

# Quality of Life and Factors Influencing it: A Study Among People Living Near a Waste Treatment Plant

**Long Thanh Phan**

Hue University

**Gia Thanh Nguyen** (✉ [gianguyen175@hueuni.edu.vn](mailto:gianguyen175@hueuni.edu.vn))

Hue College of Medicine and Pharmacy <https://orcid.org/0000-0002-7022-5446>

**Quynh Anh Dac Nguyen**

Hue University

**Hieu Song Nguyen**

Hue University

**Tin Trung Nguyen**

Hue University

**Toru Watanabe**

Yamagata Daigaku

---

## Research

**Keywords:** Quality of life, waste treatment plant, WHOQOL-BREF

**Posted Date:** August 5th, 2020

**DOI:** <https://doi.org/10.21203/rs.3.rs-46109/v1>

**License:**   This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

---

# Abstract

**Background:** The amount of waste generated has been increasing over the years, while the ability to dispose of it does not meet the needs at waste treatment plants (WTP), resulting in negative consequences on the natural environment and health of the residents living near these plants; these effects can significantly degrade their quality of life (QoL). Although previous studies on the impact of solid waste and wastewater treatment plants have focused on the health problems suffered by nearby residents, the impact of these plants has scarcely been discussed in the context of mental health, social relationships, and the environment. The objectives of this study are to evaluate the QoL as a comprehensive indicator of the impact the presence of a WTP has on nearby residents, and determine the factors that influence their QoL.

**Methods:** A cross-sectional descriptive study was conducted involving 801 subjects, aged 18 and above, who live near the WTP of Hue city, Thua Thien Hue province, Vietnam. The QoL of the subjects was quantitatively assessed using the World Health Organization's (WHO) QoL assessment scale (WHOQOL-BREF). The general, health, and environmental factors influencing QoL were identified using bivariate and multivariate logistic regression analyses.

**Results:** It was found that only 22.6% of the subjects have a good QoL. In particular, the proportions for good psychological health (6.9%) and environment (13.6%) were low, which may indicate an influence of the WTP. Significant factors that degraded the residents' QoL are: a lower educational level defined by not graduating from high school (OR=2.78; 1.09–7.06), poor health status (OR=2.50; 95% CI: 1.56–4.01), dissatisfaction with water quality (OR=2.41; 95% CI: 1.10–5.25), and unacceptance of the WTP presence (OR=1.70; 95% CI: 1.11–2.60). Moreover, it was found that subjects living within 2 km of the plant had dermatological syndromes and digestive disorders more frequently than those who lived farther away from the plant. They also reported more complaints about water, air, and soil quality, which were probably due to the operation of the WTP.

**Conclusions:** Burying and disposing of solid waste at the WTP could lead to a degradation of the surrounding water and soil environments, while its collection and transportation is believed to cause odor and dust. The efforts of responsible authorities to strictly supervise and inspect these activities at the WTP are essential, not only to protect the surrounding environment but also to improve the QoL of those who live near these plants.

## 1. Introduction

The rapid development of industry and technology has led to enhancement in the quality of life (QoL) all over the world. However, as a result of these changes, people have also had to face huge challenges of waste management and treatment. It is estimated that the rate of waste accumulation is even faster than the rate of urbanization [1]. For example, a study reported that humans have produced 8.3 billion tons of plastic waste since the beginning of the industry in the 1950s, but only a negligible 9% of it was recycled;

12% was burned, and the rest was discarded and buried worldwide [2]. Such waste comes directly from daily activities of human beings and sometimes causes serious issues for the natural environment and human health, such as diarrhea, respiratory illnesses, or cancer [3–5]. Besides, as shown in a research study, the environment surrounding a waste treatment plant (WTP) and the system of underlying groundwater resources have also been damaged to a serious degree as the result of the long-term operation of such plants [6]. Moreover, along with the unsustainable practices of natural resource use and environmental management, the QoL of residents living near these WTPs is also likely to be affected negatively due to their operation [6–9]. Even in developed countries, despite the promulgation of policies and strategies on waste recycling and disposal, the effectiveness of these policies is low. For example, only 25.8% of the waste in the USA was recycled in 2017, and countries in the European Union (EU) are in a similar situation with only 30% of the waste recycled every year [10–12].

The QoL of a population can be affected by environmental factors. For example, the QoL of people in the physical and psychological domains was negatively impacted by air pollutants, toxins, noise and dirtiness in a study in Colombia [13]. In Vietnam, a typical developing country in Asia, the amount of domestic waste in urban areas nationwide was 38,000 tons per day in 2015, 85% of which was collected and treated. Whereas, in the same year, the amount in rural areas was 32,000 tons per day and only about 55% was collected [14]. Domestic waste is mainly treated by burial (70%), leading to rising indignation among people living near unsanitary landfills [15], although its detrimental effect on water and soil environment has not been well investigated. Burning without closed processing technology, which is likely to degrade air environment, is another popular waste treatment (up to 28%) in Vietnam [16]. These treatments of domestic waste probably have contributed to the fact this country was ranked 77th out of 132 countries in an overall environmental assessment by the Environmental Performance Index in 2015 [17]. Specifically, air pollution (for which Vietnam is in 123rd place) had the most detrimental effect [17]. According to a research study conducted in Ho Chi Minh city, Vietnam, in 2016, a  $10 \mu\text{g}/\text{m}^3$  increment in air pollutants increases the risk of respiratory admissions from 0.7–8.0% and that of cardiovascular diseases from 0.5–4.0% [18].

The Thua Thien Hue (T.T. Hue) province is a center of economy and tourism in central Vietnam with a local population of over 1.1 million and more than 4 million tourists visiting in 2018 [19]. The pressure for waste treatment in this province has invariably been high and a WTP was built and operations started in 2007. The treatment capacity is 200 tons per day and solves the problem of household waste disposal. In the treatment plant, the waste is sprayed with antiseptic chemicals, followed by a process of waste categorization, composting, and combustion. The inert waste is dumped into a nearby landfill. However, the massively increasing amount of waste has overloaded the WTP, which very likely has caused environmental pollution with negative impacts on the QoL of people living in this area. Even in this situation, they seem to be unaware of its long-term impacts on their QoL due to a lack of knowledge of these issues or a belief that an authority is responsible for providing a better waste recycling system [20].

While most previous studies that evaluated the impact of WTPs focused on the health problems from which nearby residents suffer, other aspects such as mental health, social relationships, and the

environment have been scarcely discussed [21–25]. The present study aims to evaluate the residents' QoL as a comprehensive indicator of the impact of a WTP on these aspects for the people living near one using the World Health Organization's (WHO) Quality of Life assessment scale, WHOQOL-BREF, which has been used to measure the QoL both for the general population and for those suffering from different diseases [26,27,28]. This study also aims to determine the factors influencing the QoL of the residents. To the best of our knowledge, this is the first study investigating the QoL of people living near a WTP.

## **2. Materials And Methods**

### **2.1 Study design**

This study is a cross-sectional descriptive study conducted from May to August of 2019 in a town near Hue city, the capital of T. T. Hue province in Vietnam. In this study, the required sample size was calculated to be 768, based on previous research [29]. A multi-stage stratified sampling method was used to select the participants. First, the town, which is composed of 12 wards, was separated into two regions based on the distance from the WTP (one within 2 km and the other farther away than 2 km). Then, two wards from each region were randomly selected and 10 hamlets randomly isolated from the four selected wards, and the number of subjects from each hamlet was determined corresponding to its population (Appendix 1). Only those subjects that complied with the following criteria were included in the study (n = 801): (1) aged 18 or above, (2) have lived continuously in the target area for at least six months prior to the study, and (3) willing to be involved in the study. Those who were in a state of inattentiveness, difficult to contact, suffering from a mental illness, hearing or speech impaired, and those who could not control their actions and thoughts mentally, were excluded.

### **2.2 Measures and instruments**

Using the WHO's QoL assessment scale (WHOQOL-BREF) [30], the QoL was quantified based on the main domains, including physical, mental, environmental, social, and general aspects [22]. The QoL was assessed based on the scores obtained, following a previous study of the QoL of Indian women, where the following criteria were applied: those who obtained scores from 0 to 33.3%, from 33.3–66.7%, and 66.7% and higher were judged to have poor, average, and good QoL, respectively [31]. In the present study, the score was compared only with the range of 66.7% and higher, since the aim is to judge whether the subjects have a good QoL or not.

In order to determine the factors influencing the QoL, general characteristics of the research subjects, including gender, age, marital status, economic status, occupation, educational level, number of persons living together, and duration of living in the target area, were obtained through face-to-face interviews. The subjects were also asked verbally about their general health status, past illnesses, treatment history, and satisfaction levels with air, water, and soil qualities and noise in the surrounding area.

As another environmental factor, the residential distance from the WTP was considered by categorizing the subjects into two groups, with Group 1 (n = 405) comprising those living within 2 km of the WTP, and

Group 2 (n = 396) those who live outside the range of 2 km from the WTP.

## 2.3 Statistical analysis

A chi-square test was performed to analyze the associations between the score of the overall QoL evaluation and possible factors influencing it. A *P* value less than 0.05 was considered statistically significant. Afterwards, the multivariate logistic regression analysis was performed to evaluate the independent associations between the overall QoL and the variables which were found to be significantly associated in the previous analysis. The odds ratio (OR) was used to assess the strength of the associations. SPSS 18.0 was used for all statistical analyses.

## 2.4 Research ethics

This study was approved by the Hue University of Medicine and Pharmacy and the local authorities in the area where the study was conducted. Written informed consent was obtained from all participants after clearly introducing the survey process. The research subjects participated voluntarily and could refuse to participate or withdraw from the interview at any time. The data collected were used for scientific purposes only, and all information related to the subjects was encrypted and kept confidential.

## 3. Results

### 3.1 Quality of Life assessment of the research subjects

Table 1 shows the QoL of the research subjects assessed on the WHOQOL-BREF scale. The overall assessment illustrates that only 22.6% of the residents had a good QoL. The factors physical health and social relationships contributed positively to the QoL, although the mean scores are lower than the criterion (66.7). However, factors that led to a lower QoL are clearly related to psychological health and environment, which may be attributed to the operation of the target WTP.

Table 1  
Quality of life of the research subjects on WHOQOL-BREF scale (n = 801)

Aspects	Mean score $\pm$ SD	Subjects with good QoL (%)
Physical health	62.7 $\pm$ 12.4	41.8
Psychological health	58.0 $\pm$ 7.7	6.9
Social relationships	65.7 $\pm$ 13.6	45.2
Environment	56.8 $\pm$ 9.8	13.6
Overall evaluation	60.8 $\pm$ 7.7	22.6

### 3.2 General characteristics of the research subjects

Table 2 shows the general characteristics of the research subjects. The number of female and male subjects was approximately the same in this study. The average age of the subjects was 45.9  $\pm$

16.5 years and one-fifth of them were over 60 years old at the time of this study. Further, 88.6% of the subjects were married and only 3.4% of them lived alone. Besides, 4.1% lived in difficult economic circumstances, and more than 90% of the subjects had lived in the study area for a period of more than five years.

Table 2

General characteristics of the research subjects (n = 801) and the association with overall QoL based on the chi-square test

Factors		All		Overall QoL		<i>P</i>
		N	%	Not good (n = 620) (%)	Good (n = 181) (%)	
<b>Gender</b>	Women	427	53.3	344 (53.4)	83 (45.9)	0.052
	Men	372	46.4	274 (46.4)	98 (54.1)	
	Others	2	0.2	2 (0.2)	0 (0.0)	
<b>Age</b>	< 60	622	77.7	475 (76.6)	147 (81.2)	0.191
	≥ 60	179	22.3	145 (23.4)	34 (18.8)	
<b>Marital status</b>	Not married	91	11.4	63 (10.2)	28 (15.5)	<b>0.048</b>
	Married	710	88.6	557 (89.8)	153 (84.5)	
<b>Living alone</b>	No	774	96.6	597 (96.3)	177 (97.8)	0.325
	Yes	27	3.4	23 (3.7)	4 (2.2)	
<b>Educational background</b>	Unschooling	70	8.7	64 (10.3)	6 (3.3)	<b>&lt; 0.001</b>
	Primary school	155	19.4	135 (21.8)	20 (11.0)	
	Secondary school	217	27.1	170 (27.4)	47 (26.0)	
	High school	195	24.3	146 (23.5)	49 (27.1)	
	University/Post-graduate	164	20.5	105 (16.9)	59 (32.6)	
<b>Financial status</b>	Poor	33	4.1	30 (4.8)	3 (1.7)	0.058
	Average or above	768	95.9	590 (95.2)	178 (98.3)	
<b>Time living in the study area</b>	Under 1 year	6	0.7	3 (0.5)	3 (1.7)	0.169
	1 to 5 years	65	8.1	52 (8.4)	13 (7.2)	
	5 to 10 years	68	8.5	48 (7.7)	20 (11.0)	
	Above 10 years	662	82.6	517 (83.4)	145 (80.1)	
<b>Self-report health status</b>	Not satisfied	351	56.2	312 (50.3)	39 (21.5)	<b>&lt; 0.001</b>
	Satisfied	450	43.8	308 (49.7)	142 (78.2)	

Table 2 also shows the associations between marital status, educational background, self-reported health status, and the overall QoL ( $P < 0.05$ ). Being married, having a higher educational degree, and good health were identified as significant factors that determined a better QoL.

### **3.3 Health status of the research subjects**

The above-mentioned analysis reveals that 56.2% of the subjects were not satisfied with their current health status. Table 3 shows the health problems reported by the subjects, which might be possible reasons for their dissatisfaction. Health problems with a high incidence reported in this community include musculoskeletal diseases (27.1%), chronic diseases (25.3%), and digestive disorders (25.0%). The subjects who reported a “not good” QoL had higher incidences of musculoskeletal, respiratory, and chronic diseases ( $P < 0.05$ ) than the other subjects, while no significant difference was found for digestive disorders.

Table 3

Health issues of the research subjects (n = 801) and the association with QoL based on the chi-square test

Diseases	All subjects (n = 801)		Overall QoL				P value
			Not good (n = 620)		Good (n = 181)		
	Suffered n (%)	Non- suffered n (%)	Suffered n (%)	Non- suffered n (%)	Suffered n (%)	Non- suffered n (%)	
Respiratory	145 (18.1)	656 (81.9)	127 (20.5)	493 (79.5)	18 (9.9)	163 (90.1)	<b>0.001</b>
Digestion	200 (25.0)	601 (75.0)	156 (25.2)	464 (74.8)	44 (24.3)	137 (75.7)	0.816
Dermatology	131 (16.4)	670 (83.6)	99 (16.0)	521 (84.0)	32 (17.7)	149 (82.3)	0.584
Chronic diseases	203 (25.3)	598 (74.7)	176 (28.4)	444 (71.6)	27 (14.9)	154 (85.1)	<b>&lt; 0.001</b>
Allergy	56 (7.0)	745 (93.0)	40 (6.5)	580 (93.5)	16 (8.8)	165 (91.2)	0.268
Blood	52 (6.5)	749 (93.5)	45 (7.3)	575 (92.7)	7 (3.9)	174 (96.1)	0.103
Musculoskeletal	217 (27.1)	584 (72.9)	187 (30.2)	433 (69.8)	30 (16.6)	151 (83.4)	<b>&lt; 0.001</b>

### 3.4 Factors influencing the QoL of the research subjects: results of a

#### multivariate logistic regression analysis

Table 4 shows the results of the multivariate logistic regression analysis carried out to isolate the factors that influence the overall QoL of the research subjects. This analysis involved only those factors that were significant in the chi-square test (Tables 2 and 3 and Appendix 2). The results show that the overall evaluation was influenced by the educational background, with those who graduated from high school (OR = 2.78; 95% CI: 1.09 – 7.06;  $P = 0.032$ ) and university (OR = 3.89; 95% CI: 1.52 – 9.99;  $P = 0.005$ ) having a significantly better QoL. Independently from the educational background, satisfaction with general health status significantly increased the QoL (OR = 2.50; 95% CI: 1.56 – 4.01;  $P < 0.001$ ).

Table 4  
Factors affecting the quality of life of the subjects (n = 801) as the result of multiple logistic regression analysis

Factors		OR	95% CI	Pvalue
<b>Educational background</b>	Unschool	1	0.59–4.23	<b>0.366</b>
	Primary school	1.58	0.96–6.19	<b>0.060</b>
	Secondary school	2.44	1.09–7.06	<b>0.032</b>
	High school	2.78	1.52–9.99	<b>0.005</b>
	University/	3.89		
	Post-graduate			
<b>Marital status</b>	Not married	1	0.62–1.77	0.871
	Married	1.05		
<b>Self-report health status</b>	Not satisfied	1	1.56–4.01	<b>&lt; 0.001</b>
	Satisfied	2.50		
<b>Respiratory diseases</b>	Suffered	1	0.86–2.64	0.152
	Non-suffered	1.51		
<b>Chronic diseases</b>	Suffered	1	0.57–1.65	0.912
	Non-suffered	0.97		
<b>Musculoskeletal diseases</b>	Suffered	1	0.76–1.97	0.414
	Non-suffered	1.22		
<b>Water quality</b>	Not satisfied	1	1.10–5.25	<b>0.027</b>
	Satisfied	2.41		
<b>Impact of the waste treatment plant</b>	Not accepted	1	1.11–2.60	<b>0.015</b>
	Accepted	1.70		

Among the environmental factors, the water quality shows a significant relationship with QoL. The QoL of subjects who were unsatisfied with the water quality was significantly lower than that of subjects who expressed satisfaction (OR = 2.41; 95% CI: 1.10 – 5.25;  $P = 0.027$ ). The existence of the WTP is another relevant factor, as suggested by the fact that the subjects who reported being annoyed by the plant had a lower QoL than those who reported acceptance of it (OR = 1.70, 95% CI: 1.11 – 2.60;  $P = 0.015$ ).

## 4. Discussion

Only a small proportion (22.6%) of participants were found to have a good QoL. Especially, the proportions for psychological health (6.9%) and environment (13.6%) were low, which may reflect the influence of the WTP. The multiple logistic regression analysis reveals that the significant factors for low QoL are poor educational background, dissatisfaction with health status and water quality, shorter distance from the plant, and unacceptance of the plant (Table 4). A higher QoL in terms of the psychological aspect among senior residents was found in a previous study in Canada [24]. It is possible that the participants with higher education may be able to lead a more comfortable life even under the effect of the WTP. Further, it is possible that the health status of the residents and water quality were affected by the operation of the plant.

Particular attention was paid to the residential distance from the plant and we categorized the subjects into two groups as follows: Group 1 included those who lived near the WTP within a distance of 2 km, and Group 2 included those who lived farther away. The subjects in Group 1 reported poorer physical health than those in Group 2 ( $P=0.001$ ) (Appendix 3). In particular, 57.8% of those in Group 1 thought that the operation of the plant had a negative impact on their lives (Appendix 4). A previous study carried out in Greece [21] noted that the frequency of being in a bad mood, being angry, and getting sick reported by the subjects was significantly higher among residents living close to a wastewater treatment plant than all others. Although the impact of a wastewater treatment plant is certainly different from that of the plant studied here, both results combined suggest that the distance from a plant is likely an important determinant of the QoL for the residents.

In this study, although the QoL score for the aspect of physical health was relatively high, significant differences in dermatological syndromes and digestive disorders between the two residential groups ( $P<0.05$ ) could be determined (Appendix 5). In contrast, previous studies do not report any increases in illness [21] or demonstrate an increase mainly in respiratory diseases in populations living near wastewater treatment plants [23]. This could be attributed to the different impacts of solid waste treatment plants and wastewater treatment plants, as well as local factors such as living environment, health status, climate, geography, genetics, and immune status of the population.

Water quality is another relevant factor for the QoL. Most of the research subjects used tap water for domestic purposes; however, 13.4% still used water from wells and ponds for animal breeding and cultivation, making them vulnerable to the possible impact of the WTP on water quality. The most common changes in water quality were found in visible factors such as strange odors (61.8%) and colors (55.9%) for Group 1 (Appendix 6). Many subjects reported that the water quality had changed markedly after the construction of the WTP, especially in ponds and groundwater from drilled wells. The presence of chemicals, heavy metals, and pathogens in water is one of the key factors that determines the risks for human health, which is indicated by the significant differences of the dermatological diseases and the digestive disorders between Groups 1 and 2 (Appendix 5).

In addition, 64.9% of Group 1 residents reported experiencing polluted air around the WTP, especially in the early morning, late evening, and after rain or weather changes, while only 39.4% in Group 2 did so

(Appendix 7). Further, 90.9% and 4.6% of subjects in Groups 1 and 2, respectively, believed that it was caused by the WTP (Appendix 8). A study in Greece also revealed that a large number (79.6%) of subjects living near a wastewater treatment plant were affected by odors [21]. Waste transportation, which can cause dust, was also identified as a negative factor for the air quality; while 12.6% of the subjects in Group 1 mentioned this issue, none of the subjects in Group 2 were affected by the waste transportation (Appendix 9). Another impact of the WTP on the environment is soil quality, with 17.5% of subjects in Group 1 negatively affected by the degraded soil quality, in contrast with 11.1% in Group 2 ( $P < 0.05$ ) (Appendix 7).

The lacked observation of air, water and soil qualities in this study limits the discussion about the impact of the WTP to the environment and human health. Monitoring of contaminants in the air, water, and soil environments from the WTP is a topic that requires further investigation for a more reliable health risk assessment.

## 5. Conclusions

The present study comprehensively assessed the impact of a WTP in Hue city, Vietnam, on the QoL of its residents in the aspects of physical health, psychological health, social relationships, and environment, using the WHOQOL-BREF. The overall QoL was lower compared with the general criteria because of low scores in psychological health and environment. Among the possible influencing factors in these aspects, the residential distance from the WTP was significant and shown to contribute to a degradation of the QoL, along with poor education, dissatisfaction with health status and water quality, and unacceptance of the WTP. It appears that dermatological syndromes and digestive disorders were reported more frequently, corresponding to the reported degradation of water quality, among those who live near the WTP. Air pollution, such as odor and dust, and degraded soil quality may also make the plant unacceptable to the residents.

Burying and disposing waste at the WTP could degrade surrounding water and soil environments, while its collection and transportation are believed to cause odor and dust. Based on the findings in this study, the efforts of responsible authorities to strictly supervise and inspect these activities at the WTP can not only protect the surrounding environment but also improve the QoL of those who live near the plant.

## Abbreviations

### **WTP**

Waste treatment plants

### **QoL**

Quality of life

### **WHO**

World Health Organization's

### **WHOQOL-BREF**

World Health Organization Quality of Life (abbreviated)

**EU**

European Union

**T.T. Hue**

Thua Thien Hue province

**OR**

Odds ratios

**CI**

Confidence intervals

**SD**

Standard deviation

## **Declarations**

## **Acknowledgements**

The authors would like to thank the local volunteers who helped with data collection.

## **Ethics approval and consent to participate**

This study was approved by the Hue University of Medicine and Pharmacy and the local authorities in the area where the study was conducted. Written informed consent was obtained from all participants after clearly introducing the survey process.

## **Consent for publication**

Publication consent was obtained from all individual participants included in the study.

## **Availability of data and materials**

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

## **Competing interests**

The authors declare that they have no competing interests.

## **Funding**

This work was supported by JSPS KAKENHI Grant Numbers JP17H01624 and JP19H01144, and SEI Group CSR Foundation.

## Author information

### Affiliations

Faculty of Public Health, Hue University of Medicine and Pharmacy, Hue University 06 Ngo Quyen Street, Hue City 530000, Vietnam

Long Thanh Phan, Gia Thanh Nguyen, Quynh Anh Dac Nguyen, Hieu Song Nguyen, Tin Trung Nguyen

Department of Food, Life and Environmental Sciences, Yamagata University, Yamagata 997-8555, **Japan**

Toru Watanabe

## Authors' contributions

Conception and design: LTP, GTN, QADN, HSN, TTN, TW. Collection and assembly of data: LTP, QADN, HSN, TTN. Data analysis and interpretation: LTP, GTN, QADN, HSN, TTN, TW. Writing: LTP, GTN, TW. All authors read and approved the final manuscript.

## References

1. Abdhalah KZ, Tilahun NH, Blessing M. A review and framework for understanding the potential impact of poor solid waste management on health in developing countries. [Arch Public Health](#). 2016;74:55.
2. Roland G, Jenna RJ, Kara LL. Production, use, and fate of all plastics ever made. *Science Advances*. 2017;3(7):e1700782.
3. Achudume AC; Olawale JT. Microbial pathogens of public health significance in waste dumps and common sites. *J Environ Biol*. 2007;28(1):151-154.
4. Boadi KO, Kuitunen M. Environmental and health impacts of household solid waste handling and disposal practices in third world cities: the case of the Accra Metropolitan Area, Ghana. *J Environ Health*. 2005;68(4):32–36.
5. Department of Epidemiology, Regional Health Service, Lazio. Health impact assessment of waste management facilities in three European countries. *Environ Health*. 2011;10(1):53.
6. Abul S. Environmental and health impact of solid waste disposal at Mangwaneni dumpsite in Manzini: Swaziland. *Journal of Sustainable Development in Africa*. 2010; 12(7):64-78.
7. van Aalst M, Burton I. The last straw: integrating natural disaster mitigation with environmental management. Disaster Risk Management Working Paper series. No.5. Washington, D.C. : The World

- Bank. 2002. <http://documents.worldbank.org/curated/en/279041468776795940/The-last-straw-integrating-natural-disaster-mitigation-with-environmental-management>. Accessed 23 March 2020.
8. Hoornweg D, Thomas L. What a waste: solid waste management in Asia. Urban and local government working paper series; no.UWP 1.Washington, D.C. :The World Bank. 1999. <http://documents.worldbank.org/curated/en/694561468770664233/What-a-waste-solid-waste-management-in-Asia>. Accessed 23 March 2020.
  9. Tran VGP, Shaw R. Towards an integrated approach of disaster and environment management: A case study of Thua Thien Hue Province, Central Viet Nam. *Environmental Hazards*. 2007;7(4): 271-282.
  10. European Environmental Agency. The road from landfilling to recycling: common destination, different routes. EE Copenhagen. 2007. <https://wedocs.unep.org/handle/20.500.11822/916>. Accessed 23 March 2020.
  11. United States Environmental Protection Agency. Advancing Sustainable Materials Management: 2017 Fact Sheet; 2017. [https://www.epa.gov/sites/production/files/2019-11/documents/2017\\_facts\\_and\\_figures\\_fact\\_sheet\\_final.pdf](https://www.epa.gov/sites/production/files/2019-11/documents/2017_facts_and_figures_fact_sheet_final.pdf). Accessed 23 March 2020.
  12. European Commission. A European strategy for plastics in a circular economy. 2018. <https://ec.europa.eu/environment/circular-economy/pdf/plastics-strategy-brochure.pdf>. Accessed 23 March 2020.
  13. Parra DC, Gomez LF, Sarmineto OL, Buchner D, Brownson R, Schimd T, Gomez V, Lobelo F. Perceived and objective neighborhood environment attributes and health related quality of life among the elderly in Bogota, Colombia. *Soc Sci Med*. 2010;70(7):1070-6.
  14. Ministry of Natural Resources and Environment. National environmental status report in 2016: Urban environment. 2016. [http://vnniosh.vn/Portals /0/VT\\_Articles/2014/Baocao\\_tacdongMT\\_2016.pdf](http://vnniosh.vn/Portals /0/VT_Articles/2014/Baocao_tacdongMT_2016.pdf). Accessed 13 July 2020.
  15. World Bank. Assessing the solid waste management and hazardous industrial wastes: Options and plans to implement the national strategy. 2018. [http://documents1.worldbank.org/curated/pt/504821559676898971/pdf/Solid-and-industrial-hazardous-waste-management-assessment-options-and-actions-areas.pdf?fbclid=IwAR3qj12ccNJCj0VjdeuJzrhOzEsam2SlubCsqLmehezEA8yp1SW\\_aH7tfWs](http://documents1.worldbank.org/curated/pt/504821559676898971/pdf/Solid-and-industrial-hazardous-waste-management-assessment-options-and-actions-areas.pdf?fbclid=IwAR3qj12ccNJCj0VjdeuJzrhOzEsam2SlubCsqLmehezEA8yp1SW_aH7tfWs). Accessed 13 July 2020.
  16. National Assembly Portal. Persepective of delegates: Waste – Resource or Disaster?. 2019. <http://quochoi.vn/hoatdongdbqh/Pages/home.aspx?ItemID =41630>. Accessed 13 July 2020.
  17. Hoang AT, Chu XN, Tran VT. The Environmental Pollution in Vietnam: Source, Impact and Remedies. *International Journal of Scientific and Technology Research*. 2017;6(2): 249-253.
  18. Phung D, To TH, Ho NL, Ly MTL, Morawska L, Chu C, Nguyen DB, Phong KT. Air pollution and risk of respiratory and cardiovascular hospitalizations in the most populous city in Vietnam. *Science of The Total Environment*. 2016;557-558: 322-330.

19. Thua Thien Hue Portal. General Statistics Office of Vietnam. Population of Vietnamese Provinces. 2018. [http://www.gso.gov.vn/default\\_en.aspx?tabid=774](http://www.gso.gov.vn/default_en.aspx?tabid=774). Accessed 30 September 2019. Accessed 13 July 2020.
20. Nguyen TN, Nguyen HV, Lobo A, Dao TS. Encouraging Vietnamese household recycling behavior: insights and implications. *Sustainability*. 2017;9(2):179. <http://dx.doi.org/10.3390/su9020179>
21. Vantarakis A, Paparrodopoulos S, Kokkinos P, Vantarakis G, Fragou K, Detorakis I. Impact on the Quality of Life When Living Close to a Municipal Wastewater Treatment Plant. *Journal of Environmental and Public Health*. 2016;(2):1-8.
22. Rasha OAA, Ranien MEMMEM, Rawia MEE, Rogaya ADE, Safaa EWM, Said HAA, Sakina SAA, Sally MAA. Health hazards related to Soba sewage treatment plant, Sudan. *Journal of Public Health in Africa*. 2017;8:610.
23. Vrijheid M. Health Effects of Residence Near Hazardous Waste Landfill Sites: A Review of Epidemiologic Literature. *Environmental Health Perspectives*. 2000;108(Suppl 1):101-112.
24. Oiamo TH, Luginaah IN, Baxt J. Cumulative effects of noise and odour annoyances on environmental and health related quality of life. *Social Science & Medicine*. 2015;146:191-203.
25. Jaremków A, Szałata L, Kołwzan B, Sówka IM. Impact of a Sewage Treatment Plant on Health of Local Residents: Gastrointestinal System Symptoms. *Pol. J. Environ. Stud*. 2017;26(1):127-136.
26. Suárez L, Tay B, Abdullah F. Psychometric properties of the World Health Organization WHOQOL-BREF Quality of Life assessment in Singapore. *Quality of Life Research*. 2018;27(11):2945–2952.
27. Ilić I.; Šipetić-Grujičić S.; Grujičić J.; Živanović MI; Kocić S; Ilić M. Psychometric Properties of the World Health Organization's Quality of Life (WHOQOL-BREF) Questionnaire in Medical Students. *Medicina*. 2019;55(12): 772.
28. Tefera GM, Megersa WA, Gadisa DA. Health-related quality of life and its determinants among ambulatory patients with epilepsy at Ambo General Hospital, Ethiopia: Using WHOQOL-BREF. *PLoS ONE*. 2020;15(1):e0227858.
29. Karimollah HT. Sample size estimation in epidemiologic studies. *Capsian J Intern Med*. 2011;2(4): 289–298.
30. World Health Organization. WHOQOL-BREF: Introduction, administration, scoring and generic version of the assessment (field trial version). WHO, Geneva. 1996. [https://www.who.int/mental\\_health/media/en/76.pdf](https://www.who.int/mental_health/media/en/76.pdf). Accessed 26 August 2019
31. Sudhaa S, Neha M. Menopausal symptoms and its effect on quality of life in urban versus rural women: A cross-sectional study. *J Midlife Health*. 2015; 6(1): 16–20.

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [supplementaryTable.docx](#)