

Health Hazards Due to Exposure to Municipal Solid Waste in Sialkot City

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Abstract

This research was aimed to check the impact of Municipal Solid Waste (MSW) on the Human Physical health in Sialkot city. It was a survey based research and 300 urban car drivers were selected through simple random sampling. An interview schedule was used to collect the data. The results showed that there is a positive relationship between the municipal solid waste (MSW) and human physical health. Therefore, it can be concluded that MSW is effecting human health through diseases like Diarrhea, Dysentery, Skin diseases and Typhoid which are chronic to children.

1. Introduction

1.1-Background

We all know that one of the enemies of modern civilization is “Pollution”. In fact, it’s a silent killer who is responsible for causing various diseases and many of them are also fatal. Very few of us are aware about its exact impact on our physical health.

Solid waste accumulation in cities has become a problem all over the world with the population explosion. Solid waste is created both at an institutional level and at the level of individual households. Landfills have always been regarded as sources of disease and offensive odors. Early in their development cities generally had few disposal regulations and individual homes disposed of solid waste in their ways suitable for them. Therefore, means of disposal were based on the culture, background, occupation and size of each of the different households (Crane, 2000). Throwing away solid waste is always a balance between hygiene and thrift (Lucas, 2002). Used material may come in handy at a future date, but in the mean time, storage of it causes certain problems, not the least of which is sanitation concerns.

Changing lifestyles, the increasing use of disposable materials and excessive packaging are all contributing to an increase in the amount of waste being created. Waste management is now a global concern. The problems associated with MSW management are complex because of the quantity and diversity of the nature of waste and financial limitations on public services in large cities. The problem is not only confined to land, it includes air and water as well².

Pakistan, like other developing countries, faces serious environmental problems. Rapid population growth (average annual growth rate of 2.6 percent a year) and impressive GDP growth (of about 6 percent a year) have put enormous pressure on the country’s natural resource base have significantly increased levels of pollution (UNDP, 2005).

It is estimated that presently, 54,888 tons per day of solid waste is generated in Pakistan. No weighing facilities are installed at any disposal sites. Hazardous hospital and industrial wastes are being simply treated as ordinary waste. (Iges, 2011)³ reported, open burning of non-degradable components like plastic bags are added to air pollution. Collection of the solid waste is 51-69 %, which is almost half of the waste collected in Pakistan. According to National Community System (1992), Pakistan generates 47,290 tones of solid waste per day which is another reason of solid waste pollution is no disposal facilities are available. Unfortunately, none of the cities in Pakistan have a proper solid waste management

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² Municipal Solid Waste Factsheet, Pakistan Environment. www.wwfpak.org. 18-05-11

³ http://www.iges.or.jp/en/ltp/pdf/activity08/06_pakistan.pdf [no other source available]. 2011

system right from collection of solid waste up to its proper disposal. Hospital and industrial wastes are treated as ordinary waste. Much of the uncollected waste poses serious risk to public health through clogging of drains, formation of stagnant ponds, and providing a breeding ground for mosquitoes and flies with consequent risk of malaria and cholera. The annual Growth Rate is 2.4 % per year of solid waste in Pakistan.

“It is estimated that the global burden of municipal solid waste amounted to 1.3 billion metric tons in 1990, or two-thirds of a kilogram of waste per person per day”, say David and David (1995). The study revealed that the least efficient practices tend to be found in developing countries, creating serious threats to local environmental quality and public health.

According to Baodi et al. (2005), “inadequate provision of solid waste management facilities in accumulated solid waste has detrimental effects on the health of humans. Besides, the general deterioration of the environment from a bad smell, landfills attract disease vectors, contain rotting food and carcasses, accumulation infectious or toxic waste items, and produce noxious chemicals that are released into the water and air.

Exposure to hazardous waste can affect human health, children being more vulnerable to these pollutants. In fact, direct exposure can lead to diseases through chemical exposure as the release of chemical waste into the environment leads to chemical poisoning. Certain chemicals if released untreated, e.g. cyanides, mercury, and polychlorinated biphenyls are highly toxic and exposure can lead to disease or death. Some studies have detected excesses of cancer in residents exposed to hazardous waste⁴.

Sialkot has been known as Pakistan’s largest sport, as is known as a city full of industries such as leather goods producing along with leather related industries, textile metallurgical and pharmaceutical industries. The surface and ground water of Sialkot has been degraded due to rapid industrialization along with urbanization and agricultural activities in its surroundings areas cited by Qadir et al., (2008) [Rizwan et al. 2009] in study of assessment of ground water in Sialkot. Furthermore (Dawn, 2006) reported that an estimated discharge of effluent from only tanneries is approximately 1.1 million liters per day All the industrial units consume large amount of water which, together with dissolved toxic substances (acids, base or toxic chemical compounds and heavy metals) after processing is discharged into nearby agricultural lands, ponds, open ditches, rivers, streams and open land. Toxic effluents percolate down into the soil resulting in aquifer contamination, polluting potable water supplies. Open unlined drains and dumping sites of urban and industrial waste, agricultural runoff and flooding during monsoon season are other most hazardous polluting source of groundwater contamination.

According to the latest statistics, there are 264 tannery units in the district with an optimum level of leather production about 297 tons per day. They are producing about 11000 m³/ day effluent containing 130 toxic chemicals, including chromium, sulfides, chlorides, metal, salt content and organic pollutants. Adding to the chemical waste is the heavy discharge of municipal sewage which has turned natural water courses of the district into drains. Solid waste packing material, plastic bottles, rubber and polyethylene material are also being dumped into these drains to block their flow. The industrial units which claim to be ISO 14000 qualified may have good systems in the premises of their immediate premises, but they do not take care when they fill the chemical effluents in the tankers and pour them into the water courses-the habitat of the fish fauna and other human friendly species⁵.

There are some of the problems which could be faced due to such chemicals and MSW:

⁴ Health Impacts of Solid Waste. United Nations Environment Programme. 1996

⁵ 264 tanneries units emitting pollution in Sialkot. One Pakistan News. 02 July 2010 Friday | 19:00:00

Infections

- Skin and blood infections resulting from direct contact with waste, and from infected wounds.
- Eye and respiratory infections resulting from exposure to infected dust, especially during landfill operations.
- Different diseases that results from the bites of animals feeding on the waste.
- Intestinal infections that are transmitted by flies feeding on the waste.

Chronic diseases

- Incineration operators are at risk of chronic respiratory diseases, including cancers resulting from exposure to dust and hazardous compounds.

Accidents

- Bone and muscle disorders resulting from the handling of heavy containers.
- Infecting wounds resulting from contact with sharp objects.
- Poisoning and chemical burns resulting from contact with small amounts of hazardous chemical waste mixed with general waste.
- Burns and other injuries resulting from occupational accidents at waste disposal sites or from a methane gas explosion in landfill sites.

1.2-Objectives

- Disposal of solid waste

Improper disposal of household hazardous wastes can include pouring them down the drain, on the ground, into storm sewers, or in some cases putting them out with the trash. The dangers of such disposal methods might not be immediately obvious, but improper disposal of these wastes can pollute the environment and pose a threat to human health.⁶

- Health improvements

With the help of this study, we would be able to improve the health conditions of the population of Sialkot city.

- Better environment

We would try to make better the sanitary conditions and reduce the pollutants in the environment.

1.3-Significance

The results of the study will be helpful for the people of Pakistan and other developing countries in avoiding the health hazards due to exposure to MSW in urban areas. The results found will be an addition to the body of knowledge as they will represent that higher the accumulated MSW around the residential areas, higher will be the level of threat of diseases among households. This study will focus on reducing threats to human physical health such as Diarrhea, Typhoid, etc. showing irresponsible behavior towards solid waste management, through deterring the responsible persons' behavior by increasing their perceptions regarding environmental pollution. The results of the study can also prove helpful for the policy makers to devise new enforcement methods in Sialkot in order to develop a proper sense of good environment in the people of Sialkot.

2. Review of the Literature

Cities are complex ecosystems. They have to balance all of the uses by all of the citizens and institutions. One of the major problems a city faces is the disposal of waste, in

⁶ Household Hazardous Waste- Resource Conservation. US Environmental Protection Agency. December 01, 2010

this discussion, specifically solid waste. There is no solution to the problem unless the infrastructure of a city is designed to address this problem (Savage and Kong, 1993).

Semisolid or solid matters that are created by human or animal activities, and which are disposed because they are hazardous or useless are known as solid waste. Most of the solid wastes, like paper, plastic containers, bottles, cans, and even used cars and electronic goods are not biodegradable, which means they do not get broken down through inorganic or organic processes⁷. Thus, when they accumulate they pose a health threat to people, plus, decaying wastes also attract household pests and result in urban areas becoming unhealthy, dirty, and unsightly places to reside in. Moreover, it also causes damage to terrestrial organisms, while also reducing the uses of the land for other, more useful purposes.

There are a variety of diseases that are shown to be at least worsen, if not caused by the presence of open solid waste, or inadequate solid waste landfills. FRENKEL, et al, (1995), found a serious problem with *Toxoplasma-gondii*. Pneumonitis, induced by avian antigens was found by Carrillo-Rodriguez, et al, (2000), to be primarily associated with solid waste dumps. Amoebic diseases have been found concentrated in the soil and in the air in greater proximity to urban solid waste dumps (RIVERA, et al., 1994).

In cities, solid waste is created at the community level as well as the individual level. The density of the urban population produces massive amounts of solid waste that must be removed. Yet, there is not much land per household for solid waste disposal, and it is much farther away. Landfills are set aside, but, they have always been regarded as unpleasant places which are sources of disease and offensive odors (Crane, 2000).

By use of the post coded database held by the Small Area Health Statistic Unit, cancer incidence of over 14 million people living near 72 municipal solid waste incinerators in Great Britain was examined from 1974-86 (England), 1974-84 (Wales) and 1975-87 (Scotland). Numbers of observed cases were compared with expected numbers calculated from national rates (regionally adjusted) after stratification by a deprivation index based on 1981 census small area statistics. There was evidence of residual confounding near the incinerators, which seemed to be a likely explanation of the funding for all cancers, stomach and lung, and also to explain at least part of the excess of liver cancer (Elliott et al, 1996).

Third World cities results in indiscriminate disposal and unsanitary environments, which threatens the health of urban residents.” The study showed that over 80% of the population of Metropolitan area Accra, Ghana, do not have home collection services. Only 13.5% of respondents are served with door-to-door collection of solid waste, while the rest dispose of their waste at communal collection points, in open spaces, and in waterways. The majority of households store their waste in open containers and plastic bags in the home. Waste storage in the home is associated with the presence of house-flies in the kitchen. The presence of houseflies in the kitchen during cooking is correlated with the incidence of childhood diarrhea. Inadequate facilities results in burning and burying of solid waste. Furthermore, poor handling and disposal of waste are major causes of environmental pollution, creating breeding grounds for pathogenic organisms, and the spread of infectious diseases.

Overall, evidence from epidemiologic studies in the workplace suggested that dioxin (a class of chemicals- increase risk of cancer among animals) is a human carcinogen, but whether low doses affect the general population remained to be determined. The authors examined the spatial distribution of soft-tissue sarcomas and non-Hodgkin's lymphomas around a French municipal solid waste incinerator with high emission levels of dioxin. The

⁷ [Rita Putatunda](#), Land Pollution Comprises Of: Solid Waste and Soil Pollution, Land pollution

study further showed that because of the steep increase in the manufacture and use of chlorinated organic chemicals and

Plastics and in burning of household trash, municipal solid waste (MSW) incineration was one, if not the top, source of dioxin production. (Jean-Francis, 1999). The presenters of micro-organisms in municipal solid waste were studied with Herbert (1987) in Microorganisms in municipal solid waste and public health implications. The study showed that the composition of municipal solid waste was quite heterogeneous. This mixed composition resulted in the presence of a variety of microorganisms that reach densities which are relatively high, and which remain high even after many years in a landfill. Microorganism densities in the air at municipal solid waste processing plants tend to be higher than levels near wastewater treatment facilities. This might be due to indoor operations. Composting could inactivate essentially all of the microorganisms associated with fecal matter, but thermophilic fungi may cause adverse health problems. The presence of microorganisms in municipal solid waste did not mean that there was a high risk of infection or disease if a person is occupationally exposed to the waste. Dose-response relationships with various microorganisms had shown that a relatively large number of microbes are necessary to initiate an infection or cause disease.

The relation of Municipal solid waste incineration and Dioxin exposure was studied by Fabre et al (2007) in France. In the study Urbanization, socioeconomic deprivation, exposure to air pollution from traffic and from other industries were taken into account as potential confounding factors. All collected data were implemented in a geographical information system in order to estimate, at the IRIS level, cancer incidences, and exposure to MSWI (Municipal Solid Waste Incinerators) emissions and to confounding factors. Through a log-linear Poisson regression associated with a Bayesian hierarchical analysis, it was analyzed that the relationship between exposure to MSWI emissions and cancer incidences. The analysis of the data showed a positive association between exposure to incinerators in the 70s' and 80s' and the incidence of different cancers during the period 1990-1999.

Sarah and Foster discussed the impact of municipal solid waste on human health. The authors are trying to explain the dominant waste disposal method in the U.S. Furthermore they claimed that although regulatory programs had been implemented to minimize potential community health risks from MSW landfills, those facilities were often the subject of public health-related complaints. According to the authors "Public health concerns occur often among communities located near municipal solid waste (MSW) landfills, even though currently permitted landfills were broadly regulated and routinely inspected by public health and environmental agencies. The types of health effects mentioned by communities, included cancer risks, respiratory illnesses, and a variety of non-cancer effects. Releases to air and impacts on air quality tended to be the most common concern at modern landfills, even those equipped with landfill gas (LFG) treatment systems."

Some Common Household Hazardous Products and what happens when these household hazards products are burnt? They can cause nervous system damage, irritation of eyes, nose and throat infections, and damage to internal organs if ingested, inhaled or absorbed through the skin.⁸

In short, solid waste pollution in a city causes numerous problems. These include, but are not limited to, contamination of air & water, increased disease risk, the attraction of undesirable wildlife, soil sealing and flood problems.

⁸ Promoting a Future Without Landfills, Salinas Valley, Solid Waste Authority.

3. Theoretical Framework

“The spread of municipal solid waste in Zanzibar municipality has been associated with environmental pollution, unpleasant city conditions, contamination of water sources and coastal areas together with harboring of malaria vectors”, say Vuai (date not mentioned). In the study it was revealed that the contamination has a close relationship with the eruption of diarrhea, cholera and typhoid which claim the lives of the residents. Two types of wastes were selected for the research: municipal solid waste and rice milling by-products. It was found that the trace metal contents were higher in MSW than rice milling by-products which were causing threats to human physical health.

“Urban solid waste (USW) is a public health problem worldwide”, say Rego et al. (2007), “that has not yet been completely evaluated in relation to childhood health.” The research was conducted to check the association between diarrhea and exposure to USW among preschool children, taking the sample of 922 under-threes living in Salvadore, Brazil. The results showed that the main factors associated with diarrhea were rubbish in the street, intra-home rubbish packing, water in streets, poor conditions of hygiene and cleanliness and drainage problems. The study showed the 4.77% of the variability of the children’s number of days with diarrhea.

The safety risks due to municipal solid waste were observed by James et al (2009). This report presented the findings of a study to evaluate and reduce occupational risks to Florida municipal solid waste (MSW) workers, and to ascertain what was known concerning risks to residents of communities near to MSW landfills. Results of the overall study indicated high rates of mortality, injury, and disease among MSW collectors. In particular, the driver/helper occupational group suffered an average of 9.8 Worker’s Compensation cases of greater than seven calendar lost work days (LWD) per 100 workers annually, 7.4 times higher than the rate for the general workforce in Florida. Moreover, Concerns regarding liability within the solid waste industry were found to be a major obstacle to the flow of information regarding accident prevention. Risks to populations proximal to MSW landfills were largely unknown.

Municipal solid waste management is very helpful when we talk about the sorting-composting approach. But MSW contained a number of chemical and biological agents, the compost would not be necessarily a harmless product. Domingo and Nadal (2009) say that these contaminants may expose different population to health hazards, ranging from the composting plant workers to the consumers of vegetable products grown in soil treated with compost.

“Domestic solid waste is cause for current environmental concern in large cities around the world”, says Rego et al. (2002). A study was made in large Brazilian city to know the opinions of women from any outlying neighborhood. The study used a qualitative approach in Salvador, Bahia. A total of 13 women were interviewed. As the initial step in this epidemiological research on the relationship between solid waste and diarrhea, the study described the women’s perception of the garbage and the popular understanding of the relationships between garbage and disease, and between the garbage and the environment. The results indicated women’s positive response towards environmental problems like bad smell or visual pollution, attracted animals, caused disease in children or adults.

4. Research Question

“People who are living around solid waste accumulated areas are expected to face more health issues.”

4.1-Operationalisation

Municipal Solid waste (MSW)

Municipal Solid Waste (MSW)—more commonly known as trash or garbage—consists of everyday items we use and then throw away, such as product packaging, grass clippings, furniture, clothing, bottles, food scraps, newspapers, appliances, paint, and batteries. This comes from our homes, schools, hospitals, and businesses.⁹ It is further of three types:

i. Degradable Solid waste

It consists of waste which can be easily disposed of. When it is burned, bacteria decompose it and make it a natural fertilizer for the soil e.g. paper, waste of vegetables, cereals, or any other waste of agricultural products.

ii. Non- Degradable Solid Waste

It is a form of solid waste which cannot be disposed of easily e.g. plastic containers, bottles. Some sorts of chemicals are involved in the composition of these products. One more thing is Leachet which is a liquid made up when these products are exposed to heat or weather temperature and rainy water. This liquid passes through the surface of earth to underground water and polluted it.

iii. Recyclable Waste

It's a type of waste which can be passed through a series of changes or treatments (like liquid body waste, glass or cans, and even used cars and electronic items) in order to regain material for human use.

Health Hazards

Hazards are termed as the diseases which are harmful for humans, caused by exposure to MSW. Humans come in contact with the solid waste accumulated around the houses and get ill. Some of the diseases are:

1. **Diarrhea** is abnormally frequent intestinal evacuations with more or less fluid stools.
2. **Dysentery** is a disease characterized by severe diarrhea with passage of mucus and blood and usually caused by infection.
3. **Eye infections** are caused by poor hygiene.
4. **Skin problems** (e.g. Fungal or bacterial skin infections).

4.2 -Research Design

The present study is to measure the relationship between Perception of households about the disease due to exposure to MSW and impact of the solid waste on human physical health. Survey Research method will be used for carrying out the research as the data will be gathered by communicating with a representative sample of individuals.

A well structured Questionnaire (Interview Schedule) will be used as a tool to collect the data, and data will be collected by the researcher. The tool used is suitable as most of the respondents are expected to be unable to understand the questions well by themselves.

Purposive sampling will be used as our population is residing in the areas where solid waste is thrown by households themselves. The information of the households will be taken from the concerned department in Sialkot city where the data of such areas are kept. The total number of such areas of Sialkot city whose record is available in the Union Council will be our target population. List of all such areas fulfilling the criteria will be made. A sample of such 50 households will be taken out of the total population.

⁹ Wastes – Non-Hazardous Wastes- Municipal Waste. US Environmental Protection Agency. February 16, 2011

Data Collection

Primary data will be collected for this study. Data will be collected by trained interviewers. These interviewers will be selected on the basis of their previous experience in data collection related assignments. The field workers will be briefed about the topic and the related information. The researcher will supervise the field workers on daily basis.

5. Results and Discussion

From the whole discussion, it is clear that the most common diseases in Sialkot are water born and skin disease. According to the respondents the common diseases are water born and skin diseases. From the table 1 it is clear that 71.5% diseases are water born diseases.

Table.1: What is the most common diseases in your point of view in Sialkot

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Water born diseases	103	71.5	71.5	71.5
Skin Diseases	41	28.5	28.5	100.0
Total	144	100.0	100.0	

The patients who suffer from the above mentioned diseases; the frequency of their exposure to solid waste is 133 which is 92.4% of the all respondents, shown in table.2.

Table.2: What is the frequency of your exposure with solid waste

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Daily	133	92.4	92.4	92.4
Weekly	11	7.6	7.6	100.0
Total	144	100.0	100.0	

The respondents who have more exposure to MSW, they often get sick, shown in table.3.



Fig: 1. Open Dumping 15-05-11

Fig.2 showing the condition of solid waste which is thrown in the open spaces near homes. According to the respondents the drainage water of their homes also accumulated in such open spaces, hence causes malaria too, dysentery and skin infections.

Table.3: How often you get sick

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Often	59	41.0	41.0	41.0
	Monthly	63	43.8	43.8	84.7
	Once in a year	22	15.3	15.3	100.0
	Total	144	100.0	100.0	

According to the respondents the major sources diseases among the population is the wastage of the factories. Sialkot is an industrial city. The disposal of factories consists of hazardous chemicals and the polluted water which is used for washing of the products, thrown in the underground with the bore in the ground.



Fig.2: The water condition in the area of municipal solid waste. Sialkot 15-05-11

These chemicals and polluted water directly dissolve in the ground drinking water and causes diseases of diarrhea, dysentery, skin problems and stomach problems. From the Table.4 it is clear that pollution created by factories is 54.9% which is quite alarming.

Table.4: Major sources of solid waste pollution in your area

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Households	65	45.1	45.1	45.1
	Factories	79	54.9	54.9	100.0
	Total	144	100.0	100.0	

When it was asked to the doctors about the impact of MSW on population health, they reported the positive results. According to them, the patients have usually problems of Diarrhea, Eye infections and Dysentery. From the table.5 it is clear that patients of Diarrhea have the highest percentage (7.6%).

Table.5: Patients come to me usually for

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Diarrhea	11	7.6	52.4	52.4
	Eye infections	6	4.2	28.6	81.0
	Dysentery	4	2.8	19.0	100.0
	Total	21	14.6	100.0	
Missing	System	123	85.4		
Total		144	100.0		

The doctors further told that the children who have maximum exposure to the MSW (Because children play in the open spaces outside the home where waste of households and factories is thrown) have high percentage of getting sick, shown in Table.6.

Table.6: The patients are usually

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	children	13	9.0	61.9	61.9
	all age groups	8	5.6	38.1	100.0
	Total	21	14.6	100.0	
Missing	System	123	85.4		
Total		144	100.0		

6-Conclusions and Recommendations

It can be concluded from the study that it is clear that Sialkot has two major environmental issues, solid waste management and water pollution. There are two main causes of these issues. First, the households who throw all the solid waste near their homes, whether degradable or non-degradable. People who are living in the areas where they have maximum exposure to MSW have the maximum threat to health hazards. Second, the factories of leather or surgical instruments, throw all the chemical waste in the open pits which not only polluted the but stinks the environment too. Hence, causing many diseases like eye infections, skin infections and typhoid too, because these factories throw all the waste chemicals in the ground through bore holes which is polluting the underground drinking water and causing diarrhea, dysentery and stomach problems.

It puts a great socioeconomic impact on the residents living in the areas, their family and the nation as a whole. But the issue at hand cannot be resolved or its benefits cannot be achieved until and unless the proper measures are taken by related enforcement agencies to increase the enforcement effectiveness by making the living conditions and environment better.

The policy makers should ensure the visibility and effective use of enforcement procedures and measures so that instead of penalizing the violators and offenders the behavior can be controlled before the situation of surrounding gets worse. The penalty or punishment may affect the behavior of the persons who are observing it and it can also lead to the responsible behavior of the persons living in the areas and the factory owners. Therefore, the focus should be on prevention rather than the cure.

References

- Crane B.D. 2000. "Filth, solid waste and rubbish: Refuse disposal, sanitary reform and nineteenth century yard deposits in Washington, D.C.," in *Historical Archeology*, (34:1:20-38 2008)
- Lucas G. 2002. "Disposability and dispossession in the twentieth century," in *Journal of Material Culture*, (7:1: 5-22 MAR 2002).
- Savage, V.R. and L. Kong.1993."Urban constraints, political imperatives- environmental-design in Singapore," in *Landscape and Urban Planning*, (25:1-2: 37-52 AUG 1993).
- Schleuss U, Q.L. Wu and H.P. Blume. 1998. "Variability of soils in urban and periurban areas in Northern Germany," in *CATENA*, (33:3-4: 255-270 NOV 1998).
- Frenkel, J.K., K.M. Hassanein, R.S. Hassanein, E. Brown, P. Thulliez, And R. Quinteronunez. 1995. "transmission of *Toxoplasma-Gondii* in Panama-City, Panama - A 5-YEAR prospective cohort study of children, cats, rodents, birds, and soil," In *American Journal of Tropical Medicine and Hygiene*, (53:5: 458-468 NOV 1995)

- P. Elliot et al. 1996. Cancer incidence near municipal solid waste incinerators in Great Britain. *Br J Cancer*. 1996 March; 73(5): 702–710. Small Area Health Statistics Unit, Department of Public Health and Policy, London School of Hygiene and Tropical Medicine, UK.
- Jean-François Viel et al. 1998. Soft-Tissue Sarcoma and Non-Hodgkin's Lymphoma Clusters around a Municipal Solid Waste Incinerator with High Dioxin Emission Levels. *American Journal of Epidemiology*, Volume 152, Issue 1, Pp. 13-19.
- Herbert R. Pahren; C. Scott Clark. Microorganisms in municipal solid waste and public health implications *Critical Reviews in Environmental Science and Technology*. Volume 17, Issue 3, 1987, Pages 187 - 228
- Guideline for solid Waste Management. (2005). “Present status of SWM in Pakistan and strategy for its improvement.” Pakistan Environmental Protection Agency. pg# 5
- Fabre et al. Dioxin Exposure and Cancer Incidence in Vicinity to Municipal Solid Waste Incinerators in France. *Organohalogen Compounds* Vol 69, (2007)
- James D. Englehardt. (2000) Solid Waste Management Health and Safety Risks: Epidemiology and Assessment to Support Risk Reduction. State University System of Florida Florida Center for Solid and Hazardous Waste Management. University of Florida 2207-D NW 13th Street Gainesville, FL 32609. www.floridacenter.org Report #00-01
- Sarah et al. Methods For Addressing Public Health Concerns At Municipal Solid Waste Landfills. 21st International Conference on Solid Waste Technology and Management. Philadelphia, PA, USA. March 26-29, 2006.
- Domingo, J.L. and M. Nadal (2009). “Domestic waste composting facilities: a review of human health risks.” *Environ Int* 35(2): 382-9.
- Rego Rde, C., M. L. Barreto, et al. (2002). “What is garbage anyway? The opinions of women from any outlying neighborhood in a large Brazillian city.” *Cad Saude Publica* 18(6): 1583-91.
- David, N. Beede and David, E. Bloom. (1995). *The Economics of Municipal Solid Waste*. Oxford journals: committed to the environment. Volume 10, Issue 2, Pp. 113-150
- Vuai, S. A. “Characterization of MSW and related waste-derived compost in Zanzibar municipality.” *Waste Manag Res* 28(2): 177-84.
- Rego, R. F., M. L. Barreto, et al. (2007). “Rubbish index and diarrhea in Salvadore, Brazil.” *Trans R Soc Trop Med Hyg* 101(7): 722-9.
- Boadi, K. O. and M. Kuitunen (2005). “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* 68(4): 32-6.
- Ullah, Rizwan et al. (2009). “Assessment of ground water contamination in an industrial city, Sialkot, Pakistan.” *African Journal of Environmental Science and Technology* Vol. 3 (12), pp. 429-446, December, 2009