Original Article

Morbidities among People Living Close to Bio-Medical Waste Incinerator: a Study in a Rural Area of Himachal Pradesh, India

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Abstract

Introduction: Current study was planned to assess the difference in prevalence for common adverse health events among people living close and distant to biomedical management incinerator (BMWI) in district Kangra, Himachal Pradesh.

Methodology: A case-control study design was chosen to assess the association of BMWI and health events. People living close (Case) and distant (Control) to BMWI were assessed for common health problems related to gastrointestinal, respiratory, skin, and eye. Data collection was carried out by using structured interviewer administered questionnaire by trained medical professionals i.e. residents and interns.

Results: Total 1479 people were surveyed of which 735 were cases and rest 734 were controls . Distribution of variables related to demographic and socio-economic status observed to similar across case and control villages. Odds Ratio (OR) observed to be 5.53 (3.18-9.63) in case villages for all types of morbidities and for respiratory (4.04; 1.81-9.04), skin (6.27; 2.26-17.36), and eye (11.12; 4.41-32.74) related problems.

Conclusion: People living proximal to BMWI observed with high risk for adverse health events related to respiratory, skin, and eye. Establishment of surveillance system with biochemical assessments is required to establish causal effect of BMWI on population health.

Key Words: Bio-Medical Waste, Incinerator, Health

Introduction :

Production of Bio-Medical Waste (BMW) varies from developing to developed countries as 1-2 kg and 4.5 kg per bed per day respectively. In developed countries 10-15% and 45.5-50.0% in India of BMW is infectious and requires special handling.[(1)] Its management by incineration is recommended but emits toxic air pollutants and toxic ash residues that are the major source of dioxins in the environment. Dioxin, classified as a human carcinogen, is one of the most toxic chemicals known to humankind.[(2)] Historically, health concerns due to incineration raised by the communities living near to incinerator, as they face day-to-day concerns. Population around incinerator is categorized based on potential exposure; Local population, which is exposed primarily through inhalation of airborne emissions; Workers at the facility, especially those who clean and maintain the pollution control devices; and the larger regional population, who may be remote from any particular incinerator, but who consume food potentially contaminated by one or more incinerators and other combustion sources that release persistent and bio-accumulative pollutants. World Health Organization (WHO) has suggested framework for health risk assessment to estimate the short and long-term health effects of incinerator emissions. The term 'risk' quantified as

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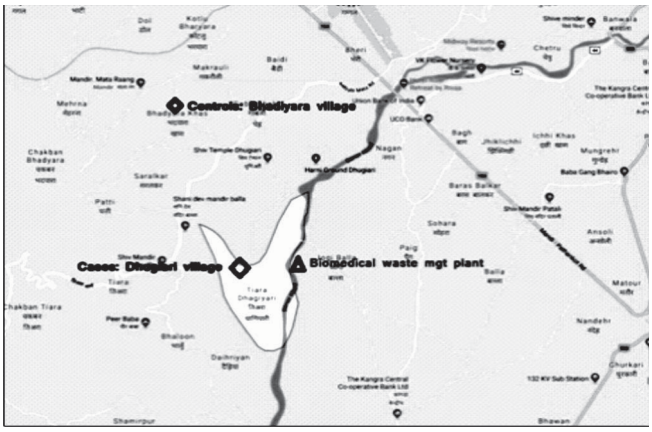
probability to harm, the fraction of potentially affected population, and number of cases of disease.

Biomedical Waste Incinerator (BMWI) located in a village of Himachal Pradesh has been causing health concerns among people living in village, where it is located. People living in proximal villages of BMWI have been raising their issues and communicated to health authorities. Despite known adverse effect of BMWI, people expressed lack of concern by the health authorities, therefore challenged the issue in court of law. BMWI in a village of district Kangra, Himachal Pradesh was started on December 2015 and was closed within 3 months on 30/3/2016 from the directions of Honorable High Court of Himachal Pradesh. However, incinerator was re-started on 06/04/2017 and again stopped functioning on 06/6/2017 because of agitation by people of affected village. With further intervention by the Honorable High Court of Himachal Pradesh, incinerator is functioning from 08/12/2017 to till date. Current study was planned to assess the difference in prevalence for common adverse health events among people living close and distant to biomedical management incinerator (BMWI) in district Kangra, Himachal Pradesh.

Figure 1: Map of case (near to incinerator) and control (distant from incinerator) in district Kangra, Himachal Pradesh



Methodology:

An unmatched case-control study design was chosen to assess the association of BMWI and health events from August to October 2019. BMWI was considered as an exposure and people living close and distant to BMWI were assessed for common health problems related to gastrointestinal, respiratory, skin, and eye. People living in village where BMWI is located considered as "case group" and distant village from BMWI as "control group". Case group was in Tiara and control village was selected from adjoining health block, Shahpur of same district Kanga as villages were geographically comparable. (Figure: 1) According to local census, case group has population of 1885 and 428 households (HHs), whereas control group has population of 830 with 182 HHs. In both the group of villages female population was 50.0% and children of less than 6 years of age were about 10.0%. Data collection was carried out by using structured interviewer administered questionnaire by trained medical professionals i.e. residents and interns. Interviewers visited all HHs of villages of both groups only once and people available during the day time (9:00 to 17:00 Hours) were interviewed. All the pertaining information has been kept strictly confidential and used for understanding said objective. No personal level information of the selected participants was and will be disclosed at any level and informed consent form people was obtained before collection of data.

Table 1: Age group and gender distribution of surveyed population in case and control villages of health blocks, Kangra, Himachal Pradesh

Age Group (Years)	Case (n= 735)		Control (n= 734)	
	Male N (%)	Female N (%)	Male N (%)	Female N (%)
<5	22 (7.0)	9 (2.2)	15 (4.7)	14 (3.5)
6-11	31 (9.9)	20 (4.7)	18 (5.5)	15 (3.7)
12-18	46 (14.9)	42 (9.9)	38 (11.9)	19 (4.7)
19-35	53 (16.9)	129 (30.6)	73 (22.5)	115 (27.9)
36-50	51 (16.5)	112 (26.4)	45 (13.8)	106 (25.9)
51-70	93 (29.8)	92 (21.7)	98 (30.4)	108 (26.3)
>70	16 (5.0)	19 (4.5)	36 (11.1)	33 (8.1)
Total	312 (100.0)	423 (100.0)	323 (100.0)	411 (100.0)

Results:

Total 1469 people were surveyed of which 735 (50.3%) were from case and rest 734 (49.7%) from control villages. Majority (66.5%) of people was females in both case and control villages due to their availability at homes during survey. Age group distribution observed that most of people were of age group 19-35 (26.1%), 36-50 (22.4%), and 51-70 (26.0%) years. This distribution of age was similar across case and control villages.

Table 1 shows that the survey was largely representative of females, and their distribution for age was largely similar across case and control population except for age groups 12-18 years (Case: 9.9%; Control: 4.7%; p=0.001) and >70 years (Case: 4.5%; Control: 8.1%; p=0.018). (Table: 1) Assessment for distribution of basic characteristics observed that people belonging to other backward class (OBC) were significantly more in villages belonging to case group (83.5 vs. 58.5%) and on the other hand SC, ST, and general social class were significantly high in control group villages. (Table: 2) Significantly, majority of head of HHs from case group were carrying out occupation related to private sector/self-business (48.4 vs. 32.8%) and government job was significantly more in control group (31.9 vs. 15.6%). Average monthly family income found to be significantly less in case group (INR 12912.2 vs. 14919.7), which is reflected as less number of people from case group were earning monthly income of more than INR 20,000 (17.0 vs. 23.5%).

As shown in Table 2, Ground water found to be major source of drinking water in both groups but significantly more in case group (Case: 94.7%; Control: 78.5%; p=0.000) whereas, river stream was observed to be another significant water source in control (16.3%) compared to case group (1.6%). Relatively, in

Table 2: Distribution of basic characteristics among surveyed population in case and control villages of health blocks, Kangra, Himachal Pradesh

Characteristics	Case (n=735)	Control (n=744)
Caste		
Schedule Caste (SC)	74 (10.1)	136 (18.3)
Schedule Tribe (ST)	4 (0.5)	17 (2.3)
Other Backward Class (OBC)	614 (83.5)	435 (58.5)
General	45 (5.9)	155 (20.9)
Occupation of head of household		
Government job	115 (15.6)	237 (31.9)
Private job/Business	356 (48.4)	244 (32.8)
Farmer	79 (10.7)	68 (9.2)
Other	185 (25.2)	194 (26.1)
Monthly family income in INR (Mean±SD)	12912.2	14919.7
Monthly family income quartiles		
<5000	255 (34.7)	235 (31.6)
5001-8000	145 (19.7)	124 (16.7)
8001-20000	210 (28.6)	210 (28.2)
>20000	125 (17.0)	175 (23.5)
Source of Drinking Water		
River stream	12 (1.6)	121 (16.3)
Ground Water	696 (94.7)	584 (78.5)
Other	27 (3.7)	39 (5.2)
Defecation in household latrine	722 (98.2)	739 (99.3)
Separate kitchen	638 (86.8)	702 (94.3)
Cooking fuel		
LPG	411 (55.9)	415 (55.8)
Firewood	81 (11.0)	80 (10.8)
LPG+Firewood	243 (33.1)	249 (33.5)

*Figure in parenthesis indicate percentage

case group, less number of people reported separate kitchen in their house (Case: 86.8%; Control: 94.3%; p=0.000). In both groups, more than half of people reported LPG as a main source of cooking fuel and about one third reported to use firewood along with LPG also. (Table: 2) People were asked about presence of any current illness, where insignificantly more people from control group reported current illness (20.6 vs. 18.8%), which was chronic in nature mainly type-2 Diabetes Mellitus, hypertension, and coronary artery disease (CAD). When inquired, none of member of both groups, reported history suggestive of diarrhoea, dysentery, or needles stick injury in last one month. Significantly, large number of people from case group reported chronic respiratory problem (Case: 5.8%; Control: 1.4%; p=0.000), skin problem (Case: 4.4%; Control: 0.4%; p=0.000) and eye problem (Case: 8.7%; Control: 5.8%; p=0.029).

Table 3 reveals that among those who reported chronic respiratory problem, symptoms did not differ significantly across both groups and the common symptoms were difficulty in breathing (Case: 51.2%; Control: 30.0%; p=0.156), chest tightness with breathing difficulty (Case: 4.7%; Control: 0.0%; p=0.143), and chest tightness with breathing difficulty and productive cough (Case: 11.6%; Control: 20.0%; p=0.940). None of person from control group reported chest tightness alone and hospitalization due to respiratory problem, where as 4.7% and 11.6% people from case group respectively. Few people reported skin problems in control (03) as compare to case group (33) so statistic interpretation for reported symptoms requires a caution. Assessment of substance use among people observes low use, as most were females, but difference was statistically indifferent. In case and control group five percent of people were currently using tobacco whereas, current use of alcohol was reported among 6.5% in case and 5.9% in control group (p=0.623). In case group, 8.9%, 9.8%, and 9.8% people reported problems of ash deposition, foul smell, and excessive noise, whereas, none reported these problems in control group. (Table: 3) Odds Ratio (OR) observed to be 5.53 (3.18-9.63) in case villages for all types of morbidities and for respiratory (4.04; 1.81-9.04), skin (6.27; 2.26-17.36), and eye (11.12; 4.41-32.74) related problems.

Discussion:

Current study was carried out to observe any adverse health outcomes among people living in villages in vicinity of BMWI. Incinerator can result unwanted health issues in general

Table 3: Distribution of morbidities and environmental hazards faced by the surveyed population

Morbidities and environmental hazards	Case n=735	Control n=744
Morbidities		
Any current illness	151 (20.6)	140 (18.8)
Chronic respiratory problem	43 (5.8)	10 (1.4)
Respiratory symptoms among affected		
Breathing difficulty	22 (51.2)	3 (30.0)
Chest tightness	2 (4.7)	0 (0.0)
Chest tightness + breathing difficulty	2 (4.7)	0 (0.4)
Chest tightness + breathing difficulty + cough	5 (11.6)	2 (20.0)
Skin problem	32 (4.4)	3 (0.4)
Skin symptoms among affected		
Excessive itching	16 (50.0)	2 (66.0)
Excessive itching with rashes	9 (28.1)	1 (33.4)
Eye problem	64 (8.7)	43 (5.8)
Tobacco use	37 (5.0)	37 (4.9)
Alcohol use	48 (6.5)	44 (5.9)
Environmental hazards		
Ash deposition	65 (8.9)	0 (0.0)
Foul smell	72 (9.8)	0 (0.0)
Excessive noise	72 (9.8)	0 (0.0)

*Figure in parenthesis indicate percentage

population depending upon extent of proximity. Significantly, more people of case group reported adverse health issues related to respiratory (5.8 vs. 1.4%), skin (4.4 vs. 0.4%), and eye (8.7% vs. 5.8%) system compared to distant (control group) villages. Assessment of nature of signs and symptoms among affected people suggested that health conditions were not severe causing significant morbidity and mortality, except for respiratory problems as 11.6% affected people in case group reported hospitalization as compare to none in control group. As number of affected people in control areas was less, so further inference based on statistical comparison of nature of signs and symptoms is limited.

As effect of incinerator on human health expected due to pollution of air, water, food products and evidence has also observed high association between incinerator and occurrences of cardiovascular and respiratory diseases.[3] Polychlorinated dibenzo p-dioxin dibenzofuran (PCDD/F) in the emissions of hazaradous and biomedical waste incinerator suspected for human health risks. Food chain modeling has also predicted its transfer to animal and plant tissues.[4] Incinerator reported to be related to respiratory, renal, hormonal, reproduction and development. A review found contradictory findings about effect of emission of municipal waste incinerator as a risk factor of human health.[5]

On the other hand, there is enough evidence mentioning inconclusive evidence in accepting and rejecting causal effect of incinerator on human health. Review evaluated epidemiological studies as they have assessed incinerator and health effects. It has observed that the reporting of effects like cancers (lung, larynx, non Hodgkin's Lymphoma) has increased in incinerator vicinity, although findings on non-carcinogen pathologies were inconclusive. Residences near to incinerator found to be associated with congenital malformations. In the end, review mentioned possible effect of biases and confounding on most of the study findings.[6] Various studies have not observed any association between PCDD/F from incinerator and adverse health outcomes on environment and health.[7-10]

Current study has limitations due to its cross-sectional nature and lack of biochemical assessments due to time and budget constraints. It was an unmatched case-control design where villages were unit of selection rather than individuals and only geographic comparison was ensured between villages. Therefore, typical selection criteria could not be adhered and analysis was only descriptive in nature. Establishment of surveillance system with biochemical assessments is required to establish causal effect of BMWI on population health. Inherently, governments should have mechanism for independent surveillance system to observed deteriorating population health for effective decision making. It should be inter-disciplinary in nature requiring scientific support form discipline like environment focusing on measuring biomarkers in air, soil, food products, and humans. As mentioned in a study, it usually requires three main arms. First, epidemiological monitoring of short-term health effects through spatio-temporal analysis and measurement of correlation between emissions and health events. Furthermore, epidemiological surveillance of long-term health effects as estimation of standardized mortality and morbidity rates. Lastly, biological monitoring of metals, PCDD/F, carbons etc.[11, 12] With this current study, have some limitations like inability to carry biochemical analysis to measure exposure and health effects.

Acknowledgements: We express our thanks to district health authority, Kangra, Himachal Pradesh for providing financial assistance along with residents Dr. Des Raj, Dr. Anil Kumar, Dr. Suresh Kumar, Dr. Garima Gupta, Dr. Sakshi Bhota, Dr. Shweta Kanwal, and Dr. Tarun Sood of department to ensure quality of data collection.

Conflict of Interest: None declared

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How to cite this article: Raina SK, Chauhan R, Kumar P, Sharma S, Bajwa H, Sharma S, Kumar D. Morbidities among People Living Close to Bio-Medical Waste Incinerator: A Study in A Rural Area of Himachal Pradesh, India. J Comprehensive Health 2020:8(1): 39-44.