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THE RELATIONSHIP BETWEEN MOTOR VEHICLE EXHAUST GAS AND MENSTRUAL CYCLE IN WOMEN OF CHILDBEARING AGE AT THE VICTORY OF FAITH INDONESIA CHURCH BEKASI IN 2017

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ABSTRACT

This research was aimed to find out the relationship between motor vehicle exhaust gases towards the menstrual cycle in women of childbearing age and to understand the impact of motor vehicle exhaust gases on abnormalities of the menstrual cycle (oligomenorrhea, menorrhagia, and hypomenorrhea). The influence of emission factors (Mileage, travel time, road density, vehicles used, and the house's location) towards the abnormalities of the menstrual cycle (oligomenorrhea, menorrhagia, and hypomenorrhea). The research method was a correlational study design survey with a cross-sectional approach on the 100 samples that met the inclusion criteria. The result of the study was that descriptive characteristics of the sample of respondents are between 20 years old and 24 years old (33%), living in a family home (68%), students/college students (47%), age of menarche between 13 years-old and 16 years-old (54%), and the use of private motor vehicles (58%). As in univariate analysis research, there are samples with symptoms of abdominal pain on menstruation (81.1%), symptoms of emotional restlessness/anxiety (70.6%), oligomenorrhea (menstrual cycles > 35 days) (49%), long menstrual <3 days (59%), menstrual blood volume > five pads (52%), menstrual disorder happens between 1 until two times in a year (52%), symptoms of eye irritation and watery due to motor vehicle exhaust gas (50.4%), transport mileage 11-20 Km (30 %), transport travel time 61-90 minutes (44%), travel in the dense main road with the use of two types of vehicles (47%), the use of motorcycles as the type of vehicle (50.7%), and the location of a place to stay near the main road (55%). Then it is concluded that there is a significant relationship between motor vehicle exhaust gases toward the menstrual cycle in women of childbearing age in the Victorious Faith Church Indonesia Bekasi ($\alpha = 0.005$). There is a significant relationship between menstrual cycle abnormalities (oligomenorrhea, menorrhagia, and hypomenorrhea) with the value of the emission factor (Mileage, travel time, road density, vehicles used, and the location of the house).

KEYWORDS: Menstrual Cycle, Motor Vehicle Exhaust Gas Exposure, Emission Factor.

INTRODUCTION

In this modern era, everyone has various conveniences in technology, so it is highly demanded to be productive in their work and education. High industrial levels can cause sources of increased air pollution and heavy traffic, poorly maintained vehicle engines and gasoline fuels that also contribute to the problem of air pollution.[1] Air pollution can be grouped by using the parameters of the pollutant concentration and the duration of contact between the pollutant or pollutant with the environment. WHO stipulates four levels of pollution as follows, namely: First level pollution for pollution that does not cause harm to humans; The second level of pollution is pollution that begins to cause harm to humans, such as irritation of the senses; The third level of pollution is pollution that can react to body physiology and cause chronic disease, and the fourth level of pollution for pollution that has caused acute illness and death for humans as well as animals and plants.[2]

According to data from the Central Bureau of Statistics of DKI Jakarta Province, until 2013, the number of motorized vehicles has reached 16,072,869 units, this shows an indication of high road density considering the length of roads in DKI Jakarta, which is only 6,956,842.26 m and with a broad area of 48,502. 763.16 m2. With the increasing population in industrial cities due to urbanization and easy access to obtain and buy

motor vehicles, the growth of motorized vehicles has been high over the last five years, reaching 9.93 per cent per year.[3] In DKI Jakarta, the contribution of pollutants from motorized vehicles to the air is around 70%.

Combustion in a motor vehicle can occur if there is fuel, oxygen and the combustion process. However, these three methods do not guarantee complete combustion. Even in practice, the motor's combustion will never be perfect, so the exhaust gases from the combustion products always contain residual oxygen and fuel. Other exhaust gases include carbon monoxide (CO), carbon dioxide (CO2), sulfur oxides (SO2 and SO3), nitrogen oxides (NO and NO2), and other toxic substances that cause air pollution and are bad for health.

According to the Indonesian Ministry of Health, women of reproductive age or better known as women of childbearing age (WUS), are women who are still in their reproductive age, namely between the ages of 15-49 years, with status unmarried, married, or widowed.[4] At the reproductive age, the female reproductive organs are mature and functioning correctly because, somatically and physiologically, they have undergone various changes characterized by primary and secondary sex signs. What is meant by Primary Sex Signs are signs of changes that are directly related to sexual or reproductive organs.[5] Moreover, as a sign of the maturity of the reproductive organs in women is the arrival of menstruation. Whereas what is meant by secondary sex signs in women are changes in the body that occur at the beginning of puberty due to the ovarian estrogen influence.[6]

Menstruation is periodic and cyclic bleeding from the uterus, accompanied by the release (desquamation) of the endometrium. The menstrual cycle as a complex process that includes reproductive and endocrine.[7] The menstrual cycle into three parts: the Endometrial cycle, the Ovarian cycle, and the pituitary-hypothalamic cycle. Thus, the incidence of menstruation indirectly becomes one of the factors that can represent the state of hormonal physiology and the level of reproduction in women of childbearing age.

Data from the study stated a relationship between exposure to air pollution and a decrease in reproductive rates in women of childbearing age. The decline in reproductive rates includes fetal death, decreased pregnancy rates, miscarriage and infertility.[8] All the disorders that occur above are caused by changes in body physiology functions due to exposure to polluting substances from motor vehicle fumes such as NO, CO, and other pollutant chemicals in the brain as regulators of hormone function and damage to reproductive organs.[9;10]

From observational studies, women aged 15-45 years at the Victory Iman Church in Indonesia are women with a high level of work productivity. On average, they spend almost 12 hours doing activities outside the home for work or school. It requires them to transport from home to their destination using motorized vehicles to shorten their time and simplify their activities. It creates a population that is vulnerable to exposure to vehicle fumes. Therefore, researchers are interested in knowing the effect of exposure to motor vehicle fumes related to the menstrual cycle in women of childbearing age so that preventive efforts, namely preventing a decline in reproductive rates in women of childbearing age at the Victory Iman Church of Indonesia, will be easier to do. Based on the background of the problem, the problem that arises in this study is "Is there a relationship between exposure to motor vehicle exhaust gases and the menstrual cycle in women of childbearing age?" intending to know the relationship between exposure to motor vehicle exhaust gases and the menstrual cycle in women of childbearing age.

LITERATURE REVIEW

Menstruation is a sign of the maturity process of the reproductive organs. However, variations of the menstrual cycle and menstrual disturbances are common. Menstrual cycles vary from woman to woman, the normal cycle being at intervals of 21-35 days, with an average cycle length of 28 days.[11] The length of the menstrual cycle is the distance between the start date of the last menstrual period and the start of the next menstruation. The first day of bleeding is said to be the first day of the cycle.

The menstrual cycle consists of the ovarian and endometrial phases.[12,13] According to Cohen, the menstrual cycle is divided into five phases: the early follicular phase, the late follicular phase, the preovulatory and ovulatory phases, the early luteal phase, and the late luteal phase. The irregular menstrual cycle is a menstrual disorder that occurs outside the regular menstrual cycle interval, at 21-35 days. According to Berek, menstrual disorders included in the irregular menstrual cycle are oligomenorrhea, polymenorrhea, menorrhagia, metrorrhagia, menometrorrhagia, hypomenorrhea.[14]

As the menstrual process is a primary sign of puberty in women, the system that influences this process is derived from the reproductive organ system and requires the relationship between organ systems in the body, such as the nervous and endocrine systems.[15] The relationship between these organ systems can be explained through activities on the Hypothalamus-Pituitary-Ovarian axis. Nerve activity causes the release of GnRH (gonadotropin-releasing hormone) in a pulsatile manner, especially in the mediobasal hypothalamus in the arcuate nucleus. The hypothalamus secretes GnRH in a pulsatile fashion for several minutes, occurring every 1 to 3 hours. The pulsatile release of GnRH causes the pulsatile release of LH and FSH as well.[16]

The series of events will be initiated by the secretion of FSH and LH, which causes the production of estrogen and progesterone from the ovaries, ultimately affecting uterine physiology changes. Estrogen and progesterone also influence the production of specific GnRH as a feedback mechanism that regulates gonadotropic hormone levels.[17] Estrogen inhibits the hypothalamus and anterior pituitary via negative feedback. Against the hypothalamus, estrogen acts directly to inhibit GnRH secretion. As a result, the release of FSH and LH triggered by GnRH is suppressed. However, the main effect of this negative feedback on the anterior pituitary is to reduce the sensitivity of gonadotropin-producing cells, especially FSH-producing cells. Estrogen has a powerful effect on this negative feedback process. The presence of progesterone magnifies the inhibitory effect.

Through positive feedback, low estrogen levels in the early follicular phase inhibit LH secretion, but high estrogen levels at the peak of estrogen secretion in the late follicular phase stimulate LH secretion and cause an LH surge. High plasma estrogen concentrations during the ovulation phase act directly on the hypothalamus to increase the rate of GnRH secretion, thereby increasing LH and FSH secretion. These levels also act directly on the anterior pituitary to increase the sensitivity of LH-producing cells to GnRH. This effect is the cause of the much more significant spike in LH secretion than FSH secretion in midcycle.[18]

LH triggers the development of the corpus luteum and stimulates the corpus luteum to secrete steroid hormones, especially progesterone. High estrogen concentrations stimulate LH secretion, progesterone predominates in the luteal phase, strongly inhibiting FSH and LH secretion. This process of progesterone inhibition aims to inhibit the growth of new follicles so that the reproductive system can be prepared to support the newly released ovum. If fertilization does not occur, the corpus luteum will regress, which will eventually lead to a sharp decrease in steroid hormones, resulting in the disappearance of the inhibitory effects of the FSH and LH hormones so that the secretion of these two hormones increases. Under the influence of these two hormones, a new group of follicles undergoes a maturation process again.[18]

Air pollution is the presence of one or more contaminants in the atmospheric air outside, such as dust, foam, gas, fog, odours, smoke or steam in large quantities, with various properties or duration in the air.[19] So that it can cause certain disturbances of human life, plants or animals, or other objects, or for no apparent reason can already affect the sustainability of the life of organisms or objects. In general, the causes of air pollution are of two kinds, namely: 1) What occurs naturally, such as dust blown by the wind, dust due to volcanic eruptions, waste decomposition and others, 2) What occurs as a result of human actions, which comes from mobile sources (motor vehicles, aeroplanes) and immovable sources, namely industrial activities.

Air pollution standards are quality standards that are permitted through stipulations from the authorities either through laws or government regulations. Any release of materials or substances into the atmosphere does not necessarily have to be said to be an air pollutant. These materials or substances can be said to be air pollutants if they are of standard size, which is commonly known as "exceeding the threshold" set by institutions related to environmental health and environmental quality, namely the Ministry of Health, the Minister of the Environment and in general. The regional government is the local government.[3]

Based on the Decree of the State Minister of the Environment No. 45 of 1997 concerning the Air Pollutant Standard Index, the government stipulates the Air Pollutant Standard Index, which is a number that does not have a unit to describe the condition of ambient air quality at a specific location and time based on the impact on human health, aesthetic value and other living things.

Motor vehicles used today are the cause of pollution. Most motor vehicles convert fossils into mechanical energy, and 40% of fossil energy is converted into heat energy which ultimately heats the environment.[20] Exhaust gas (emissions) from motor vehicles is the primary source of air pollution in urban areas. Motor vehicle emissions are caused by driving behaviour and environmental conditions3. Pollution resulting from motor vehicle exhaust is exhaust gas and hydrocarbons caused by fuel evaporation. Based on the Decree of the Environment Minister No. 13 of 1995, the emission is defined as entering or including substances, energy, and other components into the ambient air.

Emissions produced by motorized vehicles can be divided into three categories, namely hot emission, start emission, and evaporation emission.[21] Hot emission is the emission generated during the vehicle operating under normal conditions; Start Emission is the emission released by the vehicle only when the vehicle starts to run; while Evaporation Emission can occur in various ways, for example, during refuelling, and daily temperature increase.

Motor vehicle emissions contain various chemical compounds. The fuel released by the engine with gasoline or diesel fuel contains exhaust gases that are not much different in composition. The types of air pollutant parameters are based on ambient air quality standards according to Government Regulation No. 41 of 1999. The basic formula for estimating emissions using emission factors is:

Emission (g) = emission factor (g/km) * Vehicle kilometers traveled (km). Moreover, consider the

distance between the residence and the road as one of the risks of increasing exposure to vehicle exhaust gases. The primary pollutants found in motor vehicle exhaust are carbon monoxide (CO), hydrocarbon compounds, nitrogen oxides (NOx) and sulfur oxides (SOx), and dust particulates, including lead (Pb).[22] Motor vehicle exhaust gas consists of several chemical elements and particles that can affect the state of the human body because of its role in the air as a pollutant. The impact of these elements on the menstrual cycle of women of childbearing age, namely:

NO & NO2: Nitrogen Oxide and Nitrogen Dioxide are among the main products of burning fossil fuels. It is easily inhaled by humans and affects the human body. NO plays a role in mediating physiological and pathological processes in the body, including vasodilation, neurotransmission, body defence, platelet aggregation, and iron metabolism. In addition, NO is involved in inflammation-related carcinogenesis because of its effects on DNA damage, cell cycles, and modification of cancer-related proteins.[23] NO, which rapidly turns into NO2 in the air, displays an association with the reproductive system on the incidence of decreased reproductive rates, miscarriage, infant mortality and genetics carcinogenic properties of this substance. Endogenous nitric oxide is produced by converting the amino acid L-arginine to L-citrulline by the enzyme NO-synthase (NOS). There are three types of NOS isoforms: NOS1 in nerves and NOS3 in the endothelium are Ca2+ dependent proteins and are constitutively produced, in contrast to NOS2, whose expression is inducible. iNOS produces NO, which plays an essential role in normal physiological processes−regulation of blood pressure through vasodilation, wound repair and immune mechanisms−and pathophysiology. Within the peripheral nervous system, NOS is associated with non-adrenergic non-cholinergic (NANC) neural pathways. Nitric Oxide produced by NOS3 in the endothelium will diffuse into the smooth muscle of blood vessels, activating the enzyme guanylate cyclase.

Along with an increase in cyclic GMP, there will be relaxation of vascular smooth muscle. So the result of an increase in Nitric Oxide will be vasodilation. In the study, there was an increase in NO levels in the menstrual phase, which was thought to release abnormal blood volume in menorrhagic women. CO (Carbon Monoxide) and Pb (Lead): Carbon Monoxide, which is a competitor of oxygen in binding haemoglobin in the blood in the presence of Zinc Protoporphyrin IX (ZnPP), which will inhibit heme oxygenase through binding at the active site. Excessive carboxyhemoglobin binding in the body of pregnant women is one of the leading causes of miscarriage.[24] Elevated blood lead levels can interfere with erythropoiesis by inhibiting protoporphyrin synthesis and impairing iron absorption, increasing the risk of anaemia. In lead poisoning, the most visible effect is on the heme formation pathway. Lead inhibits the enzymes -aminolevulinic acid dehydrase and ferrochelatase so that the enzyme -aminolevulinic acid dehydrase cannot convert porphobilinogen. As a result, iron cannot enter the protoporphyrin cycle. The heme precursor, erythrocyte protoporphyrin converted to zinc protoporphyrin, is increased, and heme formation decreases, causing severe anaemia. Human reproduction involves interactions between hormones and organs regulated by the hypothalamus. If the brain's performance is reduced because the amount of oxygen received is not optimal, it will affect the work of the hypothalamus.[25] Therefore, anaemia can directly affect the reproductive system in women.

SO2: There is no scientific basis that is strong enough to directly show the effect of SO2 exposure on the reproductive system. Many studies link the SO2 presence and are considered to have the potential to cause defects in the fetus. Research has shown a decrease in protein synthesis in the DNA of fetuses whose mothers are often exposed to SO2. The reproductive rate is measured by the number of stillbirths, premature babies, miscarriages, low birth weight babies, and congenital disabilities/defects.[26] In addition, SO2 is estimated to be one of the carcinogenic substances because the high rate of people living with uterine cancer has been suffered by several women of childbearing age frequently.

Hypothesis: a) H1: There is a relationship between exposure to motor vehicle exhaust gases and menstrual cycles in women of childbearing age at the Victory Iman Indonesia Church Bekasi; and b) H0: There is no relationship between exposure to motor vehicle exhaust gases and menstrual cycles in women of childbearing age at the Victory of Faith Church of Indonesia in Bekasi.

Research Method

This research uses a correlational study survey design with a cross-sectional approach. This approach is used to study the correlation between variables where the dependent and independent variables studied were carried out simultaneously.[38] This research was conducted at the Church of Victory Iman Indonesia, Jakasampurna, Bekasi Barat, Bekasi in January 2017. The population was taken from the total number of women of childbearing age at the Church of Victory Iman Indonesia (GKII). A sample of 100 people will be selected using purposive sampling, which is sampling based on specific considerations such as population characteristics or certain previously known characteristics. The data collected will be processed statistically using the Statistical Product and Service Solution (SPSS 23) program. Data analysis using cross-tabulation analysis (crosstab). Cross-tabulation analysis (crosstab) is used to display an analysis between nominal data variables. Provide an informed consent application form to women of childbearing age who want to be respondents. As proof of agreement, respondents are willing to participate in the research and protect the

rights of respondents for the smooth running of this research.

RESULT AND DISCUSSION

Research conducted at the Church of the Victory of Faith Indonesia Bekasi with a total sample of 100 WUS people showed descriptive results of the respondents' characteristics as follows:

Table 1: Characteristics of Respondents (n= 100).

Characteristics	Frequency (n)	%
Age		
1. 15 - 19 year	25	25%
2. 20 - 24 year	33	33%
3. 25 - 29 year	24	24%
4. 30 - 34 year	14	14%
5. 35 - 39 year	3	3%
6. 40 - 45 year	1	1%
Residence		
1. boarding house	23	23%
2. Apartment	9	9%
3. Family house	68	68%
Profession		
1. Students	47	47%
2. Civil servant	11	11%
3. Private employees	33	33%
4. Entrepreneur	7	7%
5. Housewife	2	2%
Menarche Age		
1. <10 year	2	2%
2. 10-12 year	36	36%
3. 13-16 year	54	54%
4. >16 year	8	8%
Transport Use		
1. Private transportation	58	58%
2. Public transportation	42	42%

Table 1 shows that out of 100 respondents, the most age group is 20-24 years old (33%). In the group of residence types, the family house group (68%). The group of types of work the most is the group of students (47%). In the menarche age group, two people (2%) aged <10 years, 36 people (36%) aged 10-12 years, 54 people (54%) aged 13-16 years, eight people (8%) aged >16 years at the time of menarche. In the group using the most vehicles is the group of private vehicle users (58%).

Univariate analysis in this study describes the frequency distribution of respondents' characteristics from symptoms obtained during menstruation, emotional symptoms during menstruation, type of vehicle, physical disturbances due to exposure to gas, length of the menstrual cycle (calculated from the time you get your period until the next menstruation), the period of getting your period in 1 menstrual cycle, and the number of pads needed. The frequency distribution of respondents based on physical and emotional disturbances experienced by respondents during menstruation is explained as follows:

Table 2: Physical and Emotional Disorders in Menstruation.

Obstruction	Frequency (n)	%
Physical		
1. Symptoms of abdominal pain	73	81.1%
2. Symptoms of Nausea Vomiting	6	6.7%
3. Symptoms of Breast Pain	47	52.2%
4. Symptoms of muscle pain	38	42.2%
Emotion		
1. Restless/anxious emotions	36	70.6%
2. Stressed emotions	24	47.1%

Based on Table 2, the group of physical symptoms during menstruation shows that out of 100 respondents, as many as 81.1% experienced symptoms of abdominal pain, 6.7% experienced symptoms of nausea and vomiting, 52.2% experienced symptoms of breast pain, and 42.2% experienced symptoms of muscle pain. The group of emotional symptoms during menstruation showed that out of 100 respondents, 70.6% experienced emotions of anxiety/anxiety, and 47.1% experienced emotional stress during menstruation.

The frequency distribution of respondents based on the menstrual cycle is divided into four parts, namely based on the distance between menstrual cycles, the length of menstruation in one menstrual cycle, the volume of blood released in one menstrual cycle, and menstrual disorders for a year (cycle changes, premenstrual syndrome) which is described as follows:

Table 3: Menstrual Cycle.

Menstrual Cycle	Frequency (n)	%
Distance between cycles		
1. < 21 days, Polymenorrhea	20	20%
2. 21 - 35 days, normal	31	31%
3. >35 days, Oligomenorrhea	49	49%
Menstruation duration		
1. <3 days, hypomenorrhea	59	59%
2. 3-7 days, normal	28	28%
3. >7 days, metrorrhagia	13	13%
Menstrual blood volume		
1. 1-2 sanitary napkins	17	17%
2. 3-4 sanitary napkins	31	31%
3. >4 pads	52	52%
Menstrual disorders in a year		
1. 1-2 times	43	43%
2. 3-4 times	15	15%
3. >4 times	5	5%
4. unknown	37	37%

From Table 3, it can be seen that the group with the most distance between menstrual cycles is the group >35 days (oligomenorrhea) (49%). In the group, the most prolonged period of menstruation was the group <3 days (59%). The group with the highest volume of menstrual blood was the group >4 sanitary napkins (52%). The group of menstrual disorders in a year the most is the group 1-2 times (52%).

The frequency distribution of respondents based on exposure to motor vehicle exhaust gases is divided into seven parts, namely based on the frequency of frequent exposure to motor vehicle exhaust gases, physical symptoms due to exhaust gases, distance travelled, travel time, road density, vehicles used and location of residence which is explained as follows:

Table 4: Exposure to Motor Vehicle Exhaust.

Motor Vehicle Exhaust Gas Exposure	Frequency (n)	%
Frequent exposure to motor vehicle exhaust gases		
1. disagree	7	7%
2. Doubt	26	26%
3. Agree	53	53%
4. totally agree	14	14%
Physical Symptoms due to exhaust gases from motor vehicles		
1. Mild Cough Disorder	44	34.1%
2. Shortness of breath	20	15.5%
3. Itchy and watery eye disorders	65	50.4%
Mileage		
1.<10 Km	26	26%
2. 11 - 20 Km	30	30%
3. 21 - 30 Km	19	19%
4. 31 - 40 Km	3	3%
5. > 40 Km	2	2%
Travelling time		
1. < 30 minute	8	8%
2. 31 - 60 minutes	12	12%
3. 61 - 90 minutes	44	44%
4. 91 - 120 minutes	25	25%
5. > 120 minutes	2	2%
Road density		
1. Not solid	16	16%
2. solid, 1 type of vehicle	20	20%
3. solid, two types of vehicles	47	47%
4. solid, >2 types of vehicles	17	17%
Vehicle used		
1. Motorcycle Vehicle	76	50.7%
2. Vehicle Car/ Bus AC / KRL	42	28.0%
3. Public Transport Vehicles/Non-AC Buses/Non-AC Trains	32	21.3%
Location of residence		
1. Near the highway	55	55%
2. Not near the highway	45	45%

From Table 4, it can be seen that in the Frequently exposed to motor vehicle exhaust gas, the most groups agreed with the group (53%). Most were sore and watery eyes in the group of physical symptoms due to exhaust gas from motor vehicles (50.4%). In the group, the most mileage is the group 11 - 20 Km (30%), and in the group, the highest travel time was in the group of 61 - 90 minutes (44%). The highest density group was the congested group in the road density group, with two types of vehicles (47%). The motorized vehicles that are often used the most are the group of motorcycles (50.7%). The group of locations where the highest number of people live near the highway (55%).

Bivariate analysis was carried out using the Pearson correlation analysis method to see whether there was a statistically significant relationship between Motor Vehicle Exhaust Gas Exposure and Menstrual Cycles in Women of Childbearing Age at the Victory Iman Church of Indonesia, which is explained as follows:

Table 5: Relationship between Motor Vehicle Exhaust Exposure and Menstrual Cycle.

Statistic test		Vehicle Smoke Exposure	Menstrual Cycle
Vehicle Smoke Exposure	Pearson Correlation	1	.602**
	Sig. (2-tailed)		.000
	N	100	99
Menstrual Cycle	Pearson Correlation	.602**	1
	Sig. (2-tailed)	.000	
	N	99	99
**. Correlation is significant at the 0.01 level (2-tailed).			

Based on Table 5, it is known that there is a correlation between Vehicle Smoke Exposure and the Menstrual Cycle with a correlation value of 0.602 > 0.5 and a significance value of 0.000 < 0.05, which means that there is a significant correlation.

The results of our study obtained 100 respondents who met the inclusion criteria in the Victory Church of the Indonesian Faith. In Table 1, the characteristics of the respondents are that the most age group is 20-24 years old (33%), the group with the most type of residence is the family house group (68%), the group with the highest type of work is the student group (47%). Then in the menarche age group, two people (2%) aged <10 years, 36 people (36%) aged 10-12 years, 54 people (54%) aged 13-16 years, eight people (8%) aged > 16 years old when experiencing menarche and the group using the most vehicles is the group of private vehicle users (58%).

It can be seen from Table 1, and there are 54 people (54%) of respondents aged 13-16 years when experience menarche (first menstruation) as a sign of puberty or reproductive system maturity, followed by age group 10-12 years. These results follow research conducted by Duarsa, who argues that women generally experience menarche at the age of teenagers, namely 13-17 years, while the age of 10-12 years is pre-adolescent age.[27]

It can be seen from Table 2 as many as 73 (73%) respondents felt abdominal pain before or at the beginning of menstruation. Abdominal pain (dysmenorrhea) as one of the resulting physical symptoms is closely related to a premenstrual syndrome which is often present due to hormonal changes in the endocrine system (FSH, LH, and Estrogen).[28] Abdominal pain is divided into three classes: mild, moderate, and severe dysmenorrhea.[29] Other physical symptoms also experienced by respondents were 52.2% experienced symptoms of breast pain, and 42.2% of respondents experienced symptoms of muscle pain. These results follow Sylvia Price in her book "Pathophysiology Clinical Concept of Disease", which discusses the presence of dysmenorrhea or abdominal pain felt by women just before experiencing the menstrual phase due to increased muscle work in the uterus and the presence of other premenstrual syndromes in women of childbearing age.

It can be seen from Table 2, the group of emotional symptoms during menstruation shows that out of 100 respondents, 70.6% experienced emotions of anxiety/anxiety, and 47.1% experienced emotional stress during menstruation. There is a relationship between changes in emotional states and stress levels before and during menstruation, especially in adolescents because the neuro-endocrine relationship in the bodies of women of childbearing age affects performance.[30] The brain is the amygdala, which regulates mood. In addition, the age factor affects stress levels during menstruation as most research respondents are teenagers and pre-teens who are considered to have a low level of stress management.

In Table 3, the largest group of distances between menstrual cycles is the group >35 days (oligomenorrhea) (49%). According to Ganong, the normal menstrual cycle is 21-35 days, with an average of 28 days between cycles.[4] In the research of Hsieh GY, Wang JD, Cheng TJ, et al. (2005), the menstrual cycle is abnormal, namely oligomenorrhea in women exposed to chemicals that are toxic to the body. A prolonged menstrual cycle may indicate a delayed ovulation phase, and a short cycle may indicate a short or anovulatory follicular phase.[31] One of the chemicals that allows oligomenorrhea to occur is the level of Carbon Monoxide, a competitor of oxygen in binding haemoglobin in the blood. Excessive carboxyhemoglobin binding will result in a lack of blood supply to the brain (anaemia). In addition to CO, elevated blood lead levels can interfere with erythropoiesis by inhibiting protoporphyrin synthesis and impairing iron absorption, increasing the risk of anaemia. In lead poisoning, the most visible effect is on the heme formation pathway. The heme precursor, erythrocyte protoporphyrin converted to zinc protoporphyrin, is increased, and heme formation decreases, leading to severe anaemia. Human reproduction involves the interaction between hormones and organs regulated by the hypothalamus. If the brain's performance is reduced because the amount of oxygen received is not optimal, it will affect the work of the hypothalamus. Therefore, anaemia can directly affect the reproductive system in women in inhibiting the production of hormones, especially estrogen.

In the group, the most extended period of menstruation was the group <3 days (59%). This result is a menstrual cycle disorder called hypomenorrhea because, according to Ganong, a woman's normal menstrual cycle is experienced in approximately 3-7 days.[4] In his book "Berek and Novak's gynaecology" this disorder can occur due to disturbances in the uterus, obstruction and improper doses of oral contraceptives. The group with the highest volume of menstrual blood was the group >4 sanitary napkins (52%). The majority of respondents use >4 sanitary napkins in one menstrual day or discharge menstrual blood volume that is more than 80ml. It is an abnormality of the normal menstrual cycle called menorrhagia, as mentioned by Pitkin.[32] According to Berek, this disorder can occur due to cervical cancer, endometrial polyps, excessive production of estrogen and endogenous, and administration of estrogen and endogenous.[14] In addition, Zervou, in his research "Nitric Oxide synthase expression and steroid regulation in the uterus of women with menorrhagia", stated the role of Nitric Oxide in expelling excess blood volume.[33] In the study of Ekpenyong CE, Davies K, Daniel N (2013), there was an incidence of menorrhagia (12.3%) in women who worked at gas stations.[34]

From Table 3, it can be seen that the group often exposed to motor vehicle exhaust gases, and the most agree is the agree to group (53%). These results indicate that respondents agree that their daily activities cause them to become individuals who are easily exposed to motor vehicle exhaust gases. It is in line with Zhongan, which explains the interrelationships of urban lifestyles, the population of urban areas, and the number of vehicles. The need for work productivity of urban communities affects using motorized vehicles, which produces exhaust gases resulting from incomplete combustion. Motor vehicles used today are the cause of pollution. Most motorized vehicles convert fossil fuels into mechanical energy, and 40% of fossil energy is converted into thermal energy, which heats the environment and is a 70% contributor to pollutants in urban areas.[34] Reutman S R, LeMasters G K, Knecht EA, et al. (2002) explained the association of LH on vehicle exhaust gas inhalation.[29]

Most were sore and watery eyes in the group of physical symptoms due to exhaust gas from motor vehicles (50.4%). Physical complaints occur due to exposure to motor vehicle exhaust gases which have a terrible impact on health. WHO stipulates four levels of pollution as follows, namely: First level pollution for pollution that does not cause harm to humans; The second level of pollution is pollution that begins to cause harm to humans, such as irritation of the senses; The third level of pollution is pollution that can react to body physiology and cause chronic disease, and the fourth level of pollution for pollution that has caused acute illness and death for humans as well as animals and plants.[1] According to Edward in the journal "Respiratory effect of differing air pollution levels", physical complaints that occur are due to the presence of substances and particulates in vehicle exhaust gases that are irritating to the body, such as dust particles (pm 2.5), SO, Pb, CO, and NO.

In the group, the most mileage is the group 11 - 20 Km (30%). It is in line with Zhongan's explanation of the interrelationships of urban lifestyles, the population of urban areas, and the number of vehicles. The longer the distance required for transportation, the higher the tendency of individuals to be exposed to particulate pollutants while driving. The need to travel long distances and advances in transportation technology encourages motorized vehicles in urban communities. It has also become one factor that makes people who ultimately use motorized vehicles en masse and produce many exhaust gases from combustion.

In the group, the highest travel time was 61 - 90 minutes (44%). According to Wardhana, in his book "The Impact of Environmental Pollution", the increasing average time consumption in urban communities is caused by an increase in urban vehicle density.[3] The increase in vehicles in DKI Jakarta itself increases by 9.93% per year, as stated by the DKI Jakarta Statistics Agency in the 2013 Land Transport Report.[2] In the research of Ekpenyong CE, Davies K, Daniel N (2013), they explained that there was a relationship between the amount of time exposure to pollutant gases and menstrual cycle abnormalities seen from the examination of levels of the hormones estradiol, progesterone, prolactin, FSH, and LH. Air pollution can be grouped by using the pollutant concentration parameters and the duration of contact between the pollutant or pollutant with the environment1. The highest density group was the congested group, with two types of vehicles (47%). The tendency of respondents' transportation behaviour is carried out on congested roads and where they need an average of 2 types of vehicles to reach their destination. It is one of the factors in increased exposure to motor vehicle exhaust gases for urban communities, as stated by Zhongan.[36] In addition to road density, other factors mentioned that affect exposure to motor vehicle exhaust gases, more commonly referred to as emission factors, are distance travelled, travel time, and the vehicle used.

The group of motorized vehicles that are often used the most is the group of motorcycles (50.7%). DKI Jakarta Statistics Agency in the "2013 Land Transport Report" regarding the mass use of motorcycles and their significant increase from year to year. The use of motorbikes is the most common type of transportation and is most in demand by the public because of its ease of use and ease of obtaining or buying compared to cars or other types of transportation. Motorcycles occupy the highest emission factor because of the high chance of exposure to vehicle exhaust gases due to no ventilation and filtering of vehicle exhaust gas exposure to the body, especially the respiratory tract. The emission value of motorcycles set by the Government in Indonesia is still low using the Emission3 standard. At the same time, on average developed countries with low pollution levels, such as the European Union and Russia, have better emission standards for motorized vehicles regulated in Emission5.

The group of residential locations had the highest number near the highway (55%). It can be one factor that affects the exposure of motor vehicle exhaust fumes, as stated by Pope on "Health Effects on fine particulate air pollution". The existence of houses near roads is typical in urban areas, and people tend to be interested in living near roads because of more accessible access to transportation. However, this is one of the risk factors for menstrual disorders, as happened to 53 mothers who live near the highway who experienced menorrhagia in the study.[29]

Based on the study results, there was a significant relationship between vehicle smoke exposure to the menstrual cycle with a correlation value of $0.602 > 0.5$ and a significance value of $0.000 < 0.05$. Research by Miguel A. C. et al. (2016) shows 368 studies regarding the relationship between vehicle gas exposure and the reproductive system. Of all these studies, the 15 most

qualified researchers got a reliability level above 95%. The results of the 15 studies mentioned a relationship between motor vehicle exhaust gases and the reproductive system.[9] Factors related to reproductive system abnormalities such as infertility, miscarriage, egg and sperm quality, and changes in the menstrual cycle illustrate the effect of vehicle exhaust gases on hormone regulation and reproductive system quality related to the respondent's emission factor value.

CONCLUSION

This research is a correlational study on 100 samples that meet the inclusion criteria, with the following conclusions: a) There is a significant relationship between exposure to motor vehicle exhaust gases and the menstrual cycle in women of childbearing age at the Victory Iman Indonesia Church Bekasi ($\alpha = 0.005$); and b) There is a significant relationship between menstrual disorders (oligomenorrhea, menorrhagia, and hypomenorrhea) with emission factor values (mileage, travel time, road density, vehicle used, and house location). Therefore, for fertile women, according to the hypothesis results and the conclusion that there is no relationship between exposure to motor vehicle exhaust gases and the menstrual cycle in women of childbearing age at the Church of the Victory of Faith in Indonesia. It is hoped that respondents will still need to reduce and prevent exposure to motor vehicle exhaust gases because of the risk of danger to the reproductive system.

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