

Original Article

# Prevalence and Determinants of Occupational Health Hazards among Sewage Workers in EL-Beheira Governorate

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## Abstract

**Background:** Wastewater treatment plant (WWTP) is considered one of the most treacherous sectors in the industrial field. Many workers still die each year due to poor awareness of workers about occupational health hazards. **Aim:** to assess prevalence and determinants of occupational health hazards among sewage workers in El-Beheira Governorate. **Design:** A cross sectional descriptive design was used. **Setting:** The study was conducted in all sewage water treatment stations in 14 Administrative centers in El-Beheira governorate which including 32 stations. **Subjects:** a convenient sample was used to select 400 sewage workers in the previously mentioned settings. **Tools for data collection:** Three tools were used for data collection, Tool (I): Sewage Workers Structural Interview Questionnaire, part socio-demographic characteristic of workers. Part (2) working profile related to workers. Part (3) Workers' occupational hazards knowledge structured interview sheet. Part (4) Worker's health status assessment sheet. Tool (II) Observational checklist of sewage workers regarding safety and health at work. It is composed of (5) parts. Tool (III) Workplace Stress Scale consists of (8) items that were used to measure job stress levels. **Results:** the studied workers were exposed to high levels of chemical hazards followed by biological, physical, and mechanical hazards. Skin problems were the common health problems, followed by respiratory problems and GIT problems. The main risk factors that affect workers health and safety were age, income, number of family members, years of experience, absenteeism at work, and presence of health clinic at workplace. **Conclusion:** most of the workers had a poor level of knowledge regarding occupational health hazards and personal protective equipment so most of them were exposed to all types of occupational hazards. **Recommendations:** Health programs should be conducted for both the workers and the relevant authorities regarding occupational health hazards and its prevention. Implement a standardized occupational health problems screening strategy and follow up visits. Periodic teaching programs to provide workers with adequate knowledge.

**Keywords:** Wastewater treatment Plant, Prevalence, Sewage Workers, Occupational Health, Hazards

## Introduction:

Occupational safety and health are multidisciplinary area that focuses on improving workplace conditions for people's safety, health, and welfare. Employers under management practices have a common law duty of reasonable care of the safety and health of employees as may be mandated by constitution and pertinent laws. Low compliance to occupational safety and health regulations affects staff work satisfaction. A significant tool for creating or enforcing occupational health and safety standards is the "healthy workplace" idea, which helps to ensure that working conditions for the population are always improving. However, a safe working environment also offers a dynamic and fulfilling environment for the employees, making it a healthy workplace. <sup>(1,2)</sup> Any injury that comes from a work accident or from exposure to a single occurrence in the workplace is referred to as an occupational injury. An occupational disease results from exposure to one or more risk factors over time, whereas an occupational injury happens suddenly. <sup>(3)</sup>

Every year, throughout the world an estimated number of 271 million people suffering from work-related injuries and two million diseases a consequence of these injuries. Current global work force stands at about 2.8 billion, workers spend about one third of their life time at work place. <sup>(4)</sup> The national and worldwide media periodically pay attention

to the health and safety of the global workforce. Industrial disasters, especially those that result in several fatalities, make international news. But the truth is that thousands of individuals perish from work-related causes every day around the world, and a large number of these deaths go unreported or unnoticed. <sup>(5)</sup> Wastewater treatment plant (WWTP) is considered one of the most hazardous sectors in the industrial field. Many workers continue to perish every year due to poor awareness of workers about occupational health hazards. <sup>(1)</sup> The hazards in the WWTP can be described as a station, equipment or maintenance that have been neglected to be under control. Additionally, the key categories of risks in the WWTP include physical, biological, mechanical, chemical and psychosocial hazards. <sup>(6)</sup>

Occupational health nursing is a specialty of nursing practices that offers and conveys health, safety programs and services to laborers and community groups. The practices focus on advancement, maintenance, restoration of health, prevention of illness and injury, in addition to protection from occupational hazards. Occupational health nurse play an important role in the primary care which is the set of nursing actions that are provided to manage illness or functional challenges in the workplace. The goal is to prevent complications, promote recovery and facilitate rehabilitation of either occupational and non-occupational illness or injury. The nursing process, a theoretical foundation that is compatible with occupational health nursing practices, knowledge of the health/illness continuum, and the norms and deviations of the continuum form the foundation of primary care. <sup>(7)</sup>

**Significance of the study:**

Workers represent half of the world’s population, preserving a safe working environment is mirrored on a health of workers. The International Occupational Health and Safety Information Center found that waste water treatment operation encounter no fewer than 15 accidental hazards in their daily duties. The injury rate for workers in waste water treatment in 2012 was 5.2 injuries per 100 workers. <sup>(8)</sup> El-Beheira governorate have about 1500 workers works in about 32 treatment plants. Thus, the **aim of the study** was to assess the prevalence and determinants of occupational health hazards among sewage workers in El-Beheira Governorate.

**Research questions:**

What is the prevalence of occupational health hazards among sewage workers in El- Beheira Governorate? What are the determinants of occupational health hazards among sewage workers in El- Beheira Governorate?

**Materials and Methods:**

**Research design:**

A cross- sectional descriptive research design

**Setting:**

The study was conducted in all sewage water treatment stations in 14 Administrative centers in El-Beheira governorate which includes 32 stations

**Subjects:**

All available workers at sewage stations in EL- Beheira governorate from the pre mentioned setting.

**Sampling technique:**

The sample size of workers in sewage water stations was calculated by using (EPI info 7software) based on the total Population of 1500 workers attended per six months to waste water plants, an expected frequency of 50%, precision of 7%, alpha error = 0.05. So, the total sample size was 400.

Table (1): Distribution of workers among different sewage water treatment stations in EL-Beheira governorate using single proportional allocation technique

Station	Total number of workers	Sample
1. Kafr El-Dwar (3)	152	37
2. Damanhour (4)	175	50
3. Abou hoummos (4)	165	40
4. Kom Hamada (2)	120	36

5. Mahmoudeya (4)	170	50
6. Etai El Baroud (4)	162	25
7. El Dalanggat (3)	137	40
8. Huosh Essa (2)	73	25
9. Edeikou (1)	65	20
10. Rachied (1)	50	15
11. Abou Elmattamer (1)	51	15
12. Elrohmania (1)	50	15
13. Sheprakhiet (1)	75	20
14. Wadi Elnatroun (1)	55	12
<b>Total</b>	<b>32</b>	<b>400</b>

Source: The Drinking water and Sanitation Company in El Beheira governorate 2020 <sup>(9)</sup>

**Tool for data collection:**

Three tools were used **Tool (I): Sewage Workers Structural Interview Questionnaire**. It was developed by the researcher after reviewing the recent literature in order to collect data from the workers and it included the following **four parts: Part (1) socio-demographic characteristic of workers:** age, gender, level of education, marital status, income, place of residence and crowding index. **Part (2) working profile related to workers** e.g. working department, number of shifts, time of shifts, taking breaks and how often, years of experiences, work schedule, absenteeism, causes of absent of work, presence of health insurance, presence of occupational health nurse and unit, in-service training programs about occupational health hazard, personal protective devices and first aid. **Part (3) Workers’ occupational hazards knowledgestructured interview sheet**. It was used to assess workers knowledge regarding occupational hazards, safety and personal protective devices and their source of knowledge. The workers’ Knowles regarding occupational hazards were calculate foreach item. It consists of 8 items. Each knowledge was scored as followed: a correct & complete answer was scored (2), correct & incomplete answer was scored (1), incorrect & or don’t know answer was scored (0). The total Knowles score was calculated (0 - 16) and converted into percent score to be categorized into three levels as follow:

**Scoring of Workers’ occupational hazards knowledge structured interview sheet (Tool I, part 3)**

Score	Interpretation
<50 % ( < 8 points)	Poor level of knowledge
50 % - < 75% (8- 12)	Fair level of knowledge
≥ 75% (≥ 12 points)	Good level of knowledge

**Part (4) Worker's health status assessment sheet** It was used to assess workers past health history, Current health status (self-reported data) e.g. current complaints including musculoskeletal, respiratory, skin, vision, hearing problems.

**Tool (II) Observational checklist of sewage workers regarding safety and health at work** it was developed by European Agency for Safety and Health at Work in sewage stations and modified by Malak Ahmed A, (2016). <sup>(10)</sup> Itcomposed of **5 parts** and the total items were 36 items. The total scores ranged from (0 – 36).

**Part I:** Mechanical hazards this part includes 7 questions (1 – 7) for example (heavy loads, power supply not correctlyfused and protected Floor or any stair having broken and slippery surface).

**Part II:** Physical hazards this part includes 6 questions (8 – 13) for example (Exposure to excessive noise levels, Cutsand pricks by sharp tools, unventilated rooms, and high temperature).

**Part III:** Chemical hazards this part includes 8 questions (14 – 21) for example (hazardous chemicals, Acute poisoning).

**Part IV:** Biological hazards This part includes 8 questions (22 – 29) for example (Diseases caused by infectious agentsas bacteria, viruses, protozoa, helminthes and fungi, caused by insects or rodents proliferating in the sludge dryingbeds).

**Part V:** Psychosocial hazards this part includes 6 questions (30 – 36) for example (abnormal behavior such as drug and alcohol abuse, lack of ability to concentrate, irritability, and depression that may indicate an issue with work-related stress).

The answer of observation sheet regarding presence of hazards among workers was scored then summed together, (0) was given to answer when there were no hazards present while (1) was given for presence of hazards. The total score was categorized into three levels as the following:

**Scoring of tool (II) Observational checklist of sewage workers regarding safety and health at work**

Score	Interpretation
0-12	Mild occupational hazard
13-23	Moderate occupational hazard
24-36	High occupational hazard

**Tool III: Workplace stress scale** it was developed by the Marline Company and the American Institute of Stress in (2009).<sup>(11)</sup> Workplace Stress Scale consist of (8) items were used to measure job stress levels, for example: item (1) asked about work condition safety, item (2) asked about job effect of worker physical & emotional wellbeing.... Each item is rated on 5-point rating scale ranging from 1 (never), 2 (rarely), 3 (sometimes), 4 (often) to 5 (very often) in the first five items and reversed in the last three items 5 (never), 4 (rarely), 3 (sometimes), 2 (often) to 1(very often). The items were scored, then coded and interpreted as following: -

**Scoring of tool III: Workplace stress scale**

Score	Interpretation
≤15	Calm
16-20	Low stress
21-25	Moderate stress
26-30	Severe stress
31-40	Very severe stress

**Methods:**

The study was implemented according to the following steps:

**i. Administrative process:**

- An official letter was directed from the faculty of nursing, Damanhour University to the director of the drinking Water and Sanitation Company in El Beheira Governorate to inform about study aim development and to obtain permission to conduct the study.
- Official letters were directed from director of the drinking water & Sanitation Company to directorate of all selected stations to gain their cooperation during collection of data.

**ii. Development of the study tools:**

- Tool I was developed by the researcher after reviewing of the recent literatures.
- Tool II safety and health at work observational check list that was developed by European Agency for Safety and Health at work in textile sector in (2006) was adapted by the researcher to assess occupational hazards.
- Tool III Workplace Stress Scale that consists of (8) items were adopted by the researcher to measure job stress levels. It was developed by the Marline Company and the American Institute of Stress in (2009).
- Content validity of the study tools (I, II, III) was tested by a jury of five experts in the field of community health from the Faculty of Nursing. Necessary modifications were done based on their recommendations such as (remove unnecessary details and change the way of some questions to be suitable with all workers' levels).

- Reliability of tools was done using Cronbach's Alpha reliability correlation coefficient. The result for the tool III (health and safety at work observational checklist) was  $r = 0.741$ , and for tool III (workplace stress scale), was  $r = 0.854$ .

### iii. Pilot study

- After development of the tools, a pilot study was conducted before starting data collection on a random sample of 40 workers (10% of the estimated sample). They were obtained from Kar El Dawar Station. To ensure the clarity of the items and their comprehension, estimate the average time needed for data collection and to identify the various problems that might be encountered during implementation of the study, so as to make necessary arrangements to deal with them. Based on the findings of jury's comments and the pilot study, the tools were reviewed, and the necessary modifications were done

### iv. Process of data collection:

- The interviews were carried out individually during the break time after a brief explanation of the purpose of the study.
- Workers were selected by convenience method from the different selected plant stations
- Each interview took approximately 20 minutes using tool I, III and tool II took from 25 to 30 minutes.
- The data were collected during the period from (May 2021 to August 2021).

### v. Statistical analysis

- Data were coded and transferred into specially designed formats to be suitable for computer feeding. Following data entry, checking and verifying process were carried out to avoid any errors during data entry. Frequency analysis, cross tabulation and manual revision were all used to detect any errors.
- Data was analyzed using PC with statistical package for social science (SPSS) version 20.
- The level of significance selected for this study was  $p$  equal or less than 0.05. The following statistical measures were used:
- The descriptive measure included: count, percentage, arithmetic mean, standard deviation.
- Analytical statistical tests included: chi square test ( $X^2$ ), and logistic regression analysis was also used.
- Graphical presentation included bar and pie graphs.

### vi. Ethical considerations:

- Permission was obtained from ethical committee in the faculty of Nursing, Damanhour University and research number (November 2020, 6).
- A written consent was taken from each worker to obtain their acceptance to participate in the research.
- Confidentiality and privacy of workers were maintained.
- Code numbers were used instead of names to ensure anonymity.

## Results:

**Table (1)** reveals that, age of the studied workers ranged from 50 to less than 60 years and more than one third (33.8%) of them were in age group ranged from 30 to less than 40 years. Regarding to marital status, approximately two thirds of workers (66.5%) were married. Regarding to education level, more than half of them (52.2%) obtained secondary/technical education, followed by more than fifth (20.5%) of them obtained preparatory education, and only (3.3%) of them were obtained university education. Regarding worker's residence, more than half (53.5%) of studied workers were living in urban areas, while less than half of them (46.5%) were living in rural areas. The table also shows, more than one third (34.2%) of workers lived in family include of 5 to less than 7 members.

Table (1): Distribution of the studied workers according to their personal data:

Socio-demographic characteristic of the studied workers	Total studied women N=400	
	N=400	%
<b>Age (years)</b>		
20-	49	12.2
30 -	135	33.8
40 -	75	18.7
≥ 50 -	141	35.3
Min-Max	23.0 – 59.0	
Mean ±SD	42.87±9.951	
<b>Marital status</b>		
Single	37	9.3
Married	266	66.5
Divorced	51	12.8
Widowed	47	11.4
<b>Level of educational</b>		
Illiterate	36	9
Read & write	46	11.5
Primary education	14	3.5
Preparatory education	82	20.5
Secondary/ Technical education	209	52.2
University education	13	3.3
<b>Place of residence</b>		
Urban	218	53.5
Rural	186	46.5
<b>Number of family members</b>		
< 3	19	4.8
3 -	128	32.0
5-	137	34.2
≥ 7	116	29.0

**Table (2)** portrays that, more than half (58.8%) of the study workers had experience of 15 years or more, followed by more than one quarter (28.8%) of them had rang of experience from 10 to less than 15 years. The majority of study workers (86.4%) hadn't enough income to meet the demands of their lives. As regards to the means of transportation to work, less than two thirds (63.5%) of the study workers stated that they were using the public transportation, followed by more than fifth (20.2%) of them were going to work on foot. Also, the table illustrates that, less than three quarters (71.5%) of the studyworkers were working 8 hours per day and more than three quarters (77%) of the study workers were working in alternated work schedule. The majority (82.3%) of those workers were took break once every shift, moreover, more than three quarters (76%) of those workers were took break time from 30 to 45 minutes.

As regards to number of days off per week, table showed that, three quarters (75%) of the study workers were obtained two days off per week and more than half (58%) of the study workers never absent from their work. More than two thirds (67.9%) from those who were absent from work, absent more than 5 days during the last 6 months. Among those, the reason for absenteeism, the table illustrated that, more than three quarters (84%) of the study workers were absent due to illness, while less than fifth (16%) of them were absent due to family related causes.

Table (2): Distribution of the studied workers according to their work-profile

<b>Years of experience</b>	<b>N= 400</b>	<b>%</b>
<5 -	15	3.7
5 -	35	8.7
10 -	115	28.8
≥15	235	58.8
<b>Monthly income</b>		
Enough & save	19	4.8
Enough	35	8.8
Not enough	346	86.4
<b>Transportation to the work</b>		
Public transportation	254	63.5
Factory bus	53	13.3
Private transportation	12	3.0
No transportation (walking)	81	20.2
<b>Daily working hours</b>		
8 hours /day	286	71.5
12 hours /day	114	28.5
<b>Working shifts</b>		
Morning	327	81.8
Evening	59	14.8
Night	14	3.4
<b>Number of days off per week</b>		
No off day	19	4.8
One day	81	20.2
Two days	300	75.0
<b>Absenteeism from work</b>		
No	232	58.0
Yes	168	42.0
<b>Duration of absenteeism (days)</b>		
< 5	47	28.0
5 -	114	67.9
≥10	7	4.1
<b>Causes of absenteeism#</b>		
Family related causes	27	16
Illness	141	84

**Figure (1):** Demonstrates that about two thirds (65.0%) of studied workers were using the services of health insurance. While about one third (35.0%) of studied workers weren't using the services of health insurance.

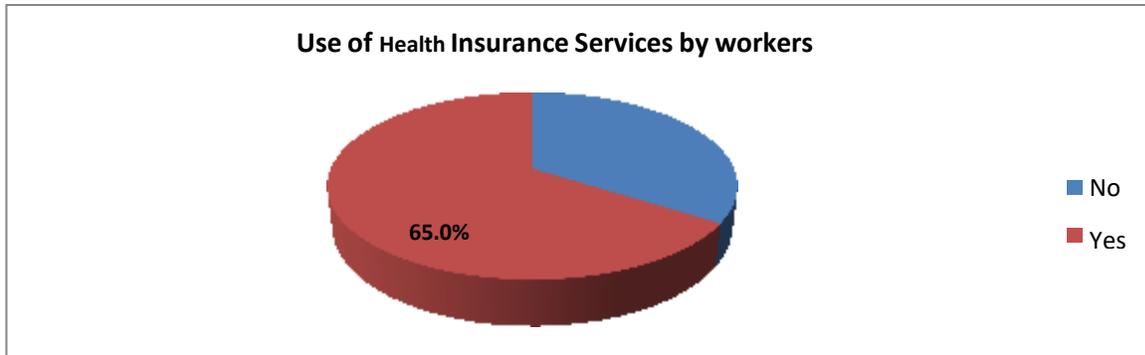


Figure (1): Use of Health Insurance Services by Workers

**Figure (2):** Shows that the majority of workers (97.8%) had current health complaints and minority (2.2%) of them hadn't health problems.

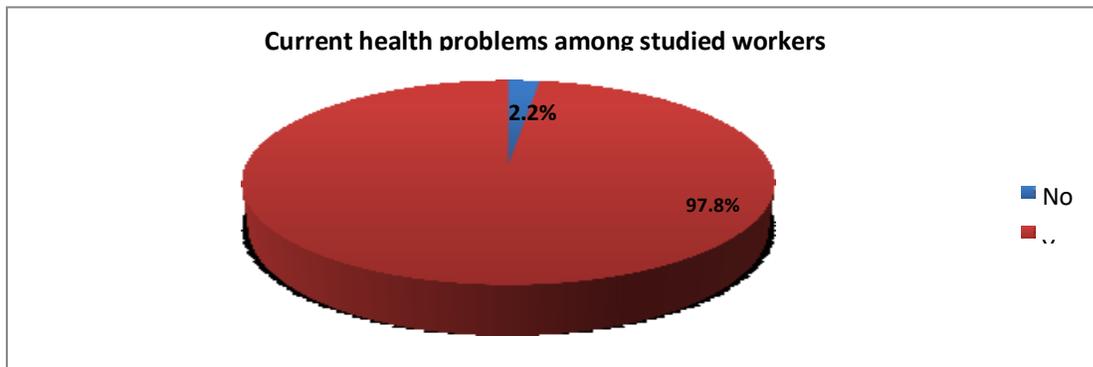


Figure (2): Current health problems among studied workers

**Figure (3):** Shows that, the highest percent of studied workers (96.2%) were suffering from skin problems, followed by (69.3%) respiratory problems, (58.8%) gastrointestinal problems, (43.5%) visions problems, (32.5%) neurological problems, (27.1) ear & hearing problems, (26.6%) musculoskeletal problems and (24.8%) of them were suffering from vascular problems.

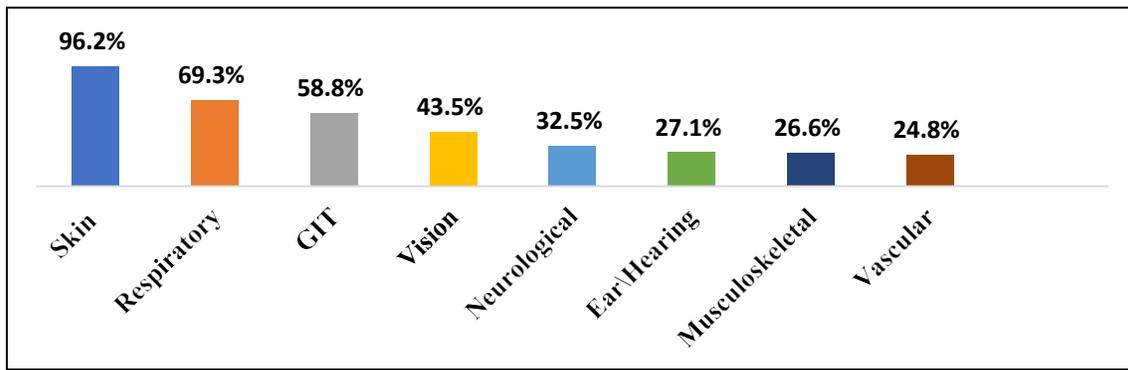


Figure (3): Current health problems of workers

**Figure (4):** Shows that more than two thirds (70.5%) of studied workers had poor level of occupational health knowledge score, and less than one third (29.5%) of them had fair level of occupational health knowledge.

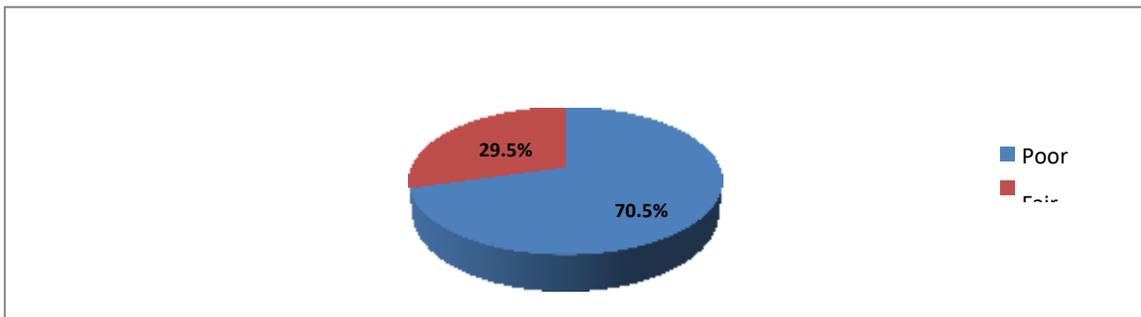


Figure (4): Total score of knowledge among sewage workers related to occupational health.

**Table (3)** shows that more than two thirds (66.0%) of workers were obtained moderate level of exposure related to physical hazards, while more than tenth (15.0%) of them obtained poor level, also more than half (50.4%) of workers were obtained moderate level related to mechanical hazards, while more than third (39.8%) were obtained poor level. According to chemical hazards, more than two thirds (65.0%) of workers obtained a high level of exposure. Related to biological hazards, more than half (56.3%) obtained high level. Moreover, concerning psychosocial hazards, more than half (52.5%) of workers obtained a poor level. According to total score of workers' exposures to occupational hazard at work, the majority (92.8%) of workers obtained a moderate level in total safety score related to occupational hazards at work.

**Table (3):** Distribution of studied workers regarding their exposure to occupational health hazards at work:

Items	N= 400	%
<b>Physical hazards</b>		
Poor	60	15.0
Moderate	264	66.0
High	76	19.0
<b>Mechanical hazards</b>		
Poor	159	39.8
Moderate	202	50.4

High	39	9.8
<b>Chemical hazards</b>		
Poor	12	3.0
Moderate	128	32.0
High	260	65.0
<b>Biological hazards</b>		
Poor	17	4.2
Moderate	158	39.5
High	225	56.3
<b>Psychosocial hazards</b>		
Poor	210	52.5
Moderate	157	39.3
High	33	8.2
<b>Total workers' exposure to occupational health hazards</b>		
Poor	17	4.2
Moderate	371	92.8
High	12	3.0

**Table (4):** reveals that, high mean percent score of exposure to occupational health hazards among workers observed with chemical hazards ( $4.99 \pm 1.217$ ) followed by biological hazards ( $4.83 \pm 1.315$ ), physical hazards ( $3.25 \pm 0.982$ ), mechanical hazards ( $3.02 \pm 1.140$ ), and finally psychosocial hazards ( $2.42 \pm 1.602$ ). Concerning the total mean percent score of exposure to occupational health hazards among workers was ( $18.52 \pm 3.318$ ).

Table (4): Mean percent score of studied workers regarding their exposure to occupational health hazards at work

Items	Total (N= 400)
<b>Physical Hazards</b>	
Min- Max Mean $\pm$ SD	0.00 – 6.00 $3.25 \pm 0.982$
<b>Mechanical hazards</b>	
Min- Max Mean $\pm$ SD	0.00 – 6.00 $3.02 \pm 1.140$
<b>Chemical hazards</b>	
Min- Max Mean $\pm$ SD	0.00 – 8.00 $4.99 \pm 1.217$
<b>Biological hazards</b>	
Min- Max Mean $\pm$ SD	0.00 – 7.00 $4.83 \pm 1.315$
<b>Psychosocial hazards</b>	
Min- Max Mean $\pm$ SD	0.00 – 6.00 $2.42 \pm 1.602$
<b>Total workers' exposure to occupational health hazards</b>	
Min- Max Mean $\pm$ SD	0.00 – 28.00 $18.52 \pm 3.318$

**Figure (5):** Portrays that, more than half (53.2%) of workers had sever level of stress compared by more than one quarter (27.5%) of them have very sever level of stress and less than fifth (17.5%) of them have moderate level of stress.

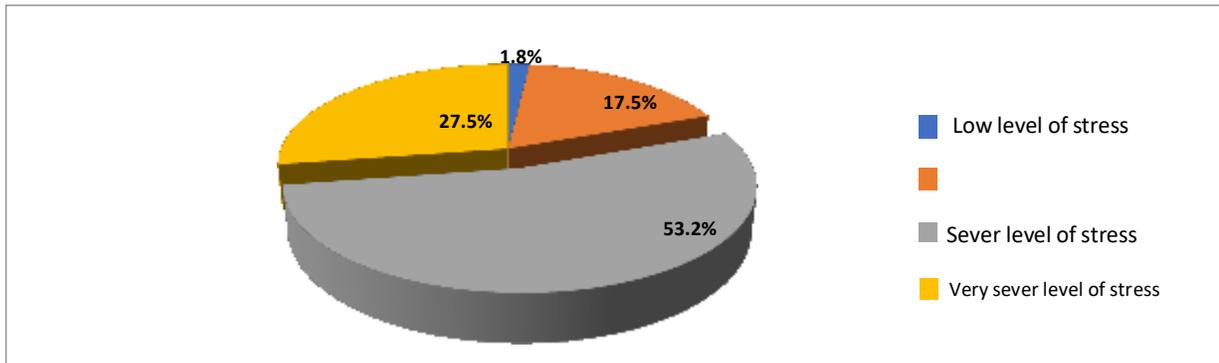


Figure (5): Workers' level of workplace stress

**Table (5):** indicates that, only 17 variables were found to be predictors of occurrence of workplace occupational hazards namely age (P=0.000), income (P=0.007), number of family members (P=0.000), years of experience (P=0.015), work shifts (P=0.049), number of day off (P=0.016), absenteeism at work (P=0.000), have health insurance (P=0.032), presence of health clinic at workplace (P=0.000), previous chronic diseases (P=0.003), previous hospitalization (P=0.022), previous infectious diseases (P=0.000), current health problems (P=0.046), regular factory checkup (P= 0.001), doing checkup alone (P= 0.000), total workers' knowledge (P= 0.000), and total fatigue (P= 0.000).

Table (5): Regression analysis for determinate of occupational health hazards among sewage workers:

Model	Unstandardized Coefficients		Standardized Coefficients	t	P
	B	Std. Error	Beta		
(Constant)	13.016	2.485		5.238	0.000*
Age	-0.871-	0.225	-0.274-	-3.872-	0.000*
Education	0.084	0.134	0.035	.631	0.528
Marital status	-0.435-	0.257	-0.101-	-1.696-	0.091
Income	0.635	0.234	0.142	2.710	0.007*
Place residence	0.037	0.346	0.005	0.107	0.915
Transportation factory	0.186	0.240	0.050	0.775	0.439
Number family members	0.992	0.241	0.260	4.119	0.000*
Years of experience	0.648	0.264	0.154	2.453	0.015*
Number of work shift	0.012	0.324	0.002	0.038	0.970
Daily working hours	0.005	0.123	0.003	0.043	0.966
Work schedule	-0.800-	0.418	-0.100-	-1.912-	0.057
Work shift	0.706	0.358	0.102	1.971	0.049*
Work over time	0.375	0.506	0.037	0.741	0.459
Work break	0.503	0.398	0.070	1.265	0.207
Number of day off	-0.837-	0.347	-0.118-	-2.412-	0.016*
Absenteeism from work	2.085	0.490	0.305	4.255	0.000*
Have health insurance	-0.822-	0.381	-0.120-	-2.157-	0.032*
Attend training occupational Health	-4.795	0.000	-0.008-	-0.139-	0.889
Presence of clinic	-2.812-	0.560	-0.247-	-5.023-	0.000*
Previous checkup	-0.742-	0.394	-0.108-	-1.885-	0.060
Previous chronic diseases	-1.358-	0.458	-0.197-	-2.963-	0.003*
Previous hospitalization	-0.884-	0.386	-0.131-	-2.293-	0.022*

Previous infectious diseases	1.481	0.331	0.219	4.478	0.000*
Previous work accident	0.304	0.350	0.044	.869	0.385
Current health problems	-2.178-	1.087	-0.096-	-2.003-	0.046*
Weight	-0.002-	0.028	-0.006-	-0.059-	0.953
Height	0.017	0.026	0.058	0.682	0.496
BMI	0.033	0.068	0.051	0.486	0.627
Regular factory checkup	1.967	0.581	0.160	3.384	0.001*
Do checkup alone	-6.750-	1.202	0.280-	-5.614-	0.000*
Practice exercises	-0.614-	0.370	0.089-	-1.659-	0.098
Presence of sleeping problems	-0.595-	0.596	0.056-	-0.997-	0.319
Number daily meal	0.159	0.316	0.030	0.503	.615
Smoking	-0.497-	0.363	0.075-	-1.369-	0.172
Have shisha	-0.579-	0.382	0.079-	-1.518-	0.130
Have drugs	0.276	0.715	0.020	0.385	0.700
Total knowledge	-0.183-	0.042	0.222-	-4.350-	0.000*
Total fatigue	0.237	0.047	0.254	5.033	0.000*

**Table (6):** illustrates that, more than two thirds (66.7%) of workers who had poor Level of occupational knowledge had sever level of stress. No significant differences were found ( $X^2=7.485$ -  $P=0.058$ ). While, majority (97.2%) of workers who had exposed to moderate hazards also had very sever level of stress. Statistically significant differences found ( $X^2= 31.117$  -  $P=0.000^{**}$ ).

Table (6): Relationship between the workers' level of stress, the occupational knowledge and their exposure to occupational health hazards at work:

Items	Level of stress								Total (N= 400)	
	Low (N=7)		Moderate (N= 70)		Sever (N=213)		Very Sever (N=110)			
	No.	%	No.	%	No.	%	No.	%	No.	%
<b>Level of occupational knowledge</b>										
- Poor	7	100	56	80.0	142	66.7	77	70.0	282	70.5
- Fair	0	0.0	14	20.0	71	33.3	33	30.0	118	29.5
- Test of Significance	$X^2= 7.485$		$P=0.058$							
<b>Level of workers' exposure to occupational health hazards at work</b>										
- Mild hazards	1	14.3	7	10.0	8	3.8	1	0.9	17	4.2
- Moderate hazards	6	85.7	57	81.4	205	96.2	107	97.2	375	93.8
- High hazards	0	0.0	6	8.6	0	0.0	2	1.9	8	2.0
- Test of Significance	$X^2= 31.117$		$P=0.000^{**}$							

$X^2$  Chi Square Test\* statistically significant at  $p \leq 0.05$

**Table (7):** Reveals that statistically significant relations were found between workers' occupational knowledge and workers' exposure to occupational hazards at work ( $P= 0.001^{**}$ ). Moreover, statistically significant relations were found between workers' stress and workers' exposure to occupational hazards at work ( $P= 0.000^{**}$ ).

Table (7): Correlation matrix between the workers’ level of stress, the occupational knowledge and their exposure to occupational health hazards at work:

Items		Workers’ Occupationalknowledge	Workers’ stress	Workers’ safety and health at work
Workers’ occupational knowledge	r			
	P			
Workers’ stress	r	0.084		
	P	0.093		
Workers’ exposure to occupational health hazards at work	r	0.173	- 0.207	
	P	0.001**	0.000**	

R= Correlation coefficient \* statistically significant at  $p \leq 0.05$

## Discussion

Workers of wastewater plants were vulnerable to many hazards and accidents due to their work field and complicated process of wastewater treatment. They are unprotected from open water, trenches, and slippery walkways, working at heights, energized circuits and heavy equipment's. Work at wastewater treatment plants could also comprise entry into confined spaces like manholes, sewers, pipelines, storage tanks and harmful gases as methane generated from anaerobic treatment of organic matter can lead to fire and explosions. <sup>(12)</sup> Additionally, labor in the sector of water treatment is seen as risky, particularly because it frequently results in fatalities in confined places. Occupational safety and health are not predominantly noticed in this area, many decision makers consider it to be somewhat less dangerous at the moment, but processing workers are still experiencing the possibility of health problems and deaths, particularly exposure to chemicals as materials for water purification. <sup>(13)</sup>

In order to identify prevalence and determinants of occupational health hazards of sewage workers it is important to understand the socio-demographic characteristics of these workers. Worker's age was an important determinant of knowledge and risk factors of hazards. According to some studies, age is positively and significantly correlated with some forms of workplace risk. This study showed that, more than one third of workers were aged between 50 to less than 60 years. This finding was in agreement with the study done in **Egypt** (2018) <sup>(14)</sup> who clarified that more than one half of studied workers at age group of 41-60 years. Moreover, the current study revealed that there was a statistically significant relation between age of the workers and their knowledge level and level of exposure to occupational health hazards at work. This might be explained by the fact that, life experiences that increase with age help workers in decrease workplace hazards exposure than before.

As regards to workers level of education the current findings portrayed that, more than half of workers obtained secondary/technical education. This finding in agreement with study by **Szulc J et al.**, (2021) <sup>(15)</sup> and showed that more than two thirds of workers passed secondary school education. But this finding disagreement with study reported by **Ahmad Shafik** (2018) <sup>(14)</sup> who revealed that more than two thirds of the studied workers were illiterate. Also, the same study results done in **Egypt** (2013) <sup>(16)</sup> by **Abou-El Wafa et.al.**, who showed that, the vast majority of the municipal solidwaste collectors were illiterate. This different of findings could be attributed due to that more than half of this study subjects from urban areas.

The workplace provides insight into the conditions under which employees live, which may have an impact on their health habits and level of knowledge according to societal values and customs. The current study showed that more than half of studied workers living in urban areas. This finding is consistent with the study done by **Zaky SM et al.**, in **Egypt** (2019) <sup>(17)</sup> who reported that (62.9%) of studied workers living in urban areas. Moreover, statistically significant relations were found between level of workers’ exposure to occupational health hazards at work and place of residence. From the investigator point of view this is due to effect of community culture.

On the other hand, the study showed that highly statistically significant relation between level of knowledge of workers and their educational qualifications. These findings were compatible with the study done in **Egypt** (2019) <sup>(17)</sup> which reported that, nearly half of uneducated workers had poor level of total score knowledge regarding to causes of occupational hazards during work. It also worth mention that there was highly significance relation between workers education level and level of exposure to occupational health hazards at work. The same finding was obtained from the study conducted in **Egypt** (2013) <sup>(16)</sup> by **Abou-El Wafa et.al.**, who reported, the moderate and high levels of exposure to occupational health hazards at work was among illiterate group of studied samples.

Years of experience may influence workers performance in several ways as increase risk of accidents and injuries among new workers retirement than experienced workers. <sup>(18)</sup> The present study was revealed that there was highly statistically significant relation between level of knowledge and workers years of experience it indicated that fair level of knowledge observed in three quarters of workers had more than 15 years of experience. This result was consistent with the study done in **Egypt** (2016) <sup>(19)</sup> who found that, about half of sewage workers had experience of 15 years or more and the moderate and high exposure to occupational hazards among those worked from 10 to 15 years. This might be explained by the fact that, level of knowledge increased whenever workers years of experience increased so they can gain knowledge from previous experiences.

The existence of a positive relationship between socioeconomic status and health has been well established; individuals who are better off financially tend to have better health and better health habits. <sup>(18)</sup> In relation to the monthly income sufficiency, the current study demonstrated that, the majority of workers had insufficient income These findings were in accordance with study done in **Egypt** (2016) <sup>(19)</sup> who found the monthly income was insufficient in the majority of studied workers. Furthermore, poor level of knowledge observed in the majority of workers who had insufficient income. This finding is supported by study conducted in **China** (2020) <sup>(20)</sup> by **Mee Kim**, who found that nearly half of workers affected their health because low socioeconomic status.

A growing body of evidence suggests that long working hours adversely affect the health and wellbeing of workers. Studies have associated overtime and extended work schedules with an increased risk of hypertension, cardiovascular disease, fatigue, stress, depression, musculoskeletal disorders, chronic infections, diabetes, general health complaints, and all-cause mortality. <sup>(21)</sup> The present study revealed that, about three quarters of workers working 8hrs\ day, statistically significant relations were found between level of workers' safety and health at work and daily working hours. These findings were in contrary to study done in **Egypt** (2016) <sup>(19)</sup> who studied occupational health hazards among sewage workers at Al – Qalyobia Governorate and found most of the workers reported that they worked for 24 hours.

As regards to workers absenteeism the study finding showed that more than half of them were absent 5 - 10 days during the last 6 months and the majority of workers absent due to illness causes, this finding was consistent with the study done in **Ghana** (2012) <sup>(22)</sup> who reported that more than three quadrants of workers absent from 4-7 due to illnesses causes. Moreover, the current study mentioned that highly statistically significant relations between levels of knowledge, level of workers' safety and health at work and workers absenteeism. This result was in agreement with the study done in **Brazil** (2013) <sup>(23)</sup> which reported that, more than half of absent workers had poor level of knowledge.

Academic studies illustrated that health insurance improves workers health and productivity, reduce turnover, or substantially cuts employers costs associated with workers' compensation and absenteeism. <sup>(24)</sup> The current study demonstrates that, about two thirds of studied workers were using the services of health insurance. While one third of studied workers weren't using the services of health insurance, On the contrary, **Khan NR et al.**, (2016) <sup>(25)</sup> found that, only 13.1% of the workers were utilizing health insurance services.

Most occupational diseases are difficult to identify due to their long latency periods (e.g. occupational cancer). <sup>(26)</sup> To find out the current health status of sewage workers this study shed light on the current health symptoms among workers. The present study showed that, the majority of workers had current health complaints. This result may due to low level of health services which provided to workers and the majority of workers had insufficient income. According to prevalence of current health problems among studied workers the highest percent of studied workers were suffering from skin problems. This finding might be explained by the fact that unavailability of PPE in workers stations and nature of work as exposure to chemical substances. This finding was supported by study of **Kohli, G**, (2014) <sup>(27)</sup> done in **India** who mentioned (40%) of studied sample had skin infections/allergies. Also, in the same line finding of study done by **Havlíček**, (2020) <sup>(28)</sup> in **United States**, who found that less than one third exposed to inflammation of the skin.

On the other hand, more than two thirds of workers were suffering from respiratory problems, this result in the same line of study done by **Kasaeinasab et al.**, (2017) <sup>(29)</sup> in **Iran** who reported that, more than two thirds of workers suffering from chest diseases. Also, the same result by a study of **Antehun et al.**, (2017) <sup>(30)</sup> in **Ethiopia**, who demonstrate that (40.7%) of workers have respiratory symptom. Moreover, the present study was revealed that, more than one third of workers were suffering from visions problems. This result was contrasted by **Malakahmed et al.**, (2014) <sup>(10)</sup> in **Malaysia** who found that, one third of workers exposed to eye infection. This finding may be due to exposure of workers to allergens (gases, chlorin, stains, etc.) Furthermore, the current study revealed that, more than half of workers were suffering from gastrointestinal problems. This finding was congruent with the study conducted in **Egypt** (2015) by **Foud MF** <sup>(31)</sup> who reported that, Giardia Lamblia was slightly more frequent in sewage group (20%) and Ascaris was found in stool of

(34.3%) of subjects. This result might be showed bad personal hygiene and hand washing of workers before eating or smoking.

Hearing problems not common among sewage workers however, the present study showed more than one quarter of workers were suffering from hearing problems. This result may be attributed to noise of machines and compressors in the wastewater plants. This finding disagreement with study done by **Szulc J et al., (2018)** <sup>(15)</sup> who was reported only (6.6%) of sewage workers suffer from weakness or hearing loss. Also, the study by **Saad et al., (2015)** <sup>(32)</sup> in **Ghana** who found that, fifth of workers were exposed to hearing loss. This variance may be due to different sits of data collection and nature of work.

New forms of occupational diseases, such as musculoskeletal and mental health disorders are increasing without adequate preventive, protective and control measures. The European Commission reports that MSDs account for the highest number of absences (49.9% all absences of more than three days) and cases of permanent incapacity for work (60 %). <sup>(33)</sup> the present study noticed that, more than one quarter of workers were suffering from musculoskeletal problems, from those three quarters were suffering from low back pain, this finding supported by a study done by **Ahmad Shafik (2018)** <sup>(14)</sup> in **Egypt** who reported the same results. In contrary to these results, study done by **Amabya G, (2016)** <sup>(34)</sup> in **Ethiopia** mentioned that, about two fifth of workers exposed to low back disorder. The same results of **Abo elwafa H, in Egypt (2013)** <sup>(16)</sup> who showed that, (60.8%) of studies sample have musculoskeletal problems and low back pain was the most frequently affected body region. From the researcher point of view this was due to lack of facilities in most of the plants that lead to the workers lifting, pushing and pulling heavy objects.

Pertaining to total score of knowledge among sewage workers related to occupational health, the present study found that more than two thirds of studied workers had poor level of occupational health knowledge score, and less than one third of them had fair level of occupational health knowledge. This finding was in agreement with study of **Zaky et al., (2019)** <sup>(17)</sup> in **Egypt** who showed that only 25.25% of the studied workers had good knowledge related to occupational health. In the researcher point of view, these findings due to neglecting of training programs and occupational health teaching for sewage workers.

Sewage workers exposures to hazards were varied such as physical, chemical, biological, mechanical and psychosocial. The workers in waste water treatment plant are dealing with machines, mechanical equipment in order to treat the sewage water expose them to different hazards on their occupational health which leads to diseases and death. <sup>(35)</sup>Concerning workers' physical hazards exposure level, the present study showed that more than two thirds of workers had moderate level of exposure related to physical hazards. This result conformed to a study done in **Egypt (2016)** <sup>(19)</sup> and stated that, more than two thirds of workers exposed to physical hazards. This result was disagreement with a study done by **Saad et al., (2015)** <sup>(32)</sup> in **Ghana** who reported that, about one fifth of workers exposed to physical hazards as electric shock and hearing loss.

As regards workers' mechanical hazards exposure level, the present study demonstrated that, more than half of workers had moderate exposure level related to mechanical hazards. This finding goes in line with study done by **Byung et al., (2016)** <sup>(36)</sup> and **Sheha E (2013)** <sup>(37)</sup> who reported the same results. On the other hands, this finding not withstanding with a study done by **Ahmed Shafik et al., (2018)** <sup>(14)</sup> in **Egypt** who reported that, about (28.7%) were exposed to mechanical hazards as sudden movement. More than that, these findings were in accordance with study done in **Sweden (2017)** <sup>(38)</sup> about organic pollutants in the effluents of large wastewater treatment plants who observed that more than two third of workers complained from sudden movement and long period of standing. Moreover, these results were contrasted with **Abo Elwafa et al., (2013)** <sup>(16)</sup> who found that, three fifth of workers exposed to falling and 14% of them exposed to standing for long period. Otherwise, this result was disagreed with the study done by **Zwoździak, J (2017)** <sup>(39)</sup> who found sewage workers were injured at workplace from sharp or slender pointed objects. These differences may be explained by variation in setting of data collection.

Regarding to chemical hazards, the current study clarified that, more than two thirds of workers had high level of exposure to chemical hazards. As exposed to organic dust, heavy metals and gases especially chlorine gas. This result was in agreement with study done by **Ahmed Shafik et al., (2018)** <sup>(14)</sup> who reported that (78.0%) of workers were exposed to dangerous gases and heavy metals. Also, the same results were found in study done in **Malaysia (2014)** <sup>(10)</sup> and reported that, two thirds of workers in the wastewater plants were exposed to chemical hazards as gases and flammable fluids.

Many cases of Gastroenteritis among swage workers caused due to poor hygiene and bad practices whilst working with sewage. The present study illustrated that, more than half of workers had high level of exposure to biological hazards. This finding was supported by study done in **Egypt (2016)** <sup>(19)</sup> and clarified that, nearly one third of studied sample were positive HAV. The same result reported by study done in **Egypt (2011)** <sup>(40)</sup> and found that, the antibody level against both HAV and HEV was significantly higher among sewage workers. Also, **Helal et al., (2013)** <sup>(41)</sup> in **Egypt**

found that, there were statistically significant differences between the exposed sewage populations (58.82%) and the control groups (20%). This result coincides with the result of **Nelson et al. (2020)**<sup>(42)</sup> in **Texas**, who found an increased risk of acquiring Hepatitis A infection, which was 2.15 times higher in wastewater workers than in those not occupationally exposed. Also, the same results were reported in study done in **French (2021)**.<sup>(43)</sup>

Pertaining to psychosocial hazards, more than half of workers had poor level of exposure regarding psychosocial hazards. These findings disagree with study done by **Albahnasawi M. (2018)**<sup>(44)</sup> who were revealed that, the psychological risk was excellent wither total domain mean and mean percentage 76.92% respectively. Also, this result conflict with study done in **KSA (2018)**<sup>(45)</sup> and found that, the most common health hazards among wastewater workers were psychological problems as they formed 84.4%. This variation may due to poor knowledge level of workers regarding psychosocial hazards in sitting of the study.

Stress related workplace include a wide range of conditions, including bullying, emotional strain, maladaptive behaviors, and intellectual disability. Additionally, emotional strain may be in the form of disappointment, exhaustion, and tension. Concerning to distribution of studied workers according to workplace stress levels the current study showed that, more than half of workers had severe stress, this finding was supported with a study done by **Shafik et al., (2018)**<sup>(14)</sup> who was found that less than half of workers exposed to stress and nervous tension at their workplace. In the same line with the study done in **Egypt (2017)**<sup>(46)</sup> who clarified that, more than half (54.2%) of the workers had severe stress. Otherwise, the result not correspond with **Sheha E (2013)**<sup>(37)</sup> in **Egypt** who reported that, more than three quarters of studied sample exposed to work related stress.

In related to regression analysis for determinate of occupational health hazards among sewage workers, based on the findings, the enter regression model was statistically significant for prediction of occupational health hazards. The model included (Age, education, income, number of family members, years of experience, sleeping problems, absenteeism at work, health insurance, presence of health clinic at workplace, previous chronic diseases, previous hospitalization, previous infectious diseases, current health problems, regular factory checkup, total workers' knowledge, and total fatigue). These finding was congruent with study done in **Pakistan (2022)**<sup>(47)</sup> who reported the same finding, Also, in the same line with the study done in **Egypt (2017)**<sup>(46)</sup> who reported the same results.

Regarding the correlation between the workers' level of stress, workers' occupational knowledge and their exposure to occupational health hazards at work, the current study revealed statistical positive correlation between workers' occupational knowledge, workers' stress and workers' exposure to occupational hazards at work. This result dis agrees with the study of **Manal et al., (2016)**<sup>(19)</sup> in **Egypt** who found negative correlation between exposure to occupational health hazards and using protective equipment. These differences may be explained by variation in setting of data collection and stations facilities.

### Conclusion:

Sewage workers were exposed to high level of chemical hazards followed by Biological, Physical and Mechanical hazards. The skin problems were the commonest, followed by respiratory problems, GIT problems, visual problems, neurological problems, hearing problems, musculoskeletal problems, and vascular problems. Moreover, the main risk factors that affect workers health and safety were age, income, number of family members, years of experience, absenteeism at work, presence of health clinic at workplace, health insurance, previous infectious diseases, regular station checkup, total workers' knowledge and exposure to health hazards. Lastly, most of workers had poor level of knowledge regarding occupational health hazards and personal protective equipment so most of them exposed to all types of occupational hazards.

### Recommendations:

- Strengthening occupational health policies and the need to provide medical clinic in sewage stations with completemedical staff and supplies.
- Implement a standardized occupational health problems screening strategy and follow up visits to ensure consistencyin screening and monitor occupational health problems among the sewage workers.
- Provide workers vaccination and basic hygiene precautions to prevent illness in the sewage environment.
- Provide medical services to workers at any time by coverage them with health insurance and first aid box at

workplace.

- Health programs should be conducted for both the workers and the relevant authorities regarding occupational health hazards and its prevention.
- Periodic teaching programs to provide workers with adequate knowledge and skills related to safety and health protection from occupational hazards.

### Limitations of Study

- Some workers were worried from their managers about station facilities questions.
- A lot of time required to complete data collection of the study due to wave of corona virus.

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### Conflicts of interest

There is no conflict of interest to disclose.

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