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Determinant Factors of Obesity in Machinist PT Kereta Api Indonesia: Occupational Health Nursing Model (Integration of Health Promotion Model (HPM) and Triangle Epidemiology)

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ABSTRACT

Introduction *:Non-Communicable diseases (NCD) are the leading cause of death globally. Increased incidence of NCDs is one of them causes by obesity.* ***Objectives*** *: This study aims to determine the dominant factors that influence the occurrence of obesity in machinists DAOP 02 Bandung, West Java.* ***Method*** *: Design of this study using cross sectional design. Sampling with simple random sampling with a sample of 121 machinists .* ***Results*** *: Bivariate analysis using the chi-square indicates that unhealthy lifestyle factors (p = 0.012) and work stress (p = 0.015) are factors that affect the incidence of obesity machinists. Having analyzed using logistic regression, showed that unhealthy lifestyle is the most dominant factor against obesity (p = 0.029 and OR = 2.344). The influence is strengthened by work stress (p = 0.036; B = 0.820 and OR = 0.440).* ***Conclusion*** *: The findings of this study can be used as a reference in formulating health policies and provide nursing care workers, especially nursing community health workers. Further research can conduct research experiments to reduce the prevalence of obesity in workers.*

Introduction

Obesity is a global health problem that tends to increase and is associated with non-communicable diseases (NCDs). Data from the World Health Organization (WHO) in 2013 showed that as many as 36 million or 63% of deaths worldwide were caused by non-communicable diseases and 90% of the incidence occurred under the age of 60 years. The problem of obesity is thought to occur due to technological development, urbanisation, and modern lifestyles (WHO, 2011; Tchernof & Després, 2013). Modern lifestyles such as alcohol consumption, smoking habits, ex-smokers and alcohol drinkers, high consumption of fatty foods, low consumption of vegetables and fruits, stress, sedentary behaviour, lack of physical activity are at risk for obesity (Lourenço, Oliveira, & Lopes, 2012; Xu et al, 2007; Gasperin et al, 2014; S. Lee et al., 2008; Jia He et al., 2014; Drapeau et al., 2004, Brunner et al., 2007; Heinonen et al., 2013 and Besson et al., 2009; S. Lee et al., 2008). Other contributing factors to obesity include low education level, increasing age, female gender and demographic factors, socioeconomic status and income level (Lee et al., 2008; Gutiérrez-Fisac et al., 2012; Abolfotouh et al., 2008; Sousa et al., 2011; Xiao et al., 2013).

According to Riskesdas data from 2007 - 2013, the prevalence of NCDs in Indonesia increased on average by 1% in Diabetes mellitus (DM), hypertension by 5.8%, and stroke by 3.8%. The problem of obesity is an impact that further increases the risk of death from non-communicable diseases in the adult population (Kemenkes RI, 2011). Deaths from NCDs in the adult population occur at 63% (WHO, 2013). One part of the adult population that experiences these problems is the working adult population.

Research conducted on American workers from 1976-2008 showed that the prevalence of obesity increased threefold from 8.7% in 1976 to 27.4% in 2008 (Singh & Siahpush, 2011). The

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prevalence of obese workers in America is increasing, which between 1997-2002 was 31.7% of men and 31.0% of women (Caban et al, 2005). While the prevalence of machine operator workers in Michigan America showed a value of 45% of workers were obese (Duffy, Cohen, & Noonan, 2012), 39.3% of 84 police respondents in America were also obese (Clark, Ramey, & Grueskin, 2011), 16.1% of academic workers in Malaysia were also obese at 37% in men and 39% in women (Cheong et al., 2010), Bank workers in Austria were also obese at 67.4% in men and 68.7% in women. Countries in Asia, namely China, are 10.5% obese (Lee et al., 2008). While in Indonesia, one of the studies on obesity in workers was conducted by Christina and Sartika (2011) and found that the prevalence of obesity in oil and gas workers in Kalimantan was 49.5%.

Many factors influence the occurrence of obesity in workers. Several studies have concluded that the obesity problem is caused by several factors, one of which is socio-demographic factors. According to Cheong et al. (2010), socio-demographic factors including age, gender, and education and psychosocial factors of understanding of health status, weight perception, and weight control goals are conditions associated with the incidence of obesity in academic workers in Malaysia. Younger workers (30-39 years old) also have a greater prevalence of obesity due to modern lifestyles and irregular exercise and alcohol consumption (Wakabayashi, 2011). According to Duffy et al. (2012), younger age, non-smoking and low levels of physical activity are also factors associated with obesity in workers. According to Nishitani & Sakakibara (2006), work stress experienced by workers in Japan is also associated with obesity due to stress responses in the form of anxiety and tension.

The study also showed that workers' anxiety and tension are associated with workload factors that reflect high work needs and low work freedom, resulting in an increase in eating frequency in workers. Shift work and work stress will also influence unhealthy food consumption behaviour (Buss, 2012). Lifestyle changes in work such as the use of computers and mechanisation in the workplace (Cheong et al., 2010), as well as the work environment which includes diet, physical activity and behavioural control (Shimotsu et al., 2007), the availability of exercise equipment and facilities such as sports centres, jogging tracks, swimming pools and tennis courts (Ball et al., 2006; Duncan et al., 2005), sedentary activities such as sitting and computer work (Jans et al., 2007) are important factors that act as predictors of workers being more prone to obesity. However, there are still rare studies related to the problem of obesity in workers, especially in Indonesia.

Some of these factors have not been able to become the basis for solving health problems due to obesity. In addition to the health consequences, obesity can also affect worker productivity in the workplace. The increasing prevalence of obesity can have an impact on the emergence of various degenerative or non-communicable diseases that are often associated with an increase in metabolic syndrome, hypertension, coronary heart disease, type 2 DM and sexual dysfunction (Wang et al. 2005; Krishnan et al. 2007; Wildman et al. 2005; Abolfotouh et al., 2008; Lee et al., 2012; Du et al, 2013), impaired pulmonary function (Chen et al. 2007), dyslipidaemia (Misra and Shrivastava, 2013) and elevated blood cholesterol levels (Listiyana et al., 2013).

Obesity is related to occupational health because it is a risk factor for the incidence of injuries and early retirement in workers. Lin et al., 2013 stated that the results of a longitudinal research study he had conducted on workers in America that obesity increased the risk of occupational injuries by 25%. While prospective research studies in the Nordic and several European countries conducted by Robroek et al., (2013) state that the incidence of obesity is associated with a 50% high risk of retirement due to disability in workers.

According to (Brown, Adeoye, Jason, & Evans, 2013), obesity has an impact on the incidence of chronic fatigue syndrome in workers. Chronic fatigue syndrome is a complex complaint that involves all body systems. Usually fatigue is experienced for 6 months or more

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which is characterised by fatigue, sleep disturbances and health status, function and vitality that feels decreased. This study was conducted by (Brown et al., 2013) in Chicago USA on 28,673 random adult samples using data collection via mobile phones. From the results of the study, 29.4% of the study sample experienced chronic fatigue syndrome.

Workers, who represent 1/2 of the world's population, can have a significant impact on the adult population with NCD problems (ILO, 2013). The working population is also an at-risk population that is exposed to risk factors and poses a threat to health (Stanhope & Lancaste, 2014). According to the Centre of Disease and Control (CDC) (2014) workers in the transport sector are second only to truck drivers as the most at-risk occupation for obesity. One of the transport sectors in Indonesia that is also at risk of increasing obesity in Indonesia is the railway transport sector. In addition, obesity in railway workers can have an impact on fatigue, sleep problems, and less than optimal health conditions, function and vitality of life (Brown et al., 2013).

The condition of machinist workers with shift work, the absence of health policies related to obesity, nutritional sources that are not provided by the company, the lack of sports facilities and irregular eating patterns are problems that occur in current machinist workers at PT KAI DAOP 02 Bandung. Data on the proportion of machinists who experience obesity problems at PT KAI DAOP 02 Bandung is 36.6% of 139 people. This shows a high value so that it can have an impact on the safety and health hazards of individuals and the working population. Decreased health functions while working, such as fatigue, sleep problems, lack of concentration, especially the occurrence of non-communicable / degenerative disease problems such as hypertension, type 2 diabetes, stroke, cardiovascular disease and hypercholesterolemia.

These problems will also have a major impact on the environment around workers, for example a train accident that will have an impact on injuries and deaths from train passengers. One of the occupational health and safety policies at PT KAI is contained in the Occupational and Environmental Health and Safety (K3L) Program has begun to be implemented in line with the issuance of 12 Decrees / Instructions of the Board of Directors regarding K3L which is strengthened by the safety policy No. KP 501/IV/6/KA/2009 dated 27 April 2009 that all levels of PT employees (PT Kereta Api Indonesia, 2013). Kereta Api Indonesia must prioritise safety, health and the environment. From the description of the health programme policy that has been prepared by PT KAI, there is no policy related to worker health that is more specific, such as worker health efforts against non-communicable diseases that are at risk of occurring in railway workers, one of which is the incidence of obesity in railway machinist workers.

Community nurses, especially occupational health nurses (OHN), are one of the health professions in the workplace that have roles and responsibilities in providing holistic nursing care to individual workers, worker populations and workers' families. Even in America, occupational health nurses can work in pharmaceutical companies, banks, supermarkets, food processing plants, oil refineries, cosmetic and meat companies, construction sites, government and insurance agencies, telephone and automotive industries, hospitals, aircraft industries, clothing factories and all workplaces that require occupational health services (Rogers, 2003).

Occupational health nurses must be able to provide protection, prevention, and health promotion to workers (Allender, Rector, & Warner, 2014). The role is applied based on the concepts and frameworks of various disciplines (nursing, medicine, public health, social and behavioural sciences and management principles (Stanhope and Lancaster, 2012). The results of a preliminary study conducted by researchers in December, the role of occupational health nurses at PT KAI tends to do more curative efforts than preventive and promotive efforts. This is indicated by the high prevalence of obesity among train driver workers, which is 36.6%. Whereas health and safety risks to machinists become increasingly high in the population of obese train

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driver workers. This study was conducted to determine the most important factors associated with obesity among machinists of PT KAI DAOP 02 Bandung, West Java.

Methods

The research design uses descriptive multivariate analytics with a cross sectional approach, namely research that aims to describe or describe a situation in a community (exploratory study). The sample size in this study was obtained according to the logistic regression research formula, namely using the role of thumbs with the sampling technique, namely simple random sampling. The total sample of this study was 121 respondents. Inclusion criteria are PT Kereta Api DAOP 02 Bandung, West Java, has worked for at least 1 year, able to communicate well, and willing to be a respondent. While the exclusion criteria are those who are not willing to participate in research activities until completion.

The Lilienfeld and Lilienfeld Epidemiological Triangle Model (1980) is to identify health hazards and the physical and social environment in the workplace which are risk factors for obesity. While the Health Promotion Model (Pender, 2002) to identify personal and interpersonal factors of workers such as age, socioeconomic status, education level and family history in lifestyle behaviour, and use of health services associated with obesity in workers.

The instrument used is the Health-Promoting Lifestyle Profile II (HPLPII) variable instrument (Walker and Polerecky, 1996) which consists of 52 question items covering responsibility for health, physical activity, diet, spiritual development, interpersonal relationships, and stress management. It showed that the validity value of the instrument was r product moment = 0.793 - 0.872 or greater than r table with instrument reliability of 0.892. Nishitani and Sakakibara's (2006) 18-item job stress instrument consisting of physical and psychological responses, number of working hours (Luckhaupt et al., 2014), physical environment and social support at work (NIOSH Generic Job Questionnaire) consists of 22 items (10 physical environment items and 12 social support items). The NIOSH Generic Job Questionnaire instrument which shows the results of the reliability test conducted by Inoue et al., (2014) r obtained is r> 0.50 so that it is a valid and reliable instrument to be used in research and sedentary behaviour in the workplace (Choi et al., 2010) in the form of measuring physical activity and sedentary behaviour related to the proportion of sitting time in the workplace shows a correlation coefficient reliability value of r = 0.76 which means greater than r table = 0.50 . The instrument is valid and reliable after validity and reliability tests. For the dependent variable, obesity was categorised as BMI < 25 (not obese) and BMI > 25 (obese) (Ministry of Health, 2013).

Results

The results showed that the average machinist worker was 35.48 years old or early adulthood, with an average education level of high school graduates, and 3 workers had families with a history of obesity. All workers have an income (socioeconomic status) > UMR (Rp. 2,400,000). The lifestyle of respondents which includes physical activity, diet, spiritual development, interpersonal relationships and stress management obtained data that more than half, namely 61 respondents (51%) have an unhealthy lifestyle. all respondents work in work shifts with working time < 40 hours / week, and have sedentary behaviour (light activity and total sitting time > 4 hours / day) in the workplace which is at risk of 100%. More than half of the respondents experienced work stress at 57% with a physical work environment at risk at 51% and social support for respondents was poor at 32%. Almost half of the respondents, 41%, were obese.

PROFESIONAL HEALTH JOURNAL
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The results of bivariate analysis showed that unhealthy lifestyles (p = 0.012) and work stress (p = 0.015) were associated with obesity in machinists. The results of multivariate analysis are shown in the following table:

Table 1.1 Bivariate test results of multivariate candidate variable selection (N = 121)

No	Variable	P value
1	Age	0,457
2	Education level	0,561
3	Obesity record	0,776
4	Unhealthy lifestyles	0,012*
5	Work stress	0,015*
6	Work environment	0,508
7	Social support	0,853

Note : * move forward to next model

The results of the bivariate test, obtained variables that can enter the next modelling or p value <0, 25 are lifestyle variables (p value 0.012) and work stress levels (p value 0.015). The final results of the multivariate logistic regression test modelling are shown in the following table:

Table 1.2 Multivariate logistic regression results (N = 121)

No	Variable	B	Wald	P Value	OR	95% CI
1	Unhealthy lifestyles	0,852	4,791	0,029	2,344	1,093-5,027
2	Work stress	0,820	4,387	0,036	0,440	0,204-0,949
	Constant	-0,397	0,353			

The model generated from the multivariate test results is as follows:

$Z=\alpha+\beta 1\ X1+\beta 2\ X2+\ldots+\beta i\ Xi$

$\text{Obesity} = -0.397 + 0.852_{\text{unhealthy lifestyle}} - 0.820_{\text{work stress}}$

According to the model, it can be concluded that unhealthy lifestyles in respondents will have a 2.34 times greater chance of being obese after controlling for work stress (95% CI: 1.093 - 5.027). Meanwhile, respondents who experience work stress will have a 0.44 times greater chance of being obese than respondents who do not experience work stress after controlling for lifestyle (95% CI: 0.204 - 0.949).

Discussion

Overview of Obesity in Machinist Workers at PT KAI

The findings of this study showed that almost half of the machinists were obese with an average BMI value of 26-30 kg/m2. The standard value of obesity is in accordance with the IMT standard guidelines according to WHO, 2004 & Kemenkes RI in 2014 which states that IMT> 25 kg/m2 is included in obesity.

Similar research has also been conducted by (Bonauto et al., 2014) conducted on 37,626 workers showed that truck driver workers are the most at risk of obesity, which is 38.9%, transportation service workers by 37.9% and security services by 33.3%. So that these three professions are occupations with a higher risk of being associated with obesity than other occupations. This is in accordance with the findings of researchers through observations and interviews that the activity as a driver or machinist shows a high level of sedentary.

Age. The findings of this study show that most machinists are in the early adult age group (20-40 years old). The youngest age is 22 years old and the oldest is 54 years old. The average age of respondents who work as PT KAI machinists is 35.48 years. The findings of this study

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statistically showed no relationship between age and obesity, but the prevalence of obesity was higher among machinists with young adult age. Moreover, specific age brackets have been identified as critical in the context of occupational health. For instance, a study conducted in Brazil found that the prevalence of obesity was notably higher among industrial workers aged 30 and above, correlating with increased cardiometabolic risks and higher rates of absenteeism due to chronic pain (Xavier et al., 2022). This finding aligns with other studies that have documented a similar association between age and obesity, emphasizing that older workers face heightened risks of obesity-related health issues (Linaker et al., 2020). This suggests that middle-aged workers are particularly vulnerable to weight gain, potentially due to lifestyle factors associated with their work schedules, such as shift work, which has been shown to exacerbate obesity risks (Bayon et al., 2022).

Education level. The level of education in this study is categorised into 2, namely high school and university because it is in accordance with the existence of graduates of machinist workers at PT KAI. The results of the univariate analysis showed that most of the machinists were high school graduates, as many as 111 people with 45 people being obese. The results of other studies are also similar to the findings of this study, that there is no relationship between education level and obesity. a study in Malaysia reported no significant association between educational level and body fat percentage among healthcare workers, suggesting that other factors, such as occupational stress or lifestyle choices, may play a more substantial role in obesity prevalence within this group (Kit et al., 2020). However, this is not universally applicable, as some studies have indicated that even among educated workers, sedentary lifestyles and stress can contribute to obesity (Mohammad et al., 2019). For instance, a study conducted in Brazil found that female workers with only incomplete primary education exhibited a notably higher prevalence of obesity compared to their more educated counterparts, reinforcing the notion that lower education is a critical risk factor for obesity (Xavier et al., 2022). The high level of education that has been owned by machinists apparently shows that it is not a factor associated with obesity because there are other factors that are more influential on the incidence of obesity such as the length of working hours, less physical activity, sedentary work and the environment in the workplace.

Socioeconomic Status. The research findings show that all machinists have a socioeconomic status or income level that is more than the UMR of Bandung City in 2015, which is more than Rp. 2,400,000. The findings of this study are in accordance with the salary standards applied by PT KAI to machinist workers which show that in 1 month of work, the income earned by machinist workers is > UMR. Research has demonstrated that urban environments with limited access to recreational spaces and healthy food options contribute to higher obesity rates, particularly among lower SES groups (Adlakha et al., 2020; , Yoon & Kwon, 2014). The findings of this study are in accordance with research (Xiao et al, 2013) conducted on 16,013 respondents in Zhejiang Province, China in 2013. The results of the research findings indicate that machinists who earn> UMR or high socio-economic status, will have an impact on the ability of machinists in the consumption of technology use. This condition will trigger a lack of physical activity, so that the daily food intake needed by machinists is not balanced with the body's energy expenditure.

Genetic Factors. The findings of this study show that most machinists do not have a family history of obesity, namely 118 people. Only 2 out of 3 machinists have a family history of obesity. These genetic factors can manifest as a genetic risk score (GRS), which aggregates the effects of multiple genetic variants to assess an individual's susceptibility to obesity (Sokary, 2024; , Belsky et al., 2013). Research has shown that individuals with a higher GRS are more likely to experience weight gain, especially when exposed to an obesogenic environment characterized

PROFESIONAL HEALTH JOURNAL
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by poor dietary choices and low physical activity levels (Dashti et al., 2022; , Wang et al., 2017). This can be attributed to different activities or habits between respondents and family environments that may have obesity.

Lifestyle. The findings of this study indicate that more than half of the machinists have unhealthy lifestyle behaviours associated with obesity, namely 32 people. Shift workers, especially those on long or rotating shifts, demonstrate higher body mass index (BMI) levels compared to their day-working counterparts (Sun et al., 2017; Zahra & Chandra, 2021). The disruption of circadian rhythms and sociomoral patterns inherent in shift work can lead to behavioral changes that promote unhealthy eating and sedentary lifestyles (Ramin et al., 2014; Buchvold et al., 2015). This is compounded by the fact that many low-wage workers experience limited access to healthy food options and physical activity opportunities, further contributing to obesity prevalence in these populations (Strickland et al., 2015; Luckhaupt et al., 2014). Modern lifestyles, especially related to excessive use of technology, are also predicted to reduce physical activity, especially exercise. Changes in diet due to work such as the habit of not having breakfast due to working in the morning, high workload, support from a less harmonious work environment and irregular work patterns (in shifts) can also shape unhealthy lifestyle behaviours.

Long Working Hours. The findings of this study show that all machinists have working hours < 40 hours per week. Therefore, no bivariate test was conducted regarding the relationship between the variable number of working hours and obesity. The findings of this study indicate that more than half of machinists do not have obesity, one of which is due to the number of working hours < 40 hours / week. In accordance with research conducted by (Luckhaupt et al., 2014) that excessive working hours (> 40 hours per week) is one indicator that is closely related to the incidence of obesity in workers.

Shift Work. The findings of this study show that all machinists work with 3 irregular shift patterns. Therefore, no bivariate test was conducted on the relationship between shift work and obesity. The number of machinists who are obese despite working with shift work patterns is less than those who are not obese, which is a difference of 2%. The findings of this study contradict research conducted by (Armani et al,. 2013) which showed that shift workers have worse lifestyle behaviours, such as a higher tendency to smoke and drink alcohol. Another research showed that is shift work can lead to behavioral changes that promote unhealthy eating and sedentary lifestyles (Ramin et al., 2014; Buchvold et al., 2015)

Work Stress. According to (NIOSH, 1997), work stress can be defined as a dangerous condition of physical and emotional response that occurs when work conditions are not balanced with the abilities, resources and needs of workers. Work stress is also one of the psychosocial health hazards in the triangle epidemiology theory model according to Lilienfeld and Lilienfeld, (1980); AAOHN, (2013) which arises due to conditions that threaten psychosocial or social welfare in individuals and groups of workers. The findings of this study show that more than half of the workers are stressed and related to obesity, which is as many as 68 people. The results of the analysis showed that there was a relationship between work stress and obesity.

Research indicates that high levels of workplace stress can lead to unhealthy lifestyle choices, including poor dietary habits and reduced physical activity, which are critical contributors to weight gain and obesity (Garza et al., 2015). Additionally, specific occupational groups, such as bus drivers and shift workers, have been shown to have a higher prevalence of obesity due to the unique stressors associated with their jobs. For example, bus drivers with high stress levels were more likely to be overweight or obese, highlighting the direct impact of occupational stress on body mass index (BMI) (Mohsen & Hakim, 2019). This sedentary behavior, combined with stress-induced eating, creates a compounded risk for obesity (Lipińska-

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Ojrzanowska et al., 2021). The results showed that there was a relationship between work stress and obesity due to tension or anxiety at work that changed eating patterns and frequency increased, decreased physical activity, increased frequency of eating high-fat foods, and lack of sleep. The work stress will divert the stress by consuming soft and sweet foods and drinks and will be lazy to do physical activities or an unhealthy lifestyle.

Sedentary Behaviour in the Workplace. The findings of this study show that all driver workers behave sedentary at work, namely light physical activity at work and a length of sitting time of 6 hours during 1 work shift. Therefore, a bivariate test was not carried out on research related to the relationship between sedentary behaviour at work and obesity. Another study by (Cocker et al., 2014) on adult workers in Australia during 2013 also showed that workers who sat at work for 3.75 hours/day were at risk of experiencing an increase in BMI due to light work activities

Social Support for Workers. The findings of this study show that almost half of the machinist workers get good social support from family, colleagues and supervisors or companies and are obese, which is 33 people. The findings of this study are not much different from the research conducted by (Couto & Stephen, 2011) which aims to determine the continuation of social support with burnout and work violence as well as health problems. Individuals with obesity have consequences of negative experiences in their social life and interpersonal relationships with peers, family and partners. Most workers behave unhealthily (52.5%) such as rarely exercising, irregular diet, insufficient consumption of fruits and vegetables, consumption of fatty foods, so they are at risk of obesity. In addition, the work stress experienced by 51.6% of machinist workers shows that tension, boredom and boredom in working as a machinist worker are a description of work stress conditions. So that the role of community nurses, especially occupational health, is important to provide occupational health nursing care in accordance with the concept of the Health Promotion Model (HPM) capital theory and the epidemiology triangle as a promotive, preventive and rehabilitative effort and provide direct nursing care and provide suggestions and inputs to PT KAI to develop policies related to obesity in train mechanic workers.

Conclusion

1. The prevalence of obese railway machinist workers is 41%
2. Lifestyle factors and work stress are factors related to obesity in machinist workers
3. An unhealthy lifestyle has a 2,344 times chance of causing obesity in railway mechanic workers.

Ethics approval and consent to participate

This research has received ethical approval from FIK UI Number: KET-186/UN2.F12.D1.2.1/PPM.00.02/2015. This research was carried out by considering ethical aspects according to the National Commission on Health Research Ethics of the Ministry of Health of the Republic of Indonesia or KNEPK (2005) which said that all health research that includes human volunteers as research subjects must be based on three general ethical principles, namely respect for persons, beneficence, nonmaleficence, and justice. The principle of the right to self-determination in this study is applied in a way that respondents are given the freedom to choose to participate or refuse in the study. The researcher also explained in detail the research objectives, research procedures, and possible benefits as well as the confidentiality of the information.

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PROFESIONAL HEALTH JOURNAL
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