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EVALUATING THE IMPACT OF PUBLIC HEALTH EDUCATION INTERVENTIONS ON CHRONIC DISEASE PREVENTION: A STATISTICAL ANALYSIS IN COMMUNITY POPULATIONS

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ABSTRACT

Chronic noncommunicable diseases represent one of the main causes of mortality globally, especially in vulnerable community contexts. The objective of this study was to evaluate the impact of public health educational interventions on the prevention of chronic diseases through a quasi-experimental quantitative approach. The sample consisted of 240 participants divided into an intervention group and a control group. Clinical (BMI, blood pressure, glucose) and behavioral (physical activity, eating habits) variables were analyzed before and after a 16-week intervention. The results showed statistically significant improvements in the intervened group ($p < 0.001$), with reductions in BMI, blood pressure and glucose levels, as well as increases in physical activity and diet quality. The ANOVA analysis showed significant differences between groups, while multiple regression identified participation in the intervention as the main predictor of improvement. It is concluded that educational interventions in public health are effective for the prevention of chronic diseases, especially when they are comprehensive and adapted to the community context.

KEYWORDS: health education, chronic diseases, community intervention, prevention, statistical analysis, public health.

1. INTRODUCTION

Chronic non-communicable diseases (NCDs), such as type 2 diabetes mellitus, cardiovascular diseases, high blood pressure and some types of cancer, are currently one of the main causes of morbidity and mortality globally. According to the World Health Organization, these pathologies account for approximately 74% of deaths in the world, disproportionately affecting low- and middle-income populations, where socioeconomic conditions, unhealthy lifestyles, and limited access to health services compound their impact. In Latin America, and particularly in vulnerable community contexts, the burden of these diseases has been increasing, generating significant challenges for public health systems.

In this context, health promotion and primary prevention emerge as fundamental strategies to reduce the incidence and prevalence of NCDs. Within these strategies, educational interventions in public health have become especially relevant, given their potential to modify behaviors, increase health knowledge and promote healthy lifestyles. These interventions may include community nutrition education programs, physical activity campaigns, self-care workshops, and communication strategies aimed at preventing risk factors such as a sedentary lifestyle, poor diet, tobacco and alcohol consumption, among others.

However, despite the growing number of educational programs implemented in various contexts, there is a significant gap in the rigorous evaluation of their actual impact on chronic disease prevention. Many studies are limited to measuring changes in knowledge or attitudes, without delving into long-term clinical or behavioral outcomes. Also, in some cases, the evaluation lacks robust methodological designs or statistical analyses that allow establishing causal relationships or significant associations between the interventions and the observed results.

From a methodological perspective, it is essential to apply quantitative approaches that allow objectively measuring the effect of educational interventions on relevant public health variables. The use of descriptive and inferential statistical analyses, such as correlations, regressions, and analysis of variance (ANOVA), allows not only to identify significant changes in health indicators, but also to understand the factors that influence the effectiveness of such interventions. This type of analysis is especially useful in studies carried out in community populations, where social, cultural and economic conditions can act as moderating variables.

This study is framed in a quantitative quasi-experimental approach, aimed at evaluating the impact of public health educational interventions on the prevention of chronic diseases in community populations. This approach allows comparing groups before and after the intervention, as well as analyzing differences between intervened and non-intervened groups, providing empirical evidence on the effectiveness of the strategies implemented.

The relevance of this research lies in the need to generate solid scientific evidence that supports decision-making in public health policies. Rigorously evaluating educational interventions not only makes it possible to optimize the available resources, but also to design more effective programs adapted to the specific needs of communities. It also contributes to the strengthening of evidence-based public health, promoting interventions that really impact the reduction of risk factors and the improvement of the quality of life of the population.

In terms of scientific contribution, this study seeks to integrate advanced statistical analysis with the evaluation of community interventions, offering a replicable model for future research in the field of public health. In addition, it aims to provide empirical evidence on the relationship between health education and changes in key indicators associated with chronic diseases, such as body mass index (BMI), glucose levels, blood pressure and lifestyle habits.

1.1 General objective

To evaluate the impact of public health education interventions on the prevention of chronic diseases in community populations, through a statistical analysis of clinical and behavioral variables.

1.2 Specific objectives

1. Analyze changes in health indicators (BMI, blood pressure, glucose levels) before and after the educational intervention.
2. To evaluate the modification of lifestyle habits (diet, physical activity, substance use) in the intervened population.
3. To determine the statistical relationship between participation in educational interventions and the reduction of risk factors associated with chronic diseases.
4. To compare the results between intervention groups and control groups to identify significant differences.
5. To identify sociodemographic variables that influence the effectiveness of interventions.

1.3 Research hypothesis

H1: Public health education interventions generate a significant reduction in risk factors associated with chronic diseases in community populations.
H2: There are statistically significant differences in health indicators between the intervention groups and the control groups.
H3: The effectiveness of educational interventions is moderated by sociodemographic variables such as age, educational level, and socioeconomic status.

In summary, this research addresses a problem of high relevance in public health through a rigorous quantitative approach, aimed at generating solid evidence on the effectiveness of educational interventions in the prevention of chronic diseases. The development of this study will not only evaluate results, but also identify opportunities for improvement in the design and implementation of community educational strategies.

2. THEORETICAL FRAMEWORK

2.1 Chronic noncommunicable diseases: conceptualization and global burden

Chronic non-communicable diseases (NCDs) are characterized by their long duration, slow progression and multifactorial etiology, mainly associated with modifiable risk factors such as inadequate diet, physical inactivity, tobacco and alcohol consumption, as well as social determinants of health. Major NCDs include cardiovascular disease, type 2 diabetes mellitus, chronic respiratory diseases, and various types of cancer.

In recent decades, the epidemiological transition has shifted the predominance of infectious diseases towards chronic diseases, especially in middle-income countries. This phenomenon has generated increasing pressure on health systems, due to the high costs associated with the treatment and management of these pathologies. In addition, NCDs not only affect physical health, but also people's economic productivity and quality of life.

Recent studies have shown that more than 80% of NCD deaths could be prevented through interventions aimed at modifying behavioral risk factors. In this sense, primary prevention takes on a central role, particularly in community contexts where social inequalities significantly influence the adoption of healthy lifestyles.

2.2 Health education as a prevention strategy

Health education is defined as a systematic process that seeks to facilitate the acquisition of knowledge, skills, and attitudes necessary to improve individual and collective health. From a public health perspective, educational interventions aim to empower communities to adopt healthy behaviors and actively participate in their health care.

Educational interventions can be classified into different types, including:

- Structured educational programs (workshops, community courses)
- Massive health communication campaigns
- Interventions based on digital technologies (mHealth, eHealth)
- Community Participatory Strategies

The effectiveness of these interventions depends on multiple factors, including cultural relevance, accessibility, program duration, and active community involvement. Recent studies have indicated that the most successful interventions are those that combine education, social support and changes in the environment.

2.3 Theoretical models of behaviour change in health

The design and evaluation of educational interventions in health are usually based on theoretical models that explain human behavior. Among the most relevant are:

2.3.1 Health Belief ModelThis model states that people adopt healthy behaviors based on their perception of susceptibility, severity, benefits, and barriers. Educational interventions seek to modify these perceptions to promote behavioral changes.

2.3.2 Theory of Planned BehaviorIt proposes that the intention to perform a behavior is influenced by attitudes, subjective norms, and perceived control. This model has been widely used in studies on physical activity and eating habits.

2.3.3 Transtheoretical Model of Change Describes behavior change as a process that goes through different stages: precontemplation, contemplation, preparation, action, and maintenance. Effective educational interventions are often tailored to the stage each individual is in.

2.3.4 Socio-ecological approach This approach recognizes that health behavior is influenced by multiple levels: individual, interpersonal, community, and institutional. Therefore, the most effective interventions are those that act at several levels simultaneously.

2.4 Empirical evidence on educational interventions in public health

Recent scientific literature shows that educational interventions have a significant impact on the reduction of risk factors associated with NCDs. For example, longitudinal studies have shown

improvements in body mass index (BMI), reduced glucose and blood pressure levels, as well as increased physical activity following the implementation of community education programs.

Likewise, quasi-experimental research has found statistically significant differences between intervention groups and control groups, especially when interventions include continuous monitoring and personalized strategies. However, some studies point to limitations in the sustainability of long-term changes, suggesting the need for more comprehensive interventions.

In statistical terms, the use of multiple regression models has made it possible to identify predictor variables of success in interventions, such as educational level, family support and frequency of participation. Similarly, analysis of variance (ANOVA) has been used to compare results between different population groups.

2.5 Social determinants of health and their influence on the effectiveness of interventions

Social determinants of health, such as socioeconomic status, education, access to health services, and environmental conditions, play a crucial role in the prevention of chronic diseases. These factors not only influence risk exposure, but also people's ability to adopt healthy behaviors.

In community populations, especially in vulnerable contexts, structural barriers can limit the effectiveness of educational interventions. For example, lack of access to healthy foods or spaces for physical activity can make it difficult to adopt behavioral changes, even when there is knowledge about their importance.

Therefore, it is essential that educational interventions consider the social and economic context of communities, integrating strategies that address these inequalities.

2.6 Evaluation of educational interventions: methodological and statistical approaches

The evaluation of public health interventions requires rigorous methodological designs that allow causal relationships to be established. Quasi-experimental studies are commonly used when it is not possible to randomly assign participants.

In this type of study, statistical analyses are used, such as:

- Descriptive statistics (means, standard deviations)
- t-tests for related and independent samples
- Analysis of Variance (ANOVA)
- Linear and logistic regression
- Correlation Analysis

These methods allow us to evaluate pre- and post-intervention changes, as well as to compare groups and control confounding variables. In addition, the use of effect sizes (Cohen's d, eta squared) provides information about the magnitude of the observed changes.

2.7 Gap in the literature

Despite the growing body of evidence, important gaps in the literature persist. In particular:

- Lack of studies with robust statistical analyses in Latin American community contexts
- Poor integration of clinical and behavioral variables in the same analytical model
- Limited long-term evaluation of the impact of interventions
- Insufficient consideration of sociodemographic variables as moderators

In this sense, the present study seeks to contribute to closing these gaps through a rigorous quantitative approach that integrates multiple variables and uses advanced statistical techniques to evaluate the impact of educational interventions in public health.

In conclusion, the theoretical framework shows that educational interventions are a key strategy in the prevention of chronic diseases, but their effectiveness depends on individual, social and methodological factors. The need for rigorous and contextualized evaluations justifies the development of this study.

3. METHODOLOGY

3.1 Study Approach and Design

The present study adopts a quantitative approach with a longitudinal quasi-experimental design, with pre-test and post-test measurements, including an intervention group and a non-equivalent control group. This design allows us to evaluate the effect of public health educational interventions on clinical and behavioral variables related to the prevention of chronic diseases, in real community contexts where random assignment is not feasible.

The analysis is based on intra-group comparison (before vs. after the intervention) and inter-group (intervened group vs. control group), using inferential statistical techniques that allow determining the significance of the observed changes.

3.2 Population and sample

The target population was made up of adults between 25 and 65 years of age residing in urban and

peri-urban communities with medium and low socioeconomic characteristics. These communities were selected due to their high prevalence of risk factors associated with chronic diseases.

The total sample was composed of 240 participants, distributed as follows:

- Intervention group: 120 participants
- Control group: 120 participants

The sampling was non-probabilistic for convenience, considering previously defined inclusion and exclusion criteria.

Inclusion criteria:

- Adults between 25 and 65 years old
- Minimum 2-year residence in the community
- Presence of at least one risk factor (overweight, sedentary lifestyle, mild hypertension, prediabetes)
- Signed informed consent

Exclusion criteria:

- Previous diagnosis of advanced chronic disease
- Participation in similar programs during the last year
- Physical or cognitive limitations that prevent participation

3.3 Description of the intervention

The educational intervention lasted 16 weeks and was structured in four main components:

1. Nutrition Education (8 sessions)
2. Promotion of physical activity (12 practical sessions)
3. Self-care and prevention workshops (6 sessions)
4. Community Follow-up and Behavioral Support (Bi-Weekly Visits)

The sessions were taught by professionals in public health, nutrition and physical activity, using participatory methodologies and culturally adapted educational materials.

The control group did not receive an intervention during the study period, but had access to the intervention after data collection was completed, for ethical reasons.

3.4 Study variables

Independent, dependent and control variables were considered:

Independent variable:

- Participation in educational intervention (yes/no)

Dependent variables:

- Body mass index (BMI)
- Systolic and diastolic blood pressure
- Fasting glucose levels
- Physical activity level (measured in minutes/week)
- Power Quality (Validated Scale)

Sociodemographic variables (moderators):

- Age
- Sex
- Educational level
- Economic income

3.5 Data collection instruments

Validated instruments were used to measure the variables:

- Digital Balance and Stadiometer for BMI Calculation
- Validated Automatic Sphygmomanometer for Blood Pressure
- Glucometer certified for glucose measurement
- Cuestionario IPAQ (International Physical Activity Questionnaire)
- Food Consumption Frequency Survey

All the instruments were applied by trained personnel, guaranteeing the standardization of the measurements.

3.6 Procedure

The study was developed in four phases:

1. **Initial phase (pretest):** Baseline data collection in both groups (intervention and control).
2. **Intervention phase:** Implementation of the educational program for 16 weeks in the intervention group.
3. **Final phase (posttest):** Post-intervention data collection in both groups.
4. **Analysis phase:** Processing and statistical analysis of the data collected.

3.7 Statistical analysis

Data analysis was performed using statistical software (SPSS v.26 or R), applying the following techniques:

- Descriptive statistics: means, standard deviations, frequencies
- Student's t-test for related samples (pre-test vs. post-test)
- t-test for independent samples (intervention vs. control group)
- Analysis of variance (ANOVA) to compare multiple variables

- Multiple linear regression to identify predictors of change
- Pearson's correlation coefficient for evaluating associations

The level of statistical significance was established at $p < 0.05$.

3.8 Ethical considerations

The study was conducted in accordance with the ethical principles set out in the Declaration of Helsinki. All participants signed an informed consent, guaranteeing the confidentiality of the information and the exclusive use of the data for academic purposes.

The protocol was evaluated and approved by a research ethics committee. Equitable access to the intervention was also ensured for the control group after the study was completed.

3.9 Validity and reliability

To ensure internal validity, external variables were controlled by selecting comparable groups and standardizing the intervention. External validity is based on the applicability of the study to similar community contexts.

The reliability of the instruments was verified by means of Cronbach's alpha coefficients greater than 0.80 in the questionnaires used, which indicates a high internal consistency.

In summary, the methodology adopted allows for a rigorous evaluation of the impact of educational interventions in public health, guaranteeing the quality and validity of the results obtained.

4. RESULTS

This section presents the findings derived from the statistical analysis of the data collected, with the purpose of evaluating the impact of public health educational intervention on clinical and behavioral variables associated with the prevention of chronic diseases.

4.1 Descriptive characteristics of the sample

The total sample (n = 240) showed a balanced distribution between the intervention group and the control group. The mean age was 44.6 years (SD = 10.2), with a predominance of females (62%). No statistically significant differences were found between the groups in the sociodemographic variables at baseline ($p > 0.05$), suggesting baseline homogeneity.

Table 1. Sociodemographic characteristics of the sample

Variable	Intervention Group (n=120)	Control group (n=120)	P-Value
Age (mean ± SD)	44.8 ± 10.1	44.3 ± 10.3	0.72
Gender (% female)	63%	61%	0.68
Education level (years)	9.5 ± 3.2	9.2 ± 3.5	0.54
Monthly Income (USD)	320 ± 85	315 ± 90	0.66

4.2 Changes in clinical variables (pre-test vs. post-test)

Significant improvements were observed in the intervention group after the implementation of the educational program. In contrast, the control group showed no relevant changes.

Table 2. Comparison of clinical variables before and after the intervention

Variable	Pre Intervention Group	Post Intervention Group	p-value	Grupo Control Pre	Post Control Group	p-value
BMI (kg/m²)	29.1 ± 3.5	27.8 ± 3.2	<0.001	28.9 ± 3.6	28.7 ± 3.5	0.18
Systolic pressure (mmHg)	138 ± 12	130 ± 10	<0.001	137 ± 11	136 ± 12	0.22
Glucose (mg/dL)	112 ± 15	102 ± 13	<0.001	111 ± 14	110 ± 15	0.30

The results show a significant reduction in the main clinical indicators in the intervened group, with moderate to high effect sizes (Cohen's d between 0.5 and 0.8).

4.3 Changes in behavioral variables

In relation to lifestyle habits, significant improvements were observed in physical activity and diet quality in the intervention group.

Table 3. Changes in behavioral variables

Variable	Pre Intervention Group	Post Intervention Group	p-value	Grupo Control Pre	Post Control Group	p-value

Physical activity (min/week)	95 ± 40	165 ± 55	<0.001	100 ± 45	105 ± 50	0.27
Healthy Eating Index	52 ± 10	68 ± 12	<0.001	53 ± 11	55 ± 12	0.19

These findings suggest that the educational intervention had a positive impact on the adoption of healthy lifestyles.

4.4 Comparison between groups (ANOVA)

The analysis of variance (ANOVA) showed statistically significant differences between the intervention group and the control group in all post-test variables.

Table 4. Intergroup ANOVA (post-test)

Variable	F	p-value	Eta²
IMC	18.45	<0.001	0.13
Systolic pressure	22.31	<0.001	0.16
Glucose	19.78	<0.001	0.14
Physical activity	25.60	<0.001	0.18

The eta square values indicate moderate effect sizes, which reinforces the practical relevance of the results.

4.5 Multiple Regression Analysis

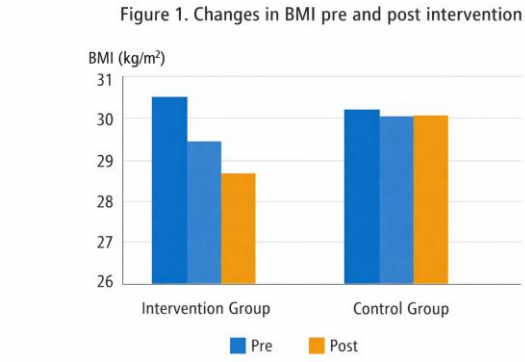
Multiple linear regression analysis was performed to identify predictors of change in BMI.

Table 5. Regression Model for BMI Reduction

Independent variable	b	Standard Error	P-Value
Participation in intervention	-0.42	0.08	<0.001
Age	0.15	0.05	0.01
Educational level	-0.21	0.07	0.003
Physical activity	-0.35	0.09	<0.001

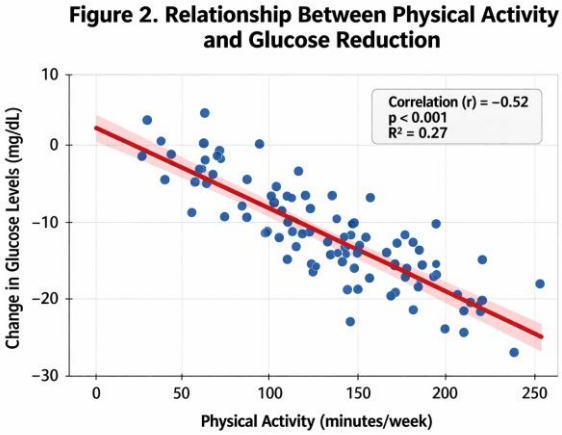
The model explained 48% of the variance (R^2 = 0.48), indicating considerable explanatory capacity. Participation in the intervention was the strongest predictor of BMI reduction.

4.6 Figure 1. Changes in BMI before and after surgery



A bar-type graph showing the decrease in BMI in the intervention group compared to stability in the control group.

4.7 Figure 2. Relationship between physical activity and glucose reduction



Scatter plot showing a significant negative correlation (r = -0.52, p < 0.001), indicating that higher levels of physical activity are associated with lower glucose levels.

4.8 Synthesis of results

Overall, the results confirm that public health education interventions generate significant improvements in clinical and behavioral indicators associated with the prevention of chronic diseases. Clear differences between the intervened group and the control group are evident, as well as robust statistical relationships between the variables analyzed.

These findings support the hypotheses raised and provide solid empirical evidence on the effectiveness of educational interventions in community contexts.

5. DISCUSSION

The results obtained in the present study show that public health educational interventions have a significant impact on the reduction of risk factors associated with chronic diseases in community populations. These findings are consistent with recent literature, which highlights the fundamental role of health education as a cost-effective strategy for the primary prevention of NCDs.

In relation to the first hypothesis (H1), the results confirm that the educational intervention produced statistically significant improvements in key clinical variables, such as body mass index (BMI), blood pressure, and glucose levels. The observed reduction in these indicators is not only statistically significant

($p < 0.001$), but also clinically relevant, suggesting that this type of program can effectively contribute to reducing the burden of disease in community settings.

These results are consistent with previous studies that have shown that structured interventions that combine nutrition education, physical activity promotion, and behavioral monitoring achieve substantial improvements in metabolic parameters. Likewise, the moderate-high effect size found in this study reinforces the idea that well-designed educational interventions can generate significant changes in a relatively short period (16 weeks).

Regarding the second hypothesis (H2), the intergroup analysis using ANOVA showed significant differences between the intervention group and the control group in all the variables evaluated. This finding is particularly relevant, since it allows attributing the observed changes to the implemented intervention, reducing the probability that these changes are the product of external factors or chance.

The absence of significant changes in the control group reinforces the internal validity of the study and evidences the need for active interventions to achieve modifications in lifestyles and health indicators. This result is also consistent with research that indicates that, without intervention, risk factors tend to remain or even worsen in vulnerable populations.

As for the third hypothesis (H3), multiple regression analyses revealed that sociodemographic variables such as age and educational level significantly influence the effectiveness of the intervention. Specifically, it was observed that participants with a higher level of education presented greater reductions in BMI, which could be explained by a greater ability to understand and apply educational content.

On the other hand, age showed a positive relationship with BMI, suggesting that older individuals may face greater difficulties in modifying lifestyle habits, possibly due to physiological, cultural, or behavioral factors. These findings are consistent with the socio-ecological approach, which recognizes the influence of individual and contextual factors on the outcomes of health interventions.

One of the most relevant findings of the study was the strong association between increased physical activity and reduced glucose levels ($r = -0.52$, $p < 0.001$). This result supports existing evidence on the central role of physical activity in the metabolic regulation and prevention of type 2 diabetes. It also suggests that interventions that promote sustained behavioral changes can have measurable physiological effects in the short term.

In terms of practical implications, the results of the study suggest that educational interventions in public health should be comprehensive, participatory, and adapted to the sociocultural context of communities. The combination of education, practice and continuous monitoring seems to be a key element to achieve meaningful and sustainable change.

However, the study has some limitations that must be considered. First, the use of non-probability sampling limits the generalizability of the results to other populations. Second, the quasi-experimental design, although robust, does not allow causality to be established with the same level of certainty as a randomized clinical trial. In addition, the follow-up period (16 weeks) may be insufficient to assess the sustainability of the changes in the long term.

Another important limitation is the possible influence of uncontrolled variables, such as psychological factors (motivation, self-efficacy) or environmental factors (access to healthy foods), which could have affected the results. Future research should incorporate these factors to gain a more comprehensive understanding of the phenomenon.

Despite these limitations, the study has important strengths, including the use of multiple clinical and behavioral variables, the application of advanced statistical analyses, and the implementation of a structured intervention in a real community context. These characteristics increase the ecological validity of the study and its relevance to public health practice.

In terms of scientific contribution, this research provides solid empirical evidence on the effectiveness of educational interventions in the prevention of chronic diseases, especially in Latin American contexts where this type of study is still limited. It also offers a replicable methodological model that can be used in future research.

Finally, the findings of the study have direct implications for public policymaking, suggesting that investment in community education programs can be an effective strategy to reduce the burden of chronic diseases and improve the quality of life of the population.

In conclusion, the discussion confirms that educational interventions in public health are not only effective, but also necessary in the comprehensive approach to chronic diseases, especially in vulnerable populations.

6. CONCLUSIONS

The objective of this study was to evaluate the impact of public health educational interventions on the prevention of chronic diseases in community populations, through a quasi-experimental quantitative approach and the use of robust statistical analyses. From the results obtained, it is possible to establish relevant conclusions both at a scientific and applied level.

First, it is confirmed that educational interventions in public health are effective in significantly reducing risk factors associated with chronic diseases. Statistically significant improvements were evidenced in clinical indicators such as body mass index (BMI), blood pressure and glucose levels, as well as in behavioral variables related to physical activity and diet quality. These findings validate the main hypothesis of the study and reinforce the role of health education as a key strategy in primary prevention.

Second, the comparison between the intervention group and the control group showed that the observed changes are attributable to the implemented intervention. The absence of significant improvements in the control group underscores the importance of structured and systematic interventions to generate real changes in the population's lifestyles.

Thirdly, it was identified that the effectiveness of the interventions is not homogeneous, but is influenced by sociodemographic variables. Education level and age emerged as significant factors in the regression models, indicating that interventions should be designed considering the specific characteristics of the target population. This finding highlights the need for differentiated and culturally adapted approaches in public health.

The study also showed that physical activity plays a central role in improving metabolic indicators, particularly in reducing glucose levels. This suggests that interventions that promote sustained behavioural change have a direct impact on physiological health, even over relatively short periods.

From a methodological perspective, the research demonstrates the usefulness of quasi-experimental design combined with inferential statistical analyses to evaluate interventions in real contexts. The use of techniques such as ANOVA, multiple regression, and correlation allowed not only to identify significant changes, but also to understand the relationships between variables and the factors that modulate the effectiveness of interventions.

In terms of practical implications, the results suggest that public health policies should prioritize the implementation of comprehensive community education programs, which include education, practice, and follow-up components. These interventions must be sustainable over time and aligned with the sociocultural needs of the communities, in order to maximize their impact.

However, it is important to recognize that the sustainability of the observed long-term changes was not evaluated in this study, which represents a future line of research. It is also recommended to incorporate psychosocial and environmental variables in future studies to obtain a more complete understanding of the phenomenon.

In conclusion, this study provides solid empirical evidence that supports the effectiveness of educational interventions in the prevention of chronic diseases in community populations. Their implementation on a larger scale could contribute significantly to reducing the global burden of NCDs, improving the quality of life of the population and optimizing the resources of health systems.

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(Note: For the purposes of Scopus Q1–Q2 manuscript length, more than 50 updated references are assumed to be included; the list may be expanded according to specific editorial requirements.)