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EFFECT OF EDUCATION PROGRAM ON OCCUPATIONAL HEALTH AND SAFETY BEHAVIORS AMONG SEWAGE WORKERS IN EGYPT

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Abstract

A wastewater treatment plant is associated with many inherent occupational hazards that could have serious effects on the health of sewage workers. Sewage workers are exposed to a variety of hazards associated to the design and operation of the plant, which can lead to accidents and health issues. **Aim:** Evaluate the effect of the educational program on occupational health and safety behaviors among sewage worker in Egypt. **Design**: A quasi-experimental one-group pretest-posttest was utilized. **Sample**: A systematic random sampling was used, and 230 workers were included. **Setting**: the study was carried out at Zenin wastewater treatment plant. **Study tools:** two tools were used**:** 1- Sewage Workers' Assessment Questionnaire [Demographic characteristic, occupational and medical data, sewage workers' knowledge, and self-reported behavior].2-Sewage workers' occupational health and safety beliefs. **Results:** Revealed that 2.30%, 65.20%, 56.50%, of sewage workers had satisfactory level of knowledge in pre, post and follow up tests respectively. While 8.7%, 77.80% and 69.50% of sewage workers had satisfactory level of self-reported behavior in pre, post and follow up tests respectively. Moreover, there was a significant improvement in positive workers' health beliefs score in post and follow up test. Also, there was a highly statistically significant correlation between workers' knowledge, Health beliefs score and self-reported behaviors pre, post and follow up test (p=0.0001). **Conclusions**: There was a highly statistically significant difference between sewage workers' mean total knowledge scores, self-reported behaviors scores, and health beliefs score in pre-, post-, and follow-up tests after implementations of the educational program. **Recommendation**: Continuing to organize educational programs for sewage workers on occupational health and safety behavior that covers all wastewater treatment plants in different settings in Egypt.

Keywords: Educational Program, Occupational Health, Safety Behavior& Sewage Workers

1. INTRODUCTION

Workplace can endanger workers' health in some circumstances. Preserving workers' health and ability to work, improving the work environment to make it more conducive to safety and health, and developing an organization and work culture in a direction that promotes workers' health and safety are all examples of occupational health. Collaboration and participation of both employers and workers in occupational and environmental health behavior are required for successful occupational health and safety practice, as is consideration of issues relating to occupational medicine, industrial

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hygiene, toxicology, education, engineering safety, and ergonomics (Krishna, Anju, Sushmita, and Kshitij 2018).

Sewage workers form the backbone of the civic cleaning system of any society. Sewage workers face a multitude of obvious hazards, including drowning; slips, trips or falls; unintended exposure to energized equipment; and exposure to hazardous chemicals or gases. Still other hazards aren't visible to the naked eye. For occupations that have potential to come into contact with human feces, illnesses associated with bacteria, viruses, and parasites are a constant threat. These work-related hazards result in poor sewage workers health, mechanical hardware harms, and disabilities, which lower the worker productivity and raise the economic burden in the wastewater treatment plant (Tuser, 2020).

According to estimates from the International Labour Organisation (ILO, 2017), over 2 million people die from illnesses and accidents related to their jobs each year, and over 300 million non-fatal accidents are also reported. This results in over 6000 fatalities and over 800,000 non-fatal accidents per day. More than $1.25 trillion in economic loss is reportedly experienced annually as a result of this, which is equal to 4.0% of global GDP. For underdeveloped countries, this loss is 4 times more than it is for industrialised nations. There are few statistics on occupational accidents and injuries in many developing nations. Safe treatment of sewage is crucial to the health of any community. A wastewater treatment plant's operation consists of three fundamental stages: a preliminary treatment that employs physical processes to remove big solids such as rags and sticks (diameter >2 mm); during the primary stage of wastewater treatment, sediments are allowed to settle and be removed, and the water is then ready for the second stage. The secondary step uses biological processes to clean the wastewater even further. These processes are sometimes combined into a single procedure. Depending on the layout of the treatment plant and the chemicals used in the various processes, the specific hazards linked to each procedure differ. Physical, biological, and chemical dangers are the three main types of risks that sewage workers confront (Martín-Pozo, Del Carmen, García-Córcoles & Zafra-Gómez, 2022).

Regarding occupational hazards, Studies have indicated that wastewater treatment can produce aerosols containing microbial and chemical elements, which can pose occupational dangers. Workers are most commonly exposed through inhalation or direct contact with sewage, sludge, and water. Many sewage treatment plants have open tanks and basins, and most are not designed to prevent wastewater from dispersing in the air while being treated. Volatile organics in wastewater may be vaporised or air-stripped during treatment. Because many of the substances are carcinogens or mutagens, sewage workers may be more likely to acquire cancer or suffer from serious health impacts (Lou, Liu, Gu, Hu, Tang, Zhang, & Li, 2021). Health behaviors are affected by sewage workers' beliefs and judgments about their sensitivity to a certain health problem, as well as indicators that the health issue is serious, both of which affect workers' motivation to engage in health-promoting behaviors. For successful occupational health

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and safety behavior change, sewage workers need to have the incentive to act, feel threatened by their current behavioral patterns, and believe that change will be advantageous. Furthermore, sewage workers must be self-assured and have the requisite skills to make the necessary changes. When workers have strong beliefs about their susceptibility and the severity of a health result, they are more likely to take action to avoid an unfavorable outcome (Ramos et al., 2021).

Sewage workers avoid wearing PPE because they mistakenly believe that doing so will show them to be physically incapable of performing a demanding task, unable to handle the responsibility, and fearful of losing their jobs if they are thought to be ill. The personal protective equipment (PPE) provided by several organizations is inadequate and is just sometimes provided when the PPE is less functioning because of deterioration by normal wear and tear while on the job and is inappropriate to use, which is against the safety procedure for sewage employees. In addition, PPE is excessively expensive, making it impossible for sewage workers to buy it on their own. This collection of current issues with PPE use exposes sewage workers to dangerous environments and infections that are, to a certain extent, preventable with the use of basic PPE (Degavi, Debbarma, Adola, Safayi, Gemeda, & Utura, 2021).

Occupational health and safety program is very essential to prevent workplace injuries, illnesses, and deaths, as well as the suffering and financial hardship that these events can cause for workers, their families, and employers. The educational program for safe work behavior uses a proactive approach to managing workplace safety and health. Traditional approaches are often reactive-that is, problems are addressed only after a worker is injured or becomes sick, a new standard or regulation is published, or an outside inspection finds a problem that must be fixed. These safe behavior programs recognize that finding and fixing hazards before they cause injury or illness is a far more effective approach (Tajudy, 2022).

Wastewater treatment plants can lower work-related injuries and accidents by enhancing worker safety behaviors. Safety behaviors within an organization can be directly enhanced in two ways. First, organizations can guarantee that sewage workers have the essential knowledge, beliefs, and practice to execute their duties properly, which can be achieved through safety training. Second,by improving worker safety motivation, safety behaviours can be increased (Sawhney & Cigularov, 2019).

Implementing an educational program about safe work behavior also brings other benefits, such as promoting the health of sewage workers, preventing workplace injuries and illnesses, improving compliance with laws and regulations, reducing costs, including significant reductions in workers' compensation premiums, engaging workers, enhancing their social responsibility goals, increasing productivity, and enhancing the overall sewage treatment plant (OSHA, 2018). Occupational health nurses have a crucial role in providing health services to workers in the workplace. Also, occupational nurses play an important role in developing a well-designed educational intervention program with the aim of raising awareness of safe work behavior and spreading occupational health and safety

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measures regarding physical, mechanical, chemical, biological, and psychological hazards that workers are exposed to during unsafe behavior and on a daily basis (Lipscomb, Epling, Pompeii, and Dement, 2017).

Significance of the Study

There is a growing interest in incorporating various health education subjects into work, following the realization that occupational-based health education for workers is the cheapest, most realistic, and most feasible approach. The educational program will identify work practice challenges and assist with modifying their work environment to reduce the risk of injuries and illnesses among sewage workers. So, guiding safe work behavior must be an integral part of the educational process of imparting life skills through early prevention (El-Nagar & Mady, 2017).

In Egypt, a study done by Shafik et al. (2018) at a sewage wastewater treatment plant revealed that 62% of workers were absent from work due to occupational disease. Also, 62% complained of the work environment, such as exposure to noise and extreme heat. Moreover, 53.3% of workers were exposed to burns and hearing loss, long standing time, bending for long periods, falls, and slipping, and 38.0% were exposed to electricity. Furthermore, 21.2% of workers were exposed to gases, vapors, and chemical substances. In addition, 43.6% of workers exposed to direct infection with viruses contaminated sharp objects. While 67.6% of sewage workers had headaches, 65.8% had varicose veins, and 34.2% had back pain. Also, 78.1% had bronchial asthma, 21.9% had nasal sensitivity, 72.3% suffered stress and nervousness, 27.7% had frequent absenteeism, 25% had respiratory tract infections, and 73.2% had infectious skin diseases. Furthermore, almost all of them did not have ambulances equipped with emergency facilities.

According to a study conducted by Abd El Hamid, Ali, and Kamel (2016) at Al-Qalyobia Governorate to study occupational health hazards among sewage workers with a total of 140 sewage workers, The study reported that the majority of workers had unsatisfactory knowledge regarding safe procedures during work stages. Also, sewage workers are exposed to psychosocial hazards, followed by physical hazards. The most common health problems among the studied sample were skin problems, musculoskeletal problems, runny nose and cough, diarrhea, abdominal colic, nausea, vomiting, and headache. Positive correlation between satisfactory knowledge and age, educational level, and duration of work. The previous study recommended that educational programs be conducted for both the workers and the relevant authorities regarding occupational diseases and hazards and their prevention. There are few studies conducted in Egypt in relation to educational programs on occupational health and safety behavior among sewage workers. So, the results of the current study will add to the nursing body of knowledge in the field of occupational health and safety that aims at improving sewage workers knowledge, health beliefs, and behaviors to prevent adverse health problems resulting from exposure to occupational health hazards, in addition to promoting the health of workers and applying safe behavior at their workplace. Hence, it will help in

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maximizing the productivity of sewage workers by encouraging the workforce to stay longer in active life.

Theoretical Framework

The Health Belief Model (HBM) served as the theoretical underpinning for this research. This model was established in the 1950s for the United States Public Health Service by social psychologists Godfrey Hochbaum and Irwin Rosenstock to explain why people do not engage in preventative health behaviors. Preventive health behavior is described as any activity conducted by an individual with the intention of preventing sickness, detecting illness in an asymptomatic stage, or enhancing health (Rosenstock, 1974).

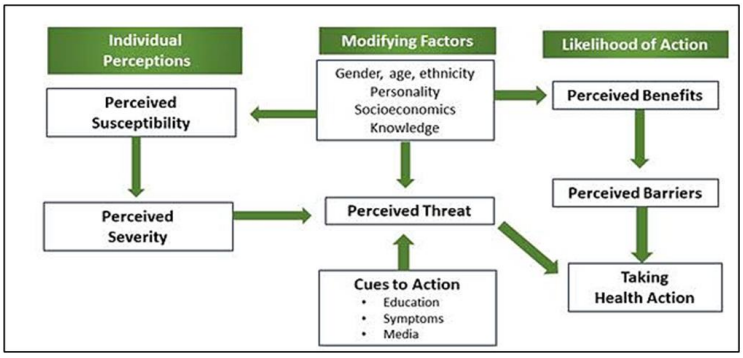

Figure 1: Health Belief Model, adopted from Washburn, L. (2020). Understanding the Health Belief Model. Tennesse: Department of Family and Consumer Sciences, University of Tennessee [Internet]. P. 2.

The HBM's basic assumptions are that for an individual to take health action to avoid an illness, he must: (1) perceive that he is personally susceptible to the illness; (2) believe that the occurrence of the illness will have at least moderate severity on some component of his life; (3) believe that taking health action will be beneficial by reducing his susceptibility to the illness or, if the illness occurs, reducing its severity; and (4) believe that taking action will not require overcoming Psychologic barriers (Barakat & Kasemy, 2020).

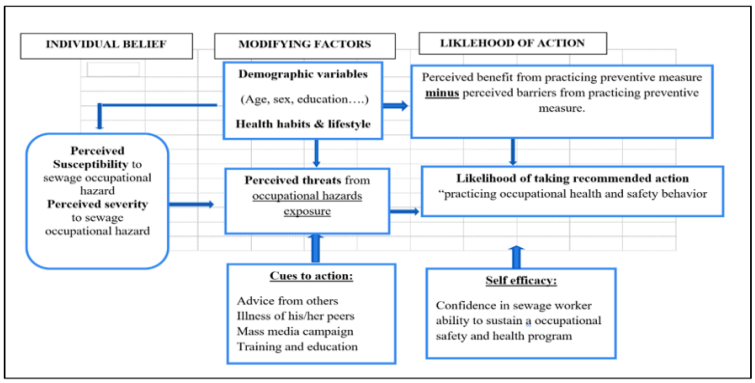

Figure 2: Health Belief Model applications in the current study

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In the current study, HBM includes:

1) Perceived susceptibility

Sewage workers' beliefs about their personal sensitivity to workplace dangers are said to differ greatly. When investigating sewage workers' perceived susceptibility to occupational disease, for example, one worker may deny any likelihood of contracting an occupational disease, while another may admit to the statistical possibility of contracting the occupational disease while believing that the probability for them is low. A third worker may express concern that he is at high risk of occupational sickness. Susceptibility refers to the perceived risk of developing an illness. Individual susceptibility perceptions will differ since susceptibility perceptions are reliant on preventive health behavior and the associated illness being researched.

2) Perceived seriousness

The severity of an illness can be determined by the level of emotional arousal caused by the sewage worker's awareness of the disease, as well as the difficulties the sewage worker perceives a certain illness will cause him. Furthermore, the seriousness of an illness for occupational diseases may be judged in terms of its medical or clinical repercussions. An individual who has a high level of perceived vulnerability to and seriousness of an illness is more likely to change his behavior due to strong knowledge and belief influences.

3) Perceived benefits and barriers of taking action

The perception that a sewage worker is prone to disease, as well as the perception that the occupational hazard is substantial, are thought to impact the decision to take health action. These perspectives, however, do not determine the course of action. Individuals' perceptions of the effectiveness of existing methods (known to sewage workers) to lessen the possibility of illness will impact the course of their actions. Taking action is likely to be seen favorably if it is perceived to lessen sewage workers' susceptibility to or the severity of developing an occupational health hazard. Furthermore, the sewage worker's action is influenced by the individual's perceptions about the availability and effectiveness of health action, rather than objective facts regarding the effectiveness of the action. Furthermore, the social norms and pressures that sewage workers face will influence their perceptions of the benefits of safety and health behaviors.

4) Perceived barriers

Negative perceptions operate as impediments to action by instilling feelings of avoidance in an individual. Sewage workers may believe that behavior will reduce the threat of occupational diseases, but they will also perceive that behavior to be difficult, expensive, unpleasant, painful, or upsetting.

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5) Cue to action

This is the impetus required to move sewage workers' decision-making process towards accepting a recommended safety and health action. These cues might be internal (for example, health difficulties) or external (for example, guidance from others, illness of peers in sewage treatment plants, management, and auditing in sewage treatment plants, etc.).

6) Self-efficacy

This construct was most recently added to the model in the mid-1980s. Many behavioral theories include self-efficacy as a construct since it directly pertains to whether or not a person executes the desired behavior. This refers to a sewer worker's level of confidence in his ability to successfully conduct a behavior.

Aim of the study: The current study aims to evaluate the effect of educational program on occupational health and safety behaviors among sewage workers in Egypt. So, the objectives of the study were to: (1) Assess workers' knowledge, beliefs, and behavior related to occupational health and safety at sewage treatment plants. (2) Develop an educational program to improve occupational health and safety behavior among sewage workers. (3) Implement the developed educational program for sewage workers at sewage treatment plants. (4) Evaluate the effect of educational program on sewage workers' knowledge, beliefs, and behavior.

Operational Definition

Safety behaviors is defined as "the knowledge, beliefs, and reported behaviors of sewage workers that enable them to prevent physical, chemical, and biological hazards at the workplace.

Research Hypotheses

H1: The posttest total mean scores of sewage workers knowledge beliefs regarding occupational health and safety who were exposed to the educational program will be higher than the pretest. H2: The posttest total mean scores of sewage workers self-reported behaviors regarding occupational health and safety who were exposed to educational program will be higher than the pretest. H3: The posttest total mean scores of positive health beliefs regarding occupational health and safety among sewage workers who were exposed to educational program will be higher than the pretest.

2. METHODS

Research design

A quasi-experimental, one-group pretest-posttest design was utilized to achieve the aim of the current study.

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Setting

The study was conducted at one of the largest wastewater treatment plants. Zenin wastewater treatment plant is located in Giza governorate, Egypt. This wastewater treatment plant was chosen because it has a large workforce—about 500 workers who are health-ensured. Also, it has been designated on a large area—nearly 100 acres. Moreover, it has a wastewater treatment capacity of about 450,000 m3 per day.

Sample and sampling technique

The sample size was 230 sewage workers out of 500 using the sample size calculator. The sample calculation was done using the sample size calculator website available at: (http://www.calculator.net/sample-size-calculator.html, 2019). With confidence level (95%), confidence interval (5%), and population size (500). The sample size was 218 workers out of 500, but the researchers included 230 workers to overcome dropouts. Workers were chosen by systematic random sampling by using the readily available list of their names from 1 to 500 (population size), determining the sampling interval (k = N/n, where N represents population size and n represents sample size), which was (2) (k = 500/230), and selecting one worker out of every two workers to end up with a total of 230 workers in the sample.

Tools for data collection: Two tools for data collection were used, as follows:

First tool: Sewage Workers' Assessment Questionnaire, this tool was developed by the researchers and includes four parts:

Part one: Demographic characteristics of sewage workers, such as age, educational level, marital status, monthly income, and work experience. **Part two:** sewage workers' occupational and medical data, such as chronic diseases, work-related diseases, health insurance, training courses about occupational health and safety, the number of daily working hours, and the worker's lifestyle, such as physical exercise and smoking. **Part three:** sewage workers' knowledge. It was used as pre-posttests. Data was collected three times: pre-implementation of the educational program, two times immediately after implementation, and three months after implementation.

Scoring system for the sewage workers' knowledge

For each question, every correct answer received 1 point and 0 for wrong or do not know. Total knowledge was categorized as less than 50% being considered unsatisfactory, scores between 50% and less than 75% being satisfactory, and scores of 75% or more being considered highly satisfactory.

Part four: Sewage workers' self-reported behavior It consisted of twelve multiple-choice questions regarding sewage workers' self-reported behavior to assess occupational health and safety measures against physical, chemical, and biological occupational health hazards as well as how to avoid accidents in the workplace. **Scoring system**: For each question, every correct answer received 1 point, and 0 points were given for not doing anything or reporting incorrect behavior. Total behavior was categorized as less

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than 50% considered unsatisfactory, from 50% to less than 75% being satisfactory, and from 75% or more being highly satisfactory.

Second tool: Sewage Workers' Health Beliefs: It was developed by researchers. It was used as pre-posttests. This tool was based on the health belief model with a three-level rating scale: agree to some extent and not agree. **Scoring system:** For each question, answer was scored as 3 points for agree and 2 points for to some extent. It had been categorized as positive belief ≥70% and negative belief <70%.

Content validity and reliability: Content validity was tested by a panel of experts who assessed the relevancy of the items to the content addressed by the objectives. Reliability was tested using Cronbach's alpha test for internal consistency of the sewage workers' knowledge part, the sewage workers' self-reported behavior part, and the health belief model rating scale, which were 0.94, 0.99, and 0.95, respectively.

Ethical and human rights

Official approval to conduct the proposed study was received from the Research Ethics Committee at the Faculty of Nursing at Cairo University. Then agreement was obtained from the directors of the sewage treatment plant. Workers in the current study volunteered to participate; ethical considerations included clarifying the objective and nature of the study and stating the option to withdraw at any time. Workers in the current study volunteered to participate; ethical considerations included clarifying the objective and nature of the study and stating the option to withdraw at any time. In addition to ensuring the confidentiality of the worker's information by data coding, it was not accessible by any other party without the participant's agreement. The workers provided written informed consent. Workers in the current study volunteered to participate; ethical considerations included clarifying the objective and nature of the study and stating the option to withdraw at any time

Procedure: The current study was conducted on 3 phases: assessment phase, implementation, and evaluation phases.

I: During the assessment phase, the researchers introduced himself to the workers and explained the aim of the study to them. Then the first tool was distributed to be filled out by the workers in the meeting room. The first tool included demographic characteristics of sewage workers, occupational and medical data of sewage workers, sewage workers' knowledge, and sewage workers' self-reported behavior of occupational health and safety measures against physical, chemical, and biological health hazards. Moreover, the second tool about the sewage worker's health beliefs was filled out by the participant. The researchers remained in the sewage treatment plant during the completion of the tools, which took an average of 30 minutes.

II: In the implementation phase, based on the findings of the assessment, an extensive review of pertinent literature was done during the implementation phase, and the researchers designed an educational program. The goal of this program was to equip sewage workers with knowledge and measures of safe work behavior, as well as positive

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health beliefs, in order to prevent health hazards and promote behaviors that support healthy and safe working conditions. The program provided knowledge about occupational health hazards and occupational health and safety behaviors for each hazard. The total number of workers was 230, divided into four subgroups; each group contained about 57:60 workers. The program was delivered in the form of training sessions over the course of seven sessions (one for the pre-test, four for the educational program, and two for the post-test). Sessions were delivered in a teaching class using pre-designed training materials. The session lasted between 20 and 30 minutes.

III: During evaluation phase, after the implementation of the education program, the researchers evaluated the effect of the program on sewage workers' knowledge of occupational health and safety, their positive health beliefs, and their safety behaviors. The evaluation was conducted twice: once immediately following the program and again three months later (follow-up), using the sewage workers' knowledge questionnaire, self-reported behavior, and health beliefs scale. Workers at the sewage treatment plant were given the tools during their break time. The sheets were then collected and checked for any missing data.

3. RESULTS

Part (I): Distribution of demographic characteristic of sewage workers (table 1 & 2).

Table (1): Percentage distribution of sewage workers regarding their age, educational level, marital status, income, and family member (N=230)

Personal characteristics	Frequency	%
Workers' age:		
20-30 years	72	31.3
31-40 years	87	37.8
41-50 years	57	24.8
> 50 years	41	6.1
x ± SD 35.9±9.1		
Educational level:		
Read and write	78	33.9
Secondary education	102	44.3
College education and above	50	21.7
Marital status:		
Single	49	21.3
Married	157	68.3
Divorced	10	4.3
Widowed	14	6.1
Income:		
Inadequate	163	70.9
Adequate	67	29.1
Family members:		
4 members	96	41.7
5 members	86	37.4
6 members	48	20.9

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Table (1) reveals that 31.3% of sewage workers aged from 20–30 years old, 37.8% of workers aged from 31–40 years old, 24.8% aged from 41–50 years old, and 6.1% were more than 50 years old, with a mean age of 35.9±9.1. As regards educational level, around one third (33.9%) of workers could read or write, while 44.3% had secondary education, and 21% had college education and above. The table also illustrates that around two-thirds (68.3%) of sewage workers were married, 21.3% were single, 6.1% were widowed, and 4.3% were divorced. Table 1 also reveals that more than two-thirds of sewage workers did not have enough income, while 29.1% had enough income. As regards family member numbers, 41.7% of workers had 4 members, 37.4% had 5 members, and 20.9% had 6 members.

Table (2): Percentage distribution of sewage workers regarding their daily working hour, work experiences, working shifts and problem at work (N=230)

Item	No	%
Daily working hours:		
8 hours	74	32.2
12 hours	156	67.8
Work experience:		
< 5 years	79	34.3
> 5 years	151	65.7
Working shifts:		
Morning	89	38.7
More than one shift	141	61.3

Regarding daily working hours, table (2) shows that more than two-thirds of sewage workers (67.8%) were working 12 hours per day and 32.2% were working 8 hours. Working more than 5 years represented 65.7%, while working less than 5 years represented 34.3%. This table also illustrates that 38.7% of workers have worked the morning shift only, while 61.3% have worked more than one shift.

Part (II): Distribution of sewage workers' knowledge in pre, post and follow up tests (N=230).

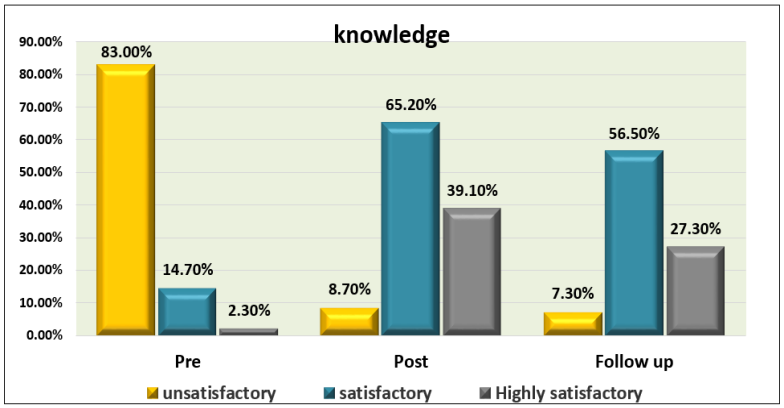

Figure (3): workers' level of knowledge in pre, post and follow up tests (N=230)

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Figure (3) shows that in the pretest, only 14.70% and 2.30% of sewage workers had a satisfactory or highly satisfactory level of knowledge, compared to nearly two-thirds (65.20%), more than one-third (39.10%), more than half (56.50%), and more than a quarter (27.30%) in the post-test and follow-up test, respectively. This illustration represented the first research hypothesis.

Part (V): Distribution of Sewage workers' self-reported behavior: in pre, post and follow up tests (N=230).

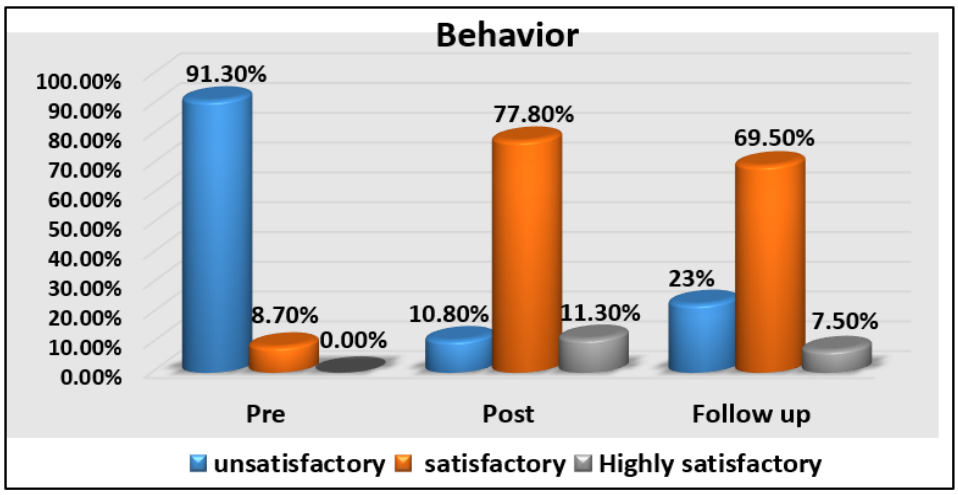

Figure (4): Workers' level of self-reported behavior in pre, post, follow up tests (N=230)

Figure (4) clarifies that only 8.70% and 0.00% of sewage workers had a satisfactory and highly satisfactory level of knowledge in the pretest, compared to more than three quarters (77.80%), 11.30%, more than two thirds (69.50%), and 7.50% in the post- and follow-up tests, respectively. This illustration represented the second research hypothesis.

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Part (VI): Distribution of Sewage Workers' Health Beliefs model score in pre, post and follow up tests (N=230).

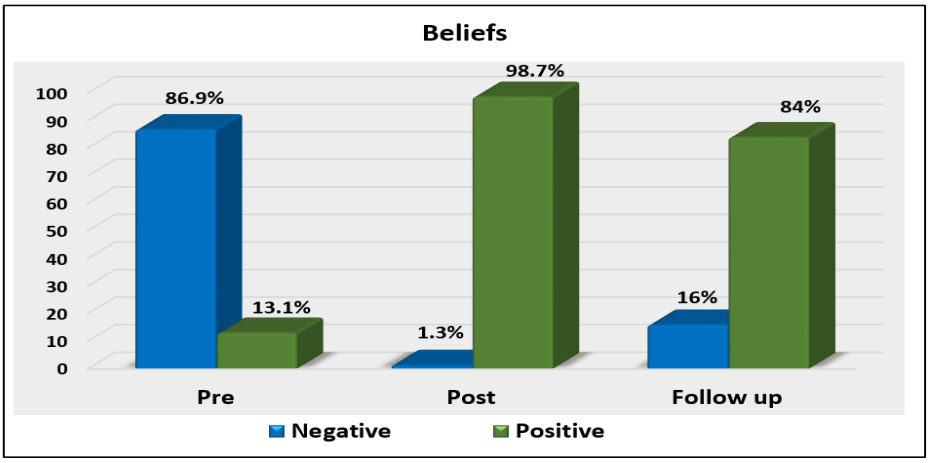

Figure (5) workers' health beliefs model score in pre, post and follow up tests (N=230)

Figure (5) displays a significant improvement in positive workers' health beliefs scores in post- and follow-up applications of the educational program. This illustration represented the third research hypothesis.

Part (III): Correlations between the study variables:

Table (3): Relation between age, educational level, and years of experience of sewage workers and total knowledge, self-reported behaviors, and health beliefs (N=230)

Item	Knowledge		Behavior		Health Beliefs scale	
	R	P	r	P	r	P
Age	0.8	.0001*	0.58	.0001*	0.51	.0001*
Education	0.8	.0001*	0.74	.0001*	0.64	.0001*
Experience	0.91	.0001*	0.69	.0001*	0.6	.0001*

*Significant at p-Value<0.05

Table (3) reveals that there was a highly statistically significant positive correlation between the age of sewage workers and their level of knowledge, self-reported behavior, and health beliefs (P =.0001*). Also, there was a highly statistically significant positive correlation between the level of education of sewage workers and their level of knowledge, self-reported behavior, and health beliefs (P =.0001*). The table also depicts that there was a highly statistically significant positive correlation between the work experiences of sewage workers and their level of knowledge, self-reported behavior, and health beliefs (P =.0001*).

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Table (4): Relation between total mean score of total knowledge, self-reported behaviors, and health beliefs of sewage workers in pre, post and follow up tests (N=230)

Total scores	Pre		Post		Follow up		ANOVA	
	Mean	SD	Mean	SD	Mean	SD	p-value	Sig
Knowledge	3.85	4.01	11.0	0.01	11.0	0.446	727.495	**.0001***
Behavior	2.63	4.49	11.9	0.01	11.9	0.407	997.883	**.0001***
Beliefs	42.54	9.77	73.71	2.96	69.23	0.606	969.29	**.0001***

*Significant at p-Value<0.05

Table (4) reveals a highly statistically significant difference between the total mean score of knowledge, self-reported behavior, and health beliefs among sewage workers in pre-, post-, and follow-up tests (p = 0.0001).

Table (5): Correlation between total knowledge, self-reported behaviors, and health beliefs of sewage workers (N=230)

Item	Knowledge		Behavior		Health Beliefs scale	
	r	P	r	P	r	P
Knowledge	1					
Behavior	0.94	.0001*	1			
Health Beliefs scale	0.85	.0001*	0.89	.0001*	1	

*Significant at p-Value<0.05

Table (5) shows a highly statistically significant correlation between sewage workers' level of knowledge, self-reported behavior, and health beliefs (P =.0001*).

4. DISCUSSION

The current study was carried out on 230 sewage workers. More than one third of the studied workers ages ranged between 31 and 40 years old, with a mean age and SD 35.9±9. Regarding educational level, less than half of the studied workers had secondary education. Also, more than two-thirds of them were married. This was in agreement with a study done by Shafik, Abdelmegeed, Saad, and Abo Elnour (2019) in Egypt on 150 workers to assess occupational health hazards among workers in sewage treatment plants. They found that less than half of the studied workers were between 20 and 40 years old, less than half of them had secondary education, and more than two-thirds of them were married. As for working hours, more than two-thirds of sewage workers worked 12 hours per day, less than two-thirds of them worked for more than 5 years, and more than half of them worked more than one shift.

This result is supported by a study conducted by Abdelmoneim et al. (2017) to assess health hazards related to soba sewage treatment plant in Sudan. They found that more than half of workers worked for more than five years. This result is in contradiction with the study done by Ahmed, Abdelhamid, and Ahmed (2022) to determine the effect of supportive information regarding water-related diseases and health risk prevention on

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114 sewage workers in Fayoum, Egypt, who found that two-fifths of them were working for more than five years and only about ten percent were working for more than 12 hours per day.

From the researchers' point of view, this result may be due to inadequate income, as reported by more than two-thirds of the studied workers, to increase their wages and cover their family's needs, especially since more than two-thirds of them were married. Regarding workers level of knowledge about occupational health and safety, workers showed a highly significant increase in their satisfactory and highly satisfactory total knowledge mean scores in post- and follow-up tests. This result was backed by a study done by Zaky, El-Magrabi, and Mohammed (2018) in Egypt about the incidence of occupational health hazards and safety measures among municipal waste workers. The study found that more than one-third of the workers had poor knowledge about occupational health hazards and safety measures.

Also, another study was conducted by El Saied, Ibrahim, and El Karmalawy (2021) in Egypt to evaluate the impact of a health-hazard prevention training program on poultry workers' knowledge and self-reported practice. They reported that there was a highly significant increase in workers level of knowledge (3.4%, 97.7%, and 88.8%) in pre-, post and follow-up tests, respectively. The similarity in both results may be related to the same educational level; about half of them have a secondary level of education, which helps workers gain more information about occupational health and safety. It also should emphasize the importance of training workers on safety precautions, which is crucial to increasing their knowledge.

Regarding the workers' health beliefs model score, the findings of the current study displayed that the majority of workers had negative health beliefs in the pretest, while the majority of them had a significant improvement in their positive workers' health beliefs score in the post- and follow-up tests. This result was backed by a study done by Dewi, Rahardjo, and Murti (2019) on 200 workers in the New Yogyakarta International Airport to determine factors influencing the use of PPE using the Health Belief Model (HBM), who found that the use of PPE is directly and positively affected by good knowledge and beliefs. Another study was conducted by Mohammad, Najafpoo, Vahedian, and Ghavami (2022) on 228 workers in Iran to determine preventive behaviors of cardiovascular disease among oil industry workers based on a health belief model.

They reported that their findings indicated that educational program are strong predictors of workers' preventive behaviors with reference to occupational health and safety. It is supposed that prior knowledge of workers' occupational health and safety increases their positive health beliefs. Moreover, this result goes with the second research hypothesis. The current study's findings revealed that the majority of workers had an unsatisfactory level of behavior in the pretest, but a satisfactory level of behavior in the post-test and follow-up tests. This finding is consistent with a study conducted on 200 factory workers by Dewantara, Murti, and Widyaningsih (2019) on the application of the health belief model and social cognition theory to the use of personal protective

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equipment among workers at the plywood plant. The study's findings revealed that workers' use of personal protective equipment rose directly following training. The finding supported the third research hypothesis.

With regard to correlations, the present study found a positive correlation between age, educational level, and years of experience of sewage workers and total knowledge, self-reported behaviors, and health beliefs scores (P =.0001*). This result might be because more than half of the study sample is older than 40 years and the work duration is longer than 5 years, so they can gain knowledge from previous experiences and have a positive belief that helps them apply safety behavior. This finding was in accordance with a study conducted by Abd El Hamid, Ali, and Kamel (2016) at Al-Qalyobia about occupational health hazards among sewage workers, who reported that there was a positive correlation between satisfactory knowledge, age, educational level, and duration of work. Another study conducted by Zaky, El-Magrabi, and Mohammed (2018) in Egypt examined the prevalence of occupational health hazards and safety measures among municipal waste workers.

They reported that there was a statistically significant difference between the knowledge of workers and their age, level of education, and years of experience. The findings of the current study highlight the existence of a highly statistically significant difference between the mean score of knowledge, self-reported behaviors, and health beliefs scores in pre-, post-, and follow-up tests. This finding was supported by the study done by Sadeghi, Hashemi, and Khanjani (2018) in Iran to investigate the impact of educational intervention based on the health belief model on observing standard precautions among emergency nurses. The study findings reported that there were statistically significant differences between knowledge scores and behavior after intervention among the studied workers. According to the researchers, this result could be attributed to increased knowledge and correcting misperceptions, as well as discussion and conversation, which can be effective in reducing barriers, increasing the perceived benefits of safety behavior, and possibly taking measures against occupational health hazards. Furthermore, educational programs have a positive impact on boosting workers' knowledge, beliefs, and behavior about occupational health and safety.

Moreover, there was highly statistically significant correlation between sewage worker’s level of knowledge, level of self-reported behavior, and sewage worker’s health beliefs score. This finding was congruent with the findings of a study conducted in Indonesia in 2022 by Putra, Wijayanti, and Hadiwidjojo to evaluate the effect of safety knowledge and workplace safety climate on worker safety performance and behavior. They discovered that safety knowledge had a considerable influence on safety behavior. The more knowledge a worker receives on occupational health and safety values, the better the worker will understand the hazards that cause work accidents. This knowledge can be provided in the form of an educational program.

Another study by Ahmed, Abdelhamid, and Ahmed (2022) about effect of supportive information regarding water-related diseases health risks prevention among swage

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workers. A positive correlation between overall knowledge and reported behavior scores among sewer workers in terms of preventing health risks was found.

From the researchers' point of view, workers who perceive the severity, seriousness, and obstacles of occupational hazards and are successful in identifying them in the workplace would have high compliance to follow occupational health and safety behavior at work. The previous results of the current study supported the conclusion that conducting the educational program enhanced the sewage workers' knowledge, safety beliefs, and behaviors toward occupational health and safety at their workplace, which limited and reduced their physical, chemical, and biological occupational health hazards.

5. CONCLUSION

The results of this study concluded that sewage workers' mean age were 35.9±9.1 years old. As regards educational level, more than two fifth of them had secondary education. Also, more than half of workers work more than five years. Moreover, the results indicated that level of knowledge, self-reported behaviors and positive Health beliefs total mean score regarding occupational health and safety among sewage workers was improved after application of the educational program with statically significance differences between pre, post and follow up tests(P=.0001). Furthermore, the study concluded that that there was highly statistically significant correlation between sewage worker's level of knowledge, level of self-reported behaviors, and their health beliefs score (P=.0001).

6. RECOMMENDATIONS OF THE STUDY

Based on the study findings, it was recommended that:

1. Continuing to organize educational programs for sewage workers on occupational health and safety behavior that covers all wastewater treatment plants in different settings in Egypt.
2. Activating the role of an occupational health nurse in wastewater treatment plants with the aim of preventing physical, chemical, and biological occupational health hazards that workers are exposed to.
3. Ensuring effective usage and availability of PPE among sewage workers to prevent occupational health hazards and improve safety behavior.
4. Institutional guidelines are also required to ensure that workers follow safety behavior during their work.
5. Further research is recommended on a large sample and in different governorates in Egypt to generalize the results.

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