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Body Mass Index and Suicide

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ABSTRACT

Background: In recent years a growing body of evidence have suggested an association of Body Mass Index with suicide. Most researches favoured inverse linear relationship between the two i.e. suicide decreases with increase in body mass index. The current research aims to find out mean body mass index score difference between suicide and non-suicide groups and to examine the association between body mass index and suicide in Indian scenario.

Method: Case-control study was conducted in the Department of Forensic Medicine and Toxicology, Gandhi Medical College, Bhopal. 171 study sample (cases N = 121, controls N = 50) brought for medicolegal autopsy were selected. Height and weight measured, body mass index calculated and categorised. Data were analysed using R version 3.3.3.

Conclusion: Victims of suicide had lower mean body mass index compared to control ($p < 0.001$). The study resulted in inverse linear relation between body mass index and suicide between BMI < 18.5 kg/m^2 to 24.99 kg/m^2. Association between BMI and suicide is inverse but not strong in overweight.

Keywords: *Body Mass Index, Suicide, Autopsy, Manner of death.*

INTRODUCTION

Body Mass Index[1] (BMI) is an anthropometric index of obesity based on weight and height, defined as weight in kilograms divided by height in meters square (kg/m^2). BMI, as a measure of relative obesity, has flaws most importantly the index cannot distinguish between heaviness due to adiposity, muscularity, or edema.[2] Despite this flaw, BMI has great merit that the measurements can be made easily with a fair degree of accuracy. These advantages are widely utilized in epidemiology, and in individual patient assessment. Current classification system of obesity is based on BMI.[3]

Suicide is the act of deliberately killing oneself. [4] It is described in International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) as Intentional self-harm (X60-X84). [5] In year 2015, worldwide, about 8,00,000 people committed suicide. [6] In India, during the same period, 1,33,623 persons committed suicide.[7]

Anthropometric indices of obesity as predictor of suicide was first studied by Paffenbarger and Asnes (1966).[8] In recent years a number of studies have reported the association of BMI and suicide, with generally similar results–a stepwise lower risk of completed suicide with heavier BMI, throughout the normal, overweight, and obese ranges (i.e., from 18.5 to ≥ 30 kg/m^2). Cumulatively the studies suggest an association is not by chance alone. [8-13] In a few studies no association could be found.[14-16]

Most of the studies relating BMI to suicide were conducted in the Western countries. The objective of the current study is to examine the difference between mean BMI score between cases (suicide group) and controls (non-suicide group) and to find out association, if any, between BMI with the suicide in a postmortem study in Indian scenario.

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METHOD

The case-control study was conducted in the Department of Forensic Medicine, Gandhi Medical College, Bhopal (M.P.) during the period September, 2014 to November, 2015. Study samples (N = 171) were deceased brought by police for medicolegal autopsy. Cases (N = 121) were those who commited suicide whereas controls (N = 50) had manner of death other than suicide.

History of the incidence was obtained from inquest papers, hospital records and from available relatives. Death-to-postmortem interval was estimated from hospital records, inquest papers, and history. In cases where information differs between inquest papers and history by relatives, the time when the deceased was last seen alive was used as a proxy for time since death. Length (vortex-to-heel) and weight of the deceased were taken in supine position, after removing clothes and articles. Weight was measured on digital weighing scale with accuracy upto 0.020 kg. Deceased body length was taken by placing two vertical aluminum square tubes, one at head end and another at heel. The horizontal distance between the two aluminum tubes were measured using another metallic tube mounted with measuring tape (accuracy upto 0.01 meter). Weight and length were measured up to two decimal places. BMI was calculated using the following formula. BMI obtained was categorized according to standard weight status categories (Table 1).

$$BMI\ (in\ kg/m^2) = Weight\ (in\ kg)/(Height\ (in\ meter)^2)$$

Known cases of suicide brought for medicolegal autopsy; both genders, male and female; and samples with age between 15 to 60 years were included in the study. Exclusion criterias were decomposed or mutilated bodies; duration of hospitalization more than 24 hours, death-to-postmortem interval more than 24 hours, clinical history of ascites, renal disease or cardiovascular disease and, in case of females, history of or postmortem finding of pregnancy.

Statistical analysis were performed using R version 3.3.3 after removing the identification data. A two-tailed p-value < 0.05 was considered statistically significant.

Table 1: The International Classification of adult underweight, overweight and obesity according to BMI

Classification		BMI (kg/m²)	
		Principal cut-off points	**Additional cut-off points**
Underweight		< 18.50	
	Severe thinness		< 16.00
	Moderate thinness		16.00 - 16.99
	Mild thinness		17.00 - 18.49
Normal range		18.50 - 24.99	18.50 - 22.99
			23.00 - 24.99
Overweight		≥ 25.00	
	Pre-obese	25.00 - 29.99	25.00 - 27.49
			27.50 - 29.99
Obese		≥ 30.00	
	Obese class I	30.00 - 34.99	30.00 - 32.49
			32.50 - 34.99
	Obese class II	35.00 - 39.99	35.00 - 37.49
			37.50 - 39.99
	Obese class III	≥ 40.00	

Table 2: Distribution of study population according to BMI

BMI categories	Study Sample							Total
	Case			Control				
	N	Ncol%	Nrow%	N	Ncol%	Nrow%	N	Ncol%
Underweight	29	24%	94%	2	4%	6%	31	18.13%
Normal	81	67%	69%	37	74%	31%	118	69%
Overweight	11	9%	50%	11	22%	50%	22	12.87%
Total	121	100%	70.76%	50	100%	29.24%	171	100%

Table 3: Descriptive Statistics

Study Sample	BMI Category	N	BMI (Mean ± SD) (kg/m^2)
Complete sample		171	21.24 ± 2.92
Case		121	20.39 ± 2.63
	Underweight	29	17.37 ± 0.77
	Normal	81	20.67 ± 1.35
	Overweight	11	26.32 ± 1.04
Control		50	23.27 ± 2.58
	Underweight	2	18.32 ± 0.01
	Normal	37	22.43 ± 1.59
	Overweight	11	27.02 ± 0.83

Table 4: Comparison of Group Means

Groups	t (df)	p-value	95% CI
Case vs. Control	t(169) = -6.55	< 0.001	-3.75, -2.01
Underweight (Case vs. Control)	t(28.26) = -6.67	< 0.001	-1.24, -0.66
Normal (Case vs. Control)	t(116) = -6.21	< 0.001	-2.32, -1.12
Overweight (Case vs. Control)	t(20) = -1.75	0.096	-1.54, 0.14
Case (Underweight vs. Normal)	t(87.06) = -15.99	< 0.001	-3.71, -2.89
Case (Normal vs. Overweight)	t(90) = -13.35	< 0.001	-6.49, -4.81
Case (Underweight vs. Overweight)	t(38) = -29.88	< 0.001	-9.55, -8.34
Control (Underweight vs. Normal)	t(36.1) = -15.75	< 0.001	-4.64, -3.58
Control (Normal vs. Overweight)	t(32.58) = -12.67	< 0.001	-5.33, -3.85
Control (Underweight vs. Overweight)	t(10.03) = -34.56	< 0.001	-9.26, -8.14

Table 5: Analysis of linear trend between BMI and suicide

BMI category	Case	Control	Odds Ratio	X^2	p-value
Underweight	29	2	1.00	13.46	< 0.001
Normal	81	37	0.15		
Overweight	11	11	0.07		

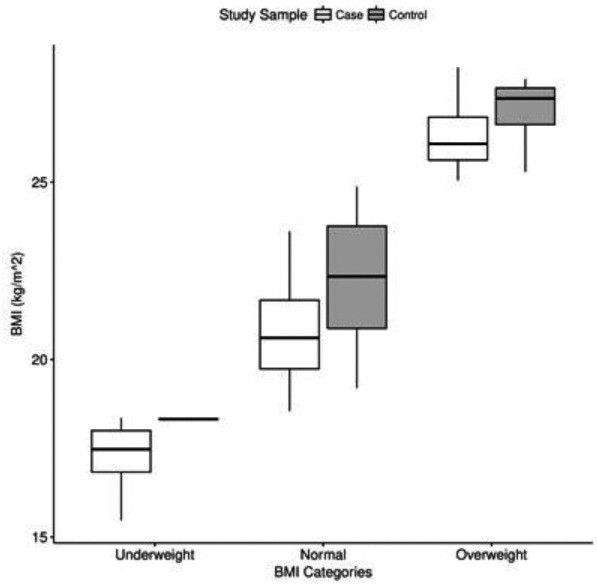

Figure 1: Difference of Mean between Cases and Controls by BMI categories

RESULTS

Study sample (N = 171) comprises of 70.76% cases and 29.24% controls. Normal BMI category (18.50 – 24.99 kg/m^2) forms 69% of the study population (N = 118). Underweight (18.13%, N = 31) and overweight (12.87%, N = 22) forms the rest. No study sample, either case or control, with BMI ≥ 30 kg/m^2 was found during the study period.

Significant difference (t (169) = -6.55, p < 0.001, 95% CI: -3.75, -2.01) in mean BMI score between cases (20.39 ± 2.63 kg/m^2) and controls (23.27 ± 2.58 kg/m^2) suggests, overall, BMI does have an effect on manner of death. Difference in mean BMI between cases and controls in underweight and in normal BMI categories were also significant (p < 0.001). In overweight, comparison of mean between case (26.32 ± 1.04 kg/m^2) and control (27.02 ± 0.83 kg/m^2) was not significant (p > 0.05). (Figure 1)

BMI (underweight vs. normal) differs significantly between suicide and control samples (X^2(1, N = 149) = 7.88, p < 0.001). Significant difference was also observed for BMI (underweight vs. overweight) between cases and controls (X^2(1, N = 53) = 13.13, p < 0.001). In contrast, BMI (normal vs. overweight) do not differ significantly between cases and controls (p > 0.05).

Linear trend between BMI and suicide show that, overall, death by suicide decreases with increase in BMI (X^2= 13.46, p < 0.001). The odds ratio compared with BMI < 18.50 kg/m^2 were 0.15 and 0.07 for BMI 18.50–24.99 kg/m^2 and BMI 25.00–29.99 kg/m^2 respectively.

DISCUSSION

This case-control study was conducted on 171 postmortem samples (121 suicide and 50 control) to explore the mean BMI score difference between cases and controls; and to explore the association between BMI and suicide.

In the current study the cause of small sample size is stringent inclusion and exclusion criteria, so the BMI is least affected by antemortem pre-existing disease and/or by postmortem changes. The present study is the first study, to the best of our knowledge, to relate obesity to suicide in Indian setting.

Samples in the current study belong to both genders, age from 15 to 60-years and both married and unmarried. As suicide is observed in both genders, this study included both male and female; this is in contrast with the studies where study participants were male only. [9,10] Most of the researches were done in age > 18 years old population, except for the study conducted in 11 Caribbean Islands [15] which included age group 15–100 years in the study. The present study included cases between 15 to 18 years, provided they fulfill selection criteria, keeping with the finding of National crime record bureau (NCRB). According to NRCB in 2015, 7% of suicides occurred in the age group below 18 years. [7] On the other hand, samples over age > 60 years were excluded from the study, because in older age group many possible disease confounders may be present which may affect the results of the study.

In the study BMI ≥ 30 kg/m^2 were not found fulfilling the selection criteria. Hence, the study was restricted to underweight, normal and overweight BMI categories. The study resulted in a significant difference in mean BMI score between cases (20.39 ± 2.63 kg/m^2) and controls (23.27 ± 2.58 kg/m^2), p < 0.001. The finding is consistent with other studies. In this study comparison of mean of overweight subgroup between case (26.32 ± 1.04 kg/m^2) and control (27.02 ± 0.83 kg/m^2) was not significant (p > 0.05). These results suggest that overall, BMI does have an effect on manner of death.

The current study shows suicide decreases with increase in BMI in underweight, normal and overweight

BMI categories. Odds ratio between BMI groups compared to underweight were 0.15 and 0.07 for normal and overweight groups respectively (= 13.46, p < 0.001). This suggest decrease in suicide with increase in BMI from Underweight to Overweight. The study suggests an inverse linear tendency between BMI and suicide. This inverse linear relation between BMI and suicide is supported by studies despite racial and geographical differences.[9-12,17]

In contrast to present study a prospective cohort of 1.1 million adults resulted in nearly equal adjusted hazard ratios for completed suicide for BMI values < 18.5 (0.99 (95% CI: 0.72, 1.37)) compared with a BMI of 18.5-22.9 kg/m^2. [13] Study on cohort of Taiwanese people resulted in an increased risk of suicide in both underweight and extremely obese subjects which is different from our finding. There was a non-linear, J-shaped association between BMI and suicide risk (p for the quadratic term = 0.033). Compared with individuals whose BMI was 18.5–22.9 kg/m^2, adjusted hazard ratios for those with a BMI < 18.5 kg/m^2 or ≥ 35 kg/m^2 were 1.56 (95% CI: 1.07, 2.28) and 3.62 (95% CI: 1.59, 8.22), respectively.[18]

On the other hand, ecological study in the Caribbean Islands[15], National Mortality Follow-back Survey data[14], and South Australian autopsy cohort [16] have found no association.

CONCLUSION

The study resulted in significant difference in mean BMI score between cases (suicide) and controls (non-suicide) (p < 0.001) suggesting BMI does affect manner of death. Overall, suicide decreases with increase in BMI specifically in underweight and normal BMI category. Association between BMI and suicide in overweight is inverse but not strong.

Stringent inclusion and exclusion criterias were main strength of the study, though it resulted in small sample size. Such strict criterion were necessary to ensure the BMI measurement is least affected by antemortem pre-existing disease and/or by postmortem changes. Information on any incident psychiatric disorders or suicide attempts suffered by study samples was not obtained. Nevertheless, there is no clear indication that the presence of such disorders at baseline greatly influenced any of our assessments of BMI-suicide associations. [9] This study has limitations too, most importly single measurement of BMI and study cohort is a selected population of medico-legal cases referred by police for medicolegal autopsy.

Study with longitudinally design and a larger sample size may provide additional insight into the issue. Healthy diet, regular exercise, regulation over sale of insecticides and pesticides, and establishment of help centers for the person who are at the moment of psychological conflict or crisis, are among other recommendations of this study.

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