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Physical preconception readiness among unmarried adolescents: A multivariate analytical approach

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Abstract

The preconception period is an important stage in the reproductive life cycle that aims to prepare physical, mental, and social conditions before pregnancy occurs. Physical readiness during this period is the main foundation for ensuring a healthy pregnancy and minimizing the risk of complications for both the mother and the fetus. This study aims to analyze the factors that influence physical readiness among adolescents in Indonesia. This study used a quantitative design with a cross-sectional approach, with the population being unmarried adolescents spread across ten provinces in Indonesia in 2024. The sampling technique used cluster random sampling with a sample size of 524 respondents. Data were collected using a structured questionnaire with a survey method via a Google Form link. Body Mass Index (BMI) data collection based on respondents' self-reports. To minimize the risk of information bias, researchers requested height and weight data separately, provided standardized measurement instructions, applied logical value range limits, and performed data validation and cleaning prior to statistical analysis. Data analysis used univariate analysis, bivariate analysis with chi-square tests, and multivariate analysis with multiple logistic regression to examine the relationship and dominant factors affecting physical readiness for preconception. Research ethics principles were followed through an ethics approval letter No. 027/KEP-UMPP/V/2024.The results of the study indicate that there is a significant relationship between BMI (p = 0.007, OR: 1.825), reproductive health status (p = 0.000, OR: 3.553), and mental readiness (p = 0.000, OR: 2.278) with physical readiness during the preconception period. In addition, multivariate analysis shows that BMI is the most dominant factor affecting physical readiness with an Exp (B) value of 1.342 (CI 95%: 1.342-3.107). A balanced BMI is associated with hormonal balance, optimal reproductive function, adequate energy reserves, and a lower risk of complications. Therefore, interventions to improve nutritional status should be a key component of preconception programs. This study recommends the need to strengthen comprehensive preconception education programs, including improving preconception health literacy, regular reproductive health check-ups, and psychological interventions to improve mental readiness before entering pregnancy.

Keywords

Preconception health, Physical readiness, Adolescents, Reproductive health, Body mass index (BMI)

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Introduction

The preconception period is a critical and important period in the reproductive cycle that plays a significant role in determining the health of mothers, unborn babies, and future generations. Preconception readiness is not only relevant for married women or those planning to become pregnant (Ayuanda et al., 2024). It is also an important aspect for adolescents as part of long-term reproductive health promotion and prevention efforts (WHO, 2017). Scientific evidence shows that many maternal and infant health problems, including pregnancy complications, premature birth, and fetal growth disorders, stem from health conditions that existed before pregnancy (Stephenson et al., 2018).

Preconception care is defined as a series of interventions or programs aimed at identifying and facilitating useful decisions to modify biomedical, behavioral, and psychosocial risks to the future health of mothers and children through counseling, prevention, and management, emphasizing factors that must be addressed before conception and early in pregnancy to achieve maximum impact (Shawe et al., 2015). Preconception care is beneficial for everyone, but especially for those with suboptimal lifestyles or certain medical conditions. If couples have sufficient knowledge about factors that negatively impact fertility and pregnancy outcomes, they can take the initiative to adjust their lifestyle, quit smoking, avoid alcohol before pregnancy, maintain a healthy weight, and optimize their diet, including folic acid intake (for women). However, most people are unaware of these important steps, so they can benefit from preconception care (Fleming et al., 2018).

Physical readiness is the main foundation of preconception health. Physical readiness during the preconception period includes nutritional status, general health condition, medical history related to risk factors that may affect future pregnancy, healthy lifestyle habits, and so on (Dean et al., 2014a). Nutritional status, particularly as reflected in body mass index (BMI), is an important determinant of women's reproductive health. An abnormal BMI, whether underweight or overweight, can affect ovulation, hormonal metabolism, and increase the risk of complications such as anemia, gestational diabetes, preeclampsia, and fetal growth disorders (Schmied et al., 2020).

Adolescents are a group that is vulnerable to various health problems, including anemia, nutritional status, lack of physical activity, and risky behaviors that can impact optimal preconception readiness (Patton et al., 2016). Based on problems in developing countries, including Indonesia, adolescent nutritional problems such as iron deficiency anemia, chronic energy deficiency, and overweight remain major challenges and have the potential to lead to suboptimal pregnancy outcomes (Lassi et al., 2016). Therefore, preconception health interventions that begin in adolescence are an important strategy in reducing maternal and infant morbidity rates.

Although the concept of preconception health has been widely studied, most research still focuses on women of childbearing age who are married or planning a pregnancy (Stephenson et al., 2018). However, adolescents have different biological, social, and

behavioral characteristics compared to other reproductive age groups, requiring a more comprehensive approach (Black et al., 2013).

Based on several previous studies, assessing preconception readiness in specific aspects, such as reviewing nutritional status or knowledge related to reproductive health separately (Kassa et al., 2019) (Lassi et al., 2016). However, this approach has not been able to describe the complex relationship between various physical factors such as body mass index, anemia status, physical activity, and other health conditions. In addition, research using a multivariate analytical approach to identify the dominant factors associated with physical preconception readiness in adolescents is still minimal. The lack of such studies has the potential to hinder the formulation of evidence-based and long-term adolescent health policies and interventions.

This study aims to analyze the factors that influence preconception physical readiness among unmarried adolescents in Indonesia. The results of this study are expected to contribute scientifically to the development of comprehensive preconception education and intervention programs, with an emphasis on improving nutritional status, regular reproductive health check-ups, and strengthening mental readiness as an integral part of preparing for a healthy pregnancy.

Method

This study used a quantitative cross-sectional design to analyze the relationship between various determinants and preconception physical readiness among adolescents. The study was conducted in 2024 and covered ten provinces in Indonesia. The research locations were selected to represent the diversity of social, cultural, and geographical characteristics of adolescents in Indonesia. The population in this study was unmarried adolescents in Indonesia. The inclusion criteria included adolescents aged 10-18 years, unmarried, and willing to be respondents and complete the questionnaire, while the exclusion criteria were respondents who were unwilling and did not complete the questionnaire. The sampling technique used cluster random sampling with the cluster being the provincial area. From the ten selected provinces, respondents were selected randomly according to the proportion of adolescents in each region. The final sample size was 524 adolescents.

The variables in this study were independent variables, including BMI (Body Mass Index), reproductive health status, and mental readiness. Meanwhile, the dependent variable was physical readiness for preconception.

Data was collected using a structured questionnaire. The questionnaire included questions about respondent characteristics, nutritional status (based on BMI), reproductive health, mental readiness, and indicators of physical readiness for preconception. Data collection was conducted through an online survey using a Google Form link, which was distributed to respondents through educational networks and youth communities in each research area. Before completing the questionnaire,

respondents were given an explanation of the research objectives and informed consent to participate.

Specifically, Body Mass Index (BMI) data was collected via Google Forms based on respondents' self-reported information. Respondents were asked to fill in their weight (in kilograms) and height (in centimeters) separately, rather than calculating their BMI themselves. BMI calculations were performed by researchers using the formula of weight (kg) divided by height squared (m^2) to ensure consistency and reduce calculation errors.

To minimize potential reporting bias (self-report bias), the researchers included clear anthropometric measurement guidelines at the beginning of the questionnaire, including recommendations to use available scales and height measuring devices, to take measurements without shoes, and to use the most recent measurement data. In addition, logical range checks were applied to the data entry system to prevent irrational inputs (e.g., height and weight outside reasonable physiological limits).

Before statistical analysis is performed, data undergoes a data cleaning process that includes consistency checks, identification of outliers, and verification of data distribution suitability. These steps are taken to improve internal validity and reduce the possibility of distortion of results due to input errors.

Data analysis was carried out in stages using SPSS statistical software, which included univariate analysis to describe the frequency distribution and proportion of each research variable, bivariate analysis using the chi-square test to determine the relationship between independent variables and preconception physical readiness, and multivariate analysis using multiple logistic regression to identify the dominant factors that influence preconception physical readiness. with the results presented in the form of odds ratios (OR), Exp(B) values, 95% confidence intervals (CI), and significance values (p-values).

This study has obtained ethical approval from the Health Research Ethics Committee with number 027/KEP-UMPP/V/2024. The entire research process was carried out in accordance with research ethics principles, namely respecting respondent autonomy, maintaining data confidentiality, and ensuring the safety and comfort of respondents during the research process.

Resuls

Based on the research results, univariate, bivariate, and multivariate analyses were obtained, which can be seen in the following Table 1. The univariate analysis presents the distribution of respondents based on body mass index (BMI), reproductive health status, mental readiness for preconception, and physical readiness for preconception.

Regarding body mass index (BMI), the majority of respondents were classified as having an ideal BMI (18.5–24.5 kg/m^2), accounting for 338 respondents (64.5%). Nevertheless, a

considerable proportion of respondents exhibited non-optimal nutritional status. A total of 67 respondents (12.8%) were categorized as underweight, while 30 respondents (5.7%) were classified as severely underweight. In addition, respondents with excess body weight were also identified, including 60 respondents (11.5%) who were overweight, 24 respondents (4.6%) with obesity class I, and 5 respondents (1.0%) with obesity class II. These findings indicate that although most adolescents had an ideal BMI, a substantial proportion remained at nutritional risk, which may potentially affect physical readiness for preconception.

Table 1. Univariate analysis of factors affecting physical readiness for preconception

Variable	F	%
Body Mass Index (BMI)		
Severely underweight (<17 kg/BB)	30	5.7
Underweight (17-18.4 kg/BB)	67	12.8
Ideal (18.5-24.5 kg/BB)	338	64.5
Overweight (25-29.5 kg/BB)	60	11.5
Obesity I (30-34.5 kg/BB)	24	4.6
Obesity II (>35 kg/BB)	5	1.0
Reproductive Health Status		
Good	372	71.0
At Risk	152	29.0
Mental of Preconception Readiness		
Ready	238	45.4
Not Ready	286	54.6
Physical of Preconception Readiness		
Ready	132	25.2
Not Ready	392	74.8

In terms of reproductive health status, the majority of respondents were categorized as having good reproductive health, with 372 respondents (71.0%), while 152 respondents (29.0%) were classified as at risk. This distribution suggests that nearly one-third of adolescents still experience reproductive health conditions that warrant further attention and monitoring within the context of preconception readiness.

The distribution of respondents based on mental readiness for preconception revealed that more than half of the respondents were not mentally ready, comprising 286 respondents (54.6%), whereas 238 respondents (45.4%) were considered mentally ready. This finding indicates that mental readiness for preconception among unmarried adolescents remains relatively low and represents an important aspect that should be strengthened through preconception health programs.

Furthermore, with respect to physical readiness for preconception, the majority of respondents were classified as not physically ready, accounting for 392 respondents (74.8%), while only 132 respondents (25.2%) were considered physically ready. These results demonstrate that most unmarried adolescents have not yet achieved optimal physical readiness for preconception, despite a relatively high proportion of respondents having an ideal BMI and good reproductive health status.

Overall, the univariate analysis highlights a notable gap between objective physical conditions, mental readiness, and overall physical readiness for preconception among unmarried adolescents. These findings provide an important foundation for subsequent bivariate and multivariate analyses to identify factors associated with and most strongly influencing physical preconception readiness.

The bivariate analysis examined the association between body mass index (BMI), reproductive health status, and mental readiness with physical preconception readiness among unmarried adolescents (Table 2).

Table 2. Bivariate analysis of factors affecting physical readiness for preconception

Variable	Category	Physical of Preconception Readiness				Total		p	OR	CI 95% Lowe-Upper
		Good		Not Good						
		n	%	n	%	n	%			
BMI	Normal	98	29.0	240	71.0	338	100	0.007	1.825	1.176-2.834
	At Risk	34	18.3	152	81.7	186	100			
Reproductive Health Status	Normal	115	30.9	257	69.1	372	100	0.000	3.553	2.050-6.161
	At Risk	17	11.2	135	88.8	152	100			
Mental of Preconception Readiness	Ready	80	33.6	158	66.4	238	100	0.000	2.278	1.522-3.410
	Not Ready	52	18.2	234	81.8	286	100			

The analysis revealed a statistically significant association between BMI and physical preconception readiness (p = 0.007; OR = 1.825; 95% CI: 1.176–2.834). Adolescents with an ideal or normal BMI demonstrated a higher proportion of good physical preconception readiness (29.0%) compared to those classified as at risk due to severely underweight, underweight, overweight, or obesity (18.3%). Conversely, a greater proportion of adolescents with at-risk BMI were categorized as not physically ready (81.7%) compared to those with normal BMI (71.0%).

A significant relationship was also observed between reproductive health status and physical preconception readiness (p = 0.000; OR = 3.553; 95% CI: 2.050–6.161). Adolescents with normal reproductive health status were more likely to be physically ready for preconception (30.9%) than those with reproductive health conditions classified as at risk (11.2%). In contrast, the majority of adolescents with at-risk reproductive health status were categorized as not physically ready (88.8%).

Furthermore, mental readiness for preconception showed a significant association with physical preconception readiness (p = 0.000; OR = 2.278; 95% CI: 1.522–3.410). Adolescents who were mentally ready demonstrated a higher proportion of good physical readiness (33.6%) compared to those who were not mentally ready (18.2%). Among adolescents who were not mentally ready, the majority (81.8%) were classified as not physically ready for preconception. Overall, the bivariate analysis indicates that BMI, reproductive health status, and mental readiness are significantly associated with physical preconception readiness among unmarried adolescents.

The multivariate analysis using multiple logistic regression identified body mass index (BMI) as the most dominant factor influencing physical preconception readiness among

unmarried adolescents (Table 3). The analysis showed that BMI had a statistically significant effect on physical preconception readiness, with an Exp(B) value of 2.04 and a 95% confidence interval ranging from 1.342 to 3.107 (p = 0.001). These findings indicate that adolescents with a normal BMI were more than twice as this result confirms that nutritional status plays a critical role in determining physical readiness during the preconception period.

Table 3. Multivariate analysis: factors affecting physical readiness for preconception

Variable	Exp (B)	CI 95%		p
		Lower	Upper	
BMI	2.04	1.342	3.107	0.001

Discussion

This study shows that body mass index (BMI), reproductive health status, and mental readiness are significantly related to preconception physical readiness among unmarried adolescents in Indonesia. These findings confirm that preconception physical readiness is a multidimensional condition that is simultaneously influenced by biological and psychological factors.

The relationship between reproductive health status and physical readiness for pregnancy

This study also found a highly significant relationship between reproductive health status and preconception physical readiness (p = 0.000; OR = 3.553). Adolescents with good reproductive health status are more than three times more likely to be physically ready for future pregnancy than those with reproductive health problems.

Optimal reproductive health reflects good reproductive organ function, regular menstrual cycles, and the absence of infections or chronic disorders that can affect fertility(WHO, 2019). Many reproductive health disorders are latent and can begin during adolescence without being noticed, thereby potentially increasing the risk of pregnancy complications if not detected and treated early (Dean et al., 2014b).

These findings support the research by Stephenson et al. (2018), which emphasizes the importance of reproductive health screening in preconception care as part of primary prevention efforts. Thus, regular reproductive health check-ups for adolescents, even if they are not yet married, are a strategic step in preparing for a healthy pregnancy in the future (Stephenson et al., 2018).

The relationship between mental readiness and physical readiness for pregnancy

In addition to biological factors, this study shows that mental readiness has a significant relationship with preconception physical readiness (p = 0.000; OR = 2.278). Adolescents with good mental readiness are more likely to achieve preconception physical readiness than those with low mental readiness.

These findings reinforce the concept that mental health and physical health are two interrelated aspects of the reproductive system (Ayuanda et al., 2024). Psychological stress, anxiety, and mental disorders can affect the endocrine system, increase stress hormone levels such as cortisol, and have a negative impact on reproductive function and metabolism (Patton et al., 2018). These conditions can ultimately reduce preconception physical readiness.

Previous studies have also shown that psychological interventions and increased mental health literacy among adolescents contribute to the formation of healthy behaviors, adherence to nutritional intake, and utilization of reproductive health services (Ayuanda & Mufdlillah, 2020). Therefore, mental readiness needs to be viewed as an integral component of comprehensive preconception health programs.

The Relationship between body mass index and preconception physical readiness

The results of this study indicate that BMI has a significant relationship with preconception physical readiness ($p = 0.007$; $OR = 1.825$) and is the most dominant factor in multivariate analysis with an Exp(B) value of 2.04 (95% CI: 1.342–3.107). These findings indicate that adolescents with a balanced BMI are more likely to achieve preconception physical readiness than adolescents with an abnormal BMI.

Biologically, a balanced BMI is closely related to hormonal balance, optimal ovulation function, and the availability of adequate energy reserves to support future pregnancy (Goossens et al., 2018). Conversely, malnutrition or obesity can disrupt reproductive hormone regulation, increase systemic inflammation, and contribute to the risk of pregnancy complications such as preeclampsia, gestational diabetes, and fetal growth disorders (Frayne, 2016).

These findings are consistent with previous research stating that nutritional status during adolescence is an important predictor of reproductive health in adulthood (Charaf et al., 2015). Therefore, interventions to improve nutritional status from adolescence onwards are a key strategy in strengthening physical preconception readiness and breaking the cycle of intergenerational health problems.

Body mass index (BMI) deviations, such as overnutrition and obesity as well as undernutrition and malnutrition, affect the health of women and men during their reproductive period. Along with increasing population levels, overweight and obesity worldwide, obesity has become a serious global health problem, affecting individual fertility and preconception health. However, awareness of these risks during the preconception period remains low among the general public (Poels et al., 2017).

There is growing evidence that obese individuals are at higher risk of various health problems during the preconception period that impact their fertility. Not surprisingly, more evidence relates to overweight or obese populations, while studies focusing on malnutrition or undernutrition are still limited. Changes in body mass index affect both

men and women. As obesity rates increase globally, greater awareness of this metabolic syndrome is crucial (Stephenson et al., 2018).

Despite having several limitations, such as not taking into account an individual's age or gender (Brazier, 2018), Body Mass Index (BMI) remains an important risk tool that can help us predict disease in individuals (WHO, 2020). Both overweight and underweight are associated with many risk factors that impair reproductive capacity (Imterat et al., 2019). Obesity is a major global health problem and can also affect preconception health. Data from 2016 show that 39% of adults aged 18 years and older are overweight, while approximately 13% of the world's adult population is obese (WHO, 2020).

In addition, obesity itself can cause various health problems during pregnancy and childbirth, and can affect the health of new-borns. Obese women have a higher risk of gestational diabetes and type 2 diabetes due to insulin resistance and are at higher risk of hypertension, pre-eclampsia and hypothyroidism. Women with a BMI classified as obese are at greater risk of infertility, spontaneous miscarriage, fetal death, and premature birth (Ornaghi et al., 2018).

On the other hand, low BMI (such as in anorexia nervosa) and malnutrition can have serious consequences for women's reproductive health and subsequently for the fetus (Imterat et al., 2019). Malnutrition can cause fetal growth restriction and vitamin and micronutrient deficiencies. Women and adolescent girls from low- and middle-income countries in particular face nutritional deficiencies, resulting in deficiencies in iron, vitamin A, zinc, and calcium (Patton et al., 2018). Due to different dietary patterns among women and adolescent girls in high-income countries, they also face deficiencies in several important nutrients, including magnesium, iodine, calcium, and vitamin D (Bath et al., 2013).

Health workers should emphasize the importance of healthy lifestyles during the preconception period, with a focus on public health awareness. Young girls and boys, as well as young adults, should be encouraged to maintain a healthy weight, while counselling for individuals who are overweight or obese should also be offered in relation to future impacts on reproduction. They should also be offered weight loss programs with an emphasis on healthy lifestyle changes, dietary restrictions, and adequate physical activity. Healthcare professionals should promote a normal BMI during the preconception period and raise awareness among the general public (Petrocnik et al., 2021).

Limitation

This study has several limitations. First, BMI data were obtained through self-reporting without direct measurement verification, which could potentially cause self-report bias, recall bias, and social desirability bias. Second, data accuracy is highly dependent on the availability and accuracy of the measuring instruments used by each respondent.

Although several bias control measures have been implemented, including standardized measurement instructions, input value range restrictions, and data cleaning processes prior to analysis. These efforts aim to reduce the possibility of systematic and random errors in anthropometric data reporting. However, residual bias is still possible and may affect the estimation of the strength of the relationship between variables. Further research is recommended to conduct direct anthropometric measurements or perform validation on sub-samples to improve data accuracy and validity.

Conclusion dan Recommendation

The dominant role of BMI as a determinant of preconception physical readiness in this study confirms that nutritional status is the main entry point for preconception interventions in adolescents. However, these findings also show that improving nutritional status alone is not enough without improving reproductive health and mental readiness.

This study makes an important contribution by highlighting preconception physical readiness in unmarried adolescents, a group that has received relatively little attention in preconception programs. Using a multivariate analysis approach, this study was able to identify the dominant factors that influence physical readiness more comprehensively, thereby providing a basis for the development of evidence-based adolescent health policies and programs. Although this study provides meaningful findings, there are several limitations that need to be considered. The cross-sectional design does not allow for causal conclusions. In addition, the use of online questionnaires allows for self-report bias. Further research is recommended using a longitudinal design and objective measurements of nutritional status and reproductive health to strengthen the scientific evidence.

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