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Community-Based Health Education Improves Early Detection of Diabetes Risk in A Religious Community: A Quasi-Experimental Study in Indonesia

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A B S T R A C T

Diabetes frequently remains undiagnosed in the early stages, resulting in delayed effective management. This study analyses the effectiveness of community-based health education in improving knowledge levels, early detection of diabetes risk, and diabetes risk factors, including body mass index (BMI), waist circumference, and blood pressure, in the GKI Oikumene Bahtera Injil Aspol Remu community. It was a quasi-experimental study utilizing a prospective approach conducted over six months. There were 110 respondents, 55 in the intervention and 55 in the control group. The health education intervention comprised four intensive sessions encompassing diabetes comprehension, lifestyle management, and early detection of diabetes risk. Data were collected using validated questionnaires and physical parameter measurements. Data analysis used the paired t-test and chi-square test. The results showed that knowledge scores increased from 55.3 ± 10.2 to 82.4 ± 8.5 ($p<0.001$) in the intervention group. In addition, the early detection rate in the intervention group was higher, 70.9%, compared to that in the control group, which was 31.8%. In addition, there were significant reductions in body mass index (-1.2 ± 0.8 kg/m²) and systolic blood pressure (-5.4 ± 4.2 mmHg) compared to the control group. Physical activity also increased significantly (+45.6 ± 15.3) in the intervention group. Further, the 31–50-year age group has the highest early detection rates. Community-based health education increases knowledge levels and early detection of diabetes risk, as well as decreases diabetes risk factors, such as decreased body mass index (BMI) and blood pressure, and increased physical activity, especially in productive age groups.

INTRODUCTION

Diabetes mellitus represents a major global health challenge, with an increasing prevalence, particularly in developing countries. According to the International Diabetes Federation (Magliano and Boyko, 2021), more than 537 million individuals worldwide have diabetes. The incident is projected to increase to 643 million by 2030. Diabetes mellitus frequently remains undiagnosed in the early stages, resulting in delayed effective management. Health education and early detection play crucial roles in preventing and managing diabetes, especially in communities with low levels of health literacy. Community-based approaches are promising strategies, as they can reach populations that are difficult to access through the formal health system and utilize existing social capital (Adams, 2020; Ahmed *et al.*, 2022).

Diabetes is a significant threat in Indonesia, with a prevalence of 10.4% in adults (Soeatmadji *et al.*, 2023; Tanoey and Becher, 2023; Darmawan *et al.*, 2024). The Malasimsa Public Health Centre working area, which encompasses the faith-based community at the Indonesian Christian Church or Gereja Kristen Indonesia GKI Oikumene Bahtera Injil Aspol Remu, faces similar challenges. There was a high prevalence of diabetes risk factors such as obesity, hypertension, and a sedentary lifestyle. Those issues

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indicate the need for more effective interventions. Health education approaches in faith-based communities have considerable potential to increase public awareness, given the strong social influence within these communities. However, implementing health education programs remains limited and lacks systematic evaluation.

A major challenge in diabetes management is the early detection of risk factors. Many individuals are unaware of diabetes risks until complications arise, leading to significant health and economic burdens. This challenge is particularly evident in areas with limited access to health facilities and low levels of health literacy, such as in the Malasimsa Public Health Center (PHC) working area. Individual counseling and health screening in health facilities only reach a small proportion of the at-risk population. Community-based health education offers a potential solution; however, its effectiveness has not yet been fully explored in local contexts.

Recent research suggested that community-based health education could increase awareness, knowledge, health, and preventive behavior (Jones *et al.*, 2015; Suprayitno *et al.*, 2021; Paudel *et al.*, 2022; Artawan Eka Putra *et al.*, 2023; Badulla, Alshakka and Mohamed Ibrahim, 2023; Mathias *et al.*, 2023). However, most research focused on urban populations with superior access to health resources or did not consider the local cultural context (Amalba *et al.*, 2020; Li *et al.*, 2023; Rong, Ristevski, and Carroll, 2023). At the same time, other investigations emphasized the importance of cultural context in the success of health programs but often lacked exploration of faith-based communities as research subjects (Latif, 2020; Dwivedi *et al.*, 2021; Layson, Carey and Best, 2023; Afrianti *et al.*, 2024). Other studies also frequently employed less robust designs, making it challenging to measure the long-term impact (Alderwick *et al.*, 2021; Vaiyapuri *et al.*, 2023; Elsheli, Patrick and Stokes, 2024; Leong *et al.*, 2024). These research gaps underscore the necessity for more comprehensive studies with community-based approaches in specific contexts, such as faith-based communities, to evaluate the efficacy and sustainability of community-based health education programs. This study offers an approach to integrating health education into faith-based community activities. This innovation supports existing theories and creates a new model relevant to the socio-cultural context of Indonesian society. From a practical standpoint, this research can potentially enhance the effectiveness of public health programs in areas with limited access to formal health facilities.

This study analyses the effectiveness of community-based health education in improving knowledge levels, early detection of diabetes risk, and diabetes risk factors, including body mass index (BMI), waist circumference, and blood pressure, in the GKI Oikumene Bahtera Injil Aspol Remu community. It expands the application of the Health Belief Model (HBM) theory in the context of faith-based communities (Jones *et al.*, 2015; Glanz, 2017; Alamer, 2023). From a practical perspective, this research

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can also be a foundation for developing relevant and contextualized community-based health education programs. This paper utilizes innovative approaches, i.e., the integration of health education with church community activities. It can potentially reach populations that have been challenging to access through the formal health system.

METHOD

This study used a quasi-experimental design with a prospective approach, measuring the effectiveness of community-based health education in enhancing knowledge and early detection of diabetes risk in the target population over a specified period. A prospective approach was selected, enabling observation of changes over time and providing more robust evidence than a retrospective design. The study duration was six months, encompassing participant recruitment to the final evaluation. The independent variable in this study was health education. At the same time, the dependent variables comprised knowledge level, early detection of diabetes risk, and diabetes risk factors, including body mass index (BMI), waist circumference, and blood pressure. The Authors implemented various strategies to control potential bias. Participant recruitment was conducted inclusively based on clearly defined criteria to avoid selection bias. Information bias was mitigated through the utilization of validated instruments. Confounding bias was controlled by regression-model-based statistical analysis to adjust for confounding variables that might influence the study results.

The intervention in this study utilized a group-based health education approach with materials developed based on national guidelines. The program consisted of four main sessions, each 90 minutes, covering a range of salient topics. The first session addressed a fundamental understanding of diabetes and its risk factors. The second session focused on managing a healthy lifestyle, including nutrition and physical activity. The third session taught risk factors measurement techniques, such as BMI calculation and blood pressure measurement. The final session examined prevention strategies and early detection of diabetes. The intervention procedures were standardized to ensure uniformity of implementation across groups. Researchers provided training materials to health workers through simulations and practical guidance over two training days. Attendance registers monitored participant compliance. There was a brief evaluation after each session. The principal investigator provided direct supervision during each session to maintain fidelity.

Meanwhile, the control group received only standardized information in leaflets without health education. The intervention schedule was conducted at separate locations and times to prevent potential information contamination between the groups. Additionally, a blinding procedure was applied to data analysis (single-blinded), wherein respondents did not know the allocation of intervention or control groups to

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ensure objectivity in the results processing. The sample size was determined through power analysis with a significance level of 5% (α=0.05) and a test power of 80% (1-β=0.80). Based on the estimated prevalence of diabetes in the Malasimsa region (10 %), a minimum of 50 participants were required in each group. The Authors recruited 110 participants to anticipate a 10% attrition rate.

The recruitment process was conducted through a church-based approach, utilizing regular announcements and collaborating with local community leaders. The informed consent procedure was implemented in writing after giving respondents a detailed explanation of the purpose, benefits, risks, and their rights as research participants. This study employed SMS reminders and regular home visits to enhance participant retention and mitigate attrition.

The measurement instruments in this study included validated knowledge and behavior questionnaires with Cronbach's alpha reliability >0.7. In addition, physical measurements such as body mass index (BMI), waist circumference, and blood pressure using standardized and regularly calibrated tools. Data collection procedures were standardized through intensive training of data collectors to ensure consistency and accuracy. The principal investigator conducted quality control through field supervision and random rechecking of the data. All data were stored digitally on a secure server with a regular backup system. Multiple imputation analysis was applied to address missing data. The data collection timeline was divided into three stages: pre-intervention at month 0, intervention implementation from months 1 to 3, and post-intervention evaluation at month 6.

Data analysis in this study was conducted using SPSS software version 26.0. The primary analytical methods employed included the paired t-test and chi-square test to compare outcomes before and after the intervention. Furthermore, a secondary analysis was performed using logistic regression to evaluate the factors contributing to changes in early detection. Subgroup analyses were also conducted based on age to identify responsiveness to the intervention.

This study was approved by the Ethics Committee of Health Polytechnic of the Health Ministry of Sorong, Indonesia, with certificate number DM.3.1/472/2024. Informed consent procedures ensured data confidentiality and the protection of respondents' rights. There were minimal risks and no invasive interventions in this investigation. Data management adhered to privacy protection standards. The results of the study will be disseminated openly under the data-sharing policy. Adverse event reporting protocols ensured prompt response in the event of complications during the research.

RESULT

Table 1 presents respondents' demographic and baseline health characteristics. The respondent characteristic data indicates a balanced distribution between the intervention and control groups. There

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are no statistically significant differences (p>0.05) in age, sex, BMI, blood pressure, or family history of diabetes. Most respondents are aged 30–50 years. In addition, most have above-normal BMI, suggesting a high prevalence of obesity in this community. Thus, the relevance of this study in addressing diabetes risk factors is crucial.

Table 1. The Characteristics of Respondents

The Characteristics of The Respondents	Intervention Group (n=75)	Control Group (n=75)	*p*
Age (years, mean ± SD)	42.1 ± 10.5	43.3 ± 9.8	0.523
Gender (Male, %)	47.3%	50.9%	0.712
Body Mass Index (BMI)	25.4 ± 3.2	26.1 ± 3.0	0.214
Blood Pressure (mmHg)	128.5 ± 12.7	129.7 ± 11.9	0.637
Family History of Diabetes (%)	21.8%	20.0%	0.834

Table 2 summarizes knowledge level and early detection of diabetes risk assessed using pre-and post-test scores. It shows that knowledge scores increased from 55.3 ± 10.2 to 82.4 ± 8.5 in the intervention group. Knowledge levels improve significantly in the intervention group after health education (p< 0.001). In addition, the early detection rate in the intervention group is higher, 70.9%, compared to that in the control group, which is 31.8%. The early detection of diabetes risk significantly doubles in the intervention group compared to that in the control group.

Table 2. Knowledge Levels and Early Detection of Diabetes Risk

Variables	Intervention Group (n = 55)	Control Group (n = 55)	*p*
Knowledge Score (Pre-test)	55.3 ± 10.2	54.8 ± 11.0	0.794
Knowledge Score (Post-test)	82.4 ± 8.5	57.2 ± 10.8	<0.001
Early Detection Rate of Diabetes Risk (%)	70.9%	31.8%	<0.001

The results indicated the positive impact of health education on minimizing diabetes risk factors. There were significant reductions in body mass index (-1.2 ± 0.8 kg/m²) and systolic blood pressure (-5.4 ± 4.2 mmHg) in the intervention group compared to the control group. In addition, physical activity increased significantly (+45.6 ± 15.3) in the intervention group (table 3).

Table 3. Changes in Diabetes Risk Factors

Variables	Intervention Group (n = 55)	Control Group (n = 55)	*p*
Body Mass Index (BMI, kg/m²)	-1.2 ± 0.8	-0.2 ± 0.5	<0.001
Systolic Blood Pressure (mmHg)	-5.4 ± 4.2	-1.1 ± 3.6	<0.001
Physical activity (minutes/week)	+45.6 ± 15.3	+5.8 ± 12.1	<0.001

Table 4 shows increased early detection rates across all age subgroups. Further, the 31–50-year age group has the highest early detection rates. Thus, the productive age group (31–50 years) most responds to the health education intervention.

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Table 4. Early Detection Rates by Age Subgroup

Age Group (years)	Intervention Group (n = 55)	Control Group (n = 55)	*p*
18–30	65.3	28.7	0.002
31–50	75.8	33.1	<0.001
>50	70.0	35.5	0.011

DISCUSSION

This study demonstrated that community-based health education significantly enhanced knowledge levels and early detection of diabetes risk in the GKI Oikumene Bahtera Injil Aspol Remu community. Furthermore, the program contributed to decreased diabetes risk factors, such as reduced body mass index (BMI) and blood pressure and increased physical activity. These findings were consistent across age groups, with the most substantial impact observed in the 31-50 age group. Integrating these findings with the Health Belief Model (HBM) theory suggests that health education enhances community perceptions of diabetes risk and promotes health behavior change. This finding aligns with previous research indicating that community-based interventions effectively improved health literacy and chronic disease prevention (Walters *et al.*, 2020; Shao *et al.*, 2023).

The primary findings indicated that community-based health education significantly increased the early detection of diabetes risk in a religious community. These results corroborate the theory that providing relevant and comprehensible information can increase individuals' awareness of their health conditions. Thus, health education is applicable as a viable preventive approach in faith-based communities.

In addition, this investigation showed alterations in physical parameters, such as decreased BMI and blood pressure. There were also significant changes in community behavior, including increased physical activity, which is one of the indicators of lifestyle change. These diabetes risk factor reductions are likely attributable to increased risk awareness and practical guidance during the intervention. The community-based approaches effectively improve chronic disease prevention, particularly in areas with limited access to health facilities (Byun *et al.*, 2021). This finding is consistent with prior research, demonstrating the efficacy of community-based health education interventions in reducing the prevalence of diabetes risk factors (Fritz *et al.*, 2024).

However, this study revealed that the young age group (18-30 years) was less responsive to health education than those in the productive age group. This finding diverges from the study by (Chen and Wang, 2021), who found that younger age groups were more responsive to digital-based health campaigns. This discrepancy may be due to the social context and intervention methods. The method in this study may be less congruent with the communication preferences of the younger generation. In other words, this research had limited utilization of digital technology in information dissemination.

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An unanticipated finding was that a small proportion of respondents resisted change despite receiving health education. This resistance may be due to personal beliefs or adherence to unhealthy traditional dietary practices. In addition, there is an absence of social support for adopting a healthy lifestyle, particularly in neighborhoods with a high prevalence of diabetes risk factors.

This study contributes to the literature by demonstrating that community-based health education can reinforce elements of HBM, particularly in enhancing risk perception and the benefits of behavior change. In addition, it addresses the knowledge gap regarding the effectiveness of health education in faith-based communities. This research provides novel insights into how a structured and contextualized framework can significantly impact the promotion of health behavior changes. Furthermore, it offers relevant health education implementation guidelines for stakeholders, such as local governments and public health organizations. Depending on the local cultural context, it can be applied in other communities with minor modifications. Practical recommendations include utilizing digital media to engage younger age groups and integrating health education programs with primary health care. Implementing this study can potentially reduce the prevalence of diabetes through community-based prevention strategies.

However, this study had several limitations. First, the quasi-experimental design may increase the potential for selection bias. Second, the sample was limited to a specific faith-based community, necessitating cautious generalization of the results. Third, the six-month observation period may be insufficient to measure the long-term impact of this intervention. In addition, data collection relying on self-reporting may introduce information bias. Future research could employ a randomized controlled trial design to enhance internal validity. Moreover, the development of technology-based interventions, such as health applications or online modules, could be evaluated for their effectiveness in younger age groups. Other unexplored aspects were social support and local culture's influence on health education's success. New research questions include how variations in health education formats affect their effectiveness across different demographic groups.

CONCLUSION

Community-based health education increases knowledge levels and early detection of diabetes risk, as well as decreases diabetes risk factors, such as decreased body mass index (BMI) and blood pressure, and increased physical activity, especially in productive age groups. These findings strengthen community-based approaches in chronic disease prevention, supporting the Health Belief Model theory on the importance of perceived risks and benefits in driving health behavior changes. In addition, this study provides practical insights into the development of community-based interventions in diverse local contexts. Moreover, it supports efforts to strengthen public health policies by encouraging the

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implementation of health education programs at the community level, potentially reducing the prevalence of diabetes through early detection and proactive prevention.

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