

Determinant factors of anemia prevention behavior among female adolescents in border area: a path analysis on the health belief model

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ABSTRACT

Combating anemia in female adolescents may prevent long term effects of low birth weight, malnutrition, and growth failure (stunting) in their progeny. This study aimed to path-analyze the determinants of anemia prevention behavior in female adolescents with health belief model approach. This was an observational analytical study, conducted at SMAN 3 Atambua, East Nusa Tenggara, Indonesia, from May 7, 2024 to August 2, 2024. A total of 103 participants were selected by total sampling. The data collected by a set of questionnaires. This study revealed a direct and positive correlation between perceived threat ($b = 2.43$; 95% CI = 0.67 to 4.18; $p = 0.007$), perceived benefits ($b = 1.99$; 95% CI = 0.20 to 3.78; $p = 0.029$), perceived barrier ($b = 2.74$; 95% CI = 0.34 to 5.14; $p = 0.025$), self-efficacy ($b = 1.76$; 95% CI = 0.06 to 3.46; $p = 0.042$), cues to action ($b = 1.96$; 95% CI = 0.27 to 3.65; $p = 0.022$) and anemia prevention behavior. Knowledge is indirectly correlated to anemia prevention behavior through self-efficacy ($b = 2.25$; 95% CI = 0.95 to 3.54; $p = 0.001$); perceived susceptibility is indirectly correlated to anemia prevention behavior through perceived threat ($b = 2.01$; 95% CI = 0.78 to 3.24; $p = 0.001$); perceived severity is indirectly correlated to anemia prevention behavior through perceived threat ($b = 0.91$; 95% CI = 0.01 to 1.81; $p = 0.045$). The implications of this study suggest that multifaceted interventions should be put in place that combine education, empowerment, overcoming barriers, and increasing the perceived threat and severity of anemia, all of which can improve anemia prevention behavior among female adolescents.

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1. INTRODUCTION

The period of adolescence marks the shift from childhood to adulthood [1]. The adolescent stage is widely recognized as a crucial time when the dietary condition at this level would directly impact the health status in the subsequent age stage [2], [3]. Puberty brings about several physiological changes that make adolescents more susceptible to anemia. However, the occurrence of anemia is more common in female adolescents compared to male adolescents [2], [3]. It is due to the need for reproductive development, which requires an elevated amount of macro and micronutrients [4]. The frequency of anemia among female adolescents in Indonesia is relatively high. The 2018 Basic Health Research study revealed a prevalence rate of 32% for anemia, indicating that 3 to 4 out of every 10 female adolescents in Indonesia experience anemia [5].

Prevention of anemia among female adolescents represents a specific indicator within the broader framework of stunting mitigation efforts in Indonesia. However, interventions aimed at preventing anemia in female adolescents residing in Indonesian border regions continue to face significant challenges. Data from the Health Department of East Nusa Tenggara (ENT) Province in 2024 indicate that only 54.7% of female adolescents received anemia status screening (hemoglobin testing), a figure that remains substantially below the target of 90%. Additionally, the proportion of female adolescents consuming iron supplementation tablets was reported at 73.3%, which similarly falls short of the established target of 90%. The suboptimal coverage of anemia screening and iron supplementation among female adolescents may be attributed to a range of factors, including limited access to healthcare services, socio-economic constraints, and potential gaps in health education and awareness [6]. These shortcomings are particularly concerning, given the well-established relationship between anemia and adverse outcomes [7].

Female adolescents with anemia may experience difficulties such as compromised cognitive function [8]–[10] and reduced academic performance as a result of reduced learning capacity [10]. Another report indicates that anemia in adolescents is strongly associated with reduced physical capacity and a higher incidence of syncope (fainting) in school settings [11]. Given the role of female adolescents as potential mothers, it is imperative to address this issue promptly to avoid the severe consequences of low birth weight, malnutrition, and growth failure (stunting) in their progeny [12], [13].

Different research findings have identified determinant factors that contribute to the prevention of anemia. These factors include sociodemographic characteristics, attitudes [14], knowledge [15], fear of weight gain [16], protein consumption patterns [17], [18], folic acid, and iron tablets [2], [19], physical activity [20], [21], nutritional status [22], [23], upper arm circumference (MUAC) [6], [24]–[26], and menstrual duration [27], [28]. Prior research findings indicated that anemia in female adolescents is attributed to sociodemographic and behavioral variables, including inadequate food and consumption habits. Nevertheless, to promote healthy behavior among adolescents in preventing anemia, it is essential to analyze the factors that influence adolescent behavior using the health belief model (HBM) theoretical approach, particularly in the border regions of Indonesia and the Republic of Democratic Timor Leste (RDTL). HBM is a theoretical framework that elucidates and forecasts individual health behavior modifications [29].

Using HBM as a theoretical framework that elucidates and forecasts individual health behavior modifications is essential [29]. The HBM theory highlights that the existence or absence of health behavior can be explained by individual values of perceived vulnerability, perceived severity, perceived threat, perceived benefit, perceived barrier, cues to action, and self-efficacy. This study uniquely presents extensive data and information using the HBM theory approach and path analysis to examine the primary predictors and intermediate variables associated with adolescent behavior in preventing anemia. Path analysis further helps in identifying how these factors are interrelated, providing a clearer picture of what needs to be addressed in interventions. This analysis is the foundation for communicating behavioral change to modify internal and external determinants. To address the issue of anemia in female adolescents, it is necessary to implement behavioral modifications from the perspective of the female adolescents. Therefore, this study is crucial as utilizing HBM as a predictor of adolescent behavior can provide practical solutions that can be implemented to remedy the identified root cause of the problem. Therefore, this study aims to path-analyze the determinants of anemia prevention behavior in female adolescents in the Indonesia – Timor Leste border area.

2. METHOD

This was an observational analytical research methodology to accurately identify the factors that influence anemia preventive behavior in female adolescents at a public senior high school (SMAN 3 Atambua). Considering the lack of studies that measure the direct and indirect effect of HBM constructs toward anemia preventive behavior in adolescents, particularly in female adolescents residing in borderland, a quantitative study employing generalized structural equation modelling (G-SEM), a multivariate method for analyzing non-continuous dependent variables.

The study was conducted at SMAN 3 Atambua, situated on the border between Indonesia and RDTL, from May 7 to August 2, 2024. Arid conditions and minimal precipitation characterize the area. These environmental conditions increase the susceptibility of female adolescents to acquiring anemia. The participants in this study consisted of 103 female adolescents from SMAN 3 Atambua, selected from any of the 7 classes ranging from X to XII classes using total sampling. The data collection procedure was conducted through the completion of questionnaires. The study employed knowledge, perceived susceptibility, perceived severity, perceived threat, perceived benefit, perceived barrier, cues to action, and self-efficacy as the independent variables. In this study, the anemia preventive behavior served as the dependent variable.

Data collection commenced with a visit to SMAN 3 Atambua, Indonesia, during which the research team met with the school principal. The team outlined the purpose and objectives of the study and sought the principal's consent to serve as the legal guardian for the female adolescent participants. This procedure was

required because, under Indonesian laws and regulations, the participants were considered minors and therefore needed guardian approval, which in this context was obtained through the principal. Following the receipt of institutional consent, the research team visited each classroom to meet the potential participants. The team provided a detailed explanation of the study's aims and procedures and subsequently requested the students' assent to participate. Upon obtaining assent, the researchers distributed a set of questionnaires for the participants to complete. Data collection was carried out during regular instructional hours. To ensure that participants' educational rights were fully upheld, all data collection activities were scheduled in coordination with the school timetable, minimizing disruptions to the learning process. Following the completion of data collection, the researchers proceeded with data analysis using StataMP 13 software.

3. RESULTS AND DISCUSSION

3.1. Respondent characteristics

Table 1 shows that 80 adolescents (77.67%) had a high level of knowledge regarding anemia, while 23 (22.3%) had a lower knowledge level. A total of 20 female adolescents, accounting for 19.42% of the sample, consider themselves prone to anemia. In contrast, 83 female adolescents, representing 80.58%, do not possess this perception. Among the adolescents, 45 (43.69%) consider anemia a severe condition, whereas 58 (56.31%) do not. Among the female adolescents, 40 (38.83) consider anemia a concern, whereas 63 (61.17) do not recognize it. Of the female adolescents, 61 (59.22%) identify the advantages of engaging in anemia prevention behavior, whereas 42 (40.78) do not perceive any benefits. 51 (49.51%) female adolescents do not see barriers to anemia prevention behavior, whereas 52 (50.49) female adolescents encounter challenges in such behavior. Thirty-three (32.04%) female adolescents receive explicit instructions to act, while seventy (67.96%) female adolescents lack such instructions. A total of 50 (48.54%) female adolescents exhibit high self-efficacy, whereas 53 (51.46%) female adolescents demonstrate low self-efficacy. Among female adolescents, 31 (30.10%) exhibit good anemia prevention behavior, while 71 (69.90%) display poor anemia prevention behavior.

Table 1. Respondent characteristics

No	Variables	n	%	No	Variables	n	%
1	Knowledge			6	Perception of barriers		
	Poor	23	22.3		Barriers	52	50.49
	Good	80	77.67		No barriers	51	49.51
2	Perception of vulnerability			7	Cues to action		
	Invulnerable	83	80.58		No	70	67.96
	Vulnerable	20	19.42		Yes	33	32.04
3	Perception of severity			8	Self-efficacy		
	Unseverable	58	56.31		Poor	53	51.46
	Severable	45	43.69		Good	50	48.54
4	Threat perception			9	Anemia prevention behavior		
	Unthreatened	63	61.17		Poor	71	69.90
	Threatened	40	38.83		Good	31	30.10
5	Perception of benefits						
	No benefits	42	40.78				
	Benefits	61	59.22				

3.2. Path analysis

3.2.1. Model specification

An explicit model formulation elucidates the correlation between the variables under investigation. The present study examines nine variables: knowledge, perceived susceptibility, perceived severity, perceived threat, perceived benefits, perceived barriers, cues to action, self-efficacy, and anemia prevention behavior.

3.2.2. Model identification

Observed variables:

- i. Number of observed variables
- ii. Direct effects
- iii. Indirect effects
- iv. Number of parameters
- v. Degree of freedom (df)

df= degree of freedom = # observation - # parameter

Number of observations

observation= $(k * (k-1)) / 2$

k= observed variables

Number of parameters

parameter= (#regression path + # correlation path + # residual error)

Observed variables = $8 * (8-1) / 2 = 28$

Number of parameters = Number of regression path+correlation path/covariance+residual error = $8+0+0=8$

df= $(56/2) - (8)$

df= $28 - 8$

df= 20

df value is 20 (>0 = over-identified) so that path analysis can be carried out. The structural model of path analysis can be seen in Figure 1.

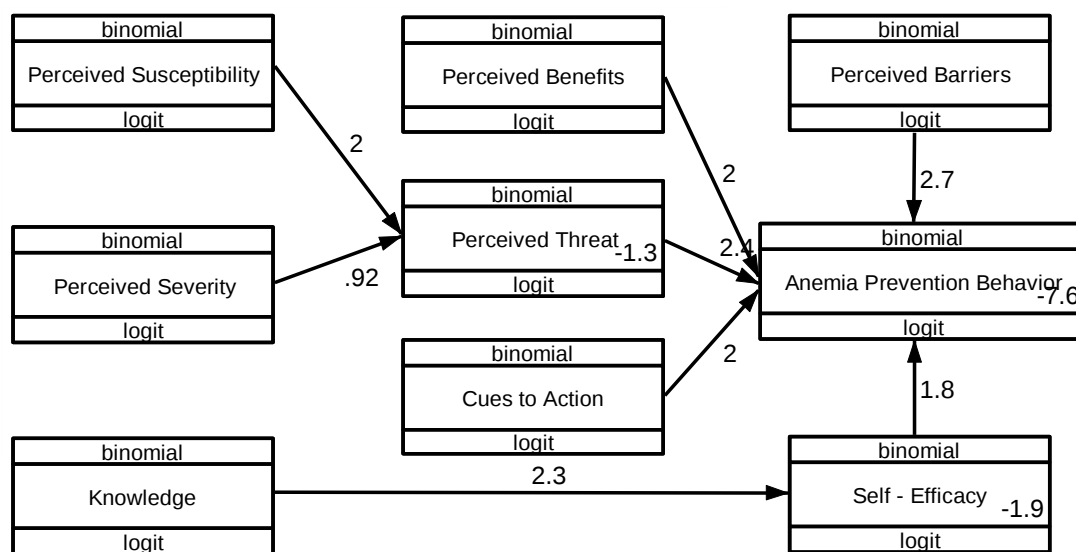


Figure 1. Structural model of path analysis

The data in Table 2 shows a direct and positive effect of perceived threat and anemia prevention behavior. Among adolescents who view anemia as a threat, the log odds likelihood of adopting anemia prevention behavior is 2.43 times higher ($b = 2.43$; 95% CI = 0.67 to 4.18; $p = 0.007$) compared to adolescents who do not view anemia as a threat. A direct and positive effect exists between perceived benefits and the implementation of anemia prevention activity. Adolescents who recognize the benefits of anemia prevention conduct have a log odds likelihood of engaging in such behavior that is 1.99 times higher ($b = 1.99$; 95% CI = 0.20 to 3.78; $p = 0.029$) compared to adolescents who do not recognize the advantages of anemia prevention behavior. Perceived barrier directly and positively correlates with activity aimed at preventing anemia. Adolescents who do not see any barriers to preventing anemia have a log odds ratio of 2.74 times higher ($b = 2.74$; 95% CI = 0.34 to 5.14; $p = 0.025$) to engage in anemia prevention behavior compared to adolescents who do perceive obstacles. A direct and positive correlation exists between self-efficacy and anemia prevention behavior. High self-efficacy in female adolescents is associated with a log-odd likelihood of engaging in anemia prevention behavior that is 1.76 times higher ($b = 1.76$; 95% CI = 0.06 to 3.46; $p = 0.042$) compared to low self-efficacy in adolescents. Cues to action are directly and positively correlated with behavior aimed at preventing anemia. Adolescents who get cues to action had a log odds of 1.96 ($b = 1.96$; 95% CI = 0.27 to 3.65; $p = 0.022$) to adopt anemia prevention behavior compared to adolescents who do not acquire directions to act. Knowledge is indirectly correlated to anemia prevention behavior through self-efficacy. The log odd for adolescents with a good understanding of anemia to have high self-efficacy is 2.25 times greater ($b = 2.25$; 95% CI = 0.95 to 3.54; $p = 0.001$) compared to adolescents with poor knowledge about anemia. The phenomenon of perceived susceptibility is indirectly associated with anemia prevention behavior through perceived threat. The log odds of adolescents who consider themselves susceptible to anemia, considering anemia as a threat, are 2.01 times higher ($b = 2.01$; 95% CI = 0.78 to 3.24; $p = 0.001$) compared to adolescents who do not regard themselves as susceptible to anemia. The perceived severity of anemia is indirectly

associated with anemia prevention activity through perceived threat. The log odds of perceiving anemia as a threat are 0.91 times higher for adolescents who view anemia as a severity compared to adolescents who do not view anemia as a severity ($b = 0.91$; 95% CI = 0.01 to 1.81; $p = 0.045$).

Table 2. Path analysis results: determinants factors of anemia prevention behavior in female adolescents using the health belief model approach

using the neural net model approach						
Dependent variables		Independent variables	b	CI 95%		p
				Upper limit	Lower limit	
Direct effects						
Anemia prevention behavior	←	Perceived threats	2.43	0.67	4.18	0.007
Anemia prevention behavior	←	Perceived benefits	1.99	0.20	3.78	0.029
Anemia prevention behavior	←	Perceived barriers	2.74	0.34	5.14	0.025
Anemia prevention behavior	←	Self-efficacy	1.76	0.06	3.46	0.042
Anemia prevention behavior	←	Cues to action	1.96	0.27	3.65	0.022
Indirect effects						
Self-efficacy	←	Knowledge	2.25	0.95	3.54	0.001
Perceived threats	←	Perceived susceptibility	2.01	0.78	3.24	0.001
Perceived threats	←	Perceived severity	0.91	0.01	1.81	0.045
N observation = 103						
df = 11						
AIC = 310.19						
BIC = 339.17						

This study expands the HBM, a theoretical framework to elucidate and forecast health-related behavior. HBM originated from the recognition that health issues are defined by the inability of people or communities to prevent or treat diseases effectively. Within the framework of this research, the HBM is employed to forecast the conduct of female adolescents in avoiding anemia. The pathway analysis revealed both direct and indirect effects of HBM components on the behavior of female adolescents in preventing anemia.

3.3. Direct effects

3.3.1. Correlation between perceived threat and anemia prevention behavior in female adolescents

This study shows a direct and positive effect of perceived threat and anemia prevention behavior. The threat perception will motivate an individual to adopt preventive measures or therapeutic actions [30]. The perception of threat can also stimulate the development of health motivation in individuals. Similarly, a lack of awareness of the danger posed by an illness will result in inadequate individual actions concerning the prevention and treatment of the disease [31]. Threat perception in this study pertains to the perspective of female adolescents about the identified threat associated with anemia. The findings indicated a diminished perception of threat, leading to inadequate conduct in preventing anemia, because it reduces the sense of urgency or importance adolescents attach to engaging in preventive behaviors. When adolescents don't fully appreciate the risks and seriousness of anemia, they are less likely to take proactive steps to avoid or manage the condition. On the contrary, a previous study has proven that perceived threat does not fully correlate with anemia prevention behavior due to a limited sense of urgency, which leads to a lack of urgency to adopt healthy behavior [32]. Additionally, fear of medical intervention can also prevent adolescents from engaging in effective prevention behaviors, as well as cultural and social norms, which are also regarded as a factor that makes it difficult for adolescents to prioritize anemia prevent, even if they recognize anemia as a threat [33].

3.3.2. Correlation between perceived benefits and anemia prevention behavior in female adolescents

This study shows a direct and positive effect of perceived benefits and the implementation of anemia prevention behavior. Perceived benefits indicate an individual's subjective assessment of the advantages or benefits experienced when mitigating the risk of a disease [34]. This perspective motivates individuals to contemplate the advantages of implementing strategies to avoid anemia. An individual will execute a course of action if they perceive the benefits of such an activity. In the case of preventing anemia, if adolescents don't recognize the benefits of prevention, they may not be motivated to take the necessary steps to avoid or manage the condition. This happens as adolescents may not see the value in making changes to their diet, lifestyle, or health behaviors. Perceived benefits in this study pertain to female adolescents' perceptions regarding the advantages of adopting healthy behaviors to prevent anemia. The findings indicated that female adolescents lacked awareness of the benefits of engaging in anemia prevention behavior. It significantly influences inadequate behavior in avoiding anemia. The likelihood of female adolescents ingesting iron tablets is higher when they perceive the advantages of such tablets compared to adolescents who do not share this perception.

However, previous study suggests that merely understanding the benefits of prevention is not enough, various social, psychological, and structural factors must also be addressed to translate it into action [35].

3.3.3. Correlation between perceived barrier and anemia prevention behavior in female adolescents

Perceived barrier directly and positively correlates with activity aimed at preventing anemia. The perception of barriers is derived from personal viewpoints of obstacles to adopting healthy lifestyle practices [34]. Potential obstacles to taking action may manifest as unpleasant emotions or discomfort experienced during treatment and sentiments of rejection. Furthermore, obstacles might manifest as financial hurdles (such as treatment expenses) and temporal obstacles (such as the time spent undergoing treatment or accessing health services that hinder productivity). Barriers may sometimes manifest as acute emotional distress experienced during medical treatment [36].

This study's perception of barriers relates to how female adolescents perceive factors hindering the implementation of anemia prevention behavior. The identified barriers comprise both situational and emotional challenges related to the consumption of iron supplements and participation in physical activity, as well as structural constraints, including limited time, insufficient financial resources to access hospital-based hemoglobin testing, and the considerable distance between participants' residences and healthcare facilities. A lack of perceived barriers can paradoxically lead to inadequate conduct in preventing anemia because it may foster a sense of complacency, overconfidence, and an underestimation of the effort required. Without recognizing the challenges and complexities involved in consistent prevention behaviors, adolescents may fail to engage with the actions needed to maintain iron levels, ultimately neglecting critical steps in managing anemia. However, cultural and familial practices and preferences can also play a significant role in determining behavior [37]. Even when adolescents perceive the barriers, they may not have the power or autonomy to change their behaviors, especially if their families do not prioritize or understand anemia prevention.

3.3.4. Correlation between self-efficacy and engagement in anemia prevention behavior among female adolescents

This study shows a direct and positive correlation between self-efficacy and anemia prevention behavior. Self-efficacy refers to an individual's confidence in accomplishing a task [38]. Most individuals will not take action or attempt to accomplish something novel without confidence in their ability. If an individual or group believes that adopting a new habit will yield favorable or advantageous outcomes, but they experience a sense of incapacity, the transformation process will remain elusive [34].

This study defines self-efficacy as the confidence level among female adolescents in consistently eating breakfast, exercising regularly, consuming protein-rich foods, taking iron tablets supplied by the health center, monitoring their anemia status, and independently purchasing iron pills. The study findings indicated that female adolescents had low self-confidence, leading to inadequate behavior in preventing anemia. Low self-confidence can significantly impact an adolescent's ability to engage in behaviors that prevent anemia because it undermines their belief in their own ability to succeed. This lack of self-belief leads to avoidance, inaction, fear of failure, and difficulty in overcoming challenges, all of which contribute to inadequate efforts in preventing anemia. Strengthening self-confidence, through education, support, and encouragement, can help adolescents take more proactive and consistent steps in managing and preventing anemia. On the contrary, while self-efficacy is important for motivating health behavior, it does not always guarantee that an adolescent will follow through on preventive actions like managing anemia. External factors such as environmental influences, social pressures, cognitive challenges, and lack of support [39] can all play a role in hindering the translation of self-efficacy into behavior.

3.3.5. Correlation between cues to action and anemia preventive behavior in female adolescents

Cues to action are directly and positively associated with behavior aimed at preventing anemia. Cues to action arise from individuals or situations that serve as the primary motivation for individuals to modify their habits [36]. Under the context of this study, cues to action are given regarding the factors that motivate female adolescents to engage in anemia prevention behavior. The cues to action are derived from parents, healthcare professionals, and peers. The study findings indicated a deficiency in prompts for action, which resulted in inadequate conduct during the prevention of anemia among female adolescents. A lack of prompts for action can result in inadequate behavior in preventing anemia among female adolescents because these prompts act as important motivators, reminders, and support systems for taking necessary health actions. Without reminders or cues, adolescents are less likely to remember or prioritize preventive behaviors such as eating iron-rich foods or taking supplements, which can lead to missed opportunities for anemia prevention and inadequate conduct in managing the condition.

However, the previous study has found that while cues to action, like health reminders or external triggers, have the potential to prompt behavioral change, they don't always lead to anemia prevention behavior in adolescents due to a variety of factors. These factors include limited personal relevance, environmental

barriers, social influences, lack of understanding, and the adolescent's developmental stage [34], [37]. To be effective, cues to action need to be well-timed, personalized, and accompanied by supportive structures (like access to resources and social support) that help adolescents act on them.

3.4. Indirect effect

3.4.1. Correlation between knowledge and anemia preventive behavior in female adolescents

Knowledge is indirectly correlated to anemia prevention behavior through self-efficacy. Anemia knowledge within the context of female adolescents pertains to their comprehension of the definition, indications, and manifestations of anemia and the necessary measures to avoid anemia. The previous study indicated that a high level of knowledge will enhance self-efficacy [40]. This study's findings show that acquiring a comprehensive understanding of anemia correlates with the level of self-assurance among adolescents to engage in anemia prevention activities. It provides adolescents with the knowledge and tools they need to take proactive steps toward prevention. This level of understanding fosters self-assurance by boosting their confidence in their ability to take action, overcome obstacles, and make informed decisions. As they gain insight into how anemia develops, how to prevent it, and why it matters, adolescents feel more empowered and capable of managing their health, which leads to a greater commitment to preventive behaviors and a higher level of self-efficacy.

However, while knowledge is essential for anemia prevention, it does not automatically lead to high self-efficacy. Self-efficacy is shaped by a combination of personal confidence, environmental factors, social influences, and emotional well-being [39], [41]. Adolescents may possess the knowledge to prevent anemia, but their belief in their ability to act on that knowledge is influenced by factors such as lack of support, emotional state, and personal circumstances.

3.4.2. Correlation between perceived susceptibility and anemia preventive behavior in female adolescents

This study shows that perceived susceptibility is indirectly associated with anemia prevention behavior through perceived threat. Perception of vulnerability is the personal assessment made by an individual regarding a deterioration in their health status or the likelihood of acquiring a disease [29], [34]. There is a positive correlation between the perceived threat and the willingness of an individual to participate in action aimed at reducing that risk. And conversely. There exists an inverse relationship between the perceived vulnerability of a disease and the level of preventive methods implemented [29], [34].

This study's findings suggest that female adolescents' perceived vulnerability affects their perception of the threat associated with anemia. Adolescents who view themselves as susceptible to anemia will heighten their impression of the threat related to anemia. In contrast, female adolescents who do not see themselves as susceptible to anemia will shape their belief that anemia is not a dangerous condition, subsequently affecting their tendency to engage in inadequate anemia prevention measures. When female adolescents do not see themselves as susceptible to anemia, they are less likely to perceive the condition as a serious health threat, leading them to underestimate its risks and fail to take preventive actions. This belief shapes their behavior, resulting in inadequate conduct in anemia prevention. Increasing awareness of susceptibility, educating them about the risks, and providing consistent reminders of how preventive measures can protect their health are key strategies in encouraging adequate action and engagement in prevention behaviors.

On the other hand, prior research found that perceived susceptibility does not always correlate to perceived threat in anemia prevention behavior in adolescents. While adolescents may acknowledge their susceptibility to anemia, they may not always perceive it as a significant threat because of various psychological, social, and environmental factors. These include a lack of immediate symptoms, competing priorities, emotional distance from the consequences, peer influences, conflicting information, and a general underestimation of health risks [41]–[43]. Without a strong sense of perceived threat, adolescents may not feel motivated to engage in anemia prevention behaviors, even if they know they are at risk.

3.4.3. Correlation between perceived severity and anemia preventive behavior in female adolescents

The perceived severity of anemia is indirectly associated with anemia prevention activity through perceived threat. Perceived severity refers to the subjective assessment made by an individual regarding the seriousness of an illness [36]. This concept is derived from the individual's presumption that the severity of an untreated sickness directly correlates with the magnitude of the threat that must be confronted [38].

Perceived severity in this study refers to the degree of seriousness experienced by female adolescents when they fail to adopt anemia prevention behavior. The study findings indicated that female adolescents who did not consider anemia a serious ailment had a less severe assessment of anemia as a threatening illness. Consequently, this resulted in inadequate measures to prevent anemia. Female adolescents who do not consider anemia a serious ailment typically have a less severe assessment of the condition because of a combination of

factors such as lack of visible symptoms, misunderstanding of its long-term consequences, lack of experience with serious illness, and social influences. This perception of anemia as a mild or non-threatening condition diminishes the likelihood that they will take preventive actions or seek treatment, as they don't feel a sense of urgency or danger related to the condition. Improving awareness and education about anemia's risks and consequences is essential in shifting this mindset and encouraging more proactive health behavior among adolescents.

Even though adolescents may recognize the severity of anemia, it does not always lead to a heightened perception of threat or motivate them to engage in preventive behavior, due to a range of factors, including the absence of immediate symptoms, confusion about long-term consequences, and a focus on short-term concern [37], [44]. Since anemia is often a gradual condition, adolescents may not experience the dramatic effects that would reinforce their belief in the severity of the condition. Without tangible signs of the condition, they might fail to perceive anemia as an urgent or serious health threat.

4. CONCLUSION

The path analysis revealed a direct and positive correlation between perceived threat, perceived benefits, perceived barriers, self-efficacy, cues to action, and anemia prevention behavior. Acquiring knowledge indirectly influences behavior to prevent anemia through self-efficacy. Perceived susceptibility indirectly influences behavior to prevent anemia through the perceived threat. Perceived severity indirectly influences behavior to prevent anemia through perceived threat.

This study contributes to advancing the understanding of the underlying factors influencing anemia prevention among female adolescents in border regions, considering the intricate challenges inherent to these settings. The implications of this study suggest that multifaceted interventions should be put in place that combine education, empowerment, overcoming barriers, and increasing the perceived threat and severity of anemia, all of which can improve anemia prevention behavior among female adolescents in this region. Additionally, future studies are expected to use mixed approaches in multilevel settings to investigate in-depth and comprehensive findings on several factors predicting anemia preventive behavior in female adolescents in the RI-RDTL border region.

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AUTHOR CONTRIBUTIONS STATEMENT

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C : **C**onceptualization

M : **M**ethodology

So : **S**oftware

Va : **V**alidation

Fo : **F**ormal analysis

I : **I**nvestigation

R : **R**esources

D : **D**ata Curation

O : Writing - **O**riginal Draft

E : Writing - Review & **E**ditting

Vi : **V**isualization

Su : **S**upervision

P : **P**roject administration

Fu : **F**unding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

INFORMED CONSENT

We have obtained informed consent from all individuals included in this study.

ETHICAL APPROVAL

This study has successfully undergone the health research ethics assessment conducted by the Health Research Ethics Commission from STRADA Institute of Health Sciences, No. 001906/EC/KEPK/I/12/2024.

DATA AVAILABILITY

The authors confirm that the data supporting the findings of this study are available within the article [and/or its supplementary materials].

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