

A Pre-Experimental Study to Evaluate the Effectiveness of a Planned Teaching Program on Knowledge Regarding the Disposal of Plastic Waste and Its Health Hazards Among Adults in Ghotawde Village of Kolhapur District

Diana Deelip Chinchawadkar^{1,*}

Abstract

Background: Plastics are widely used due to their low cost, durability, and versatility; however, their non-biodegradable nature poses serious environmental and health hazards. Improper disposal of plastic waste contributes significantly to pollution and adverse health outcomes, especially in rural communities where awareness may be limited. This study aimed to assess the effectiveness of a structured teaching program on adults' knowledge about plastic waste disposal and its associated health hazards in Ghotawde village, Kolhapur district. *Objectives:* The study sought to evaluate the impact of the teaching program on participants' knowledge regarding plastic waste disposal and its health risks, as well as to examine the relationship between pretest knowledge scores and selected sociodemographic factors. *Methods:* A community-based pre-experimental one-group pretest and posttest design was employed. A total of 100 adults were chosen using probability random sampling. Data were gathered through a sociodemographic questionnaire and a structured knowledge questionnaire. After conducting the pretest, the planned teaching program was implemented. *Results:* The pretest results indicated that 63% of participants had average knowledge, while 37% demonstrated poor knowledge regarding plastic waste disposal and its health hazards. Following the teaching program, all participants (100%) achieved good knowledge levels. The mean knowledge score increased from 9.92 in the pretest to 20.35 in the posttest. The calculated *t*-value of 24.21 was statistically significant ($p < 0.05$), confirming the effectiveness of the intervention. Additionally, a significant association was observed between pretest knowledge scores and participants' age. *Conclusion:* The findings suggest that the structured teaching program was highly effective in enhancing adults' knowledge about plastic waste disposal and related health hazards. The study highlights the importance of educational interventions in promoting safe and responsible plastic waste management practices within communities.

*Author for Correspondence

Diana Deelip Chinchawadkar*
E-mail: dianachinchawadkar86@gmail.com

Researcher, Department of Nursing, Sub District Hospital,
Malegaon, Maharashtra, India.

Received Date: November 27, 2025

Accepted Date: February 06, 2026

Published Date: February 20, 2026

Citation: Diana Deelip Chinchawadkar. A Pre-Experimental Study to Evaluate the Effectiveness of a Planned Teaching Program on Knowledge Regarding Disposal of Plastic Waste and Its Health Hazards Among Adults in Ghotawde Village of Kolhapur District. *International Journal of Community Health Nursing and Practices*. 2026; 4(1): 64–96p.

Keywords: Adults, health hazards, knowledge, planned teaching program, plastic waste

INTRODUCTION

“Say no to plastic; let this planet live.”

“Reduce, Reuse, and Recycle.”

“While there are environmental impacts on paper bags, if you look at the life span of plastic bags, there's no comparison... it will threaten wildlife for years to come.”

—The Seattle Times.

Plastics are widely used across the globe on a daily basis worldwide. The term “plastic” refers to a variety of synthetic and semi-synthetic materials and is derived from the Greek word *plastikos*, meaning “fit for molding.” Plastic bags are lightweight, durable, easy to carry, and generally cheaper than paper [1].

Initially, plastics were created from natural materials with inherent properties, such as shellac and chewing gum. This is followed by chemically treated natural materials, including rubber, nitrocellulose, collagen, and galalite, eventually leading to the development of fully synthetic plastics. One of the first notable inventions was Parkesine, which was developed by Alexander Parkes in 1855 and is now recognized as celluloid. Polyvinyl chloride (PVC) was first polymerized between 1838 and 1872. A major milestone came in 1907 when Belgian American chemist Leo Baekeland developed Bakelite, the first fully synthetic, mass-produced plastic [2].

Plastics are valued as being inexpensive, lightweight, strong, durable, corrosion-resistant, and excellent thermal and electrical insulators. Their diverse polymer types and versatile properties enable their use in a wide range of products, thereby contributing to medical and technological innovations, energy efficiency, and numerous societal benefits. Plastics are integral to transportation, telecommunications, clothing, footwear, and packaging, which support the safe transport of food, beverages, and other goods. Future innovations are expected to expand the application of plastics, including medical use, renewable energy production, and energy-efficient transportation solutions [3].

Plastic production has grown enormously, making it a fundamental part of daily life. Global plastic production exceeds 150 million tons annually, with India consuming approximately 8 million tons per year (as of 2008), which is projected to rise to 12 million tons by 2012. Plastics are widely used for packaging, shopping, garbage bags, containers, clothing, toys, household items, industrial items, and construction materials. Owing to their non-biodegradable nature, plastics have persisted in the environment for many years. Recycling is limited because mixed plastics degrade in quality over successive cycles, and recycled plastics can sometimes be more harmful than new materials. It is estimated that approximately 70% of consumed plastics are discarded, resulting in approximately 5.6 million tonnes of plastic waste annually in India, or around 15,342 tons per day [4].

Over the past 60 years, plastic production has surged from about 0.5 million tonnes in 1950 to over 260 million tonnes today. In Europe alone, the plastics industry generates a turnover exceeding 300 million euros and employs 1.6 million people. However, improper disposal has led to the production of plastic litter in urban and rural areas worldwide. This poses risks to wildlife, as grazing animals such as cattle, sheep, and goats die from ingesting plastic bags [5].

Plastics have proven to be highly versatile and continue to find new applications, potentially addressing global challenges, such as climate change and food shortages. For instance, plastics are used in the manufacturing of wind turbine rotors and polyethylene tunnels, which aid crop growth under adverse conditions. While plastic production and demand continue to grow, particularly in emerging economies, waste management infrastructure must keep pace. Unfortunately, the properties that make plastics valuable, such as durability, low weight, and low cost, make their disposal challenging. Single-use plastics, such as packaging, are particularly problematic because they persist in the environment, and lightweight plastics often float on water surfaces when they enter the oceans [6].

Plastics often contain chemicals added to enhance performance, such as plasticizers for flexibility or flame retardants in electronics and furniture. Thousands of chemicals may be present in packaging alone, with at least 63 identified as hazardous to human health. Additionally, plastics contain non-intentionally added substances (NIAS), including breakdown products, side products, and contaminants. Since the majority of chemicals in plastics are NIAS, their toxicity is largely unknown, leaving gaps in our understanding of potential health risks [7].

Microplastics, tiny plastic particles, have become a major concern owing to their persistence and accumulation in ecosystems. Studies have confirmed that humans ingest microplastics through food and water, and some particles can pass through the gut into the bloodstream, potentially reaching organs, such as the kidneys, heart, and even fetal tissue. Animal studies have shown microplastics can spread throughout the body. For example, research on rats detected plastics in the stomach, intestines, kidneys, and heart, whereas tiny particles were found in the brains of fish and mouse fetuses [8, 9].

Estimates suggest that in 2019, the average American population consumed between 74,000 and 121,000 microplastic particles annually, with bottled water identified as a significant source, averaging 100 microplastic particles per liter. Subsequent research has shown that plastic teabags and baby bottles can release millions of micro-and billions of nanoplastics into tea and formula, indicating that human exposure to microplastics may be significantly underestimated. More research is needed to determine how much plastic remains in the human body and the potential long-term health implications [10, 11].

Need for the Study

Plastics are remarkable materials with applications ranging from extending the shelf life of food products to medical equipment and the automotive industry. Effective management of plastic waste requires awareness not only among manufacturers, but also among handlers, including consumers, recyclers, brand owners, and regulatory authorities. A critical first step is to accurately assess the total quantity of plastic waste generated through proper measurement and inventory [12].

In India, plastic waste disposal remains a significant challenge as no single technology has been fully validated. Various experiments have been conducted, including the use of plastic waste in road construction and the co-processing of cement kilns. Globally, incineration is a widely used disposal method. However, poorly maintained incinerators can release harmful gases such as dioxins and furans, particularly when burning chlorinated or brominated plastics, raising serious environmental concerns. In India, alternative strategies have been explored, such as integrating plastic waste into road construction and co-processing in cement kilns. Major obstacles to enforcing the plastic waste management (PWM) Rules, 2011, include the widespread use of substandard plastic bags, littering in urban areas, and the extensive use of plastic sachets for products such as gutkha, tobacco, and pan masala [13].

Plastic durability and widespread industrial use have become global environmental concerns. Plastic pollution originates from land-based and marine sources. Land-based pollution occurs through deliberate or improper disposal of domestic and industrial waste, as well as accidental losses during transport. These plastics eventually enter waterways and oceans and are compounded by waste from marine vessels and offshore platforms. The accumulation of plastics in ecosystems has numerous adverse effects, and growing consumption, combined with plastic's resistance to degradation, exacerbates environmental concerns [14].

Chemicals associated with plastics fall into three main categories: inherent ingredients of the plastic, byproducts of manufacturing, and substances absorbed from the environment. Toxicological effects can arise from any combination of these compounds. Certain chemicals, such as heavy metals, pesticides, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs), are classified as priority pollutants owing to their persistence and potential toxicity. These substances can disrupt physiological functions in animals, thereby affecting reproduction and health. Studies have shown that 78% of EPA-listed priority pollutants and 61% of EU-listed pollutants are associated with plastic litter, from either production or environmental contamination [15].

Polyvinyl chloride (PVC) is one of the most widely produced plastics worldwide, and is used in packaging, pipes, automotive components, construction materials, and furniture. PVC is derived from the polymerization of vinyl chloride (VC), a high-production-volume chemical with an annual global demand of approximately 16 billion pounds, increasing by approximately 3% annually. Approximately 98% of VC is used for PVC production [16].

In 2017, the U.S. Environmental Protection Agency (EPA) reported that municipal solid waste generation reached 267.8 million tons, marking a 5.7 million-ton increase since 2015. Waste generation contributes to environmental degradation, affects wildlife, and poses health risks to humans. Similarly, India generates a significant amount of plastic waste. According to the 2017–2018 Central Pollution Control Board (CPCB) report, India produced approximately 9.4 million tonnes of plastic waste annually (roughly 26,000 tons per day). Of this, around 5.6 million tonnes per year (15,600 tonnes per day) are recycled, while 3.8 million tonnes per year (9,400 tonnes per day) remain uncollected or littered. Approximately 70% of plastic packaging is rapidly becoming waste. While India's recycling rate (approximately 60%) is higher than the global average (20%), a substantial portion of plastic still ends up in landfills, water bodies, or as environmental litter. Certain plastics may take up to 450 years to decompose [17].

Plastic consumption in India has grown significantly, and projections indicate that the total consumption could increase sixfold between 2000 and 2030. Combining product lifetimes with consumption rates, the weighted average lifetime of plastic products was approximately eight years. Currently, 47% of the plastic waste in India is recycled, a rate higher than that in many other countries. According to CPCB data, 2018–2019 saw the generation of approximately 3.3 million metric tons of plastic waste in India (approximately 9,200 tons per day), forming approximately 5–6% of the total municipal solid waste (55–65 million tons). States such as Goa generate the highest per capita plastic waste (60 g per day), nearly double Delhi's rate (37 g per day) [18].

The extensive consumption of plastics has created a pressing need to raise awareness regarding their use and proper disposal. Plastics are increasingly utilized in daily life, including food packaging, pharmaceuticals, cosmetics, and other products, which makes their post-use management critical. Plastics are manufactured via polymerization or polycondensation, and improper disposal can have severe environmental consequences [19].

Maharashtra, Gujarat, Andhra Pradesh, and Tamil Nadu produce the most plastic waste in India. Improper disposal has long-term environmental impacts. Burning plastics releases persistent organic pollutants (POPs), including dioxins and furans, which can circulate globally and pose health risks such as immune and enzymatic disorders. These pollutants are potentially human carcinogens. Recycling remains the most effective and environmentally safe method of disposal, although the proper segregation of different plastic types is required. Recent studies have highlighted that improper disposal and lack of awareness in rural communities make PWM a critical issue [20].

Global attention to plastic pollution has increased, especially since Charles Moore discovered the Great Pacific Garbage Patch in the late 1990s. This massive floating collection of waste, estimated at 3.43 million km² (roughly the size of Europe), primarily consists of plastics, ranging from large fishing nets to microplastics. Similar plastic accumulations, or “plastic soup,” are found in Europe, including the Mediterranean and North Sea, making marine litter and plastic pollution a high priority in EU policies [21].

Plastic remains a relatively modern material, meaning that environmental issues related to plastic waste have only recently been recognized. Awareness of the persistence of plastics in ecosystems and the potential health and environmental impacts of the chemicals contained in plastics is even more recent. Research on plastic pollution and its effects is still in its early stages; however, current findings suggest serious concerns [22].

Large portions of the planet are polluted with discarded plastics that directly harm wildlife and indirectly affect human health. Contaminated animals, which serve as food sources for humans, may carry toxins from plastic waste. Microplastics have been detected in over 100 edible marine species, including fish, shrimp, and mussels. Millions of animals die annually owing to plastic ingestion, entanglement, or starvation, with ingestion being the most common. Plastics in the stomach reduce

appetite and contribute to malnutrition. Marine animals such as seals, whales, and turtles are often caught in abandoned fishing nets or six-pack rings. Sea turtles, which feed on jellyfish, frequently mistake plastics for food, whereas seabirds may confuse microplastics with prey such as cuttlefish. Fish also ingest plastics, mistaking them for natural prey. Studies have shown that exposure to plastics can cause liver damage, cellular toxicity, and reproductive disruption in some species, such as oysters producing fewer eggs [23].

Single-use packaging materials, including plastic water bottles, grocery bags, Styrofoam cups, and various pharmaceutical and packaging products, are particularly harmful because of their short lifespan and long-term environmental impact. The damage caused by these items often far outweighs the short-term convenience they provide [24].

In 2018, World Environment Day (June 5) adopted the theme, “Beat Plastic Pollution—The world is coming together to combat single-use plastic pollution.” India has emerged as a leader in recycling, with one of the highest recycling rates in the world. This highlights the urgent need to raise awareness among the Indian population regarding the proper disposal and recycling of plastics, which forms the basis for interventions in studies focused on PWM [25–27].

Objectives of the Study

1. To assess the impact of a planned teaching program on adults’ knowledge of plastic waste disposal and its associated health risks.
2. To examine the relationship between adults’ pretest knowledge of plastic waste disposal and health hazards, and their selected sociodemographic characteristics.

OPERATIONAL DEFINITIONS

1. *Evaluate*: In this study, statistical methods were used to assess adults’ knowledge concerning the disposal of plastic waste and its related health risks.
2. *Effectiveness*: This study refers to the meaningful and positive change observed between the pretest and posttest knowledge scores of adults regarding plastic waste disposal and its health hazards.
3. *Planned teaching program (PTP)*: This study refers to a systematically developed planned teaching program by researchers for adults regarding plastic waste and its health hazards, which contains a definition, structure, classification, and hazards due to health and health due to the disposal of plastic waste and prevention.
4. *Knowledge*: In this study, it refers to the ability of adults to give correct responses to questions related to the disposal of plastic waste and its health hazards, as measured by a structured knowledge questionnaire.
5. *Plastic waste*: In a study, it refers to plastic materials that can be easily available and discarded by burning, dumping, and throwing in garbage, which causes many health hazards to humans and animals.
6. *Health hazards*: In this study, it refers to the health problems caused by unsafe methods of disposal of plastic waste, such as respiratory diseases, asthma, emphysema, and potentially carcinoma.

Assumptions

This study assumes that:

1. Adults in Ghotawde village may have some knowledge regarding the disposal of plastic waste
2. PTPs will enhance knowledge regarding the disposal of plastic waste and its associated health hazards.

Hypotheses

All the hypotheses are tested at the 0.05 level of significance.

H1: The mean posttest knowledge score of adults in Ghotawde village will be greater than the mean pretest knowledge score regarding the disposal of plastic waste after the administration of the PTP.

H2: There is an association between pretest knowledge scores of adults in Ghotawde village regarding the disposal of plastic waste and their selected sociodemographic variables.

Delimitations

The study was limited to adults in Ghotawde village, the rural community area of Kolhapur district.

Research Question

What is the knowledge about the disposal of plastic waste and its health hazards among adults in Ghotawde village of Kolhapur district?

Ethical Aspects

1. Ethical clearance was obtained from the authorities of Ghotawde village.
2. Written informed consent was obtained from the subjects to participate in the PTP.

CONCEPTUAL FRAMEWORK OF THE STUDY

The framework serves as a conceptual blueprint for this study. When a study is grounded in theory, the framework is referred to as the theoretical framework, whereas in studies derived from a specific conceptual model, it is termed the conceptual framework. A conceptual framework represents a structured arrangement of interrelated ideas or abstractions connected to a common theme.

Conceptualization is the process of forming ideas, which are then used to develop the conceptual framework and guide the research design. It helps the researcher identify the data that needs to be collected and provides direction to the overall research process.

The present study aimed to assess the effectiveness of a PTP on adults' knowledge regarding the disposal of plastic waste and its associated health hazards in Ghotawde village, Kolhapur district. The study was guided by the General Systems Theory proposed by Bertalanffy (1968). According to Bertalanffy, a system is "a complex of interacting elements," meaning that it is composed of multiple interconnected components that function together as a whole. Any dysfunction in one part can affect the entire system. A system consists of feedback loops, including input, throughput, and output, which help maintain the system's stability and effectiveness.

In this study, it is hypothesized that the PTP will enhance adults' knowledge regarding plastic waste disposal and its health hazards in Ghotawde village.

Input

Input refers to any form of energy, material, or information that enters the system through its boundaries. Inputs in a system must contribute to achieving its purpose. In the context of this study, inputs included participants' demographic information (age, gender, educational status, family type, religion, occupation, and family income) as well as the development of the teaching program.

Throughput

Throughput involves processing inputs into actions that help to maintain the functionality of the system. It represents dynamic interaction with the environment, transforming information into observable outcomes through verbal and behavioral communication. For this study, throughput included preparing and validating the teaching module and questionnaire, assessing knowledge through a pretest, administering the teaching program, and evaluating its effectiveness through a posttest.

Output

The output is the result or change produced by the system, which is observable and measurable. It reflects the difference between what enters the system (input) and what emerges after processing (throughput). In this study, output refers to the measurable change in knowledge among adult participants regarding plastic waste disposal and its health hazards after the implementation of a teaching program.

Feedback

Feedback is the process by which information from each stage of the system is evaluated and used to make adjustments or improvements. In this study, feedback helped assess the effectiveness of the teaching program and informed any necessary modifications to the intervention.

Environment

The environment encompasses all external factors that may influence participants' knowledge. In this study, the environment includes the information and experiences that adults in Ghotawde village of Kolhapur district are exposed to, which may affect their understanding of plastic waste disposal and its health hazards.

REVIEW OF LITERATURE

Literature review is a crucial step in the research process as it provides a detailed account of existing knowledge on a specific topic. Its primary purpose is to inform readers about the work that has already been conducted and the ideas and findings established by previous researchers. The literature review highlights the efforts, contributions, and achievements of scholars and researchers related to the phenomenon under study.

A literature review can be defined as a comprehensive, systematic, critical, and in-depth examination of scholarly publications, unpublished materials, audiovisual sources, and personal communication [28, 29].

Literature Related to Knowledge Regarding Plastic Waste Disposal

Several studies have explored individuals' awareness and knowledge regarding plastic waste disposal and its associated hazards.

Karthi, R., Umopathy, M., and Sathiya, N. conducted a pre-experimental one-group pretest–posttest study to evaluate high school students' knowledge about the hazards of plastic use before and after a structured teaching program (STP). Fifty students were selected using purposive sampling. The pretest mean knowledge score was 7.08 (standard deviation (SD) 2.71), which increased to 15.36 (SD 2.12) after the intervention. The paired t-test value of 9.88 was statistically significant at 0.05, indicating that the STP effectively improved students' knowledge regarding the hazards of plastic use [30].

Kaur, S., Jeganathan, J., and Kaur, M. conducted a quasi-experimental study among 30 female students in private institutions of Sirmour, Himachal Pradesh, using simple random sampling. The pretest showed that 60% had poor knowledge, 40% had average knowledge, and none demonstrated good knowledge. After administering an STP, 40% of the students achieved good knowledge, and 60% had average knowledge. The difference between the pretest and posttest scores was statistically significant at 0.01, highlighting the importance of awareness programs for both students and teachers regarding plastic hazards [31].

Srinivasan et al. conducted a cross-sectional study to assess knowledge and practices related to plastics among 563 first-year professional students at Annamalai University. The results showed that the majority had moderate knowledge, followed by good knowledge, whereas 5.4% had inadequate knowledge. The practices were moderate (33.7%) and good (22.7%), whereas one-third demonstrated poor practices. The study concluded that awareness initiatives must not only target knowledge, but also promote better practices, particularly avoiding single-use plastics [32].

Najnin Khanam, Vasant Wagh, Abhay M. Gaidhane, and Syeed Zahiruddin Quazi assessed the knowledge, attitude, and practice of plastic products among school-going adolescents in Wardha City using purposive sampling. Most students recognized the importance of reducing plastic use (75.78%) and reusing it at home (41.05%). Awareness of the non-biodegradability of plastics was reported by

26.32% of respondents, and 37.89% knew about local bans on plastic bags. Schools and the media are the main sources of information. The study emphasized the influence of family habits on proper plastic disposal and highlighted students' willingness to reduce plastic use and promote awareness [33].

Shahzadi, Hussain, Afzal, and Gillani conducted a cross-sectional study of 100 households in rural Lahore to assess knowledge, attitudes, and practices regarding household waste disposal. While 72% of respondents were aware of the adverse effects of improper disposal, 95% had a positive attitude, and 52% exhibited poor practices. The study concluded that despite adequate knowledge, improper disposal practices prevailed owing to a lack of public facilities and awareness [34].

Manuel, Varghese, Jose, Thomas, Joseph, and Shettigar conducted a community-based study among 100 adults aged 20–45 years using simple random sampling. Pretest knowledge regarding the hazards and disposal of plastic waste was 42.52%, which improved to 80.48% posttest, showing a 37.96% increase. The study highlighted inadequate baseline knowledge among adults and the significant role of information sources in enhancing awareness [35].

Mercer and Hall conducted a descriptive study to examine household plastic recycling habits in Ontario. Plastics comprise 7–8% of residential waste, with packaging accounting for 81% of the total plastics. Polyethylene bottles were collected from 91% of households, while other plastics, such as wide-mouth tubes, recyclable films, and polystyrene, were collected from roughly one-third of the households. The study concluded that municipal, commercial, and industrial plastics were largely managed through recycling programs [36].

Chaudhary, Kathuria, Tomar, Jain, Vatsa, and Singh assessed knowledge, attitude, and practice regarding plastic use among 100 school students in Meerut using purposive sampling. Before the intervention, 64% knew the chemical nature of plastics, and 88% knew that they were non-biodegradable. Post-intervention, there was a 12% increase in knowledge of environmental impacts. The study emphasized the need for education through pamphlets, health talks, and awareness campaigns [37].

Vigneshwaran et al. conducted a descriptive study of 60 residents of the Tiruchirappalli Municipal Corporation, Tamil Nadu, using convenience sampling. Three-fourths of the respondents had high knowledge, over half demonstrated a positive attitude, and 83.3% practiced responsible plastic use. Overall, more than half of the participants exhibited high levels of knowledge, attitude, and practice, highlighting the need for targeted awareness programs for those with lower engagement [38].

Adane L. and Muleta D. carried out a community survey in Jimma City, Ethiopia, with 230 participants selected by simple random sampling. Most of the respondents (76.52%) frequently used plastic bags. Open dumping was the most common disposal method (59.56%), and usage trends increased despite awareness of the environmental impacts. The study recommended public education on alternatives to plastic bags and city-level legislation to reduce indiscriminate use and promote eco-friendly materials [39].

Literature Related to Knowledge Regarding Health Hazards Due to Improper Plastic Waste Disposal

Several studies have explored awareness and knowledge of the health hazards associated with improper plastic waste disposal among different populations.

Sharmila conducted a pre-experimental study among 30 housewives in Nagunur, Karimnagar, to assess their knowledge regarding the health hazards of plastic use before and after an STP. Pretest results indicated that 60% of the participants had below-average knowledge and 40% had average knowledge. After the intervention, 76.67% achieved above-average knowledge, while 23.33% had average knowledge. The study concluded that housewives initially had insufficient knowledge, but the teaching program significantly improved their awareness of the health risks of plastic use [40].

Poudel and Thomas conducted a pre-experimental one-group pretest–posttest study among 30 adults in Bharatpur Metropolitan City, Nepal, to evaluate the effectiveness of an STP on the health and environmental hazards of plastics. The participants varied in age, education, family type, occupation, and income. Pretest assessments revealed knowledge gaps related to the storage of hot food, risks from burnt plastic, inhalation of plastic smoke, and impact on pregnant women, with significant associations at the 1% and 5% levels. After the intervention, the mean knowledge score increased from 9.5 to 20.46, demonstrating the effectiveness of the teaching program in improving awareness [41].

Malik and Roy conducted a descriptive study among 60 adolescents in Nelamangala to assess their knowledge and attitudes regarding the mismanagement of plastic waste and environmental hazards. The study found that 61.67% of the adolescents had inadequate knowledge, 38.33% had moderate knowledge, and none demonstrated adequate knowledge. The attitude assessment showed that 75% had a positive attitude, while 25% were neutral. There were no significant associations between knowledge, attitude, and demographic variables. The findings indicated that adolescents had limited knowledge, but generally positive attitudes toward PWM [42].

Joseph N., Kumar A., Majgi S.M., Kumar G.S., and Prahalad R.B. conducted a community-based cross-sectional study in Mangalore to assess awareness of health hazards associated with plastic bag usage and perceptions of related legislation. Among the 250 participants, 64% were female, and 74.8% had undergraduate or higher education. The awareness of health hazards was high (86.4%), particularly among females, educated individuals, and professionals. However, only 20% reused plastic bags and 5.2% used cloth bags as alternatives. The study emphasized the need for broader public education and effective implementation of legislation to reduce plastic use [43].

Antony, George, Jose, Paul, Babu, and Sikha carried out a pre-experimental one-group pretest–posttest study among 30 housewives in Aluva to evaluate their knowledge regarding the ill effects of plastics on health and the environment. The pretest results showed that 13.34% had poor knowledge, 76.6% had average knowledge, and 10% had good knowledge. The posttest results indicated that 96.6% of participants achieved good knowledge, while 3.34% had average knowledge. The significant improvement in the scores confirmed the effectiveness of STP [44].

Shalini V.B. K. et al. conducted a quantitative study among 300 nursing students in Ambala, Haryana, to assess their knowledge and attitudes about plastic use and related health effects. The mean knowledge and attitude scores were 59% and 80.3%, respectively, with a mild positive correlation ($r=0.07$). Knowledge was significantly associated with gender, academic qualification, and type of school, whereas attitude was associated with religion, academic year, residence, and prior knowledge. The study concluded that students had moderate knowledge and favorable attitudes toward the health effects of plastic use [45].

Omar, Hossain, and Parvin conducted a cross-sectional study among 150 residents of Karan District, Mogadishu, to examine knowledge, attitudes, and practices regarding waste management and their effects on health and the environment. The knowledge levels were classified as excellent (13%), good (58%), satisfactory (17%), and poor (12%). While the community had good knowledge and positive attitudes, actual practices related to waste management were poor [46].

Sirsat A., Bhandwalkar V., Karri S., Ramteke R., and Vishwakarma A. conducted a quasi-experimental one-group pretest–posttest study among 30 parents in Nagpur to assess knowledge about hazards of plastic use and safe disposal and to evaluate the effectiveness of an informational booklet. Posttest mean scores (17.15) were significantly higher than pretest scores (16.5), with a paired t-value of 3.03 at $p < 0.05$, demonstrating that the booklet effectively increased participants' knowledge of safe plastic disposal practices [47].

Gabuya conducted a cross-sectional survey to explore residents' knowledge of the dangers of plastic

use, their attitudes toward it, and their practices that either mitigate or exacerbate its hazards. This study used both quantitative and qualitative methods, including unstructured interviews, and involved 78 residents. The findings revealed that although participants recognized the convenience of plastic and were aware of its risks, they continued to use and dispose of it in unsafe ways. The study concludes that there is a need for effective awareness campaigns and community engagement to promote safer practices [48].

Oguge, Oremo, and Adhiambo surveyed 271 youths in Nairobi, Kenya, to examine their knowledge and attitudes regarding plastic pollution. Semi-structured questionnaires and focus group interviews were conducted. The results indicated that most participants considered single-use plastics to be a major environmental and health concern. Nearly all respondents acknowledged that plastic waste clogged drainage systems and degraded very slowly. Additionally, most participants expressed a willingness to adopt reusable alternatives, such as cloth bags and reusable containers, even if extra costs were required [49].

Barbir, Leal Filho, Salvia, Fendt, Babaganov, and Albertini carried out an online survey across 25 European countries to assess the impact of plastics on human health. Among the 1,000 respondents, the direct health effects of plastic consumption were well known, while indirect effects from plastic production were less recognized, primarily by participants with lower education. Despite a positive attitude toward reducing plastic use, daily consumption remained high. This study emphasized the need for governmental support, policy initiatives, and public campaigns to effectively reduce plastic usage [50].

Khairnar C., Shaji S.R., Khemnar D., Vyas S., Gadkari A., and Devi S. conducted a community-based, non-experimental study in Pune with 200 adults to evaluate awareness of plastic bag hazards. The results showed that most participants answered approximately 17 out of 20 questions correctly, indicating 95% awareness. A significant association was observed between awareness levels and education, highlighting the role of education in promoting informed behavior [51].

Joseph N., Kumar A., Majgi S.M., Kumar G.S., and Prahalad R.B. conducted a cross-sectional survey of 250 participants in Mangalore to assess awareness of health hazards associated with plastic bag use and perceptions of legislative bans. The mean participant age was 32.8 years, with the majority being female and well educated [52]. The awareness of plastic hazards was high (86.4%), particularly among females, educated individuals, and professionals. However, practices such as reusing bags or switching to alternatives are limited, highlighting the gap between knowledge and behavior [53].

Kombiok and Jaaga conducted a community-based cross-sectional study among 270 households in Tamale, Ghana, to evaluate the knowledge, attitudes, and practices (KAP) related to plastic waste disposal. The results revealed that 48% had moderate-to-high knowledge, 87% displayed negative attitudes, and 46% demonstrated poor disposal practices. Education and employment were significantly associated with waste management behavior. The study concluded that KAP levels were generally unsatisfactory and emphasized the need for formal and informal education along with improved waste disposal access [54].

Ashimi, Amole, Yusuf, and Michael G.C. carried out a survey among 200 healthcare workers to assess their awareness of the health and environmental hazards of plastic bags and alternatives. While most respondents (91%) knew about environmental risks and 74% were aware of health hazards, many continued to rely on single-use plastic. Awareness is significantly associated with age, sex, marital status, and ethnicity. The study recommended promoting reusable alternatives and mass education campaigns to reduce plastic waste [55].

Shaxson examined the environmental implications of plastic carrier bags and evaluated the effectiveness of regulatory measures in Israel. The study found that the free distribution of plastic bags

encourages their excessive use. It recommends educational programs rather than high levies or outright bans, suggesting that the environmental burden of plastic bags is more of a political concern than a direct hazard [56].

Reiss A. conducted a descriptive survey at 62 Zehrs shopping centers in Ontario to assess public knowledge of reusable plastic bags. The results indicated that most participants understood the environmental benefits of reusing bags but had not yet established the habit of consistently doing so. The study emphasized the need for strategies to encourage the routine use of reusable bags [57].

Lithner D.A. et al. conducted a study to rank and assess the environmental and health hazards associated with plastic polymers. With global plastic production doubling to 245 million tons in 2008, knowledge of the associated chemical risks is limited. Many chemicals in plastics are derived from nonrenewable crude oil and are hazardous. The study analyzed 55 thermoplastic and thermosetting polymers and identified hazardous substances that may require risk reduction, substitution, or phase-out measures [58].

Literature on the Effectiveness of Structured Teaching Programs

R. Regi Bai conducted a pre-experimental, one-group pretest and posttest study to evaluate the effectiveness of an STP on the hazards of plastic waste among housewives in rural areas. Thirty housewives were selected using nonprobability convenience sampling. A pretest was administered, followed by a structured teaching intervention, and a posttest was conducted one week later. Analysis using descriptive and inferential statistics revealed that the posttest knowledge score increased to 94%, with 80% of housewives demonstrating adequate knowledge, and 20% showing moderate knowledge. The pretest mean score was 13.9 ± 3.73 , while the posttest mean score increased to 14.5 ± 2.63 . The paired t-test value of 2.71 was statistically significant at $p < 0.05$. The study concluded that structured teaching significantly improved knowledge among housewives, highlighting its usefulness in promoting healthy practices among health professionals [59].

Usha Rani conducted a pre-experimental study to assess the effectiveness of an STP on knowledge regarding plastic hazards among housewives in Avalahalli, Bangalore. Thirty homemakers were selected using purposive sampling. The pretest results showed that 100% had inadequate knowledge, whereas the posttest results indicated that 63% had adequate knowledge and 37% had moderately adequate knowledge. The posttest mean score was 22.76 (75.8%) with an SD of 1.9, while the pretest mean was 8.83 (29.43%) with an SD of 3.1. The paired t-test value of 20 exceeded the table value of 2.25 ($p < 0.05$), indicating a significant improvement. The study also found a significant association between posttest knowledge scores and variables such as religion and monthly income [60].

Kirubavathi conducted a quasi-experimental study to examine the effects of an STP on waste disposal knowledge among adults. One hundred participants were selected using purposive sampling. The pretest results revealed that 86% had inadequate knowledge and 14% had moderately adequate knowledge. Following the teaching intervention, 82% demonstrated adequate knowledge, and 18% had moderately adequate knowledge. The findings highlight a significant increase in knowledge regarding waste disposal after an STP [61].

Kalaimathi, Vijayalakshmi, and Jayalakshmi implemented a pre-experimental one-group pretest and posttest study to evaluate the effectiveness of an STP on plastic waste hazards and safe disposal among 50 adults aged 20–50 years in Kizhkatchirapattu, Tiruvannamalai. Convenience sampling was also conducted. The pretest mean score was 5.4 ± 1.3 , while the posttest mean score increased to 16.4 ± 0.56 . A paired t-test value of 13.8 ($p < 0.001$) indicated a statistically significant improvement, demonstrating the effectiveness of the intervention in enhancing knowledge [62].

Abid, Husain, Majeed, and Afzal conducted a quasi-experimental pretest–posttest study with 60 high school students in Lahore, Pakistan. The intervention involved three educational sessions on plastic use,

health hazards, and preventive measures. The pretest mean score was 8.98 ± 3.28 , while the posttest mean score increased to 16.85 ± 3.04 , with a mean difference of 7.867. The results showed a statistically significant improvement in knowledge, demonstrating that educational interventions can effectively reduce plastic-related health risks among students [63].

Ashwini, Prabhu S., Shetty S., Prabhu V., Pais M., and Kuriakose B. carried out a study in hospitals of Udupi District to assess ICU nurses' knowledge regarding delirium and the impact of a STP. Using a one-group pretest–posttest design with 40 participants, the results showed a significant increase in posttest knowledge ($t=23.95$, $p < 0.0001$), suggesting that structured education can enhance nurses' ability to identify and manage delirium effectively [64].

Rawat conducted a pre-experimental study to evaluate the effectiveness of structured teaching on knowledge of polycystic ovarian syndrome (PCOS) among 94 adolescent girls aged 15–18 years. The pretest mean score was 11.13 ± 3.32 , and the posttest mean score improved to 22.55 ± 3.57 , with a mean difference of 11.42. A t-value of 23.45 exceeded the critical value, indicating a significant improvement in knowledge. The study concluded that STPs are effective in raising awareness of PCOS [65].

Nayak assessed the impact of an STP on back-care knowledge and practices among 50 staff nurses in Bhubaneswar, Odisha. The pretest mean knowledge and practice scores were 62% and 68.6%, respectively, while the posttest scores increased to 85.3% and 90.7%, respectively. The paired t-test values of 16.78 for knowledge and 7.002 for practice were highly significant ($p < 0.0001$). Positive correlations were observed between pretest knowledge and practice ($r=0.725$), and between pre- and posttest practice scores ($r=0.728$). The study demonstrated that structured teaching effectively enhances both knowledge and practical skills [66].

Sawarkar A., Shambharka M., Khandar J., Sakharwade P., Kolheka S., and Tembhare V. conducted an interventional study on 100 participants to evaluate the impact of a self-instructional module on the hazards of plastic waste and its safe disposal. The pretest results showed that 15% had poor knowledge, 83% had average knowledge, and 2% had good knowledge. The posttest assessment revealed that 87% achieved excellent knowledge, and 13% had good knowledge. The study highlighted the effectiveness of self-instructional modules in increasing awareness of plastic waste hazards and safe disposal practices [67].

METHODOLOGY

Research methodology refers to the systematic techniques and procedures that researchers use to investigate a problem, study its structure, and collect information relevant for analysis and addressing the research questions. This section outlines the methodology employed in the present study, including the research approach, research design, variables, research setting, population, sample, sample size, sampling technique, criteria for sample selection, tool development and description, validation of the tool, data collection process, and plan for data analysis (Figure 1).

Research Approach

The research approach is a fundamental component of research design as it guides the overall process of conducting the study. It serves as a framework that encompasses the systematic procedures used to gather and analyze information. Selecting an appropriate research approach that involves an organized and disciplined method for obtaining data is essential for the success of any research. In the present study, considering the nature of the research problem and objectives, a quantitative evaluative survey approach was adopted to conduct the investigation.

Research Design

The research design refers to the comprehensive plan formulated to answer a research question and ensure the validity and reliability of the study. It outlines the strategies and methods used by a researcher

to collect evidence that is both accurate and interpretable. This study aimed to evaluate the effectiveness of an STP on adults' knowledge regarding plastic waste disposal and its health hazards in Ghotawde village, Kolhapur district. A pre-experimental one-group pretest and posttest design was employed (Table 1).

Variables

Variables are concepts that can be measured, controlled, or manipulated in a study. This study identified three types of variables: independent, dependent, and attribute.

Independent Variable

The independent variable was the factor believed to influence or cause changes in another variable. In this study, the independent variable was the structured teaching program on knowledge of plastic waste disposal and its health hazards.

Dependent Variable

The dependent variable is the outcome expected to change as a result of the independent variable. The dependent variable was the knowledge of adults regarding plastic waste disposal and its associated health hazards.

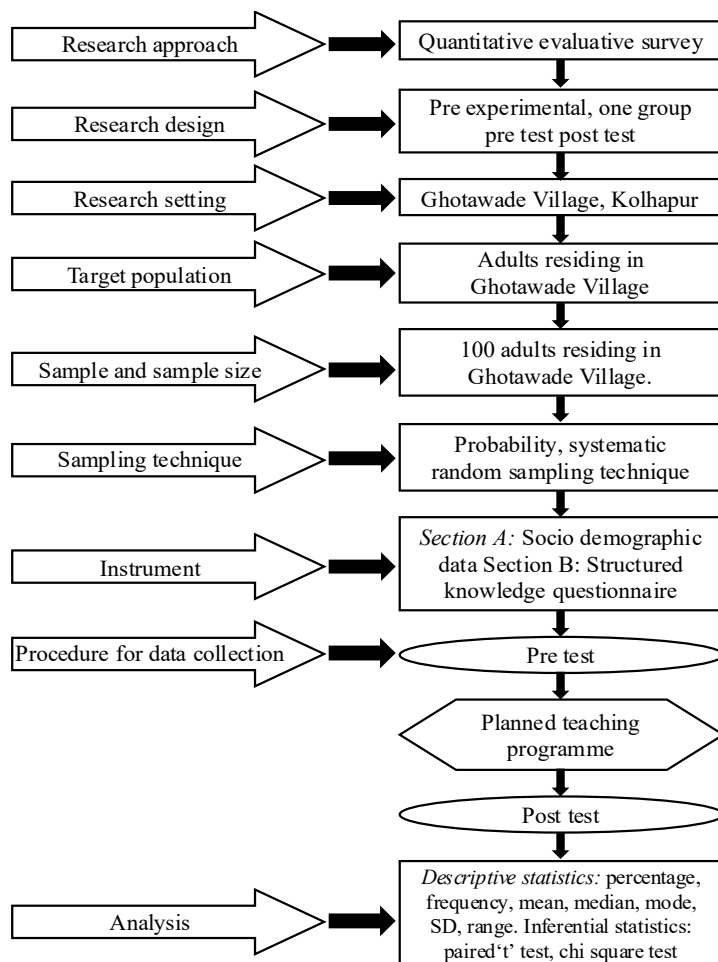


Figure 1. Schematic presentation of methodology.

Table 1. Symbolic representation of research design.

Group	Pretest	Intervention	Posttest
Pre-experimental	O ₁	X	O ₂

Attribute Variables

Attribute variables are pre-existing characteristics of participants that the researcher observes or records without manipulating them. Seven attribute variables were considered in this study: age, gender, religion, family type, educational status, occupational status, and monthly family income.

Research Setting

The research setting refers to the physical location and environment in which the data collection takes place. This study was conducted in Ghotawde village, Kolhapur district, which was randomly selected using a lottery method without replacement.

Research Population

The population comprises an entire group of individuals or objects that share common characteristics. In this study, the population consisted of adults aged 18 years and above residing in Ghotawde village.

Sample

The sample is a subset of the population selected for participation in the study. The sample in this research consisted of adults from Ghotawde village who met the inclusion criteria.

Sample Size

The total sample comprised 100 adults, and the sample size was determined in consultation with a statistician using a standard sample size formula.

Sampling Technique

Sampling involved selecting a representative portion of the population. This study employed probability systematic random sampling to select participants.

Criteria for Sample Selection

Eligibility criteria were defined as the characteristics required for participants to be included or excluded from the study.

Inclusion Criteria

- Adults willing to participate in the study
- Adults who understood Marathi or English

Exclusion Criteria

- Adults who were unavailable during the data collection period

Development of the Tool

A research tool was used to collect data relevant to the study's objectives. The tool for this study was developed after a thorough review of the literature, consultation with experts, and guidance from research advisors. The final tool consists of the following:

- *Section A:* Sociodemographic variables
- *Section B:* Knowledge questionnaire on plastic waste, its disposal, and related health hazards

The tool was validated by experts, and necessary modifications were made based on their feedback. A pilot study was conducted after the validation to ensure clarity and reliability.

Description of the Tool

Section A: Sociodemographic Variables

This section includes seven items to collect background information: age, gender, religion, type of family, educational status, occupational status, and monthly family income.

Table 2. The questionnaires for knowledge assessment.

Category	Range
Good Score	17-24
Average Score	9-16
Poor Score	0-8

Section B: Knowledge Questionnaire

This section contained 24 multiple-choice questions assessing knowledge of plastic waste, its disposal, and health hazards.

Description of Planned Teaching Program

A STP is an educational intervention designed to provide simplified information on knowledge regarding PWM and health hazards. The program included the following steps:

- Introduction
- Definition of plastic
- Role of plastic in daily life
- Life cycle of plastic
- Health hazards associated with plastic
- Effects of burning plastic waste
- Simple strategies to reduce plastic waste
- Tips for household waste management
- Conclusion
- References/Bibliography

Scoring Technique

The knowledge questionnaire consisted of 24 multiple-choice items. Each correct response was awarded 1 mark, whereas incorrect or unanswered questions received 0 marks. The maximum possible score is 24 (Table 2).

Content Validity of the Tool

- Validity refers to the degree to which an instrument measures what it is intended to measure [35].
- The tool was presented in front of the principal and other senior M.Sc. nursing teachers at D. Y. Patil College of Nursing, Kolhapur, before sending them for validation.
- The tool was sent to 17 experts who validated it. The 10 experts were Professors and Associate Professors of Community Health Nursing, three were doctors, M.D. Preventive and Social Medicine, one was a Pollution Control Officer of the Government of Maharashtra, one was a statistician, and two were M.A. (Marathi and English). The tool was translated into Marathi.
- After considering the suggestions of the guide and experts, certain modifications were made to the tool. The tool was modified and finalized accordingly for the pilot study.

Reliability

Reliability refers to the consistency of a research instrument in measuring the attributes it is intended to assess. An instrument is considered reliable when it consistently reflects the true scores of participants. In this study, the reliability of the tool was evaluated by administering it to 10 adults from Ghotawde village, Kolhapur District.

The test-retest method was used to assess the reliability of the knowledge questionnaire, and the Karl Pearson correlation coefficient was calculated. The reliability coefficient for the structured knowledge questionnaire was $r = 0.84$, indicating that the tool was reliable and suitable for use in the main study.

Pilot Study

A pilot study is an essential step in research, serving as a trial run to evaluate the feasibility of the main study and refine the data collection tools and procedures. The pilot study helped identify potential challenges and improve the overall research design. For this study, a pilot study was conducted in Unchagaon village, selected randomly from eight villages in Kolhapur district, using the lottery method. Formal permission was obtained prior to the study. The pilot study was conducted from 19/09/2022–26/09/2022.

The researcher introduced herself to the participants, explained the objectives of the study, and selected ten samples using systematic probability sampling according to the inclusion criteria. Written informed consent was obtained from all the participants. The pretest was administered on 19/09/2022 using the structured tool, which included Section A: Sociodemographic variables and Section B: Knowledge questionnaire on plastic waste, its disposal, and health hazards. The pretest took approximately 45 minutes to complete. Immediately after the pretest, a PTP was delivered. The posttest was conducted seven days later on 26/09/2022 using the same tool. The results from the pilot study indicated that the instrument was reliable and produced consistent results.

Item Analysis

An item analysis was conducted to evaluate whether the questionnaire items measured the same construction and were sufficiently discriminative. This analysis was performed based on the Gilbert classification.

- *Difficulty Index*: Three items were classified as difficult, while 21 items were considered good.
- *Discriminative Index*: 6 items were excellent, 10 items were good, 8 items were poor, and no items were marginal.

Procedure for Data Collection

The main study was conducted in Ghotawde village, Kolhapur District, which was randomly selected using the lottery method. Formal permission was obtained from the Sarpanch of the village. Data collection for the main study took place from 03/12/2022 to 10/12/2022, and the schedule was planned according to the daily activities of the residents.

The researcher introduced herself to the participants and explained the study's purpose and objectives. A total of 100 adults were selected from a target population of 400 using systematic probability sampling. The sampling interval (Kth value) was two, meaning that every second adult was selected. A total of 110 participants were initially selected to account for potential dropouts, and 100 participants completed the study. Written informed consent was obtained one day before the pretest, and confidentiality of the responses was assured.

The pretest was conducted on 03/12/2022 using a structured knowledge questionnaire, which took approximately 45 min to complete. On the same day, PTP was delivered for 45 min. The posttest was carried out seven days after the intervention to assess the effectiveness of the teaching program (Table 3).

On 10/12/2022, for the posttest, 107 samples were present from the first 100 and were considered final.

Research Setting: Ghotawde village of Kolhapur district.

Plan for Data Analysis

Data analysis involves systematic organization, summarization, and interpretation of research data as well as testing the research hypotheses based on the collected information. In this study, the data were analyzed in accordance with the research objectives and hypotheses using both descriptive and inferential statistical methods. The data analysis plan was developed in consultation with experts in statistics and nursing research.

Table 3. Schedule for data collection.

Date and time	Samples	Activity
3-12-2022 11 am to 12.30 pm	100	Pretest 1. Obtained permission from the Gram Panchayat office of Ghotawde village of Kolhapur district. 2. Introduced self and established rapport. 3. Explained the purposes and objectives of the study. 4. Written informed consent was taken from the samples. 5. Administered tool
1 pm to 2 pm		1. Administered the PTP to the samples after the pretest
10-12-2022 12 pm to 1 pm	100	Posttest 1. A posttest was conducted by administering the same tool to the same samples.

The analysis was planned as follows:

1. The collected data was compiled and organized into a master sheet.
2. Sociodemographic variables were analyzed using frequency counts and percentage distribution.
3. Knowledge scores were evaluated using frequency, percentage, mean, median, mode, range, and SD.
4. The paired t-test was applied to compare pretest and posttest knowledge scores to determine the effectiveness of the PTP.
5. The chi-square test was used to assess the association between the pretest knowledge scores of participants and their selected sociodemographic characteristics.

Analysis and Interpretation of Data

After data collection, it is essential to process and analyze the information according to the framework established during the research-planning phase. This step is crucial for a scientific study, as it ensures that the data are systematically organized, coded, classified, and tabulated, making them suitable for meaningful analysis. The analysis involved calculating relevant measures and identifying patterns or relationships among different datasets.

This article presents the analysis and interpretation of the data gathered to assess the effectiveness of a PTP on adults' knowledge regarding the disposal of plastic waste and its health hazards. Data was examined in accordance with the study objectives.

1. To assess the effectiveness of a PTP on knowledge regarding the disposal of plastic waste and its health hazards among adults.
2. To determine the association between pretest and posttest knowledge scores on the disposal of plastic waste and its health hazards with selected sociodemographic variables of adults.

Organization of Data

The collected data were systematically tabulated, analyzed, and presented in the following sections.

Section I: Description of participants based on their sociodemographic characteristics.

Section II: Analysis of adults' level of knowledge regarding the disposal of plastic waste and its health hazards.

Section III: Evaluation of the effectiveness of the PTP on adults' knowledge of the disposal of plastic waste and its health hazards.

Section IV: Analysis of the association between adults' knowledge and selected demographic variables.

Section I: Description of Samples Based on Their Personal Characteristics in Terms of Frequency and Percentage

Table 4 shows that among 100 participants, the majority, specifically 79% of the respondents, belonged to the age group of 18–30 years old, 18% of the participants belonged to the age group 31–40 years, and 3% of the participants belonged to the age group of 51–60 years.

The gender distribution shows that among the 100 participants, the majority (83% of the participants were females and 17% were males).

Education-wise distribution showed that among the 100 participants, the majority (68%) had higher secondary education, 13% had moderate education, 17% had primary education, and 2% had graduated.

Family-wise distribution showed that among the 100 participants, the majority (70%) belonged to the nuclear family, and 30% belonged to the joint family.

Religion-wise distribution shows that 100% of participants belonged to the Hindu religion.

Table 4. Description of samples based on their personal characteristics in terms of frequency and percentage (n=100).

S.N.	Demographic variables	Frequency	Percentage %
1	Age in years		
	18-30 years	79	79%
	31-40 years	18	18%
	41-50 years	00	0%
	51-60 years	03	3%
2	Gender		
	Male	17	17%
	Female	83	83%
3	Education		
	Primary	13	13%
	Secondary	17	17%
	Higher Secondary	68	68%
	Graduate	02	2%
4	Family		
	Nuclear	60	60%
	Joint	40	40%
5	Religion		
	Hindu	100	100%
	Christian	00	00%
	Muslim	00	00%
	Others	00	00%
6	Occupational status		
	Housewife	75	75%
	Unskilled worker	11	11%
	Skilled worker	09	9%
	Clerk	05	5%
7	Monthly income in rupees		
	5000 to 10,000	68	68%
	10,001 to 20,000	18	18%
	20,001 to 30,000	08	8%
	30,001 to 40,000	05	5%
	40,001 and above	01	1%

Occupation-wise distribution showed that among 100 participants, the majority (75%) were housewives, 11% were unskilled workers, 9% of the participants were skilled workers, and 5% were clerks.

The monthly income distribution shows that among 100 participants, the majority (68%) earned Rs. 5,000 to 10,000 rupees per month, 18% earned between 10,001 and 20,000 rupees per month, 5% earned 30,001 to 40,000 rupees per month, and 1% earned 40,001 and above per month.

Table 5 and Figure 2 show that among the 100 participants, the majority (79%) belonged to the age group of 18–30 years, 18% of the participants belonged to the age group of 31–40 years, and 3% of the participants belonged to the age group of 51–60 years.

Table 6 and Figure 3 show that among the 100 participants, the majority (83% of the participants were female and 17% were male).

Table 7 shows the education-wise distribution, which shows that among 100 participants, the majority, i.e., 68% of the participants, had higher secondary education, 13% of the participants had primary education, 17% of the participants had secondary education, and 2% of the participants were graduates (Figure 4).

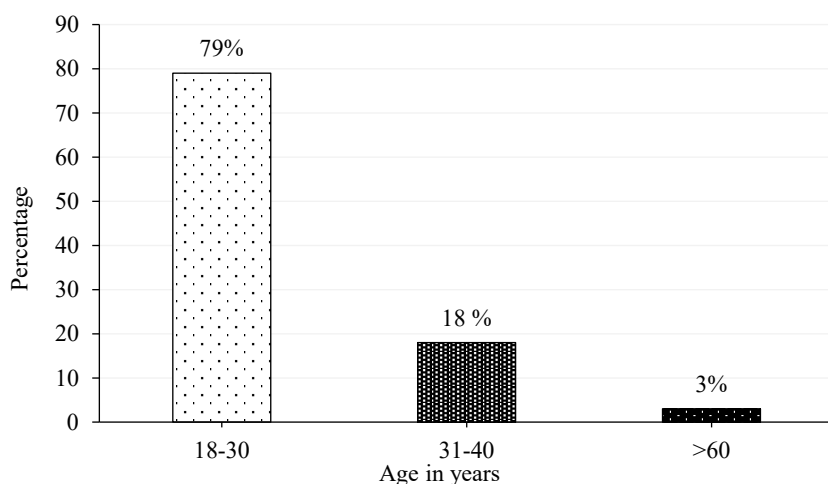


Figure 2. Distribution of participants based on their age in years.

Table 5. Frequency and percentage-wise classification of participants according to age (in years) (n = 100).

Demographic variable	Frequency	Percentage (%)
Age (in years)		
18–30 years	79	79%
31–40 years	18	18%
41–50 years	00	0%
51–60 years	03	3%

Table 6. Frequency and percentage-wise classification of participants according to Gender. (n = 100)

Demographic variable	Frequency	Percentage (%)
Gender		
Male	17	17%
Female	83	83%

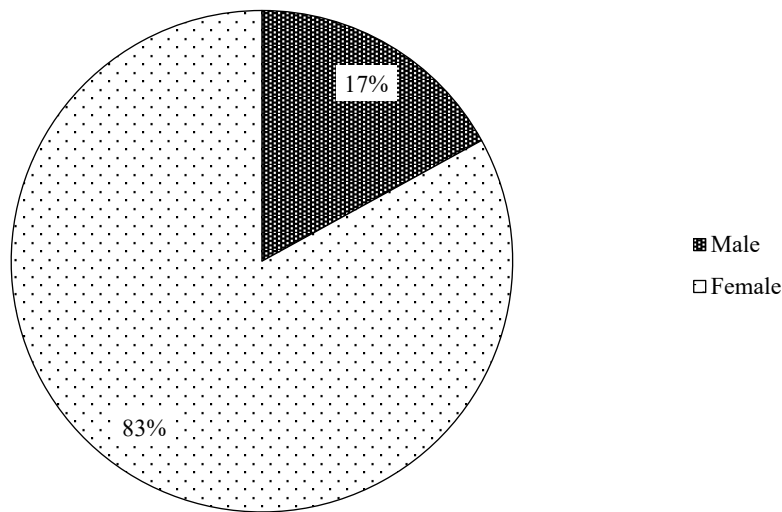


Figure 3. Distribution of participants based on their gender

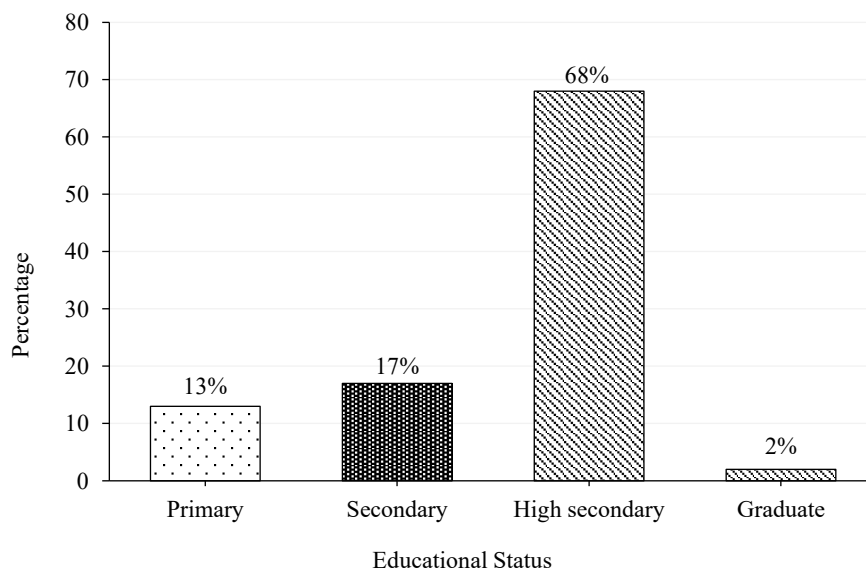


Figure 4. Distribution of participants based on their education.

Table 7. Frequency and percentage-wise classification of participants according to Education. n = 100

Demographic variable	Frequency	Percentage (%)
Education		
Primary	13	13%
Secondary	17	17%
Higher Secondary	68	68%
Graduate	02	2%

Table 8 and Figure 5 show family-wise distribution shows that among 100 participants, the majority, i.e., 70% of the participants, belonged to nuclear families, and 30% of the participants belonged to joint families.

Table 9 and Figure 6 show the religion-wise distribution, showing that 100% of participants belonged to the Hindu religion and none belonged to Christian, Muslim, or other religions.

Table 8. Frequency and percentage-wise classification of participants according to their Family. n = 100

Demographic variable	Frequency	Percentage (%)
Family		
Nuclear	60	60%
Joint	40	40%
Extended	00	00%

Table 9. Frequency and percentage-wise classification of participants according to Religion. n = 100

Demographic variable	Frequency	Percentage (%)
Religion		
Hindu	100	100%
Christian	00	00
Muslim	00	00
Others	00	00

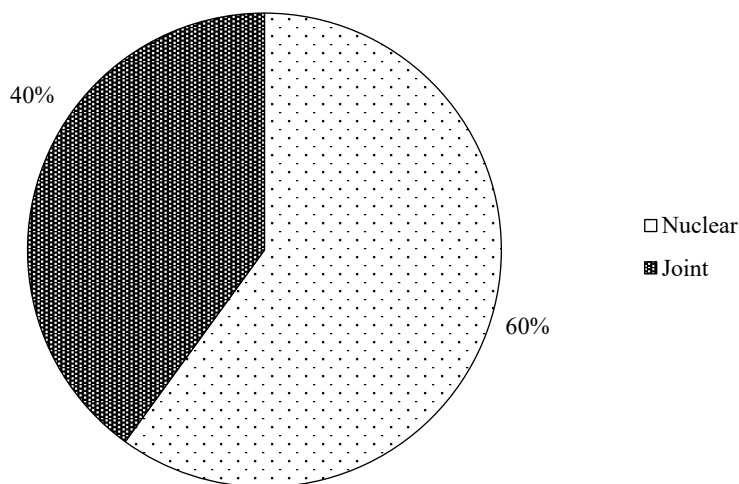


Figure 5. Distribution of participants according to their family.

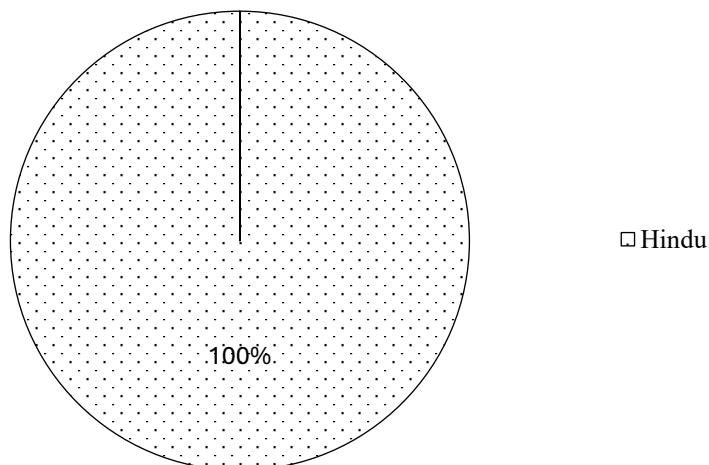


Figure 6. Distribution of participants based on their religion.

Table 10. Frequency and percentage-wise classification of participants according to occupational status (n = 100).

Demographic variable	Frequency	Percentage (%)
Occupational Status		
Housewife	75	75%
Unskilled worker	11	11%
Skilled worker	09	9%
clerk	05	5%

Table 11. Frequency and percentage-wise classification of participants according to their monthly income. n = 100

Demographic variable	Frequency	Percentage (%)
Monthly income		
Rs. 5000 to 10,000	68	68%
Rs. 10,001 to 20,000	18	18%
Rs. 20,001 to 30,000	08	8%
Rs. 30,001 to 40,000	05	5%
Rs. 40,001 and above	01	1%

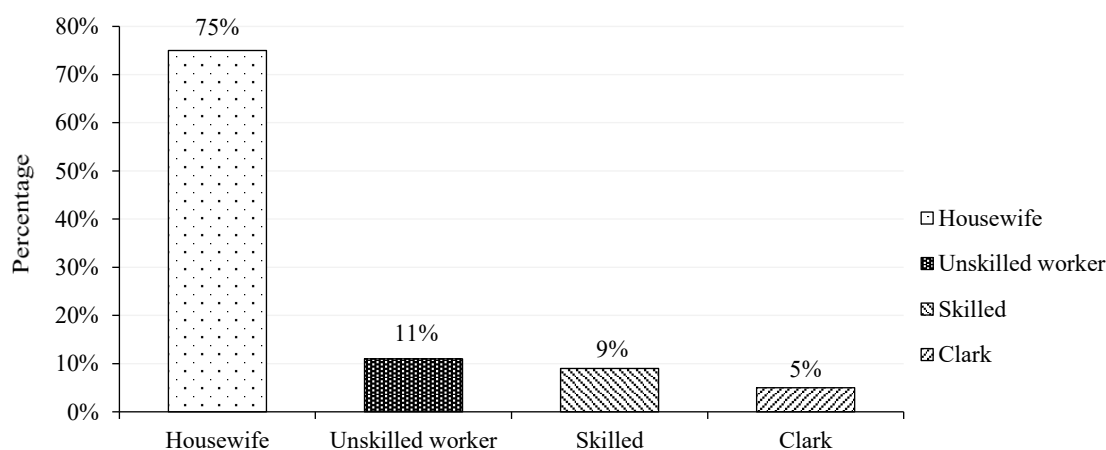
**Figure 7.** Distribution of participants according to their occupational status.

Table 10 and Figure 7 show that among the 100 participants, the majority (75%) were housewives, 11% were unskilled workers, 9% were skilled workers, and 5% were clerks.

Table 11 and Figure 8 show the monthly income-wise distribution; among 100 participants, the majority, 68% of the participants, earned 5000 to 10,000 per month, 18% earned 10,001 to 20,000, 8% earned between 20,000 and 30,000 per month, 5% earned 30,000 to 40,000 per month, and 1% earned 40,001 and above per month.

Section II: Analysis of Data on Adults' Knowledge Regarding Disposal of Plastic Waste and Its Health Hazards

This section focuses on the analysis and interpretation of data to determine the effectiveness of the PTP in enhancing adults' knowledge about the disposal of plastic waste and its associated health hazards, specifically in terms of improvements in knowledge scores. The analysis was divided into two parts: part A and part B.

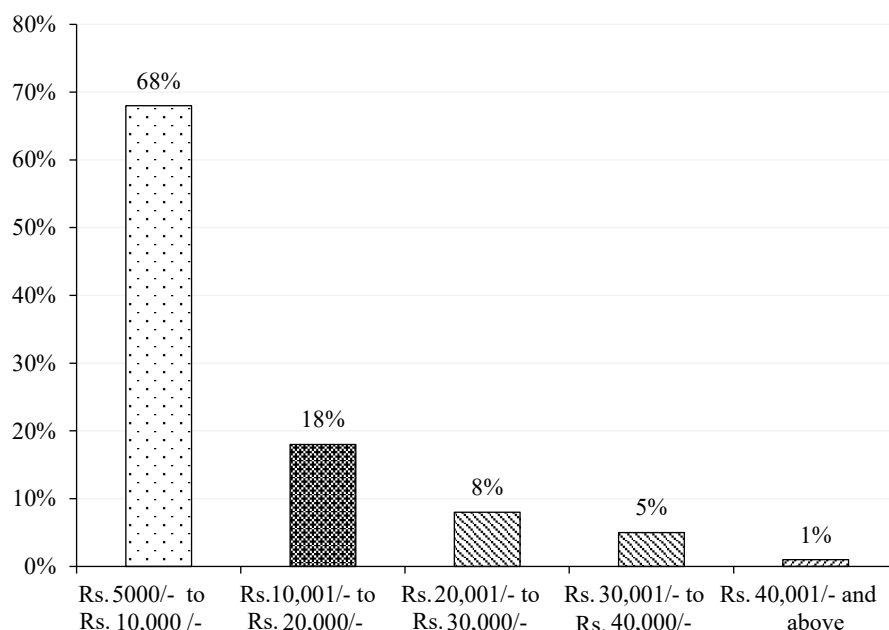


Figure 8. Distribution of participants according to their monthly income.

Table 12. Assessment of pretest knowledge of adults regarding disposal of plastic waste and its health hazards (n = 100).

Knowledge and score	Pretest		Mean score	Mean percentage	SD
	Frequency (f)	Percentage (%)			
Good (17 to 24)	0	0%	9.92	41.33%	3.43
Average (9 to 16)	63	63%			
Poor (0 to 8)	37	37%			

Table 13. Assessment of posttest knowledge of adults regarding disposal of plastic waste and its health hazards (n = 100).

Knowledge and score	Posttest		Mean score	Mean percentage	SD
	Frequency (f)	Percentage %			
Good (17 to 24)	100	100%	20.37	84.87%	1.87
Average (9 to 16)	0	0			
Poor (0 to 8)	0	0			

Part A: Assessment of adults' pretest knowledge regarding the disposal of plastic waste and its health hazards.

Pretest assessment of adults' knowledge regarding the disposal of plastic waste and its health hazards revealed that the majority; 63% of adults had average knowledge about the disposal of plastic waste and its health hazards, 37% had poor knowledge about the disposal of plastic waste and its health hazards, while none had good knowledge about the disposal of plastic waste and its health hazards (Table 12 and Figure 9).

Part B: Posttest assessment of adults' knowledge scores regarding the disposal of plastic waste and its health hazards revealed that 100% of the adults had good knowledge regarding the disposal of plastic waste and its health hazards, while none had poor to average knowledge about the disposal of plastic waste and its health hazards (Tables 13 and Figure 10, respectively).

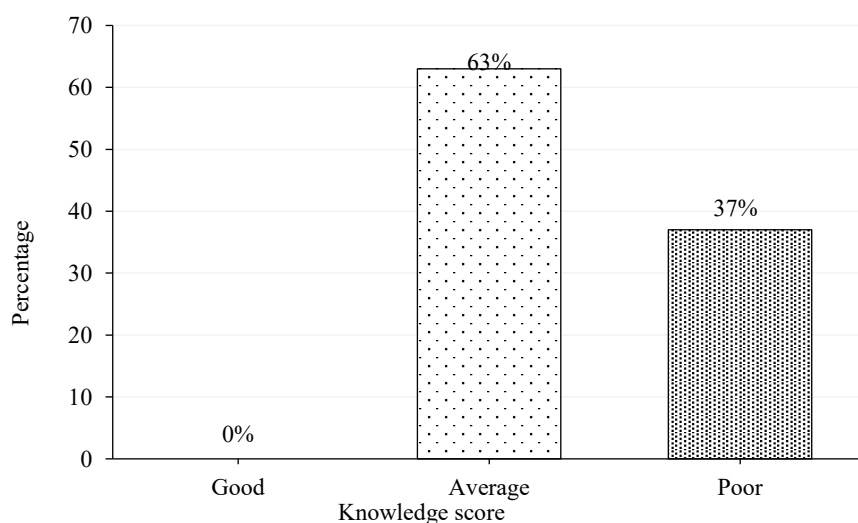


Figure 9. Distribution of adults based on pretest knowledge score regarding disposal of plastic waste and its health hazards.

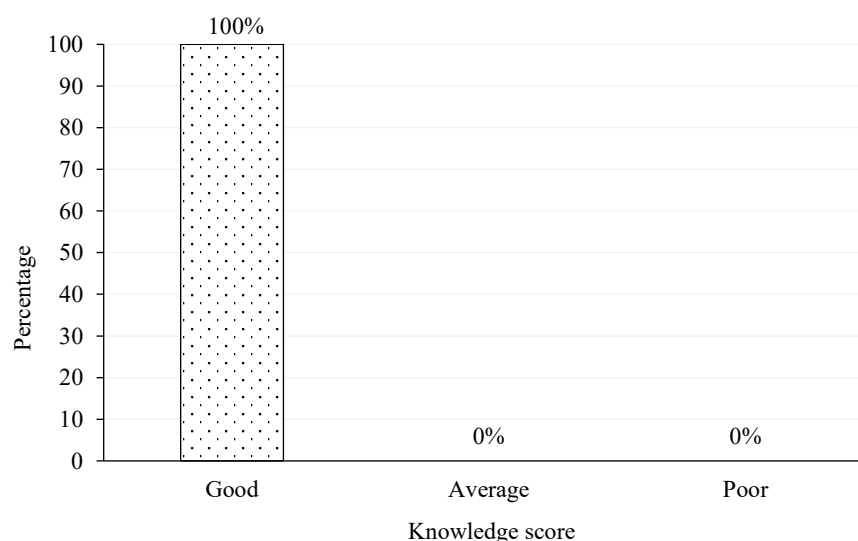


Figure 10. Distribution of adults based on posttest knowledge score regarding disposal of plastic waste and its health hazards.

Section III: Analysis of Data Related to the Effectiveness of PTP on Knowledge Regarding Disposal of Plastic Waste and its Health Hazards Among Adults

The pretest projected that among 100 adult participants, the majority (63%) had average knowledge about the disposal of plastic waste and its health hazards, 37% had poor knowledge about the disposal of plastic waste and its health hazards, and none had good knowledge about the disposal of plastic waste and its health hazards. On the other hand, a posttest assessment of the knowledge score of adults regarding disposal of plastic waste and its health hazards revealed that 100% of the adults had good knowledge regarding disposal of plastic waste and its health hazards, while none had poor to average knowledge about disposal of plastic waste and its health hazards. This indicates that the adults' knowledge improved significantly after PTP (Tables 14 and Figure 11, respectively).

The researcher applied a paired t-test to determine the effectiveness of the PTP on knowledge regarding the disposal of plastic waste and its health hazards among adults. The mean pretest score was 9.92, which increased to 20.35 in the posttest. The SD for the pretest was 3.43, and for the posttest it was 1.87. The standard error is 0.43. The calculated t-value at 99 degrees of freedom was 24.21, which

is higher than the tabulated t-value of 1.66. Hence, the research hypothesis is accepted, and it's proven that the PTP was effective in increasing knowledge of adults regarding the disposal of plastic waste and its health hazards. (Tables 15 and Figure 12), respectively.

Section IV: Association of Pretest Knowledge of Adults Regarding Disposal of Plastic Waste and its Health Hazards

The PTP was effective in increasing knowledge regarding the disposal of plastic waste and its health hazards among adults, and there was a significant association between the pretest knowledge score and selected sociodemographic variables, such as age [$\chi^2_{cal} = 20.2$, $\chi^2_{tab} = 5.99$]. The calculated chi-square values were greater than the tabulated values at the $p < 0.05$ level of significance. Hence, H2 is accepted. This indicates that there is a significant association between the pretest knowledge score and their selected sociodemographic variables ($p < 0.05$) (Table 16).

Table 14. Effectiveness of PTP on knowledge regarding disposal of plastic waste and its health hazards among adults (n = 100).

Knowledge	Pretest		Posttest	
	Frequency	percentage	Frequency	Percentage
Good (17 to 24)	0	0%	100	100%
Average (9 to 16)	63	63%	0	0%
Poor (0 to 8)	37	37%	0	0%

Table 15. Effectiveness of the PTP on knowledge regarding disposal of plastic waste and its health hazards among adults (n = 100).

Knowledge	Mean score	Mean percentage	SD	Range	Standard error	t cal.	t tab.	df	P-value
Pretest	9.92	41.33%	3.43	13	0.43	24.21	1.660	99	<0.05
Posttest	20.35	84.87%	1.87	7					
Difference	10.43	43.54%	1.56	6					

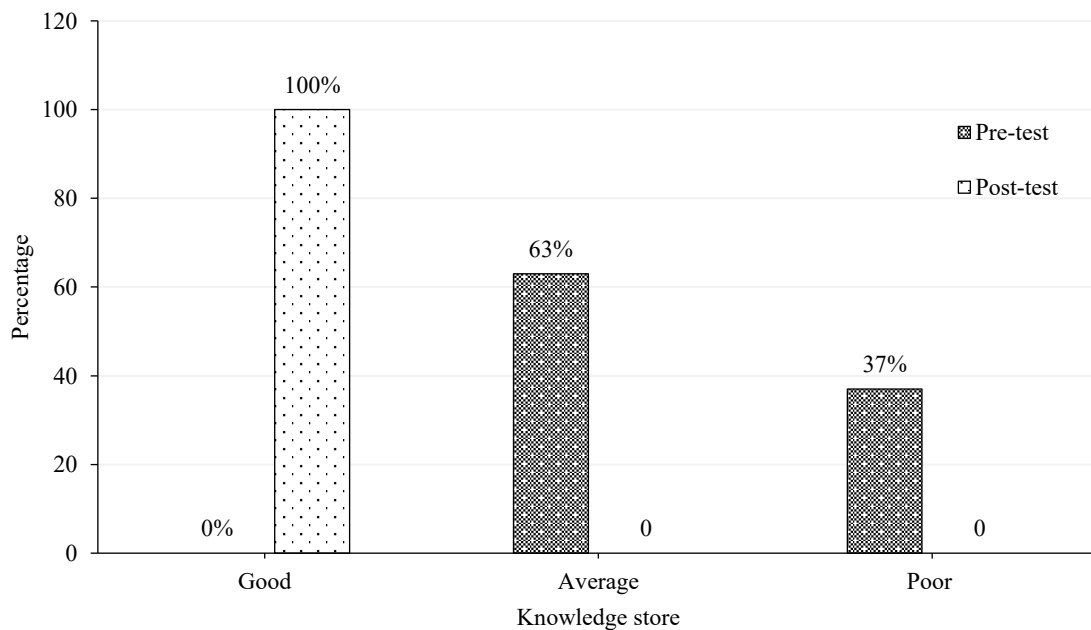


Figure 11. Distribution of samples based on the effectiveness of the PTP on the level of pretest and posttest knowledge regarding the disposal of plastic waste and its health hazards among adults.

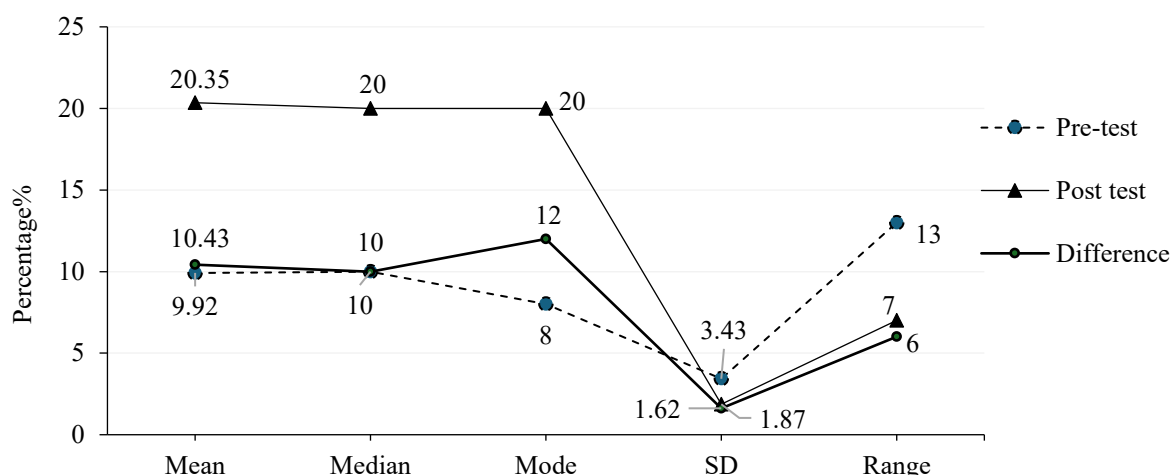


Figure 12. The effectiveness of PTP is based on the difference between the mean percentage of pretest and posttest knowledge scores of adults.

Table 16. Association of pretest knowledge of adults regarding disposal of plastic waste and its health hazards (n = 100).

S.N.	Sociodemographic variables	Good	Average	Poor	Calc. value (χ^2)	Tab. value (χ^2)	df
1	Age in years						
	18–30 years	0	50	29	20.21	5.99	2
	31–40 years	0	12	06			
	41–50 years	0	0	0			
51–60 years	0	01	02				
2.	Gender						
	Male	0	14	3	3.29	3.84	1
	Female	0	49	34			
3.	Religion						
	Hindu	0	63	37	0.62	12.59	2
	Muslim	0	0	0			
	Cristian	0	0	0			
	Others	0	0	0			
4.	Education						
	Primary	0	07	06	0.718	7.82	3
	Secondary	0	11	06			
	Higher secondary	0	44	24			
	Graduation	0	01	01			
5.	Family						
	Nuclear	0	36	24	0.579	3.84	1
	Joint	0	27	13			
6.	Occupation						
	Housewife	0	49	26	1.525	7.82	3
	Unskilled	0	07	04			
	Skilled	0	04	05			
	Clerk	0	03	02			
	Semi-Profession	0	0	0			
Profession	0	0	0				

S.N.	Sociodemographic variables	Good	Average	Poor	Calc. value (χ^2)	Tab. value (χ^2)	df
7.	Monthly income						
	Rs. 5000 to 10,000	0	44	24	1.299	9.49	4
	Rs. 10,001 to 20,000	0	11	7			
	Rs. 20,001 to 30,000	0	04	4			
	Rs. 30,001 to 40,000	0	03	2			
	Rs. 40,001 and above	0	01	0			

DISCUSSION

This article presents the key findings of the study and compares them with those of similar research conducted by other investigators. The paper concludes with suggestions and recommendations for future studies in this field. The primary objective of the present study was to assess the effectiveness of a PTP on adults' knowledge regarding the disposal of plastic waste and its associated health hazards in Ghotawde village, Kolhapur District.

Major Findings

Distribution of Subjects Based on Demographic Characteristics

This study analyzed the demographic characteristics of 100 adults from Ghotawde village, considering factors such as age, gender, religion, type of family, education, occupation, and monthly income.

- *Age:* Most participants (79%) were aged 18–30 years, 18% were aged 31–40 years, and 3% were aged 51–60 years.
- *Gender:* 83% were females, and 17% were males.
- *Education:* 68% had completed higher secondary education, 17% had primary education, 13% had moderate education, and 2% were graduates.
- *Family type:* 70% belonged to nuclear families, while 30% were from joint families.
- *Religion:* All participants (100%) were Hindus.
- *Occupation:* 75% were housewives, 11% were unskilled workers, 9% were skilled workers, and 5% were clerical staff.
- *Monthly income:* 68% earned ₹5,000–10,000, 18% earned ₹10,001–20,000, 8% earned ₹20,001–30,000, 5% earned ₹30,001–40,000, and 1% earned above ₹40,001 per month.

A similar study by Manuel et al. on adults reported comparable demographic trends, with most participants being female, aged 18–25 years, and a majority having higher secondary education.

Pretest Knowledge of Adults on Disposal of Plastic Waste and Its Health Hazards

The pretest revealed that 63% of adults had average knowledge, while 37% had poor knowledge regarding the disposal of plastic waste and its health effects. None of the participants had sufficient knowledge of this stage. In contrast, the posttest results showed complete improvement, with 100% of participants demonstrating good knowledge and none remaining in the poor or average knowledge categories. These findings align with a quasi-experimental study by Kalaimathi et al., where pretest knowledge was predominantly inadequate, and posttest results showed a significant increase in knowledge after a structured teaching intervention.

Effectiveness of the PTP

The mean posttest knowledge score (20.35) was notably higher than the mean pretest score (9.92), indicating that the PTP effectively improved knowledge of plastic waste disposal and its health hazards.

- *Standard deviation:* Pretest = 3.43, posttest = 1.8
- *Standard error:* 0.4
- *Paired t-test:* Calculated t-value = 24.21, exceeding the table value of 1.66 at 99 degrees of freedom, demonstrating statistical significance ($p < 0.05$).

Similar results were reported by Antony et al., who found that posttest knowledge scores among housewives significantly improved after an STP on the health and environmental hazards of plastics. Thus, the research hypothesis H1 is accepted, confirming the effectiveness of PTP in enhancing adults' knowledge.

CONCLUSION

Based on the findings of this study, it can be concluded that the PTP was highly effective in enhancing adults' knowledge regarding the disposal of plastic waste and its associated health hazards. The key conclusions drawn from the study are that, initially, most adults residing in Ghotawde village possessed limited knowledge about proper plastic waste disposal and its health risks. However, after the implementation of PTP, there was a marked improvement in their knowledge, with the majority demonstrating a good understanding of safe disposal practices and the hazards linked to plastic waste.

This improvement suggests that a well-structured, concise educational intervention can significantly enhance adults' awareness and understanding of the health and environmental risks posed by the improper disposal of plastic waste. Standardized educational programs on safe PWM should be integrated into community educational initiatives. Promoting awareness of reducing plastic usage, proper disposal methods, and understanding its potential hazards should be considered as essential as other routine daily living activities to foster healthier and more sustainable communities.

Implications of the Study

The findings of this study have implications across various aspects of nursing, including as follows.

Nursing Practice

Nursing involves both art and science. It is considered an art because it involves skillful and compassionate care for individuals and communities, whereas it is a science because it relies on evidence-based practices to deliver care. This study highlights the role of nurses in assessing adults' knowledge of plastic waste and its health hazards and in developing an STP to address knowledge gaps. Health education is a key component of nursing. Nurses working in primary healthcare centers, community health settings, or other healthcare environments can utilize opportunities to educate the community about the safe disposal of plastic waste and the prevention of associated health risks.

Nursing Education

With evolving trends in healthcare, nursing education should emphasize a primary healthcare approach that prioritizes prevention and health promotion. Educating nursing students to assist clients and communities in practicing self-care, including proper disposal of plastic waste. Nursing curricula should integrate the use of effective teaching strategies to deliver structured education on PWM and its health implications. Students should be encouraged to participate in seminars, workshops, and conferences to address issues related to plastic waste. Additionally, providing access to relevant literature on safe plastic disposal and the associated health hazards will further enhance their learning.

Nursing Administration

Nursing administration plays a crucial role in providing ongoing educational opportunities in response to rapidly changing healthcare needs, emerging diseases, and technological advancements. Administrators should support nurses in updating their knowledge and acquiring specialized skills through in-service training, workshops, courses, and conferences. Administrative support is also essential for developing educational resources such as posters, pamphlets, booklets, and STPs on safe plastic disposal and related health risks. Continuing education is particularly important for nurses working in community health and preventive medicine, enabling them to deliver high-quality, informed care.

Nursing Research

Research is fundamental to nursing as it strengthens the profession and expands the body of scientific

knowledge. This study contributes to the nursing literature, in which limited research has been conducted on this topic. The research design, findings, and tools developed in this study could serve as a foundation for future research. There is a pressing need for further studies to explore strategies for educating nurses and the community on safe plastic disposal, health hazards, and potential alternatives to plastics to reduce waste. Nurse researchers can expand their knowledge in this field, generate scientific data, and provide baseline information to enhance the skills and awareness of the general population regarding the health risks associated with plastic waste.

Limitations

- The findings of the study were restricted to the respondents under study, only from selected areas.
- This study was restricted to a single village. The findings of this study were restricted to the respondents.
- Data was collected from 100 samples to determine knowledge. This could be done on more samples for a larger generalization.

Recommendations

Based on the findings of the study, the following recommendations were made:

- A similar study can be conducted with large groups of samples so that the findings can be generalized.
- This study may be replicated in different settings, especially in urban and rural areas. A similar study can be conducted at the urban and city levels.
- A quasi-experimental study can be conducted with an STP on knowledge and attitudes regarding plastic waste disposal.
- Mass and individual education programs in regional languages can be organized to educate rural people.
- A similar study may be conducted using various teaching methods, such as PowerPoint presentations and health teaching.

REFERENCES

1. Ncube LK, Ude AU, Ogunmuyiwa EN, Zulkifli R, Beas IN. An overview of plastic waste generation and management in food packaging industries. *Recycling*. 2021;6(1):12. doi:10.3390/recycling6010012.
2. Plastics Europe. (2023). How plastics are made. [online] Plastics Europe. Available from: <https://plasticseurope.org/plastics-explained/how-plastics-are-made/>
3. Andrady AL, Neal MA. Applications and societal benefits of plastics. *Philos Trans R Soc Lond B Biol Sci*. 2009;364(1526):1977–1984. doi:10.1098/rstb.2008.0304.
4. Ministry of Housing and Urban Affairs. Plastic Waste Management: Issues, Solutions & Case Studies. Swachh Bharat Mission (Urban). New Delhi, India: Government of India; 2019.
5. PlasticsEurope. The compelling facts about plastics: An analysis of plastics production, demand and recovery for 2006 in Europe. Brussels, Belgium: PlasticsEurope; 2008.
6. Bashir NHH. Plastic problem in Africa. *Jpn J Vet Res*. 2013;61(Suppl):S1–S11.
7. Callan SJ, Thomas JM. *Environmental Economics & Management: Theory, Policy, and Applications*. Mason, OH, United States: Thomson/South-Western; 2004.
8. Plastic Health Coalition. Plastic and human health: Alarming evidence [Online]. Amsterdam: Plastic Health Coalition. Available from: <https://www.plastichealthcoalition.org/wp-content/uploads/2018/12/Position-Paper.pdf>
9. Belmaker I, Anca ED, Rubin LP, Magen-Molho H, Miodovnik A, van der Hal N. Adverse health effects of exposure to plastic, microplastics and their additives: Environmental, legal and policy implications for Israel. *Isr J Health Policy Res*. 2024;13(1):44. doi:10.1186/s13584-024-00628-6.
10. Plastic Health Coalition. Health effects of microplastics & pathogens [Online]. 2022. Available from: <https://www.plastichealthcoalition.org/microplastics>

11. United Nations Environment Programme and Secretariat of the Basel, Rotterdam and Stockholm Conventions. Chemicals in Plastics: A Summary and Key Findings. Geneva, Switzerland: United Nations Environment Programme; 2023. Available from: <https://wedocs.unep.org/handle/20.500.11822/42505>
12. Singh SG. (2021). Draft Plastic Waste Management Rules, 2021: Addressing the bigger problem. [online] Down To Earth. Available from: <https://www.downtoearth.org.in/waste/draft-plastic-waste-management-rules-2021-addressing-the-bigger-problem-75939>
13. Pandey P, Dhiman M, Kansal A, Subudhi SP. Plastic waste management for sustainable environment: Techniques and approaches. Waste Disposal Sustain Energy. 2023;1–18. doi:10.1007/s42768-023-00134-6.
14. Webb H, Arnott J, Crawford R, Ivanova E. Plastic degradation and its environmental implications with special reference to poly(ethylene terephthalate). Polymers. 2012;5(1):1–18. doi:10.3390/polym5010001.
15. Blastic. (2016). Toxicity of plastics. [online] Blastic. Available from: <https://www.blastic.eu/knowledge-bank/impacts/toxicity-plastics/>
16. Toxicological Profile for Vinyl Chloride. Atlanta (GA): Agency for Toxic Substances and Disease Registry (US); 2024. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK601953/>
17. Earth Day Network. (2021). How our trash impacts the environment [Online]. Earth Day. Available from: <https://www.earthday.org/how-our-trash-impacts-the-environment/>
18. Faisal F, Rasul MG, Jahirul MI, Schaller D. Pyrolytic conversion of waste plastics to energy products: A review on yields, properties, and production costs. Sci Total Environ. 2023;861:160721. doi:10.1016/j.scitotenv.2022.160721. Epub 2022 Dec 8. PubMed PMID: 36496020.
19. Mutha NH, Patel M, Premnath V. Plastics materials flow analysis for India. Resour Conserv Recycl. 2006;47(3):222–244. doi:10.1016/j.resconrec.2005.09.003.
20. Vinci G, Gobbi L, Porcaro D, Pinzi S, Carmona-Cabello M, Ruggeri M. Environmental evaluation of chemical plastic waste recycling: A life cycle assessment approach. Resources. 2024;13(12):176. doi:10.3390/resources13120176.
21. Evode N, Qamar SA, Bilal M, Barceló D, Iqbal HMN. Plastic waste and its management strategies for environmental sustainability. Case Stud Chem Environ Eng. 2021;4:100142. doi:10.1016/j.cscee.2021.100142.
22. Biswas A, Chaudhary K, Singh R, Tewari S, Singh S, Parida S. (2021). Waste-Wise Cities: Best practices in municipal solid waste management. [online] New Delhi, India: Centre for Science and Environment and NITI Aayog. Available from: <https://www.niti.gov.in/sites/default/files/2021-12/Waste-Wise-Cities.pdf>
23. Barnes DKA, Galgani F, Thompson RC, Barlaz M. Accumulation and fragmentation of plastic debris in global environments. Philos Trans R Soc Lond B Biol Sci. 2009;364(1526):1985–1998. doi:10.1098/rstb.2008.0205.
24. Ritchie H, Samborska V, Roser M. (2026). Plastic Pollution. [online] Our World in Data. Available from: <https://ourworldindata.org/plastic-pollution>
25. Daniel DC. Creating a sustainable future. Environ Sci. 2004;8:517–518.
26. Arizona State University. (2013). Health and environment: A closer look at plastics (Original written by Richard Harth). [online] ScienceDaily. Available from: <https://www.sciencedaily.com/releases/2013/01/130123133928.htm>
27. Chattopadhyay A. (2018). ‘Beat Plastic Pollution’, the theme for World Environment Day 2018. [online]. The Times of India, Mumbai. Available from: <https://timesofindia.indiatimes.com/blogs/no-filter/beat-plastic-pollution-the-theme-for-world-environment-day-2018/>
28. Heylighen F, Joslyn C. Cybernetics and second-order cybernetics. In: Meyers RA, editor. Encyclopedia of Physical Science & Technology. 3rd ed. New York, NY, United States: Academic Press; 2001.
29. Sharma S. Book of Nursing Research and Statistics. 2nd ed. New Delhi, India: Elsevier Publication; 2017. p. 101–102.

30. Karthi R, Umapathy M, Sathiya N. A study to assess the effectiveness of structured teaching programme on knowledge of high school students regarding hazards of plastic use at selected school, Villupuram. *Galore Int J Health Sci Res.* 2019;4:105–109.
31. Kaur S, Jeganathan J, Kaur M. Effectiveness of structured teaching programme on knowledge regarding health hazards of plastic use among students – A quasi-experimental study. *Nurs Healthc Int J.* 2019;3(2):000180.
32. Srinivasan N, Swarnapriya V, Felix AJW, Pravin T. Assessment of knowledge and practice on plastics among the professional course students of Annamalai University, TN. *Int J Community Med Public Health.* 2019;6(2):510. doi:10.18203/2394-6040.ijcmph20190099.
33. Khanam N, Wagh V, Gaidhane AM, Quazi SZ. Knowledge, attitude and practice on uses of plastic products, their disposal and environmental pollution: A study among school-going adolescents. *J Datta Meghe Inst Med Sci Univ.* 2019;14(2):57–60. doi:10.4103/jdmimsu.jdmimsu_27_19.
34. Shahzadi A, Hussain M, Afzal M, Gilani SA. Determination the level of knowledge, attitude, and practices regarding household waste disposal among people in rural community of Lahore. *Int J Soc Sci Manag.* 2018;5:219–224. doi:10.3126/ijssm.v5i3.20614.
35. Manuel J, Varghese J, Jose J, Thomas JK, Joseph J, Shettigar D. An educational intervention programme on hazards of plastic waste and its disposal among adults: A rural community based study. *J Health Allied Sci NU.* 2015;5(02):16–18. doi:10.1055/s-0040-1703882.
36. City of Toronto. (2017). Waste Strategy Update: Reduction & Diversion Plan. [online] City of Toronto. Available from: https://www.toronto.ca/services-payments/recycling-organics-garbage/waste-management/waste-strategy/?utm_source=chatgpt.com
37. Chaudhary V, Kathuria K, Tomar M, Jain M, Vatsa P, Singh A, et al. Study to assess the knowledge, attitude and practice of plastic use among school students of Meerut, Uttar Pradesh. *Int J Public Health Res Dev.* 2020;11:62–68.
38. Vighneswaran R, Arunkumar B. Knowledge attitude and practice on plastic usage among the residents of Tiruchirappalli municipal corporation, Tamil Nadu – A descriptive study. *IOSR J Humanit Soc Sci.* 4(4):33–39.
39. Adane L, Muleta D. Survey on the usage of plastic bags, their disposal and adverse impacts on environment: A case study in Jimma City, Southwestern Ethiopia. *J Toxicol Environ Health Sci.* 2011;3(8):234–248.
40. Sharmila R. Effectiveness of structured teaching programme on knowledge regarding health hazards of plastic usage among housewives in selected rural areas, at Karimnagar, Telangana. *Int J Sci Res.* 2021;10(9):612–615. doi:10.21275/MR21912184438.
41. Paudel A, Thomas R. A study to assess the effectiveness of structured teaching program on knowledge regarding hazards of plastic on health and environment among adults in selected community areas of Bharatpur metropolitan City, Ward No. 4, Chitwan, Nepal. *Int J Sci Eng Res.* 2020 Nov;9(11):704–708.
42. Malik H, Roy K. A descriptive study to assess the knowledge and attitude of adolescents regarding mismanagement of plastic wastes and its environmental hazards in selected community area, Nelamangala. *Int J Sci Res.* 2017;6(6):677–680. doi:10.21275/2061706.
43. Joseph N, Kumar A, Majgi SM, Kumar GS, Prahalad RBY. Usage of plastic bags and health hazards: A study to assess awareness level and perception about legislation among a small population of Mangalore City. *J Clin Diagn Res.* 2016;10(4):LM01–LM04. doi:10.7860/JCDR/2016/16245.7529. PubMed PMID: 27190841.
44. Antony A, George A, Jose J, Paul L, Babu MP, Sikha PS, et al. A study to evaluate the effectiveness of planned teaching programme on knowledge regarding the ill effects of plastics on health and environment among housewives in selected community at Aluva. *Int J Nurs Educ Res.* 2018;6(4):335. doi:10.5958/2454-2660.2018.00081.9.
45. Shalini VB, Dhaliwal K, Gautam A. Assessment of the knowledge and attitude regarding plastic use and its health effects among nursing students of selected nursing colleges of Ambala, Haryana. *Med Leg Update.* 2021 Mar;21(1):1186–1190.
46. Omar AA, Hossain MS, Parvin M. Study on knowledge, attitude and practices towards the solid waste management in Karan District, Mogadishu Somalia. *Environ Contam Rev.* 2012;1(2):22–26.

47. Sirsat A, Bhandwalkar V, Karri S, Ramteke R, Vishwakarma A. A study to assess the effectiveness of information booklet on knowledge regarding hazards of plastic usage and its safe disposal among community people in a selected area at Nagpur District. *Int J Health Sci Res.* 2021;11(2):190–194.
48. Gabuya RJ. Knowledge, attitude, and practices regarding the environmental hazards of plastic use [Preprint]. *AIJR Prepr.* 2021 May;319(1):1–5. doi:10.21467/preprints.319.
49. Oguge N, Oremo F, Adhiambo S. Investigating the knowledge and attitudes towards plastic pollution among the youth in Nairobi, Kenya. *Soc Sci.* 2021;10(11):408. doi:10.3390/socsci10110408.
50. Barbir J, Leal Filho W, Salvia AL, Fendt MTC, Babaganov R, Albertini MC, et al. Assessing the levels of awareness among European citizens about the direct and indirect impacts of plastics on human health. *Int J Environ Res Public Health.* 2021;18(6):3116. doi:10.3390/ijerph18063116. PubMed PMID: 33803525.
51. Khairnar C, Shaji SRG, Khemnar D, Vyas S, Gadkari A, Devi S. Assess the awareness regarding hazards of plastic bag use among adults. *J Pharm Innov.* 2019;8(6):139–143.
52. Kasidoni M, Moustakas K, Malamis D. The existing situation and challenges regarding the use of plastic carrier bags in Europe. *Waste Manag Res.* 2015;33:419–428. doi:10.1177/0734242X15577858. Epub 2015 Apr 1. PubMed PMID: 25827845.
53. Wilson DC, Parker D, Cox J, Strange K, Willis P, Blakey N, et al. Business waste prevention: A review of the evidence. *Waste Manag Res.* 2012;30 Suppl 9:17–28. doi:10.1177/0734242X12453609. PubMed PMID: 22993132.
54. Kombiok E, Naa Jaaga J. Disposal of plastic waste in Ghana: The knowledge, attitude and practices of households in the Tamale Metropolis. *Int J Environ Stud.* 2022;80:892–901. doi:10.1080/00207233.2022.2050568.
55. Ashimi AO, Amole TG, Yusuf A, Michael GC. Awareness of health and environmental hazards of plastic bag use and available substitutes among health workers of two hospitals in a rural area of Northwest Nigeria. *Environ Dis.* 2022;7(1):16–21. doi:10.4103/ed.ed_26_21.
56. Waste & Resources Action Programme (WRAP). UK plastics waste – A review of supplies for recycling, global market demand, future trends and associated risks. Final report. Banbury (Oxon): Waste & Resources Action Programme; 2006.
57. Petrescu DG, Tribus LC, Raducu R, Purcarea VL. Social marketing and behavioral change. *Rom J Ophthalmol.* 2021;65(2):101–103. doi:10.22336/rjo.2021.21. PubMed PMID: 34179571. PubMed Central PMCID: PMC8207857.
58. Lithner D, Larsson A, Dave G. Environmental and health hazard ranking and assessment of plastic polymers based on chemical composition. *Sci Total Environ.* 2011;409:3309–3324. doi:10.1016/j.scitotenv.2011.04.038. PubMed PMID: 21663944.
59. Bai RR. Effectiveness of structured teaching program on hazards of plastic wastes among the housewives. *Int J Nurs Med Investig.* 2021;6(3):32–36.
60. Rani RU. A study to assess the effectiveness of structured programme on knowledge regarding hazards of plastic usage among housewives in selected community area, Bangalore. *Int J Adv Nurs Manag.* 2019;7(3):255–257. doi:10.5958/2454-2652.2019.00058.1.
61. Kirubavathi V. Effectiveness of structured teaching programme on disposal of waste among adults in Thandalam Village at Kanchipuram District [master's thesis]. Melmaruvathur (IN): Adhiparasakthi College of Nursing; 2012.
62. Rani RU. A study to assess the effectiveness of structured programme on knowledge regarding hazards of plastic usage among housewives in selected community area, Bangalore. *Int J Adv Nurs Manag.* 2019;7:255. doi:10.5958/2454-2652.2019.00058.1.
63. Abid R, Husain M, Majeed I, Afzal M. Effectiveness of health education session on knowledge of high school students regarding plastic use and its health hazards. *J Health Med Nurs.* 2020 Mar;72:68–73.
64. Ashwini PS, Shetty S, Prabhu V, Pais M, Kuriakose B. Effectiveness of structured teaching programme on prevention of ICU delirium among Manipal College of Nursing, Manipal, KRN, India. *Nitte Univ J Health Sci.* 2015;5(2):28–30.

65. Rawat S, Gomathi B, Kumar L, Mahalingam V. Structured teaching programme on knowledge about polycystic ovarian syndrome among adolescent girls. *Int J Res Med Sci.* 2017;5(11):5004–5008. doi:10.18203/2320-6012.ijrms20174960.
66. Nayak G. Effectiveness of structured teaching programme on back care among staff nurses in selected hospital at Bhubaneswar, OR. *Asian J Nurs Educ Res.* 2014;4(2):235–237.
67. Sawarkar A, Shambharka M, Khandar J, Sakharwade P, Kolheka S, Tembhare V. A study to assess the effectiveness of self instructional module on knowledge regarding hazard of plastic waste and its safe disposal among people. *Int J Adv Nurs Manag.* 2020;8(2):245–250.