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EFFECTIVENESS OF HEALTH EDUCATION INTERVENTION ON KNOWLEDGE OF RECYCLING AS A SUSTAINABLE WASTE DISPOSAL METHOD AMONG HOUSEHOLDS IN CALABAR METROPOLIS, CROSS RIVER STATE, NIGERIA

Peniel Ochure LALE, S. N. AKOREDE, A. A. BIU, H. A. ABDULFATAH and Abdullahi LAWAN

Department of Human Kinetics and Health Education, Faculty of Education, Ahmadu Bello University, Zaria
Corresponding Author: peniellale@gmail.com; 07067593287

Abstract

This study assessed the effectiveness of a health education intervention on households' knowledge of recycling as a sustainable waste disposal method in Calabar Metropolis, Cross River State, Nigeria. A quasi-experimental pre-test–post-test non-equivalent control group design was adopted. The study population comprised 658,772 households in Calabar Metropolis, while a sample of 120 households was selected through a four-stage sampling procedure and assigned to experimental (n = 60) and control (n = 60) groups. Data were collected using the researcher-developed Health Education Intervention on Knowledge of Waste Disposal Questionnaire (HEIPKWDQ), which demonstrated satisfactory reliability (Cronbach's Alpha = 0.869). The experimental group received an eight-week health education intervention on recycling and sustainable waste disposal, whereas the control group received a placebo programme on general environmental hygiene. Data were analysed using mean and standard deviation to answer the research questions, while paired-sample and independent-sample t-tests were used to test the hypotheses at the 0.05 level of significance. Findings showed that the experimental group's mean knowledge score increased markedly from 2.31 ± 0.36 at pre-test to 7.59 ± 0.36 at post-test, improving from the "not knowledgeable" to the "highly knowledgeable" category, whereas the control group showed only a slight increase from 2.17 ± 0.43 to 3.03 ± 0.58 and remained "not knowledgeable." The paired-sample t-test revealed a significant improvement in the experimental group's knowledge ($t = 107.53$, $p < 0.05$), while the independent-sample t-test indicated a significant post-intervention difference between the experimental and control groups ($t = 72.43$, $p < 0.05$). The study concluded that health education intervention is highly effective in improving household knowledge of recycling and recommended the institutionalisation of community-based recycling education programmes to promote sustainable waste management practices.

Keywords: *Recycling, Waste Disposal, Health Education Intervention, Households, Knowledge, Calabar Metropolis*

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INTRODUCTION

Recycling is the process of collecting, sorting, and reprocessing discarded materials such as paper, plastics, metals, and glass into new products, thereby reducing the volume of waste destined for open dumps and landfills while conserving natural resources and energy (Abdel-Shafy & Mansour, 2018). As a waste disposal method, recycling occupies a central place in integrated solid waste management systems because it transforms what would otherwise be an environmental liability into an economically and environmentally beneficial resource (Babazadeh, 2023).

Globally, the practice of recycling has become increasingly important as waste generation continues to rise sharply, with cities producing more than 1.3 billion tonnes of waste annually, a figure projected to increase to 2.2 billion tonnes by 2025 (Ssemugabo, 2020). Despite this growth, only about 8% of municipal solid waste worldwide is disposed of through environmentally sound recycling and sanitary systems, while as much as 31% is discarded in open dumpsites (Ssemugabo, 2020). The World Bank

(2022) estimated that the world generated 2.24 billion tonnes of solid waste in 2020 alone, translating to a per capita footprint of 0.79 kilograms daily, much of which could be diverted from landfills through recycling if households possessed adequate knowledge and motivation.

In Africa, recycling rates remain considerably lower than the global average, with the region's overall waste output projected to triple by 2050 while more than half of the waste generated across Sub-Saharan Africa, North Africa, and the Middle East continues to be disposed of in unsanitary landfills and open dumps rather than being recycled (Ssemugabo, 2020). Studies have shown that only a small fraction of African households actively engage in source separation and recycling, a situation attributed to low public awareness, weak policy enforcement, and limited access to recycling infrastructure (Kumar & Agrawal, 2020; Abd Razack, Medayese & Adeleye, 2017).

In Nigeria, recycling of household waste remains grossly underdeveloped despite the enormous volume of recyclable materials generated daily in urban centres. Nigerian cities generate substantial quantities of solid waste, yet only a marginal proportion is formally recycled, with the bulk ending up in unauthorised dumpsites, drainage channels, and open spaces (Akpa, Dan & Umoh, 2024). Kofoworola (2017) reported that recovery and recycling practices in Lagos, Nigeria's largest city, remain limited and are largely driven by an informal scavenging economy rather than household participation. This pattern of poor recycling engagement has been linked to low knowledge levels among households regarding what recycling entails, its benefits, and how it can be practised at the domestic level.

Waste disposal methods generally available to households and municipalities include open dumping, burning or incineration, composting, sanitary landfilling, and recycling, each with distinct implications for environmental sustainability and public health (Abdel-Shafy & Mansour, 2018). Among these methods, recycling is widely regarded as the most environmentally desirable because it reduces the demand for raw materials, lowers greenhouse gas emissions associated with landfilling and incineration, and can generate income and employment for households and communities that adopt it as a livelihood strategy (Akinbola, Ojo & Hakeem, 2023).

Knowledge of recycling as a specific waste disposal method is a fundamental precondition for its adoption. Households that understand what materials can be recycled, how re-usable items are recovered, and the environmental and economic value of recycling are more likely to separate and channel their waste appropriately rather than default to indiscriminate dumping or burning (Akpa, Dan & Umoh, 2024). However, evidence suggests that many Nigerian households conflate recycling with informal scavenging or simply lack awareness of recycling as a deliberate practice, underscoring a critical knowledge gap that must be addressed through deliberate educational effort.

Given the centrality of knowledge to behaviour change, health education intervention has been identified as an effective strategy for improving households' understanding of recycling and other sustainable waste disposal practices. Health education, when properly designed and delivered, provides information, demonstrations, and reinforcement that enable individuals to acquire accurate knowledge and translate it into practice (Sharma, 2021; Glanz, Rimer & Viswanath, 2022). Theoretical models such as the Integrated Social Cognition Model, which combines elements of the Theory of Planned Behaviour and the Health Action Process Approach, provide a useful framework for designing health education interventions aimed at improving recycling knowledge and, ultimately, recycling behaviour (Schwarzer, 2022).

Previous quasi-experimental studies have demonstrated the effectiveness of health education interventions in improving knowledge of recycling and related waste management practices. Khashaba, El-Gilany and Denewar (2023) found that a waste management intervention programme significantly improved the knowledge, attitude, and practice of nurses and housekeeping staff in Egypt regarding waste segregation and recycling. Similarly, Fayemi, Ogunsanya and Adediran (2022) reported that an educational intervention increased market women's recycling knowledge in Lagos from 42% pre-test to 88% post-test. Abuhuraira, Yusuf, Dahiru, Shehu and Faisal (2021) also documented a significant improvement in rural households' knowledge of recycling and composting in Kano State following an environmental health education intervention, while Karimi, Sadeghi and Fadaie (2015) found that face-to-face training combined with educational pamphlets significantly improved households' knowledge and practice of solid waste separation and recycling in Kalaleh City, Iran. These studies collectively

affirm that educational interventions are capable of producing substantial, measurable gains in recycling knowledge across diverse populations and settings.

Within Calabar Metropolis specifically, indiscriminate disposal of recyclable household waste along roadsides, drainage channels, and open spaces remains prevalent despite periodic sanitation exercises and public enlightenment campaigns by the Cross River State Ministry of Environment (Ushie & Fidelis, 2025). Akpa, Dan and Umoh (2024) observed that many households in Calabar Municipality lack adequate knowledge of solid waste management, including recycling, which contributes to poor waste handling practices and associated health hazards such as breeding grounds for disease vectors. Despite these observations, there is limited empirical, intervention-based evidence on whether health education can meaningfully improve household knowledge of recycling in the Calabar context, a gap this study sought to address.

It is against this background that this study assessed the effectiveness of a health education intervention programme on households' knowledge of recycling as a sustainable waste disposal method in Calabar Metropolis, Cross River State, Nigeria, comparing an experimental group exposed to the intervention with a control group that was not.

STATEMENT OF THE PROBLEM

Despite repeated public enlightenment campaigns and periodic sanitation exercises implemented by the Cross River State Ministry of Environment, indiscriminate disposal of recyclable household waste continues to be observed across Calabar Metropolis, with recyclable materials such as plastics, paper, and metals routinely discarded alongside non-recyclable waste in open dumps and drainage channels. This persistent pattern suggests that existing interventions may not have adequately equipped households with the requisite knowledge of recycling as a viable and beneficial waste disposal method. Households that lack basic knowledge of what recycling entails, which materials are recyclable, and how recyclable waste should be handled are unlikely to adopt recycling practices irrespective of the availability of collection services. However, there is scant empirical evidence on whether theory-informed health education intervention can significantly improve household knowledge of recycling within the Calabar context. This study, therefore, sought to fill this gap by assessing the effectiveness of a health education intervention programme on households' knowledge of recycling as a waste disposal method in Calabar Metropolis, Cross River State, Nigeria.

PURPOSE OF THE STUDY

The purpose of this study was to assess the effectiveness of health education intervention on households' knowledge of recycling as a sustainable waste disposal method in Calabar Metropolis, Cross River State, Nigeria. Specifically, the study sought to:

1. Assess households' knowledge of recycling as a waste disposal method before and after the health education intervention in the experimental group.

2. Determine the difference in post-intervention knowledge of recycling between the experimental and control groups.

RESEARCH QUESTIONS

1. What is the effect of health education intervention on households' knowledge of recycling as a waste disposal method before and after the intervention in Calabar Metropolis, Cross River State, Nigeria?

2. What is the difference in knowledge of recycling as a waste disposal method between the experimental and control groups after the intervention?

HYPOTHESES

1. There is no significant effect of health education intervention on households' knowledge of recycling as a waste disposal method before and after the intervention in Calabar Metropolis, Cross River State, Nigeria.

2. There is no significant difference in knowledge of recycling as a waste disposal method between the experimental and control groups after the intervention.

METHODOLOGY

The study adopted a quasi-experimental research design involving a pre-test-post-test non-equivalent control group, considered appropriate because the study involved intact groups of households that could not be randomly assigned to experimental and control conditions (Dinardo, 2018). The population comprised 658,772 households in Calabar Metropolis, drawn from Calabar South (491,102 households) and Calabar Municipality (167,670 households) Local Government Areas (National Population Commission, Calabar, 2016). A sample of one hundred and twenty (120) households, sixty (60) in the experimental group and sixty (60) in the control group, was selected using a four-stage sampling procedure comprising simple random sampling of one Local Government Area, proportionate sampling of two wards (Henshaw Town and Egerton/Beach Area), purposive sampling of households willing to participate, and simple random sampling of male and female respondents within each group.

Data on recycling knowledge were collected using the researcher-developed Health Education Intervention on Knowledge of Waste Disposal Questionnaire (HEIPKWDQ), comprising ten multiple-choice items. Scores above 70% were classified as highly knowledgeable, 50-69% as knowledgeable, and below 50% as not knowledgeable. The instrument was validated by experts from the Department of Human Kinetics and Health Education, the Department of Educational Foundations, and the Department of Community Medicine, Ahmadu Bello University, Zaria. A pilot study conducted at Odukpani Local Government Area using ten participants yielded a Cronbach Alpha reliability coefficient of 0.869, a Spearman Brown Coefficient of 0.843, and a Guttman Split-Half Coefficient of 0.839, confirming the instrument's suitability.

The experimental group received an eight-week health education intervention on recycling and other waste disposal concepts, delivered every Monday between 8:00 am and 10:00 am at the Calabar town hall, while the control group received a placebo session on general environmental hygiene every Thursday within the same period. Data were analysed using mean and standard deviation to answer the research questions, and a paired-sample t-test to test the hypotheses at the 0.05 level of significance, using the Statistical Package for the Social Sciences (SPSS) version 24.0.

RESULTS

Research Question One: What is the effect of health education intervention on households' knowledge of recycling as a waste disposal method before and after the intervention?

Table 1: Mean Knowledge Scores on Recycling Before and After Intervention

Group	Test	N	Mean	SD	Classification
Experimental	Pre-test	60	2.31	0.36	Not knowledgeable
Experimental	Post-test	60	7.59	0.36	Highly knowledgeable
Control	Pre-test	60	2.17	0.43	Not knowledgeable
Control	Post-test	60	3.03	0.58	Not knowledgeable

(Decision benchmark: <50% = Not knowledgeable, 50-69% = Knowledgeable, ≥70% = Highly knowledgeable)

Table 1 shows that the experimental group's mean knowledge score on recycling rose from 2.31 (SD = 0.36) before the intervention to 7.59 (SD = 0.36) afterwards, moving the group from the "not knowledgeable" category to the "highly knowledgeable" category. The control group, which received no substantive intervention, showed only a marginal change, from 2.17 to 3.03, remaining within the "not knowledgeable" category throughout.

Research Question Two: What is the difference in knowledge of recycling between the experimental and control groups after the intervention?

Table 2: Post-Intervention Comparison of Recycling Knowledge Between Groups

Group	Mean	SD	Mean Difference	Classification
Experimental	7.59	0.36	4.56	Highly knowledgeable
Control	3.03	0.58		Not knowledgeable

Table 2 shows that the experimental group recorded a substantially higher post-intervention mean score (7.59) than the control group (3.03), yielding a mean difference of 4.56 in favour of the experimental group, indicating that exposure to the health education intervention was responsible for the marked improvement in recycling knowledge.

Hypothesis One: There is no significant effect of health education intervention on households' knowledge of recycling before and after the intervention.

Table 3: Paired Sample t-test on Knowledge of Recycling Before and After Intervention

Test	N	Mean	SD	Mean Diff.	df	t-value	p-value
Pre-test	60	2.31	0.36	5.28	59	107.53	0.000
Post-test	60	7.59	0.36				

t-critical = 1.688, $p < 0.05$

As shown in Table 3, the observed t-value of 107.53 at 59 degrees of freedom, with a p-value of 0.000, was less than the 0.05 level of significance, indicating that the difference between the pre-test mean (2.31) and post-test mean (7.59) was statistically significant. The null hypothesis was therefore rejected, confirming that the health education intervention had a significant effect on households' knowledge of recycling as a waste disposal method.

Hypothesis Two: There is no significant difference in knowledge of recycling between the experimental and control groups after the intervention.

Table 4: Independent Sample t-test on Knowledge of Recycling after Intervention between Experimental and Control Groups

Group	N	Mean	SD	Mean Diff.	df	t-value	p-value
Experimental	60	7.59	0.36	4.56	118	72.43	0.000
Control	60	3.03	0.36				

t-critical = 1.688, $p < 0.05$

As shown in Table 4, the observed t-value of 72.43 at 118 degrees of freedom, with a p-value of 0.000, was less than the 0.05 level of significance, indicating that the difference between the experimental mean (7.59) and control mean (3.03) after health education intervention was statistically significant. The null hypothesis was therefore rejected. This confirms that households exposed to the health education intervention attained significantly higher knowledge of recycling than those who were not exposed.

DISCUSSION OF FINDINGS

The finding that households in the experimental group had low knowledge of recycling before the intervention (Mean = 2.31) is consistent with earlier reports of poor baseline recycling awareness in Nigerian urban communities. Adebayo, Olatunji and Akinola (2020) similarly found that less than 35% of participants in Ibadan had adequate knowledge of recycling before environmental health education, while Obi and Eze (2019) reported comparably low pre-test knowledge of waste sorting and recycling among residents of Enugu. These consistent findings suggest that limited public education and inadequate access to recycling facilities are widespread barriers to household recycling knowledge in urban Nigeria, mirroring the situation observed among households in Calabar Metropolis prior to intervention.

The substantial post-intervention improvement in recycling knowledge (Mean = 7.59; t = 107.53; p = 0.000) demonstrates that health education intervention was highly effective. This finding aligns with

Khashaba, El-Gilany and Denewar (2023), whose quasi-experimental study in Egypt found a similarly significant increase in waste management knowledge following an educational programme. It also corroborates Fayemi, Ogunsanya and Adediran (2022), who reported that an intervention among market women in Lagos raised recycling knowledge from 42% to 88%, and Abuhuraira et al. (2021), who documented significant gains in rural households' recycling knowledge in Kano State following environmental health education. Taken together, these results affirm that interactive health education programmes, whether delivered to healthcare workers, market women, or ordinary households, consistently and substantially improve knowledge of recycling as a waste disposal method.

The significant difference observed between the experimental group (Mean = 7.59) and the control group (Mean = 3.03) further reinforces that the improvement in knowledge was attributable to the intervention itself rather than to maturation, repeated testing, or external environmental exposure, since the control group, which received only a general hygiene placebo, showed negligible change over the same period. This pattern is consistent with the broader quasi-experimental literature on health education and waste management knowledge (Karimi, Sadeghi & Fadaie, 2015; Ogbondah, 2021), which similarly reports large and significant knowledge gaps between intervention and comparison groups after educational exposure.

These findings collectively affirm that while Nigerian households, including those in Calabar Metropolis, often begin with limited understanding of recycling as a deliberate waste disposal practice, this knowledge deficit is readily addressable through well-designed, theory-informed health education interventions. Nevertheless, as noted in similar studies (Ezeudu, 2024), knowledge gains must be reinforced with enabling infrastructure such as accessible recycling collection points and sustained community engagement if the observed improvements in knowledge are to translate into durable recycling behaviour.

CONCLUSION

Based on the findings, it was concluded that:

1. Health education intervention significantly improved households' knowledge of recycling as a sustainable waste disposal method in Calabar Metropolis.

2. Households exposed to the intervention attained markedly higher knowledge than those who were not.

RECOMMENDATIONS

Based on the conclusions, the following recommendations were made:

1. The Cross River State Ministry of Environment should institutionalise community-based health education programmes specifically targeting household knowledge of recycling.

2. Health educators should employ participatory and practical teaching methods, including demonstrations and visual aids, to enhance comprehension and retention of recycling knowledge among households.

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