (Carlsten *et al.*, 2020; Manisalidis *et al.*, 2020), like pedicab drivers.

Continuous exposure to air pollution due to the work of pedicab drivers causes a decrease in lung function. This is due to the high levels of free radicals from exposure that cause increased inflammatory reactions in the respiratory organs. Free radicals are reactive oxygen compounds which are compounds with unpaired electrons. The compound or atom tries to reach a stable state by attracting other electrons to form new radicals. Molecules that contain one or more unpaired electrons and thus impart reactivity to molecules are called free radicals (Petersen *et al.*, 2018; Di-Meo and Venditti, 2020). Neutrophils and macrophages that are inhaled and enter the lung tissue have an important role in the production process of reactive oxygen species (ROS), in addition to induced nitric oxide (NO). ROS are responsible for oxidative damage to cellular proteins,

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lipids, DNA and carbohydrates (Phaniendra *et al.*, 2015). Oxidative stress is a phenomenon caused by an imbalance between the production and accumulation of ROS in cells and tissues and the ability of a biological system to detoxify these reactive products (Pizzino *et al.*, 2017). Oxidative stress causes a variety of pathological conditions and diseases, including cancer, neurological disorders, atherosclerosis, hypertension, ischemia or perfusion, diabetes, acute respiratory distress syndrome, idiopathic pulmonary fibrosis, chronic obstructive pulmonary disease (COPD), and asthma (Thimmulappa *et al.*, 2019; Riou *et al.*, 2020).

Cigarette smoke is one of the risk factors that are quite influential in causing respiratory symptoms and impaired lung function (Gibbs *et al.*, 2016). Cigarette smoke is also one of the largest sources of exogenous free radicals (Goel *et al.*, 2018). Pedicab drivers tend to have a low economic level and smoking is a social habit that is often carried out by pedicab drivers who are very at risk of developing pulmonary function disorders (Lorensia, Suryadinata, Istiqomah *et al*., 2021).

Antioxidants or reducing agents function to prevent oxidation or neutralize compounds that have been oxidized, by donating hydrogen and or electrons which they can act as compounds that can delay, slow down and prevent cell damage (Tan *et al.*, 2018; Sharifi-Rad *et al.*, 2020). Antioxidants will neutralize free radicals which no longer have the ability to take electrons from cells and DNA (Phaniendra *et al.*, 2015; Liguori *et al.*, 2018). In addition to providing nutritional supplements such as vitamins, minerals, and antioxidants in patients with pulmonary function disorders, consuming foods that contain high antioxidants such as vegetables and fruits will benefit patients with acute and chronic respiratory disorders (Liu *et al.*, 2018; Dhalaria *et al.*, 2020). Antioxidants prevent oxidative processes, by impeding radical species generation. It has been proved that vitamin intake lowers oxidative stress markers, alleviates cytokine storm and has a potential role in reducing disease severity, by lowering pro-inflammatory cytokines, hampering hyperinflammation and organ failure. The lack of balance between the generation of reactive oxygen/nitrogen species and the organism's endogenous ability to counteract them is the source involved in the same pathologies that favor a critical outcome in COVID-19, and these include cardiovascular disease and diabetes mellitus type 2 (Pisoschi *et al.*, 2022).

Exposure to air and tobacco smoke increases the risk of COPD, where smoking is the most common cause of COPD. Patients with chronic lung disease have a higher prevalence of coronary ischemia and other factors that put them at higher risk for COVID-19-related complications. Several observational and case-control studies have confirmed a higher prevalence of cardiovascular disease in COPD patients than in the general population, possibly due to shared risk factors or associated pathogenic mechanisms. Despite major differences in studies evaluating the association between COPD and cardiovascular disease, COPD patients undoubtedly have a higher prevalence of coronary ischemia and other risk factors that may worsen the prognosis of COVID-19. Compared with non-COPD individuals, COPD patients with COVID-19 exhibit a much poorer disease prognosis, as evaluated by hospitalization and mortality. Patients with COPD and COVID-19 had more comorbidities than non-COPD patients. COPD patients with COVID-19 show higher rates of hospitalization and death, mainly related to pneumonia (Graziani *et al*., 2020).

A strong immune system can help increase the body's resistance, thereby reducing risk in the midst of the COVID-19 pandemic (Woods *et al*., 2020). Chronic lung diseases such as COPD and asthma are particularly at risk of developing serious conditions if infected with COVID-19 (Daccord *et al*., 2020; Wang *et al*., 2020; Leung *et al*., 2020). Chronic lung diseases (COPD, asthma, pulmonary fibrosis and lung cancer) are at high risk of developing serious conditions if infected with COVID-19. Patients with severe and/or uncontrolled asthma/COPD are at higher risk for more severe infections (Woods *et al*., 2020).

Pedicab drivers are also classified as low-income groups, which causes their daily food intake to sometimes be insufficient. Thus making daily protein intake also reduced, protein intake is very important in COPD. Where protein can improve the performance of respiratory muscles and improve immune function. There was a significant difference between daily food protein intake in the pedicab rickshaw driver group with pulmonary function (Lorensia, Suryadinata and Sidabutar, 2021).

This study aimed to determine the profile of the intake of antioxidant content in the food consumed daily by pedicab drivers around East Surabaya. The results of this study can later be used as a consideration in making educational programs. The intake of antioxidants in the diet can be measured by the 24-hour recall method. The 24-hour recall method is carried out to determine food consumption quantitatively by checking for several times or several days which it can provide an overview of the actual food consumed (Minich, 2019; Goni and Hernandez-Galiot, 2019). The 24-hour recall method was used because this method is quite easy to do, only provides a minimal burden on respondents, and only requires a relatively short time for one interview, which

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is 20-30 minutes (Wark *et al.*, 2018; Santoso *et al.*, 2020). Research conducted by Pratiwi *et al.* (2018). in analyzing the level of antioxidant intake in the form of vitamins C and E, these vitamins are also widely contained in foods and can affect lung function in smokers and non-smokers. There were differences in vitamin C and E intake, the lung function of smokers and non-smokers; and the influence of Vitamin C and E intake towards lung function. The purpose was to determine the effect of antioxidant intake in food on lung function in pedicab drivers in Surabaya. Lung function measurements can be done with a spirometer on the spirometry method and a peak flow meter. Spirometry was the most objective method and can be done repeatedly in measuring airflow limits. Spirometry measured the volume of air that is forcibly exhaled from the point of maximum inspiration (forced vital capacity, FVC), the volume of air exhaled during the first second (forced expiratory volume in one second, FEV1) and the FEV1/FVC ratio (Johns *et al*., 2014; Haynes, 2018; Global Initiated for Chronic Obstructive Lung Disease, 2021).

2. Materials and methods

2.1 Research design

This study was a cross-sectional design. This research material was in the form of information from respondents by means of direct question and answer (interviews) between the interviewer and the respondent. The time of data collection was in May-July 2019. The pedicab drivers were people who used energy to run public transportation such as non-motorized bicycles, which have three wheels, a lid (the lid can be opened), one saddle in the back, and a seat for passengers in the front. This study fulfilled the ethical test No. 011/KE/III/2018 from Universitas Surabaya.

2.2 Research variable

The variables of this study were lung function value and intake of foods containing antioxidants (vitamins A, C, and E). Measurement of lung function using the value of the FEV1/FVC ratio. If the FEV1/FVC value was <70%, it means there was impaired parietal function. On the other hand, if the FEV1/FVC ratio was >70%, it means that there was no lung function disorder. The lung function value in this study was if the FEV1/FVC ratio was <70% in the measurement of lung function by spirometry (Global Initiated for Chronic Obstructive Lung Disease, 2021). Food intake is the amount or amount of food, singly or in various types, consumed by a person or group of people with the aim of meeting physiological, psychological, and sociological needs. The intake of foods that contain antioxidants is the amount of food consumed by a person or group of people that contains a number of antioxidants. The way to measure antioxidant intake was the 24-hour recall method. Vitamin A, C, and E intake was the amount of vitamin A content from food sources of vitamin E consumed on average per day, expressed in mg units (Regulation of the Minister of Health of the Republic of Indonesia, 2013).

2.3 Population and research sample

The population were pedicab drivers in the Surabaya area. The desired sample to take part in this study was a pedicab driver in Surabaya who meets the following criteria: (1) Smoker, someone who has smoked at least a hundred cigarettes during his lifetime and who currently still smokes (Jamal *et al.*, 2018); (2) Male gender; (3) Age 18-60 years; (4) Minimum working period of 5 years; (5) there was no medical history that has been confirmed by a doctor; (6) Not doing a special diet; and (7) No disease affecting appetite or eating patterns (e.g. gastritis and toothache). The sampling technique used was purposive and consecutive sampling.

2.4 Data collection

The method used a structured interview method for a week. Data collection on antioxidant intake in food used the 24-hour recall method as an interview guide for measuring food consumption in the preparation of interview questions. The 24-hour recall method was used to determine the food and beverages consumed during the previous 24 hours, by checking for several times or several days and can provide an overview of the actual consumption of the respondents being examined. The 24-hour recall method was carried out three times but not consecutively, namely twice on weekdays and once on holidays.

The data collected in the form of household size were processed to obtain data in the form of calorie intake using the Nutrisurvey program. Measurement of antioxidant intake (1st, 2nd, and 3rd). Data collection of antioxidant intake in food was carried out using the 24-hour recall method as an interview guide for measuring food consumption in preparing interview questions. The 24-hour recall method was used to determine the food and drink consumed during the previous 24 hours, by examining it several times or several days and it can provide an overview of the actual consumption of the examined respondents. The 24-hour recall method was carried out three times but not consecutive times, namely two times on weekdays and one holiday because this scheme can describe the variability of calorie and nutrient intake. The first meeting was held on a weekday. The second meeting was held on the next working day

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with an interval of at least two days from the first meeting. The third meeting was held on Sundays or holidays which were at least two days apart from the second meeting. In the 24-hour recall method, questions were asked about all food and drinks consumed in the past 24 hours, including portion sizes with the help of a photo of household sizes, such as spoons, plates, cups, or other sizes commonly used daily as shown in the Food Photo Book (Regulation of the Minister of Health of the Republic of Indonesia, 2013), then the results were equalized to the average daily intake. The data collected in the form of household sizes would be processed to obtain data in the form of calorie intake using the program Nutrisurvey. Nutrisurvey is a powerful software for analyzing food nutrients from a menu or consumption survey.

The pulmonary function test of respondents using the spirometry method was carried out, where the respondents would later be divided into two groups, namely "without decreasing lung function disorders group" (FEV1/FVC≥70%) and "with decreasing lung function disorders group" (FEV1/FVC<70%). In this study, a validated handheld spirometer was used with the brand Contec Handheld SP10 Spirometer. When using a handheld spirometer, age, gender, weight and height were included. The assessment was carried out by a clinician who is an expert in measuring lung function with spirometry.

In the 24-hour recall method, everyone was asked about food and drinks consumed in the past 24 hours, including portion sizes with the help of a household size photo, such as spoons, plates, glasses, or other sizes commonly used daily as listed. in the Food Photo Book (Regulation of the Minister of Health of the Republic of Indonesia, 2014; Hotz and Abdelrahman, 2019), then the results were equated to the average daily intake. The data obtained in this study are primary data obtained directly from the research subjects through direct dialogue (interviews). The steps for collecting data using the 24-hour recall method were by asking respondents about what time they last consumed food or drinks at the time the recall was carried out. Then the respondents were asked about the food and drink consumed during the previous 24 hours starting from the time they last consumed food and drink at the time the recall was carried out. The Food Photo Book (Osadchiy *et al.*, 2020), was shown to respondents to ask about the portion of food and drink consumed.

2.5 Data analysis

The ordinal scale data was tested using the chi-square test and the ratio scale data with the Kolmogorov-Smirnov normality test which was then followed by an independent t-test to see differences in dietary vitamin A, C, and E intake from food in both groups. The chi-square test was said to be significantly different if the p-value was <0.05. The data were also tested with the Spearman test to see the relationship between dietary vitamin A, C, and E intake from food and lung function in a pedicab in Surabaya.

3. Results

3.1 Research implementation

In total, 112 pedicab drivers were asked for approval to conduct an interview process related to the disturbance of the food profile that has been consumed previously. However, only 101 pedicab drivers were analyzed because 2 pedicab drivers' data were incomplete as they left during the interview, 7 pedicab drivers did not want to be interviewed because their time did not want to be disturbed, 3 pedicab drivers did not meet the inclusion characteristics.

3.2 Characteristics of research respondents

Most of the respondents have an age range of 56-65 years (late elderly) as many as 109 respondents (87.90%). Most of the respondents' BMI was normal (71.29%) (Table 1).

3.3 Food intake contains vitamin A with 24-hour recall

In this study, food data was obtained through interviews using a 24-hour recall questionnaire. The results of vitamin A intake were grouped into adequate (>600 µg/day) and less (<600 µg/day) categories. The types of foods containing vitamin A that was consumed by the respondents the most per day were: chili sauce (26,240.40 µg), chicken liver (10,192.50 µg), fried eggs (5,522.20 µg), omelet (1,740.00 µg), and fried chicken meat (1,370.80 µg) (Table 2).

Table 1. Characteristics of respondents

Characteristics of Respondents		without decreasing lung function		with decreasing lung function	
		Frequency	Percentage (%)	Frequency	Percentage (%)
Age (years)	Early elderly (46-55 years)	3	8.33	10	16.12
	Late elderly (56-65 years)	57	91.93	52	83.87
BMI (kg/m^2)	Normal (18.50-22.90)	62	100	57	91.93
	Overweight (23.00-24.90)	0	0	5	8.06

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Table 2. Profile of types of foods containing vitamins A, C, and E

Food material	Average intake per day		
	Vitamin A (µg)	Vitamin C (mg)	Vitamin E (mg)
Chilli sauce	26,240.40*	0.00	472.80*
Chicken's liver	10,192.50*	0.00	20.70
Fried egg	5,522.20*	61.00*	0.00
Omelet	1,740.00*	20.00*	0.00
Fried chicken	1,370.80*	0.00.	0.00
Fried *tempe*	38.00	71.00*	0.00
Fried rice	415.00	41.50*	0.00
Vegetable *lodeh*	904.00	22.60*	146.80*
Stir-fried kale	1094.40	7.60	91.20*
Tamarind vegetable soup	544.00	13.60	88.50*
Fried bananas	48.00	8.00	48.00*

* the biggest 5 types of food ingredients

3.4 Food intake contains vitamin A with 24-hour recall

The results of vitamin C intake were grouped into adequate (>90 mg/day) and less (<90 m/day) categories. The types of foods that contain vitamin C that were most consumed by respondents per day include fried tempeh (71.00 mg), fried eggs (61.00 mg), fried rice (41.50 mg), vegetable *lodeh* (22.60 mg), and omelette (20.00 mg) (Table 2).

3.5 Food intake contains vitamin A with a 24-hour recall

The results of vitamin E intake were grouped into adequate (>15 mg/day) and less (<15 mg/day) categories. The types of foods that contain vitamin E that were consumed by respondents the most per day include chili sauce (472.80 mg), vegetable *lodeh* (146.80 mg), stir-fried *kangkung belu* (91.20 mg), tamarind vegetable (88.50 mg), and fried bananas (48.00 mg) (Table 2).

Based on Table 3 shows that there were only 6 respondents who had vitamin A intake per day, while as many as 108 respondents had less level of vitamin A intake per day (87.10%). While the intake of vitamins C and E was still at a lower level in all respondents (100%). The average intake of vitamins A, D, and E on holidays was higher than on weekdays.

3.6 Cross tabulation between lung function values and intake of vitamins A, C, and E

The results of the different tests of vitamin A intake in food showed that there was a significant difference between the intake of vitamin A between the groups with and without decreased lung function (P-value = 0.000). Meanwhile, the data on vitamin D and E intake in food could not be tested statistically because none of the respondents had adequate levels of intake (Table 4).

The non-parametric analysis used was Mann-Whitney because the distribution of data from the dietary vitamin A intake variable with P-value = 0.00 (<0.05), meaning that the data to be tested had a significant difference from the standard normal data, meaning that the data was not normal. The difference between dietary vitamin A intake without and with decreasing lung

Table 3. Profile of vitamins A, C, and E intake in respondents of pedicab drivers.

		Vitamin A		Vitamin C		Vitamin E	
Category:		Adequate	Less	Adequate	Less	Adequate	Less
Frequency:		16.00	108.00	0.00	124.00	0.00	124.00
Recall 1 (weekdays):	Average	1539.40	208.52	0.00	5.49	0.00	1.37
	Minimum	261.40	0.00	0.00	0.00	0.00	0.00
	Maximum	3404.30	864.90	0.00	25.10	0.00	4.50
Recall 2 (weekdays):	Average	933.63	213.13	0.00	5.33	0.00	1.72
	Minimum	29.60	0.00	0.00	0.00	0.00	0.00
	Maximum	3511.00	724.45	0.00	22.00	0.00	6.50
Recall 3 (holiday):	Average	1636.50	179.50	0.00	5.50	0.00	189.40
	Minimum	420.70	0.00	0.00	0.00	0.00	0.00
	Maximum	3843.50	902.00	0.00	26.30	0.00	7.40
Total:	Average	1236.53	210.83	0.00	5.41	0.00	1.54
	Minimum	600.30	0.00	0.00	0.00	0.00	0.00
	Maximum	1886.20	544.08	0.00	15.32	0.00	4.40

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Table 4. Cross tabulation between lung function values and intake of vitamins A, C, and E.

Antioxidant classification (Vitamin A, C, and E)		Number of Respondents (n = 124)		P-value*
		without decreasing lung function disorders group (n = 62)	with decreasing lung function disorders group (n = 62)	
Nutritional Adequacy Rate of Vitamin A	Adequate (>600 mcg/day)	10	6	0.000
	Less (<600 mcg/day)	52	56	
Nutritional Adequacy Rate of Vitamin C	Adequate (>90 mg/day)	0	0	-
	Less (<90 mg/day)	62	62	
Nutritional Adequacy Rate of Vitamin E	Adequate (>15 mg/day)	0	0	-
	Less (<15 mg/day)	62	62	

* P-value of the Chi-Square test was <0.05, which means that there was difference between without and with decreasing lung function disorder groups

function disorders group, the result was a Sig value of 0.001 (<0.05) which meant that there was a significant difference between dietary vitamin A intake without decreasing lung function disorders and with decreasing lung function disorders group.

Spearman's non-parametric correlation analysis was used because the dietary vitamin A intake and lung function were not normally distributed. The Correlation Coefficient value was 0.0176 which indicated that there was a strong correlation between dietary vitamin A intake and lung function in the without and with decreasing lung function disorders group. Value of Sig. showed a value of <0.05, which was 0.048 which indicated that there was a significant relationship between the value of dietary vitamin A intake and the value of FEV1/FVC in the without and with decreasing lung function disorders group.

4. Discussion

The 24-hour recall method used a retrospective research design, where respondents were interviewed about the food and beverages consumed during the previous day or 24 hours. Smokers were chosen to make it easier to find respondents because most smokers were people who worked as farmers/fishers/laborers (Liu *et al.*, 2015). Smoking can induce oxidative load by disrupting the balance of oxidants and antioxidants that can cause cell damage in the lungs. Oxidative stress caused by smoking can cause damage to the alveolar walls leading to airway enlargement, increased pro-inflammatory cytokines, apoptosis, and lung injury (Strzelak *et al.*, 2018). Smoking can also cause an accelerated decline in lung function due to the inflammatory process induced by cigarette smoke. Cigarette smoke can interfere with and inhibit the normal function of epithelial cells in the respiratory tract by various mechanisms, such as decreased levels of exhaled NO, increased proinflammatory cytokines, and inhibition of airway repair processes. Exposure to cigarette smoke can also activate an inflammatory cascade in the airway epithelium, producing a number of potent cytokines and chemokines, which can lead to damage to the lung epithelium, increased permeability, and recruitment of airway macrophages and neutrophils (Strzelak *et al.*, 2018; Hikichi *et al.*, 2019).

Nicotine acts on cholinergic nicotinic receptors in the brain and autonomic nerves. Nicotine binds to nicotinic receptors to open ion channels, leading to the influx of sodium and calcium, and causing increased release of various neurotransmitters, such as systemic catecholamines and dopamine, norepinephrine, serotonin, acetylcholine, glutamate, -aminobutyric acid, and other neurotransmitters in the central nervous system. The release of hormones such as dopamine, norepinephrine, serotonin, and -aminobutyric acid by the central nervous system affects the brain to suppress and increase metabolic rate. Nicotine has several potential effects on the regulation of food and energy expenditure in the central nervous system. Regulation of eating behavior and metabolic rate is carried out by the brain in the hypothalamus, which integrates peripheral signals of satiety and adiposity as well as motivational and emotional influences. Leptin released from adipose tissue is proportional to the amount of adipose and acts centrally to suppress food intake and increase metabolic rate. Nicotine can enhance the effects of leptin on the brain by increasing leptin binding or increasing the sensitivity of the flow transduction cascade (Yaribeygi *et al.*, 2017).

Data collection on intake of Vitamins A, C, and E was obtained using the 24-hour recall method. The difficulty of using the 24-hour recall method was that the respondent did not remember the food and drink consumed in the previous day or 24 hours, because the 24-hour recall method was very dependent on the respondent's memory. The 24-hour recall method was used to quantitatively determine the consumption of food and beverages. The 24-hour recall method was carried out twice and carried out on a day that represents a working day because if it was only done once, the data

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obtained was not representative enough to describe a person's eating habits or patterns (Gibson *et al.*, 2017). In each meeting, respondents were asked about the food and drinks consumed in the previous 24 hours or one day.

The 24-hour recall method had several advantages and limitations. The advantages of a 24-hour recall are that it can be done via telephone, has high precision, small burden on respondents, has a short implementation, and can be used for respondents who are illiterate. Meanwhile, the weakness was that it relies heavily on the respondent's memory and is prone to recall bias. In addition to the 24-hour recall, there was another method to analyze antioxidant intake, namely the Food Frequency Questionnaire (FFQ). The FFQ method was a food consumption survey method by asking the average consumption of a food in a period with a predetermined list. This method used a questionnaire that contained a list of foods, consumption frequency, and the size or portion of food consumed. The period of food consumed can vary from daily intake to within the past year. The FFQ method was easy to do in a large population and is not too burdensome for respondents, but this method cannot be used to observe variations in food consumption from time to time because it was only limited to a list of specified foods and this method also requires validation (Gibson *et al.*, 2017). The 24-hour recall method was used in this study because when compared with the FFQ, the 24-hour recall method can provide an overview of the variation in the respondent's antioxidant intake from time to time.

This study showed that most respondents have low levels of vitamin A intake, and all respondents have low intakes of vitamins C and E. The results of this study are similar to those of Pratiwi *et al.* (2018), which showed that active smokers had low intakes of vitamins C and E and differences in lung function conditions and vitamin C intake, but vitamin E intake did not show significant differences between groups of active smokers and non-smokers. There was an influence between the intake of vitamins C and E on lung function. Similar research by Lorensia, Suryadinata and Sidabutar (2021) showed that pedicab drivers do have an unhealthy diet, one of which was protein intake. Previous studies looked at the dietary protein intake profiles and showed that there was a significant difference between daily food protein intake in the pedicab rickshaw driver group with impaired and non-impaired pulmonary function (Lorensia, Suryadinata and Sidabutar, 2021). In addition to antioxidant intake, many other factors in this study need further investigation because they can affect lung function, such as other types of food, eg. omega-3 (Lorensia *et al.*, 2018; Lorensia *et al.*, 2020; Lorensia and Suryadinata, 2021), physical activity (Suryadinata *et al.*, 2020; Lorensia, Muntu, Suryadinata *et al.*, 2021), and genetics (Shrine *et al.*, 2019).

Measurement of antioxidant intake using the 24-hour recall method was very dependent on the respondent's memory, but other factors could affect the results of antioxidant intake obtained. This study had several limitations, namely the measurement of vitamin intake had not been able to describe the actual condition of the respondent's vitamin intake, to be able to see the vitamin intake correctly, it must take into account the types of additives used for cooking (such as type of oil), race, and origin of food. Suggestions for future research include (1) creating an educational program to increase knowledge about the importance of vitamin intake in food to prevent respiratory disorders; (2) weighing food and drink consumed in future research; (3) observing the food processes which can affect the vitamin content in food ingredients; and (4) conducting the research at different regions to support the results of this study due to genetic, environment and diet differences.

4. Conclusion

The profile of food intake containing antioxidants in the form of vitamins A, C, and E in pedicab drivers has not met the minimum amount of antioxidants needed in one day. Most of the respondents had less level of vitamin A intake per day. Vitamin A is effective in increasing lung function, but most of the respondents who experience decreased function have a low intake of vitamin A. While the intake of vitamins C and E was still at a lower level in all respondents. There was a significant difference between dietary vitamin A intake in without decreasing lung function disorders and with decreasing lung function disorders group and there was a significant relationship between dietary vitamin A intake and lung function in FEV1/FVC value.

Conflict of interest

The authors declare no conflict of interest.

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