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Effectiveness of school-based peer education on knowledge, attitudes, and behavior of diabetes mellitus prevention among adolescents

Efektivitas Edukasi Sebaya Berbasis Sekolah terhadap Pengetahuan, Sikap dan Perilaku Pencegahan Diabetes Melitus pada Remaja

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ABSTRACT

Background: *Diabetes Mellitus (DM) has become a global health concern with a rapidly increasing prevalence, including among adolescents. Early prevention efforts are essential and can be implemented through school-based peer education approaches.*
Objective*: To determine the effectiveness of school-based peer education on knowledge, attitudes, and behaviors related to diabetes mellitus prevention among adolescents.*
Methods: *A quasi-experimental design with a pretest and posttest control group was employed. The sample consisted of 90 adolescents, divided equally into the intervention and control groups (45 participants each). The intervention group received peer education through four weekly sessions, each lasting 60 minutes, while the control group did not receive any intervention. Data were collected using validated and reliable questionnaires assessing knowledge, attitudes, and behaviors related to diabetes mellitus prevention. The analysis employed the Mann-Whitney U test, the Wilcoxon signed-rank test, the independent t-test, and the paired t-test.*
Results: *The intervention group exhibited a considerably greater increase in knowledge scores compared to the control group (p=0.001). Attitude scores improved in the intervention group but declined in the control group, with a statistically significant difference (p = 0.005). Despite a marginally bigger improvement in behavior scores within the intervention group, the difference lacked statistical significance (p=0.802).*
Conclusion: *School-based peer education improved adolescents' knowledge and attitudes toward diabetes mellitus prevention but did not significantly influence preventive behaviors. Therefore, sustainable educational interventions that are integrated into school programs and support from various stakeholders are needed to enhance diabetes mellitus prevention behaviors among adolescents.*

Keywords: adolescents, DM, prevention, peer education

ABSTRAK

Latar Belakang: Diabetes Melitus (DM) menjadi masalah kesehatan global dengan prevalensi yang terus meningkat, termasuk pada remaja. Upaya pencegahan dini sangat penting dan dapat dilakukan melalui pendekatan edukasi sebaya berbasis sekolah.
Tujuan: Mengetahui efektivitas edukasi sebaya berbasis sekolah terhadap pengetahuan, sikap, dan perilaku pencegahan diabetes melitus pada remaja.
Metode: Penelitian ini menggunakan desain quasi-eksperimen dengan rancangan pre-test dan post-test control group design. Sample terdiri dari 90 remaja terbagi kedalam kelompok intervensi dan kontrol (masing-masing 45 responden). Kelompok intervensi

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mendapatkan edukasi sebaya sebanyak empat sesi selama 60 menit setiap minggunya, sedangkan kelompok kontrol tidak menerima intervensi. Data dikumpulkan menggunakan kuesioner yang telah diuji validitas dan reliabilitasnya untuk mengukur pengetahuan, sikap, dan perilaku pencegahan diabetes melitus. Analisis data dilakukan menggunakan uji Mann-Whitney U, uji Wilcoxon signed-rank, uji-t independen dan uji-t berpasangan.

Hasil: Kelompok intervensi menunjukan peningkatan skor pengetahuan yang jauh lebih tinggi dibandingkan kelompok kontrol (p = 0,000). Skor sikap meningkat pada kelompok intervensi, tetapi menurun pada kelompok kontrol dengan perbedaan yang signifikan secara statistik (p = 0,005). Meskipun terdapat peningkatan yang sedikit lebih tinggi pada kelompok intervensi, perbedaan tersebut tidak signifikan secara statistik (p = 0,802).

Kesimpulan: Edukasi sebaya berbasis sekolah efektif dalam meningkatkan pengetahuan dan sikap terkait pencegahan diabetes melitus, tetapi belum memberikan pengaruh yang signifikan terhadap perilaku. Intervensi edukasi berkelanjutan yang terintegrasi dengan program sekolah serta dukungan dari berbagai pihak diperlukan dalam meningkatkan perilaku pencegahan diabetes melitus pada remaja.

Kata kunci: DM, edukasi sebaya, pencegahan, remaja

INTRODUCTION

Diabetes Mellitus (DM) is a long-term health condition that is becoming more common around the world. An estimated about 589 million adults between 20 and 79 years old have diabetes mellitus. If current trends continue, this number could reach about 853 million by 2050, with most cases occurring in lower-middle-income countries.[1] According to Global Burden of Disease (GBD) 2021 data, millions of adolescents worldwide have diabetes mellitus. In 2021, there were about 14.6 million cases of type 2 and 3.4 million cases of type 1 among this age group. This trend shows that it is affecting young people earlier, likely due to rising rates of obesity and unhealthy habits among adolescents.[2]

The prevalence of diabetes mellitus is increasing in Indonesia. Between 2013 and 2023, the proportion of individuals aged 15 years and older with diabetes mellitus rose from approximately 10.7% in 2013 to 11.8% in 2018 and remained elevated at 11.3% in 2023.[3] The incidence of diabetes mellitus is also rising annually among children and adolescents.[4] While type 1 remains the most common chronic illness in children, the incidence of type 2 is increasing rapidly among younger populations. This trend is associated with a higher prevalence of overweight and obesity among children and adolescents.[5] These statistics indicate that diabetes mellitus represents a significant public health challenge for both adults and youth, particularly regarding the prevention of type 2 diabetes mellitus. The health status of today's adolescents will have a substantial impact on the health of future adult populations.

Type 2 diabetes mellitus is becoming more common among young people because of unhealthy habits, less physical activity, and higher obesity rates in children and adolescents. Since adolescence is a key time for developing behaviors, it is important to teach young people about diabetes mellitus prevention early through focused education. Good health education can help them understand the risks, encourage healthy habits, and support long-term diabetes mellitus prevention, especially when led by their peers.[6]

Providing prevention education to adolescents is necessary to prevent the incidence of diabetes mellitus in the future. School-based peer-to-peer education can be one educational method for adolescents.[6] The peer education approach is a health

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education method that involves adolescents as teaching agents to influence their peers. This model is based on the idea that information from peers will be more readily accepted due to close social relationships, equal communication, and significant group influence among adolescents. Research shows that education conducted by peers can improve knowledge, attitudes, and health-related behavioral skills among adolescents regarding various health issues, including the prevention of chronic diseases and lifestyle-related risks.[6]

A peer-led intervention study addressing type 2 diabetes mellitus prevention demonstrated that peer-led education programs enhance adolescents' understanding, health beliefs, and prevention practices following structured training and school-based interventions. These findings indicate that peer-led education is an effective strategy for promoting knowledge and behavioral change related to diabetes mellitus prevention.[6] The effectiveness of peer-led education is further strengthened when supported by suitable educational media. Additional research on adolescent health education has shown that materials such as booklets can function as effective educational tools.[7] Other forms of media, interactive e-booklets, have also been shown to significantly improve adolescents' health literacy and foster behaviors that prevent diabetes mellitus. These educational media serve as important models for diabetes mellitus prevention among adolescents, particularly in school settings or adolescent communities.[8]

Despite various preventive and therapeutic approaches to diabetes mellitus, cases of this disease continue to increase. This indicates that efforts are still insufficient. The growing problem of diabetes mellitus raises concerns about short-term and long-term complications and their impact on the quality of life of patients and families.[9] This indicates that promotive and preventive efforts for diabetes mellitus are still needed, especially in the adolescent age group, as a future at-risk population. A school-based approach through peer education is considered relevant because it utilizes the social dynamics of adolescents and the role of peers as agents of behavior change in their environment. Although various studies have reported the effectiveness of peer education in improving health knowledge and attitudes, evidence regarding its impact on diabetes mellitus prevention in adolescents in Indonesia is still limited. The novelty of this study lies in measuring the effectiveness of school-based peer education that simultaneously disseminates changes in three domains: knowledge, attitudes, and behavior in preventing diabetes mellitus among adolescents.

This study aimed to determine the effectiveness of school-based peer education on knowledge, attitudes, and behaviors related to diabetes mellitus prevention in adolescents. Preventive strategies for diabetes mellitus from an early age are very important and relevant, especially through interventions that involve adolescents themselves as drivers of behavioral change in their social environment.

METHODS

Study design

This study employed a quasi-experimental design with a pretest-posttest control group approach to evaluate the effectiveness of school-based peer education in improving adolescents' knowledge, attitudes, and behaviors related to diabetes mellitus. The study was conducted at a private junior high school in Bandung, Indonesia, between July and August 2025.

Data source and sampling procedure

This study utilized primary data collected from junior high school students during the study period. The study population comprised adolescents enrolled at the chosen

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school. Participants were recruited using a purposive sampling technique based on eligibility criteria. The inclusion criteria were adolescents aged 12-15 years, not diagnosed with type 1 or type 2 diabetes mellitus, willing to participate in the educational program, and able to attend all intervention sessions. The exclusion criteria included adolescents with special needs, particularly those with intellectual disabilities characterized by significant limitations in intellectual functioning and adaptive behavior that could interfere with their ability to comprehend educational materials and independently complete the questionnaires. A total of 90 participants met the eligibility criteria and were included in the study, with 45 students assigned to the intervention group and 45 students to the control group.

Variables of the study

The independent variable in this study was school-based peer education on diabetes mellitus prevention. The dependent variables were adolescents' knowledge, attitudes, and preventive behaviors related to diabetes mellitus.

Data collection

At baseline, both the intervention and control groups completed a pre-test using a questionnaire measuring adolescents' knowledge, attitudes, and preventive behavior related to diabetes mellitus. The same instrument was administered again as a post-test following the completion of the intervention to measure change in outcomes.

The intervention group received a school-based peer education program focusing on diabetes mellitus prevention, while the control group did not receive any intervention during the study period. Ten peer educators were selected based on teacher recommendations. Prior to implementation, the research facilitator team provided training to the peer educators to ensure consistency and accuracy in delivering the educational content. The peer education consisted of four 60-minute sessions each week. The session consisted of group discussions and the distribution of educational booklets. The booklets contained adolescent-focused information on diabetes mellitus, including its definition, symptoms, risk factors, prevention, management, and potential complications.

Measurement and instruments

Data were collected using a questionnaire designed to assess adolescents' knowledge, attitude, and preventive behavior related to diabetes mellitus. The knowledge domain was measured using a true/false format, attitudes were assessed using a Likert scale, and prevention behaviors were evaluated using a frequency scale. The instrument underwent validity and reliability testing in a pilot study involving 38 students from a public junior high school. The results of the validity test showed the calculated r values for the knowledge, attitude, and behavior instruments surpassed the critical r value of 0.320. Reliability testing using Cronbach's alpha indicated that all instruments had coefficients greater than 0.7. These findings indicate that the instrument was both valid and reliable.

Ethical Considerations

This study has been approved and declared ethically appropriate by the Health Research Ethics Commission, Poltekkes Kemenkes Bandung No. 07/KEPK/EC/VII/2025.

Data analysis

Descriptive analyses were used to assess respondent characteristics and the research variables of knowledge, attitude, and behavior, utilizing frequency distributions, means, and standard deviations. Bivariate analyses were conducted to compare knowledge, attitude and behavior scores between the intervention and control groups across three stages: pre-test, post-test, and the change (improvement) in

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scores. The Shapiro–Wilk was used to assess data normality. Knowledge scores were not normally distributed; therefore, nonparametric test, including the Mann–Whitney U test and the Wilcoxon signed-rank test, were applied. Similarly, the attitude data followed were not normally distributed; thus, nonparametric methods were used for between-group comparisons. However, as the distribution of change scores for attitudes met the assumption of normality, an independent t-test was used for this analysis. Behavior data were normally distributed; therefore, parametric tests, including the independent t-test and paired t-test, were employed. Statistical significance was set at $p < 0.05$. In addition to statistical significance testing, effect sizes were calculated to assess the magnitude of the intervention's impact. Cohen's *d* was used for parametric tests (independent and paired *t*-tests), while rank-biserial correlation was applied for nonparametric tests (Mann–Whitney U and Wilcoxon signed-rank tests).

RESULTS

Table 1. Demographic Characteristics of Respondents

Characteristics	Control group (n=45)	Intervention group (n=45)	p-value
Age			
Mean ± SD	14.27 ± 0,45	14.44 ± 0,5	0.080 [a]
Median (min-max)	14 (14 - 15)	14 (14 - 15)	
Gender (n, %)			
Male	26 (57.8%)	24 (53.3%)	0.832 [b]
Female	19 (42.2%)	21 (46.7%)	

The p-value is based on a) the Mann-Whitney U test, b) the Chi-Square test. The characteristics are declared homogeneous if p>0.05

Table 1 shows the demographic characteristics of respondents in both groups. The average age of respondents in the control group was 14.27 years, while in the intervention group it was 14.44 years. The median age in both groups was 14 years, with an age range of 14–15 years. A demographic homogeneity test was conducted to ensure there were no significant differences between the intervention and control groups at the beginning of the study. The results of the statistical tests showed no significant differences between the two groups (p>0.05) for age (Mann-Whitney U Test) or gender *(χ^2 Test).* This indicates that the samples in both groups were homogeneous before the intervention, allowing their knowledge, attitudes, and behaviors to be compared.

Table 2 presents a comparative analysis of knowledge between the control and intervention groups. At the pre-test stage, the control group exhibited a slightly higher median knowledge score than the intervention group. The Mann-Whitney U test produced a p-value greater than 0.05, indicating no significant difference in baseline knowledge levels between the groups. This result demonstrates that both groups were homogeneous at baseline. Following the peer education intervention, knowledge scores changed significantly. The median score in the intervention group increased by 23 points compared to the control group. Post-test score comparisons yielded a p-value of 0.001 (Mann-Whitney U test), indicating a highly significant difference in knowledge after the intervention. The magnitude of this difference was reflected by an effect size of 0.384, indicating that the difference in median values between the two groups falls within the medium category (0.30-0.50). Knowledge improvement within each group was assessed using the Wilcoxon Test. The control group showed a significant increase (p=0.028), while the intervention group showed a much stronger, highly significant increase (p=0.000). The effect size in the intervention group was classified as large (greater than 0.500), as indicated by a value of −0.983. Analysis of

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the difference in score improvement revealed that the intervention group had a higher median difference than the control group. The Mann-Whitney U test for this median difference produced a p-value of 0.000, confirming that the peer education intervention was effective and statistically significant in improving adolescents' knowledge of diabetes mellitus prevention compared to the control group.

Table 2. Comparative Analysis of Knowledge of Control and Intervention Groups

Variables	Control group (n=45)	Intervention group (n=45)	p-value	95% CI (Hodges-Lehman Estimates)	Effect Size (rbc)
Knowledge					
Pre-test				1.000	
Mean ± SD	20.38 ± 2.71	19.31 ± 2.85	0.054 [a]	($-2.252x10^{-2}$ to 2.000)	-0.235
Median (min-max)	21 (14 - 24)	20 (12 - 24)			
Post-test				-1.000	
Mean ± SD	21.31 ± 1.93	22.58 ± 1.59	0.001 [a*]	(-2.000 to	0.384
Median (min-max)	22 (17 - 24)	23 (18 - 25)		$-2.304x10^{-5}$)	
p-value pre-post test	0.028 [b*]	0.000 [b*]			
Difference				-2.000	0.482
Mean ± SD	0.93 ± 2.66	3.27 ± 2.6	0.000 [a*]	(-3.000 to	
Median (min-max)	0 (-5 - 8)	3 (-1 - 12)		-1.000)	
95% CI Diff					
Non-Parametric Effect Size					
Rank biserial correlation (rbc)	-0.439	-0.983			

The p-value is based on a) Mann-Whitney U test, b) Wilcoxon test, *comparison is declared significantly different (p<0.05)

Table 3. Comparative Analysis of Attitudes of Control and Intervention Groups

Variables	Control group (n=45)	Intervention group (n=45)	p-value	95% CI (Hodges-Lehman Estimates)	Effect Size (rbc
Attitude					
Pre-test				$-1.253x10^{-5}$	
Mean ± SD	34.24 ± 2.96	34.69 ± 2.22	0.754 [a]	(-1.000 to 1.000)	0.039
Median (min-max)	35 (26 - 39)	34 (30 - 39)			
Post-test					
Mean ± SD	33.24 ± 3.25	35.47 ± 2.76	0.001 [a*]	-2.000	0.395
Median (min-max)	34 (26 - 39)	36 (30 - 40)		(-4.000 to -1.000)	
p-value pre-post test	0.041 [c*]	0.062 [c]			
Difference				-1.778	
Mean ± SD	-1 ± 3.2	0.78 ± 2.62	0.005 [b*]	(-3.002 to -0.553)	-0.608
Median (min-max)	-1 (-7 - 6)	1 (-4 - 8)		Mean Diff & 95% CI	Cohen's d
Effect Size					
Non-Parametric					
Rank biserial correlation (rbc)	0.376	-0.332			

The p-value is based on a) Mann-Whitney U test, b) independent t-test, c) Wilcoxon test, *comparison is declared significantly different (p<0.05)

Table 3 presents a comparative analysis of attitudes between the control and intervention groups. During the pre-test, the median attitude score in the control group

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did not differ significantly from that in the intervention group. The Mann-Whitney U test confirmed no statistically significant difference in initial attitude scores (p=0.754), demonstrating homogeneity of attitudes before the intervention. In the post-test, the median attitude score in the intervention group increased to 36 (range 30-40), whereas the control group's median score remained at 34 (range 26-39). The comparison of post-test scores between groups revealed a statistically significant difference (p=0.001). This finding was further supported by an effect size in the medium category (0.395). The analysis of the change in attitude scores showed that the control group experienced a decrease (Mean ± SD = -1 ± 3.2), while the intervention group showed an increase (Mean ± SD = 0.78 ± 2.62). This indicated an overall tendency toward a decline in attitudes in the control group. The comparison of score differences using an independent t-test yielded a p-value of 0.005, which was supported by an effect size of −0.608 (a large effect, greater than 0.500). These findings indicated that peer education interventions were effective in maintaining or enhancing adolescents' positive attitudes toward DM prevention, with effects that are significantly different from those observed in the control group.

Table 4. Comparative Analysis of Behavior of Control and Intervention Groups

Variables	Control group (n=45)	Intervention group (n=45)	p-value	95% CI (Mean Difference)	Effect Size (Cohen's d)
Behavior					
Pre-test					
Mean ± SD	26.73 ± 3.48	27.71 ± 3.73	0.202 [a]	-0.978 (-2.490 to 0.534)	-0.271
Median (min-max)	27 (18 - 34)	26 (20 - 36)			
Post-test					
Mean ± SD	28.07 ± 3.97	29.24 ± 3.54	0.141 [a]	-1.178 (-2.752 to 0.397)	-0.313
Median (min-max)	28 (18 - 35)	30 (20 - 38)			
p-value pre-post test	0.056 [b]	0.001 [b*]			
Difference					
Mean ± SD	1.33 ± 4.56	1.53 ± 2.75	0.802 [a]		
Median (min-max)	1 (-10 - 14)	2 (-6 - 8)			
Effect Size Cohen's d	-0.292	-0.557			

The p-value is based on testing a) an independent t-test, b) a paired t-test, *comparison is stated as significantly different (p<0.05)

Table 4 presents a comparative analysis of behavioral outcomes in the control and intervention groups. In the pre-test measurement, the intervention group's mean behavioral score was 27.71 ± 3.73, marginally higher than the control group's (26.73 ± 3.48). The Independent t-test yielded a p-value of 0.202, indicating no statistically significant difference in baseline diabetes mellitus prevention behavior between groups, confirming homogeneity. Following the peer education intervention, mean behavioral scores increased in both groups. The intervention group's post-test mean was 29.24±3.54, while the control group's was 28.07±3.97. The post-test comparison using an independent t-test yielded a p-value of 0.141, indicating no statistically significant difference in behavioral levels between groups after the intervention. Although not statistically significant, the effect size of −0.313 indicated a moderate difference between groups.

Intra-group analysis revealed a statistically significant increase in behavior only within the intervention group (p=0.001) with an effect size of improvement (−0.557), indicating a large magnitude, whereas the control group's change was not significant (p=0.056). The primary analysis, which compared mean differences (intervention

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effect), showed a mean behavioral increase of 1.53±2.75 in the intervention group and 1.33±4.56 in the control group. However, the independent t-test for these mean differences resulted in a p-value of 0.802, indicating that the difference in behavioral improvement between groups was not statistically significant. Therefore, school-based peer education interventions did not demonstrate statistical effectiveness in improving diabetes mellitus prevention behaviors compared to the control group.

DISCUSSION

The findings of this study demonstrate that both the control and intervention groups exhibited increased knowledge scores at the post-test. Multiple factors may have contributed to the improvement observed in the control group. One such factor is the testing effect, wherein exposure to a pre-test can facilitate learning and lead to higher post-test scores through both formal instruction and active engagement following the pre-test. Participants may have been motivated to seek additional information after the initial assessment and were likely exposed to health information from parents, teachers, and the broader school environment. Additionally, adolescents' widespread access to the internet or social media provides further opportunities to acquire health information informally.[10–12]

The intervention group showed a significantly greater increase in knowledge. These results indicate that peer education enhances adolescents' understanding of diabetes mellitus risk factors, early symptoms, and preventive strategies. A comparison of increases in knowledge scores between the two groups showed that the intervention group achieved a statistically significant improvement relative to the control group. These findings indicate that the difference in knowledge gain is attributable to the peer education intervention rather than to natural factors or pretest effects. This finding aligns with a cluster-randomized trial, which demonstrated that peer-based education significantly improved diabetes mellitus knowledge and preventive behaviors among adolescents compared with the non-intervention group.[6]

Attitude measurements in this study showed an increase in the attitude score for the intervention group. This difference was statistically significant, indicating that participants who received peer education developed a more positive attitude towards diabetes mellitus prevention than those in the control group. Analysis of difference scores revealed a positive mean increase for the intervention group, while the control group showed a negative mean difference, indicating a decline in attitudes. The comparison of difference scores between groups yielded a p-value of 0.005, further supporting the conclusion that peer education significantly influences adolescent attitudes.

These findings are consistent with previous studies. Peer education interventions in school settings have been shown to increase knowledge and influence health attitudes and beliefs about type 2 diabetes mellitus prevention, compared with a control group without intervention, while also promoting healthier behavioral changes in adolescents.[6] The learning process in peer education is facilitated through observation and imitation, whereby individuals model the actions of socially relevant figures, such as peers. These results are consistent with research assessing the efficacy of peer education among adolescents using the Social Cognitive Theory framework, which demonstrated that this approach improves knowledge and healthy behaviors.[13] Additional studies have shown that peer education significantly improves adolescents' health attitudes compared with a control group that did not receive it. The control group did not exhibit significant changes in attitude after baseline measurements.[14] Collectively, these findings underscore the role of peer education in motivating positive

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attitude changes in adolescents through social interactions, including open discussion, recognition of shared experiences, and active learning, which helps prevent feelings of embarrassment and fear when expressing opinions.[13,14]

The control group that did not receive peer education demonstrated a decline in attitude scores. This decline may result from the absence of ongoing reinforcement of health messages provided during the initial assessment. In the absence of targeted intervention, adolescents' attitudes toward health issues generally do not improve or remain static, as information from environmental or media sources is often inadequately structured and insufficient to promote sustained attitude change. Peer education, by facilitating open discussion and the expression of personal opinions, can enhance individuals' capacity to initiate and maintain health-related actions.[15,16]

Behavioral measurements indicated that the mean post-test score in the intervention group was slightly higher than in the control group. However, an independent t-test demonstrated no statistically significant difference in behavioral levels between the two groups following the intervention. These results suggest that, by the end of the measurement period, diabetes mellitus prevention behaviors among adolescents in both groups were comparable. Intra-group analysis showed that only the intervention group exhibited a statistically significant improvement in behavior, whereas the control group did not. This finding implies that peer education contributed positively to behavioral change within the intervention group. However, the mean behavioral increase in the intervention group exceeded that in the control group; the difference did not reach statistical significance.

Although some studies indicate that peer education can improve understanding and attitudes, the evidence regarding its effectiveness in changing adolescent health behaviors remains inconclusive. A review of various peer-led interventions in schools reported that effects on psychological outcomes, such as mental well-being and self-esteem, were not statistically significant. These findings indicate that anticipated behavior changes have not been consistently demonstrated across different contexts.[17] Additionally, another review found that while many interventions have improved health literacy, there is limited evidence of significant behavior change, suggesting that peer education may not reliably sustain consistent behavioral improvements among adolescents. The effectiveness of peer education was influenced by several key mechanisms, particularly peer proximity, delivery approaches, and supportiveness of the school environtment.[16,18]

The findings of this study demonstrate that peer education effectively enhances adolescents' knowledge and attitudes regarding the prevention of diabetes mellitus. Individuals are more likely to comprehend and retain information delivered by influential members of their social environment. Peer educators serve as accessible, relatable role models, facilitating the adoption and application of health messages in adolescents' behaviors. Peer education has been recognized as a strategy that promotes social learning and psychosocial support among adolescents, as peer-delivered messages are often more relevant and easily adopted by participants.[13,19,20] This approach enables two-way communication, encourages open discussion, and allows for clarification of material using language that is both simpler and culturally appropriate. Such conditions foster greater cognitive and emotional engagement, thereby improving information retention.[13] Adolescents who participated in peer-led education interventions achieved significantly higher knowledge scores than those exposed to one-way education methods, likely due to greater comfort asking questions and engaging in discussion. Peer education has been shown to improve knowledge, attitudes, health behaviors, and self-efficacy.[21]

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Several studies and systematic reviews indicated that peer education is generally effective in enhancing health knowledge and attitudes. However, its influence on adolescents' health behaviors remains ambiguous. Reviews of school-based peer education report limited or inconsistent evidence of behavioral change, with most interventions demonstrating greater success in improving knowledge than in altering behavior. These findings imply that behavioral change is a complex process that often requires reinforcement and a supportive environment to achieve meaningful outcomes.[16,17]

This study has several strengths, including the use of a control group design and comprehensive measurement of knowledge, attitudes, and behaviors related to diabetes mellitus (DM) prevention in adolescents. Implementing the intervention in a school setting also provides added value because it utilizes peer group dynamics as a social factor influencing the formation of health attitudes and behaviors. However, this study has several limitations. The use of a quasi-experimental design without randomization leaves the study vulnerable to selection bias and the influence of students' inherent confounding variables. Furthermore, the research location, which was limited to a single school, restricts its external validity, meaning results cannot be directly generalized to different populations, regions, or educational contexts. The final limitation is the absence of a long-term follow-up evaluation, which means this study has not been able to measure how long the affect the intervention can last permanently.

CONCLUSION

School-based peer education has been demonstrated to be effective in improving adolescents' knowledge and attitudes regarding diabetes mellitus prevention; however, it has not shown a significant effect on behavioral change. Therefore, sustainable educational interventions that are integrated into school programs and support from various stakeholders are needed to improve and promote behaviors among adolescents. Furthermore, future studies are recommended to employ a randomized experimental design to better control for selection bias, include a larger and more diverse sample across multiple schools to enhance external validity and generalizability, and incorporate long-term follow-up assessment to evaluate the sustainability of intervention effects.

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