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Factors Influencing Age at Menarche, a School-Based Cross-Sectional Study

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ABSTRACT The last few years have seen the increasingly young age of menarche in teenagers. The average age of the national menarche from year to year is declining. The more children experience early menarche, the greater the risk of negative implications such as lack of personal hygiene, breast cancer, and early pregnancy. Menarche's age is influenced by nutritional, economic, pornographic, and genetic status. The purpose of this study was to determine the factors that affect menarche in adolescents aged 10-12 years. The research conducted is descriptive-analytic with a cross-sectional design. The population of MIN 3 Magetan students aged 10-12 years who have menstruated and have met the inclusion and exclusion criteria. The study sample was 87 respondents with a purposive sampling technique. Data collection using questionnaires. Statistical calculations are carried out by statistical and descriptive analysis with binary logistic regression tests. The average age of menarche is 11 years with the youngest age being 9 years and the oldest at 12 years, most female students experience early menarche (65.5%). There is an effect of nutritional status on menarche (p =0.048, *Exp* (B)= 4.3), there is an economic influence on menarche (p=0.000, *Exp* (B)= 11.3), there is an influence of pornographic exposure on menarche (p=0.001, *Exp* (B)= 12.1), and there is no genetic or age influence maternal menarche against menarche (0.388). Nutritional status, economic status, and exposure to pornographic media increase the incidence of early menarche. The highest risk factors for exposure to pornography resulted in 12.1 times the incidence of early menarche, economic status by 11.3 times, and nutritional status by 4.2 times. Strict supervision of mass media access and maintaining nutritional intake are necessary to prevent early menarche.

INDEX TERMS Menarche, nutritional status, economy, pornography, genetics

I. INTRODUCTION

The first menstrual cycle in the adolescent's life is called menarche. It is a late event of puberty and an important indicator of sexual maturation. This milestone typically occurs within two to three years after puberty onset and is characterized by thelarche, which is represented by the development of the mammary bud [1]. A menarche is an event that symbolizes reproductive ability and represents a woman's transition from childhood to womanhood [2]. The time of menarche is the age when a young woman first experiences menstruation [3]. Girls experience menarche in different ages but usually it occurs between the ages of 10 and 16 years and the mean age at menarche varies significantly by geographical region, race, ethnicity, and other characteristics factors, especially nutritional factors [4]. However, from year to year menarche shifts to a younger age called early menarche, that is, less than 12 years. In Indonesia, the timing of age at menarche onset has significantly lowered during the 40 years before 2010. Age at menarche was changed from 14.43 years to 13.63 years. The predicted average age at menarche shows a decrease of 0.0245 years each year [5].

The occurrence of menarche earlier is due to genetic factors or the age of the maternal menarche, economic status, media exposure, nutritional status (BMI), maternal education, physical activity, and more sleeping hours [6] [7]. Nutritional status can affect sexual maturity. Nutritional status parameters, such as Body Mass Index by Age, have an important role in the incidence of menarche. The research conducted showed that adolescents with high nutritional status experienced menarche earlier.

Other factors affecting the onset of menstruation include the socio-economic environment, such as, for example, the social class. The economic status of the family affects the age of the menarche. Sufficient economic status indicates the ease of obtaining quality foodstuffs in the sense of being nutritious, such as protein and fat. A high ratio of the intake of proteins and fats can influence the speed of maturation of the reproductive organs which in women is characterized by the incidence of menarche [4].

Exposure to pornographic mass media can provide psychological stimulation to the activation of the hypothalamus to release hormones that result in sexual maturity. For example, movies, books, magazines, and social media that contain pornographic images, writings, and videos. It can cause sexual reactions and can be a trigger for menarche [8].

Menarche is also influenced by genetics. Genetic factors can influence the acceleration and slowdown of menarche i.e. the age of the mother's menarche can affect the age of her daughter's menarche. The study showed the existence of a relationship between genetic factors with menarche [9].

The average age of the first menarche has decreased and raises several health issues. These include eating disorders, depression, substance abuse, sexual exploitation, and teenage pregnancies. Early onset of menstruation in girls is also linked to increased risk of breast, ovarian and endometrial cancers, type 2 diabetes, metabolic syndrome, hypertension, and cardiovascular disease. The early onset of pubertal development is an important medical and social problem. From a physiological perspective and public health perspective, the age of menarche serves as an important clinical indicator of a girl's physical maturation, nutritional status, and reproductive health. From a social perspective, the onset of menstruation has traditionally served as a symbol of fertility, sexual readiness, and marriageability, depending on the local cultural context [10]. Among young adult women, age at menarche less than 12 years was associated with higher levels of metabolic cardiovascular risk factors. The mediation analysis showed that body composition measured by the fat mass index, BMI, and the waist-to-hip ratio at 30 years old, captured part of the effect of age at menarche on diastolic blood pressure and LDL-cholesterol [11].

This risk makes menarche an important factor in health planning programs related to Adolescent Reproductive Health, especially at the Elementary School level through School Health Enterprises. For this reason, education about menarche is needed. Knowledge about menarche needs to be possessed early since it can have an impact on readiness to face menarche. In addition to the provision of education, the role of parents is needed in controlling adolescent activities in media [12].

Based on a preliminary study on February 10, 2022, at MIN 3 Magetan, in 12 female students who had menarche, menarche age ranged from 9 to 12 years. Therefore, the researchers are the purpose of this study was to determine the factors that affect menarche in adolescents aged 10-12 years at MI Negeri 3 Magetan. The difference between this study and previous studies lies in measuring nutritional status based on age using the WHO AnthroPlus application. WHO AnthroPlus is a software of the WHO reference to monitor the growth of school-age children (5-19 years). In addition, as a differentiator from previous research, the data analysis technique used is binary logistic regression, which is to analyze the relationship between the dependent and independent variables.

II. METHOD

This research uses a type of analytical survey research, which is to explore the risk factors that affect menarche. The research design used is cross-sectional, that is, the investigator measures the outcome and the exposures of the study participants at the same time [13]. The population is female students aged 10-12 years in MIN 3 Magetan. The inclusion criteria in this study were female students aged 10-12 years at MIN 3 Magetan who have already menstruation and are willing to be respondents. While the exclusion were students who were suffering from chronic diseases and taking long-term treatment, and also students who were not present in data collection. The sampling calculation technique with purposive sampling so that 87 samples were obtained by dividing the number of samples in each class. The independent variables in this study are nutritional status, economic status, exposure to pornographic mass media, and maternal menarche (genetics), while the dependent variable is menarche. Data collection techniques use questionnaires in Google Forms. Calculation of nutritional status with the application of WHO AnthroPlus. The data analysis technique uses a binary logistic regression statistical test with variable selection first using chi-square. The variable passed the selection if the sig was less than 0.25 and a significant relationship was obtained if the p-value less than 0.05.

III. RESULT

The results of the frequency distribution of research variables in MIN 3 Magetan students can be seen in the following table:

TABLE 1
Frequency Distribution of Research Variables

Menarche (Y)	f	%
Normal	30	34.5
Early	57	65.5
Nutritional status (X1)		
normal	55	63.2
high	32	36.8
Economic status (X2)		
Low	50	57.5
High	37	42.5
Pornography exposure (X3)		
Not Exposed	21	24.1
Exposed	66	75.9
Menarche mother (X4)		
Normal	38	43.7
abnormal	49	56.3
Total	87	100.0

TABEL 1 shows that most min 3 Magetan students experience early menarche (65.5%), normal nutritional status (63.2%), low economic status (57.5%), and exposure to pornography (75.9%), and have a mother with abnormal menarche (56.3%).

TABLE 2
Tabulasi Pengaruh Variabel Terhadap Menarche

Variabel	Status Menarche				Total	Sig
	Normal		Dini			
	f	%	f	%		
Nutritional status						0.001
normal	26	47.3	29	52.7	55	
high	4	12.5	28	87.5	32	
Economic status						0.000
Low	27	54.0	23	46.0	50	
High	3	8.1	34	91.9	37	
Pornography exposure						0.000
Not Exposed	15	71.4	6	28.6	21	
Exposed	15	22.7	51	77.3	66	
Menarche mother						0.388
Normal	15	39.5	23	60.5	38	
abnormal	15	30.6	34	69.4	49	

TABLE 2. Based on the results of cross-tabulation, of the 55 students who had normal nutrition experienced early menarche as many as 29 students (52.7%), and of the 32 students with more nutrition experienced early menarche as many as 28 students (87.5%). Of the 50 students who had low economic status experienced early menarche as many as 23 students (46.0%) and of the 37 students with high economic status experienced early menarche as many as 34 students (91.9%). In 21 students who were not exposed to pornographic mass media experienced early menarche as many as 6 students (28.6%) and of the 66 female students exposed to pornographic mass media experienced early menarche as many as 51 female students (77.3%). Of 38 schoolgirls who had normal menarche mothers experienced early menarche as many as 23 students (60.5%) and of the 49 female students with abnormal menarche mothers experienced early menarche as many as 34 students (69.4%). From the results of the *chi-square* statistical test, only the maternal menarche variable did not pass the selection, then h_0 was accepted.

TABLE 3
Logistic Regression Test Results

Variable	*P-value*	Exp(B)
Nutritional Status	0.048	4.2
Economic Status	0.000	11.3
Exposure to Pornography	0.001	12.1

TABEL 3 All three variables have a significance level smaller than $\alpha = 0.05$, then H_0 all three variables are rejected. So it can be concluded that there is an influence between nutritional status, economic status, and exposure to pornographic mass media on menarche.

IV. DISCUSSION

A. EFFECT OF NUTRITIONAL STATUS ON MENARCHE

One of the factors affecting the occurrence of sexual maturity is the presence of nutrients in the body. Adolescents who experience menarche earlier tend to have a higher nutritional status than adolescents with smaller nutritional status at the same age [14]. Nutritional status related to the intake of food consumed, excess nutrients, or nutrients can have an impact on accelerating the development of reproductive organs [15].

In adolescents with an excess nutritional status (overweight), menarche can occur faster. This is associated with leptin levels secreted by the adipocyte glands[16]. The increase in leptin concentration spurs an increase in serum luteinizing hormone (LH) which affects female puberty. LH levels that increase faster than normal effect increasing estradiol levels which then affect reproductive maturity [17] [18].

This is in line with [19]. The study aims to describe the time trend of age at menarche in Brazilian schoolgirls evaluated in 2007, 2012/2013, and 2018/2019. Girls with overweight were more likely to have had an earlier age at menarche than girls without overweight (Hazard Ratio 1.57; 95% CI 1.36; 1.80). The increase in the prevalence of girls with overweight (including obesity) may be associated with the age of menarche. Girls with overweight had a higher risk of earlier age at menarche than girls without overweight.

The mutual proportion of body height and mass also influenced the age of menarche. It is in line with another study where body mass, alongside Nutritional status was even distinguished as one of the factors with the strongest influence on the onset of menarche. In the present study, a higher probability of a relatively earlier onset of menarche was noted in girls with a higher Body Mass Index (BMI). This is consistent with the results of other studies carried out on the Indian population. The relation between BMI, as well as other causal factors, and menarche occurrence did not change with a girl's age, but the probability of menarche become stronger in higher age groups, as expected [4].

Lack of nutrition in a person will have an impact on a decrease in reproductive function which is characterized by late menarche. Insufficient food intake, inadequate diet, strict dietary restrictions, and general nutritional deficiencies result in loss of body weight and physical performance, delayed puberty, ovarian cycles, and increased infertility. Lower gonadotropin secretion levels with alterations of the physiological ovarian cyclicity and increased infertility [20]. When children experience severe environmental stresses such as malnutrition, maturation is delayed until conditions improve and normal growth can resume.

This research is in line with [21]. This research was an analytical study employing a cross-sectional research design. The population of this research was all female students in this junior high school with a total of 92 female students. The sample selection was done by total sampling with took all students to become the research population and who were

willing to be respondents were 81 female students. The analysis in this research was conducted by cross-tabulation aimed to look at the relationship between the independent variables (the nutritional status) and the dependent variable (the age at menarche). The statistical test conducted was *Chi-square* with a significance level of $p < 0.05$.

This is also in line with [22]. The result of the research showed that nearly half of the respondents (46.2%) had normal nutritional status, whereas most of them (53.8%) had menarche at a normal age. Moreover, the result of Spearman's Rank test showed that $p = (0.018) < \alpha = (0.05)$ so H_0 was rejected illustrating that there was a relationship between nutritional status and age at menarche.

The age of a teenage girl getting menarche varies and is influenced by various factors, one of which is nutritional status. The better the nutritional status, the faster the age of menarche. Nutrition affects sexual maturity in adolescents who get menarche earlier. In general, those who mature earlier will have a higher nutritional status, and those who mature late have a smaller nutritional status at the same age. Malnutrition in adolescents results in inhibition of their reproductive health including development from puberty. The speed of menarche is accompanied by the fulfillment of adequate nutrition where good nutrition can help the growth of adolescent reproductive organs. Therefore, researchers hope that young women can regulate nutritional intake because it will greatly affect the occurrence of menarche.

B. EFFECT OF ECONOMIC STATUS ON MENARCHE

The economic status of the family is related to the ability to meet the nutrition needs, with the fulfillment of nutritional needs will have an impact on sexual maturity. Adolescents who come from environments with higher economic status can meet nutritional needs than adolescents who come from low socioeconomic environments. Therefore, families with high economic status can influence the state of nutritional status and influence reproductive maturity characterized by the presence of menarche [23].

This is in line with [24]**.** In the examined sample, 446 girls do not menstruate yet, while 1570 already had menarche, and for this group of girls mean age at menarche was determined with the use of the retrospective method. The mean age at menarche was 12.86 ± 1.30 years, while the median was 12.92 years. The minimum menarche age was 9.03 years, while the maximum was 17.33 years. The results of the analysis of variance showed that all the analyzed socioeconomic affect age at menarche in the examined girls.

The result of [25] said that economic status was highly correlated at (p<0.01) with age at menarche. Girls belonging to the high economic status group were found to be attaining sexual maturity 13.16 ± 1.15 earlier than those in middle14.01 ± 1.16 and low 15.14 ± 1.70. The probability of the correlation between age at menarche and economic status was 0.000, and the correlation coefficient was 0.327.

For adolescents with high socioeconomic conditions, parents will have their daily needs met so that adolescents get adequate nutritional intake such as protein and fat. High fat intake is a risk factor for early menarche. The more cholesterol produced, the higher the levels of leptin secreted in the blood. Leptin Triggers the release of FSH and LH in the ovaries, resulting in follicle maturation and the formation of estrogen. Estrogen causes negative feedback on FSH, increasing due to follicular growth will decrease as well. Decreased levels of estrogen cause the endometrial blood vessels to proliferate or constrict and intermittently, the endometrial layer desquamates so that bleeding occurs and flows through the vagina in the form of the first menstruation or menarche [26].

The increase in nutritional intake, especially protein and calcium, is a risk factor for early menarche. High protein intake is at 3.2 times the risk in the event of early menarche. Protein can increase the secretion of *the hormone insulin-like growth factor-1* (IGF-1) which plays a role in the process of forming steroid hormones, one of which is estrogen. Calcium intake is also associated with the incidence *of early menarche*. In the study, high calcium consumption was 13.6 times the risk of getting menarche at an early age. Calcium is a regulatory element of cellular processes including as a mediator of the work of hormones which can increase the secretion of IGF-1 and the secretion of GnRH by the hypothalamus. Calcium sends physiological signals to regulate the somatic growth and maturation of the reproductive organs [27].

This research is not in line with [28]. This was a cross-sectional study. A total number of 400 schoolgirls, aged 12 - 18 years, from different secondary and high schools in Sanandaj. The sampling method for the selection of the study subjects was multi-stage sampling. Results showed that the mean age of menarche incidence was 12.87 ± 1.17 years. In this study, there was no significant relationship between socioeconomic status and menarche age. The study stated that the level of economic status did not directly affect the age of menarche.

This result is not in line with [29]. This was a cross-sectional study, conducted among 311 secondary school adolescent girls (10 - 19 years) from two secondary schools (one boarding school and one day school) in Nnewi North LGA of Anambra State of south-eastern Nigeria between May and June 2018. The majority of the participants 177 (56.91%) came within the menarcheal age range of 12 - 14 years with mean menarcheal age of 12.90 ± 0.78. Although the age at menarche increased with reducing the social class by 12.56 ± 1.51; 12.76 ± 1.21; and 12.90 ± 1.05 for high class, middle class, and low class respectively, the difference was not statistically significant (p = 0.283). Lower SES was associated with earlier thelarche and longer duration of puberty in overweight or obese girls, whereas the age of menarche was not affected [30].

Economic status is not a direct factor that causes the occurrence of reproductive maturity of a person. However, the high economic status has an impact on the ease of fulfilling

daily needs such as nutritious foods, or ready-to-eat foods, junk foods, and soft drinks, and the availability of facilities to access print and communication media so that adolescents are more open in obtaining information. The information obtained does not escape the sexually inviting content which can affect reproductive maturity. The higher the economic status, the more needs, and facilities are met. However, in contrast to the low economic status, the knowledge of children's needs and facilities is very limited. Parents who have a high income can meet the needs of children, especially nutritional needs and information properly, in contrast to the limited income of parents who can only meet nutritional needs and sober information. Therefore, the high and low economic status of adolescents can affect sexual maturity, either slowing down or accelerating sexual maturity characterized by the presence of menarche.

C. THE EFFECT OF PORNOGRAPHY MASS MEDIA EXPOSURE ON MENARCHE

Adolescents are exposed to pornographic mass media due to the ease of accessing pornographic information from various media such as smartphones and the internet. They get outside impulses, such as soap operas featuring children playing adults, films about sex (blue films), reading books (novels), temptations and stimuli from men, and observations. Direct sexual activity causes the release of estrogen hormones thus accelerating the maturity of reproductive organs such as the endometrium which is the lining of the uterus. And then there is the decay of the lining of the uterus so that the occurrence of menstruation/menarche [31].

A similar finding was reported in a study conducted in Nepal, the analysis showed that exposure to sexual material (readable, visual, and audible), having a boyfriend, and having indirect sexual activity were found statistically significant with early menarche. Girls exposed to sexual materials (p=0.001), having a boyfriend (p=0.006), and having an indirect sexual activity (p=0.002) were 3.8 times, 2.7 times 7.7 times more at risk of early menarche than those not having mentioned characteristics. Exposure to materials promoting sexual activities, indirect sexual activity, and being in a relationship is statistically significant with early menarche in this study [10].

The sexuality of young people is a continuous fascination to the popular imagination as well as in sexuality research[32]. Online pornography use, also known as Internet pornography use or cybersex, may be one of those Internet-specific behaviors with a risk for addiction [33]. Sensory stimuli in the form of images or sexual scenes are processed in the cerebral cortex and channeled to the hypothalamus. Stimulation of the hypothalamus will provide stimulation in the form of the formation of GnRH which stimulates the anterior pituitary with the reproductive system to release FSH which will stimulate the ovaries (folikel de graaf) to produce the hormone estrogen. Estrogen can trigger sexual maturity which can be seen from changes in secondary sex organs such as hair growth, fatty tissue deposits, vulvar growth, and finally the development of the endometrium in the uterus and also primary sex development which is characterized by the appearance of menarche [34].

This is in line with [35]. Early puberty was found to be positively related to adolescent Internet use. A higher prevalence of excessive Internet use, more than 20 hours/week, was noted among those with early maturation (11.7%). What matters is viewing pornography at this age is that the adolescent brain might not be fully mature in terms of cognitive and emotional functions and judgments [27], thus endangering precocious individuals with a higher risk. Under the biological drives of gonadal hormones and neurobehavioral changes during puberty, early maturing adolescents may express a higher interest in sexual behaviors [36]. Whether and how viewing pornography mediates the link between early sexual maturation and sexual activity requires more research. This study is in line with [37], children's exposure to media for adults above 17 years is a risk factor that accelerates the occurrence of early menarche. The results showed that mass media exposure was significantly related to the incidence of early menarche at junior high school Umi Kulsum Banjaran, Bandung. Respondents with high media exposure are at risk of experiencing early menstruation 4.54 times greater than students with low media exposure to various media or videos for adults (above 17 years).

Exposure to internet mass media is closely related to the age of menarche. This is due to the development of the times that make it easier to access various information through all media. This diverse information does not escape pornographic material. The continuous spectacle of pornography consumed by the sensory will arouse sexual desire and trigger sexual hormone-producing glands to accelerate the maturity of the sexual organs. The hormones produced include estrogen which increases LH production. The production of LH in the body stimulates the ovaries to release the ovum that is ready to be fertilized, but if the ovum is not immediately fertilized there will be a decay of the uterine wall along with the ovum. So that the first menstruation or menarche occurs. Exposure of a person to the mass medium will accelerate puberty, which is characterized by the occurrence of menarche.

D. THE EFFECT OF MATERNAL MENARCHE ON MENARCHE (GENETICS)

Maternal age at menarche was positively associated with the timing of genital development, pubic hair development, first ejaculation of semen, voice break, axillary hair development, and acne in sons, and with the timing of breast development, pubic hair development, menarche, axillary hair development and acne in daughters. In sons, the associations were of similar strength for all pubertal markers, whereas in daughters, the associations were strongest for breast development and menarche [38] [39].

The results of this study show that the majority of female students have mothers with a history of abnormal menarche.

Most female students with normal menarche mothers experience early menarche and most students with abnormal menarche mothers also experience early menarche. Based on the selection of variables through the chi-square test, insignificant values were obtained, so the variables did not pass the logistic regression test selection. Therefore, in this study, it can be concluded that there is no influence of maternal menarche on the menarche of MIN 3 Magetan students.

The result is not in line with [38]**.** Daughters of mothers who reported Age At Menarche (AAM) earlier than peers, had an earlier age at all markers of pubertal development than daughters of mothers with AAM same time as peers, with the largest difference in months observed for breast development Tanner Stage 5 (−6.06 (95% CI: −7.92; −4.20) months). Daughters of mothers reporting a later AAM than peers were older at the time of onset of all pubertal markers. The study examined maternal pubertal timing about the age at menarche and age at onset of the development of genitals, breasts, and pubic hair [40].

Each of the children acquires the genetic code obtained from his parents. Genetics is considered to be a risk factor for the maturity of a woman's reproductive organs, for example, the age of the mother at the time of menarche can affect the speed of body growth and also affect the menstrual time of her daughter's adolescents. This does not rule out the possibility that if the mother experiences menarche at a normal age, the child will experience menarche at a normal age. On the other hand, if the mother experiences menarche sooner or later, then it is very likely that her child will get menarche sooner or later as well [41].

This descriptive analysis is in line with that The mean menarche age for the mothers (12.97 ± 1.71 years) was significantly higher than the daughters (11.5 ± 1.48 years). But, that study has found a correlation between mothers' and daughters' age at menarche [42]. The results of this study are in line with research which states that there is no relationship between maternal age at menarche and respondent's age at menarche. This can happen because of differences in lifestyle and technological advances that can affect the age difference at menarche which is becoming earlier at this time, because nowadays young women often consume fast food, snacks, and soft drinks, consuming these foods excessively before menarche. will cause an increase in nutritional status, causing early menarche.

In this study, adolescents with a history of normal maternal menarche experienced early menarche, as well as a history of abnormal menarche mothers. There is no influence of genetic factors, namely the age of the mother when menarche with the age of adolescent menarche in this study is likely due to lifestyle differences. Nowadays, access to food with high nutritional sources is easier than in the past. The types of nutritious food are also more varied so that the adequacy of nutrients is easier to fulfill. This is different from the past which only consumed certain foodstuffs without considering nutritional aspects. In addition, the development of the times is also accompanied by technological developments. The process of information turnover is easier to reach by anyone, this convenience can also adjust the ability of adolescents of all ages to process information, especially information that contains sexual elements. Unlike in ancient times, information is more limited and not complex, the area of distribution is also limited by economic conditions and geography. Therefore, genetics or maternal menarche are not risked factors for early menarche events due to differences in conditions at the onset of adolescence.

V. CONCLUSION

Factors influencing age at menarche in adolescents aged 10-12 years at MI Negeri 3 Magetan are nutritional status, economic status, and exposure to pornographic mass media. The higher their nutritional status the faster they experience menarche, the higher the economic status the faster they experience menarche, and the more exposed to pornography the faster they experience menarche. There is no age of maternal menarche against menarche, normal or abnormal mother's menarche does not affect the occurrence of menarche sooner or later. It is also expected for parents or guardians to supervise the use of information media and control food intake. From the media, everyone can find out the latest information, and people can also interact with others. A message from the media information can be conveyed well if the media is developed properly and the information would be beneficial to the publisher and the target.

More in-depth studies are required to find other factors and understand how underlying factors influence age at menarche.

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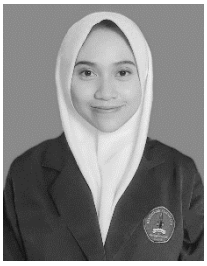

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