A Modified Questionnaire to Find Out the Association of Depression with Increased Mortality, Among Urban Decedents, Dying Due to Various Causes

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Abstract: *Introduction:* Depression and Type A behaviour are important risk factors of death due to cardiovascular disease (CVD) and diabetes. Depression also predisposes deaths due to suicides. In the present study, we examine the association of endogenous depression with causes of deaths and accuracy of the questionnaire for diagnosis, among urban decedents in a lower middle income country.

Methods: We studied the randomly selected record1s of death of 2222 (1385 men and 837 women) decedents, aged 25-64 years, out of 3034 death records overall from the records at Municipal Corporation, Moradabad, India. All the families of these decedents could be contacted individually to find out the causes of death, by scientist/doctor administered, informed consented, verbal autopsy questionnaire, completed with the help of the spouse and local treating doctor practising in the appropriate health care region. Clinical data and causes of death were assessed by a questionnaire based on available hospital record and verbal autopsy questionnaire, suggested by WHO and International College of Nutrition (ICN). Decedents were classified into mild to moderate and severe depression based on available records and verbal autopsy questionnaire validated for this study by Agnieszka. The association of depression with causes of death was calculated by Mantel-Haesnzel Chi square test.

Results: Several of the decedents had mild to moderate depression (n=153, 6.88%) (men 6.64 %, n=92; and women 7.28 %, n=61). The prevalence of severely depressed victims was similar among men (1.08%, n=15) women 1.67% (n=14) with a total of 1.3%(n=29). The total prevalence of depression was 8.19% (n=182). There was an overall increase in diabetes mellitus, hypertension, and CAD among decedents with depression and the trend was significant. The prevalence of depression showed a significant rising trend among decedents dying due to circulatory and suicidal causes of death, both among men and women. Multivariate logistic regression analysis after adjustment of age and body mass index revealed that hypertension and CAD and diabetes mellitus were strongly associated whereas depression and sedentary behaviour were weakly associated with risk of deaths due to CVDs. Social class 3 and 4 were not associated with risk of deaths due to CVDs and diabetes. Depression was an important risk factor of deaths due to CVDs and suicides.

Conclusions: The prevalence of depression was substantial among decedents dying due to various causes of death as revealed by the Agnieszka's questionnaire. Depression may be accurately diagnosed as contributing risk factor among decedents dying due to circulatory diseases and suicides.Larger studies would be necessary to demonstrate the accuracy of the questionnaire in the diagnosis of depression and its association of with causes of death among decedents.

Keywords: Behavior, decedents, mortality, stress, suicide, verbal autopsy.

INTRODUCTION

Patients suffering from coronary artery disease (CAD), who have anxiety, have two fold risk of dying from any

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1876-3960/15 2015 Bentham Open

cause compared to those without anxiety and patients with both anxiety and depression have triple the risk of dying [1-3]. Depression is a risk factor of stroke and type 2 diabetes mellitus and they have increased risk of mortality [2-5]. These findings suggest that as many as 4% of the estimated 795,000 strokes that occur in the United States each year can be attributed to depression [6]. Compared to hypertension and diabetes,depression is a relatively minor risk factor for stroke and CAD and other health conditions and behaviours that damage blood vessels.Presence of obesity, hypertension and unhealthy lifestyle factors, in association with depression increases dramatically the risk of cardiovascular disease (CVDs) [7, 8]. Depression appears to be a potential risk factor also for suicides [9].

Depression could contribute to strokes and CAD in many ways, because depressed patients are more likely to smoke or drink heavily, to follow an unhealthy diet, and to neglect their personal health which are well known risk behaviours for CVDs and diabetes [7-10]. Depression can increase the production of stress hormones, cortisol and catecholamines in the body and can trigger inflammation in the blood vessels, cardiomyocytes and neurones. Poor dental hygiene or lack of socializing with friends, that are common among patients with depression, all affect inflammation levels. Depression may also cause people to slack on taking medications needed to control other stroke-related conditions, such as diabetes or high blood pressure. Some atypical antipsychotic medications prescribed for depression have been shown to cause weight gain and obesity, a known risk factor for stroke and CAD. In the present study, we examine the validity of verbal autopsy questionnaire, to find out, if it can be extended to the diagnosis of endogenous depression and its association with deaths due to CVDs, among decedents dying due to various causes without access to autopsy.

SUBJECTS AND METHODS

The details of subjects and methods of this study have been published [11]. In brief, religious considerations in India do not allow us to conduct autopsy to find out the exact causes of death among victims dying due to various causes in the hospital and elsewhere. Therefore, records available at the Municipal Board, based on death certificates were the only sources which might not be absolutely correct.In India, many people die at home without consultation and treatment by a qualified doctor and hence medical certificate and records of treatment, indicating causes of deaths, remain unknown. These records are based on certificates issued by the doctors based on clinical diagnosis and laboratory examinations or by doctors not qualified in modern medicine and are open to bias.

We studied the records of randomly selected, 2842 adult decedents, aged 25-64years, of which 2222 victim's relatives could respond for this study, during the last two years, July1999 to July 2001, as reported earlier [11]. Of 2222 victims, 1385 were males and 837 were females. All the families of these 2222 victims were contacted individually to find out the causes of deaths by verbal autopsy questionnaire [11]. WHO and other experts have proposed that the causes of death may be diagnosed by detailed questionnaires, administered to spouse and the doctors involved [12-14]. The head of every family was personally called after communication with the help of the local accessible doctor in the street. The calls were made via letter, telephone and personal contact via street doctor, before any subject or family was declared a non-contact or non-replier. The verbal autopsy questionnaire was pre-tested by the concerned committee in roughly 30 to 60 families on various aspects concerned with causes of deaths. It was found that 10% of the families who came within reach of survey were declared non-contact or non-responder as reported earlier [11]. Detailed interviews were possible among 90% of the families approached. Clinical data on age, sex, height, weight, marital status, occupation, education, past and family history, history of hypertension, diabetes, stroke, heart attack, kidney disease, liver disease, alcohol intake, drug intake, tobacco intake, lung tuberculosis, bronchitis, asthma, cancer, mental diseases, diarrhea and dysentery, and brain, CVD, infectious diseases, malaria, dengue and accidents, etc., were recorded. Leading questions were asked to get information on the body systems involved in causing death, as given in Appendix **I**. The questionnaire was completed based on the medical record of the victim, death certificate issued by the doctor, interview of the doctor and the family doctor, interview of the spouse and other family members, with the help of a pretested verbal autopsy questionnaire, to accurately know the cause of death in each record of the victims (Appendix **I**). Verbal autopsy questionnaire allowed the interviewer to ascertain the clinical presentation of the victim during illness and up to death based on above documents. This information on probable cause of death related to each body system was reviewed by the internist physician to assess the final cause of death among all the victims. Verbal autopsy questionnaire was extended to study risk factors of the diseases causing death; hypertension, acute coronary syndrome, stroke, obesity, depression, as well as health behavior which may be important in the prevention of these diseases in other populations [13-15]. The questionnaire for the diagnosis of depression was developed by Agnieszka Wilczynska (first author).

CRITERIA OF DIAGNOSIS OF RISKY OR HEALTH BEHAVIOUR

Subjects who admitted to drinking of alcohol at >10 drinks per week were categorized as "high alcohol-consuming' (alcoholism). Physical activity was assessed by questionnaire based on occupational, household and spare time activity. Practice of yoga/active prayer was considered if it was practised for at least 20 minutes per day, at least 5 days in a week. Western style dietary habits were considered in the presence of increased intake of biscuits, refined bread, sugar, syrups, brown or white chocolates and other sugar products and rapidly absorbed fast foods. Tobacco consumption was considered when there was past history of tobacco intake of any form of tobacco, at least once during the last 30 days before death.

The criteria for sedentary behaviour were; walking <14.5 km a week, or climbing <20 flights of stairs a week, during household or occupational activities or in presence of moderately vigorous spare time physical activity on five days a week. Physical activity autopsy was conducted by

verbal autopsy questionnaire.Tobacco intakes of the victims were studied by completing a questionnaire by asking probing questions to spouse [15]. Smoking of cigarettes, beedies, hukka and pipe as well as chewing of tobacco in the form of flavored tobacco, khaini and gutka (chewable tobacco) were duly assessed. The socio- economic status (SES) of the family was classified based on attributes of housing condition, education and health education, occupation, per capita income and ownership of consumer durables like car, television, etc., in the household. Per capita income was calculated by dividing the total income of the family, by the number of family members. Social classes were graded into SES 1-5 depending upon scores.

Dietary intakes of the victim were obtained by trained interviewers by finding out the food intake of the spouse by using 3-day dietary diaries and filling of questionnaires, by asking probing questions about differences in food intake by the decedents. Food models, food measures and food portions were used by the dietitian to find out the exact food intakes of the victims. Salt intakes were assessed by finding out the amount of salt mixed in the food divided by the number of family members and then adding salt consumed by each member during eating. Family doctor or spouse of the victim was asked to suggest a person with identical age, sex, height and weight as that of the victim. In those medical records, in which data on height and weight were not available, we collected these data from these matching subjects. Subjects were classified according to BMI into; overweight (23-24.9Kg/m^2), obese (25-29.9Kg/m^2) and obesity (>30Kg/m^2). The diagnosis of risk factors was based on available records, inquiry from the spouse and doctors involved.

DEPRESSION AUTOPSY

Depression was considered based on attributes of; no desire to get up in the morning, no desire to work, excess of thinking, tingling and heaviness on head in association with anxiety, memory dysfunction, agitation, fear and weeping as given in the Appendix **II**. Depression was graded based on a five item scale, on scores 1-4, of these attributes, into; possible depression, mild to moderate depression and severe depression. Depression scores were recorded as a continuous measure; 0 to 30 as reported in other studies [16]. The reliability of the modified version of this scale has been validated in about 50 subjects with depression. Clinically, a score ≥5 should be recognized as "at risk of clinical depression"; however, we used continuous depression scores in our analyses, instead so as not to lose any information by categorization.

STATISTICAL ANALYSIS

We used the chi-square test for the comparison of frequencies of men and women in the two groups. Only P values <0.05 and the two tailed t-test were considered significant to find out the level of significance and difference. Multivariate logistic regression analysis was conducted, after adjustment of age and body mass index, to demonstrate the association of depression and other factors with risk of death due to CVDs.

RESULTS

The results for demographic data as well as protective factors based on the records and by verbal autopsy questionnaire, among 2222 victims, aged 25-64 years, dying due to cardiovascular causes, are given in the Table **1**. The mean age, and body weight were significantly higher among men compared to women victims. Spare time physical activity and moderate alcohol intake were significantly more common among male decedents compared to females. Regular active prayer and no tobacco were significantly more common among female decedents compared to males. However, the protective factors; spare time physical activity, prudent diet, no tobacco, active prayer were not very common among decedents dying due to CVDs and depression.

There was a high prevalence of obesity, tobacco intake among men compared to women (Table **2**). Social classes 3-5 were comparable in the two sexes. The prevalence of overweight decedents was 29.4% (n=654) and obese 20.8% (n=461) and majority of the overweight and obese victims were from social class 1-3. Several of the decedents had mild to moderate depression (n=153,6.88%) (men 6.64%, n=92; and women 7.28%,n=61). The prevalence of severely depressed victims was similar among men (1.08%, n=15) and women 1.67 % (n=14) with a total of 1.3% (n=29). The total prevalence of depression was 8.19% (n=182).

Table **3** reveals the causes of deaths according to the modified verbal autopsy questionnaire [11]. This modified questionnaire was able to diagnose 23.4% deaths due to heart diseases and 9.8% due to brain diseases, including stroke (7.8%) and inflammatory brain diseases (1.9%) and 5.8% deaths due to malignant causes. Thus, circulatory diseases were the cause of death among 31.2 % (n=695) of the victims. Deaths due to suicides were significantly more common among women compared to men, respectively (1.1 vs. 2.9%, n=16 vs. 25, P <0.05). Renal diseases including acute renal failure and chronic renal failure were the cause of death among 11.2% of victims, pulmonary diseases in 22.3%

Table 1. Clinical data and protective factors among decedents, based on records and answers given by spouse.

Clinical Data	Male (n=1385)	Female (n=837)
	Mean (Standard deviation)	
Mean age	42.12(13.02)	40.05 (11.60)
Body weight	60.12(6.24)*	53.10(6.95)
Body mass index (kg/m)	23.18 (2.18)	23.65 (2.46)

*=P<0.05, P values was obtained by chi square test by comparison of two groups.

Table 2. Prevalence of risk factors among decedents dying due to various causes.

Risk Factors, n (%)	Male (n=1385)	Female (n=837)
Obesity (BMI>25kg/m^2)	277(20.0)	184(22.0)
Overweight (23-24.9kg/m^2)	470(33.9)*	184(22.0)
Hypertension (>140/90mmHg)	457(33.0)	251(30.0)
Diabetes mellitus (known)	110(8.0)	58(7.0)
Depression (by record and interview)	107(7.72)	75(8.96)
Social class 1-3	899(64.9)	484(57.8)
Social classes 4-5	486(35.1)	353(42.2)
Poverty (< US$ 300.00 per month)	508(36.7)	362(43.2)
Sedentary behaviour	747(53.9)*	368(44.0)
Tobacco intake (>Once per week)	623(45.0)**	125(15.0)
Salt intake (>10g/day)	782(56.4)	491(58.6)
Western type diet	775(56.0)	455(54.4)
Alcoholism (>10 drinks/week)	65(4.7)**	1(0.12)
Lack of knowledge on health education	1204(86.9)	732(87.4)

*=P <0.05,**=P <0.001, P value were obtained by chi square test by comparison of frequencies in the two groups.

Table 3. Causes of deaths based on available records and verbal autopsy.

Cause of death	Men	Women	Total
	(n=1385)	**(n=837)**	**(n=2222)**
1. Cardiovascular diseases (n=695, 31.27%))			
Coronary artery disease	137(9.9)	85(10.1)	222(10.0)
Sudden cardiac death	25(1.7)	20(2.4)	45(2.0)
Valvular heart disease	105(7.5)	55(6.5)	160(7.2)
Inflammatory cardiac disease	24(1.7)	20(2.4)	44(2.0)
Diabetic vascular disease	23(1.6)	26(3.1)	49(2.2)
Cerebrovascular disease (CVD)	115(8.3)	60(7.1)	175(7.8)
2.Suicides	16(1.1)	25(2.9)*	41(1.8)
3. Malignant neoplasm			(n=131, 5.8%)
4. Injury- accidents			(n=313, 14.0%)
5. Renal diseases (n=250, 11.2%)	163(11.7)	87(10.3)	250(11.3)
6. Pulmonary diseases			(n=495, 22.3%)
7. Liver diseases			(n=107, 4.8%)
8. Miscellaneous			(n=189, 8.5%)
Total	**1385(62.33)***	**837(37.66)**	**2222(100)**

*=P<0.05, by comparison of death rate in men and women by chi square test.

and liver diseases in 4.8% of the victims.Miscellaneous or other causes of deaths were reported among 8.5%. Results on tobacco intakes and food intakes have been reported in other publications [15,16].

Multivariate logistic regression analysis conducted after adjustment of age and body mass index, revealed that hypertension and CAD and diabetes mellitus were strongly associated whereas depression, sedentary behaviour were

weakly associated with risk of deaths due toCVDs (Table **4**). Social class 3 and 4 were not associated with risk of deaths due to CVDs and diabetes.

DISCUSSION

Recent studies indicate that risk factors and health behaviour appear to be important in the pathogenesis and complications of obesity, hypertension, CAD, stroke and type 2 diabetes mellitus [17-20]. CVDs, type 2 diabetes and suicides are important causes of morbidity and mortality [9,11,20].Tobacco intake and depression appears to be quite common among these patients. It is also established that health behavior or protective factors are also important in providing health and the prevention of CVDs and type 2 diabetes mellitus [17-20]. This study reveals that in both sexes, hypertension and CAD, and diabetes mellitus were strongly associated and depression and sedentary behaviour were weakly associated with risk of death due to CVDs and suicides. Tobacco intake was weakly associated with risk of death among men but not in women because this habit is not common among women (Table **4**). The lower rates of tobacco and alcohol consumption in women, most pronounced in the lower-middle income and low-income countries, are likely due to cultural factors and social stigma associated with women drinking and smoking in these societies. However, some reports suggest that as incomes, independence and affluence in these countries increase, smoking and drinking as well as sedentary behaviour among women could also increase [21,22]. Our study shows that a large gap is present, between existing and desired status of key lifestyle behaviours among decedents dying due to CVDs and other chronic diseases.

Depressive symptoms occur in 19% to 30% of the elderly, but only 1% of those affected receive the necessary treatment but many of them may have increased risk of mortality due to myocardial infarction (MI) [1-4,23,24]. In one meta analysis, 22 prospective studies determined the association of depression with the cardiovascular outcome of patients with (MI, comprised of 6367 patients with MI who had a follow up of 13.7 months (1). Post-MI depression was significantly associated with all-cause mortality (odds ratio [OR], fixed 2.38; 95% confidence interval [CI], 1.76–3.22; P<.00001) and cardiac mortality (OR fixed, 2.59; 95% CI, 1.77–3.77; P<.00001). Depressive MI patients were also at risk for new cardiovascular events (OR random, 1.95; 95% CI, 1.33–2.85; P = .0006). It is possible that post-MI depression was associated with a 2- to 2.5-fold greater risk of impaired cardiovascular outcome. The association of depression with cardiac mortality or all-cause mortality was more pronounced in the older studies (OR, 3.22 before 1992) than in the more recent studies (OR, 2.01 after 1992). Another study systematically reviewed the recent studies of the contribution of depression to the onset of CAD and to estimate the magnitude of the risk posed by depression for onset of CAD [23]. Ten published cohort studies of 4 years or more follow-up, meeting the inclusion criteria, that controlled for other major CAD risk factors and reported relative risks (or a comparable measure) of baseline depression for the onset of CAD were reviewed. Relative risks ranged from 0.98 to 3.5. Nine studies reported significantly increased risk, including two with mixed results; one study reported no increased risk. The combined overall relative risk of depression for the onset of CAD was 1.64 (95% CI = 1.41-1.90). This quantitative review suggests that depressive symptoms contribute a significant independent risk for the onset of CAD, a risk (1.64) that is greater than the risk conferred by passive smoking (1.25) but less than the risk conferred by active smoking (2.5).

In a prospective cohort of 5888 elderly Americans (≥65 years), 4493 participants who were free of CVDs at baseline, were followed up for 6 years and provided annual information on their depressive status [24]. Depression was assessed using the Depression Scale of the Center for Epidemiological Studies. The cumulative mean depression score was assessed for each participant up to the time of cardiovascular event during the 6-year follow-up. Using time-dependent, proportional-hazards models, the unadjusted hazard ratio associated with every 5-unit increase in mean depression score for the development of CAD was 1.15 (P=0.006). The ratio for all-cause mortality was 1.29 (P<0.0001). In multivariate analyses adjusted for age, race, sex, education, diabetes, hypertension, cigarette smoking, total cholesterol, triglyceride level, congestive heart failure, and physical inactivity, the hazard ratio for CAD was 1.15 (P=0.006) and that for all-cause mortality was 1.16

Table 4. Multivariate logistic regression analysis for association of risk factors with risk of death from cardiovascular diseases, after adjustment of age and body mass index, among men and women.

Risk factor	Men	Women
Odds ratio,(95% confidence interval)		Odds ratio,(95% confidence interval)
Diabetes mellitus	0.71(0.65-0.78)**	0.78 (0.74- 0.86)**
Hypertension and CAD	0.75(0.70-0.81)**	0.85 (0.79-0.91)**
Depression	0.92(0.85- 0.99)*	0.90 (0.85-0.97)*
Sedentary behaviour	0.82 (0.76-0.91)*	0.91 (0.83-0.99)*
Tobacco intake	0.88 (0.77- 0.97)*	0.90(0.81-1.01)
Social class 3,4	1.21(1.10-1.34)	1.15(1.08-1.28)

*= P value <0.01, ** = P<0.001.CAD= Coronary artery disease.

(P=0.006). Among participants with the highest cumulative mean depression scores, the risk of CAD increased by 40% and risk of death by 60% compared with those who had the lowest mean scores. It is clear that among elderly Americans, depressive symptoms constitute an independent risk factor for the development of CAD and total mortality.

A great majority of patients with type 2 diabetes die because of CVDs. The association between depression and all-cause and cardiovascular mortality in people with diabetes was studied by systematically reviewing the literature and carrying out a meta-analysis of relevant longitudinal studies [4]. Sixteen studies met the inclusion criteria, which were pooled in an overall all-cause mortality estimate, and five in a cardiovascular mortality estimate. After adjustment for demographic variables and micro- and macrovascular complications, depression was associated with an increased risk of all-cause mortality (HR = 1.46, 95% CI = 1.29–1.66), and cardiovascular mortality (HR = 1.39, 95% CI = 1.11–1.73). Heterogeneity across studies was high for all-cause mortality and relatively low for cardiovascular mortality, with an I-squared of respectively 78.6% and 39.6%. Sub-group analyses showed that the association between depression and mortality did not significantly change when excluding three articles presenting odds ratios, yet this decreased heterogeneity substantially (HR = 1.49, 95% CI = 1.39–1.61, I-squared = 15.1%). A comparison between type 1 and type 2 diabetes could not be undertaken, as only one study reported on type 1 diabetes specifically. This meta analysis revealed that depression is associated with an almost 1.5-fold increased risk of mortality in people with diabetes. Research should focus on both cardiovascular and non-cardiovascular causes of death associated with depression, and determine the underlying behavioural and physiological mechanisms that may explain this association. Several longitudinal epidemiological studies concluded that the combination of diabetes mellitus and depression is associated with higher mortality rates [4,5,25,26]. Patients with diabetes mellitus and depression have younger age of diabetes onset; poor adherence to diet, exercise, and disease control medications; poorer glycaemic control; and an increased risk of macrovascular and microvascular complications [25]. These patients with diabetes are approximately twice as likely to meet the criteria for major depression than the general medical population, with depressive symptoms affecting up to 20–25% and may increase all-cause mortality [25]. In the ACCORD (Action to Control Cardiovascular Risk in Diabetes) Health-Related Quality of Life sub-study, 2,053 subjects completed the Patient Health Questionnaire (PHQ)-9 measure of depression symptoms at baselineand 12, 36, and 48 months [25]. In fully adjusted models, depression was not significantly related to the ACCORD primary composite outcome (cardiovascular death, nonfatal heart attack, or stroke) (HR 1.53 [95% CI 0.85–2.73]) or to the ACCORD microvascular composite outcome (0.93 [0.53–1.62]), but all-cause mortality was significantly increased both in those with PHQ-assessed probable major depression (2.24 [1.24–4.06]) and PHQ score of 10 (1.84 [1.17–2.89]). The effect of depression on all-cause mortality was not related to previous CVDs or to assignment to intensive or standard control of glycaemia. Probable major depression (by PHQ-9) had a borderline impact on the ACCORD macrovascular end point (1.42 [0.99–2.04]). It is possible that depression increases the risk of all-causemortality andmay increase the riskof macrovascular events among adults with type 2 diabetes at high risk for cardiovascular events. Another study included subjects aged 25 to 80 years; neither diabetes nor major depression (n = 214,749), 2) major depression alone (n = 77,568), type2diabetes alone (n = 40,953), and co-morbid major depression and type2diabetes (n = 12,679) [26]. After adjusting for covariates, patients with type 2 diabetes alone and patients with major depression alone were at ∼30% increasedrisk for myocardial infarction (MI), and patients with type 2 diabetes and major depression were at 82% increased risk for MI (hazard ratio 1.82 [95% CI 1.69-1.97]) compared with patients without either condition. It is possible that compared with patients with only diabetes or only major depression, individuals with type 2 diabetes and major depression are at increased risk for new-onset MI. Monitoring cardiovascular health in depressedpatients with type2diabetes may reduce the risk of MI in this especially high-risk group.

This newly developed extended verbal autopsy questionnaire allowed us to find nearly 8.2% of the decedents having depression (Table **2**). This study shows that using the modified and extended verbal autopsy questionnaire, allowed us to diagnose depression as well as risk factors of CVDs and diabetes; sedentary behaviour, tobacco intake, alcoholism, western dietary habits and social classes (Tables **2** & **3**). The questionnaires also allowed us to diagnose 31.2% deaths due to CVDs (23.4% deaths due to heart diseases and diabetes and 7.8% due to stroke) as well as deaths due to suicides (n=41,1.8%); deaths in patients of diabetes mellitus were due to vascular diseases (Table **3**). No other study has used verbal -autopsy questionnaires to examine the presence of depression among decedents dying due to various causes. Therefore, we cannot compare our results with other studies.

It is important that depression screening instruments should be accurate. The accuracy of Spanish language depression-screening instrument was studied in a meta analysis, for the use of primary care physicians [27]. Twelve studies met inclusion criteria. In general primary care screening, the Spanish language version of the Center for Epidemiologic Studies-Depression scale (CES-D) had sensitivities ranging from 76% to 92% and specificities ranging from 70% to 74%. We found no US study reporting the accuracy of the Primary Care Evaluation of Mental Disorders (PRIME-MD-9) or the Patient Health Questionnaire (PHQ-9) depression module in Spanish-speakers. One fair-quality European study and 1 poor-quality study conducted in Honduras found the 9-item PRIME-MD had sensitivities ranging from 72% to 77% and specificities ranging from 86% to 100%. The 2-item PRIME-MD was 92% sensitive, but only 44% specific for depression in 1 US study. In geriatric outpatients, the 15-item Spanish language version of the Geriatric Depression Scale (GDS) had sensitivities ranging from 76% to 82%, and specificities ranging from 64% to 98%. In postpartum women, the Spanish language version of the Edinburgh Postnatal Depression Scale (EPDS) was 72% to 89% sensitive and 86% to 95% specific for major depression (2 non-US

studies). The Spanish language version of the Postpartum Depression Screening Scale (PDSS) was 78% sensitive and 85% specific for combined major/minor depression (1 US study).For depression screening in Spanish-speaking outpatients, evidence somewhat supports the diagnostic accuracy of the CES-D and PRIME-MD-9 in general primary care, the GDS-15-Spanish for geriatric patients, and the Spanish language versions of the EPDS or PDSS for postpartum patients. The ultra-short 2-item version of PRIME-MD may lack specificity in US Spanish-speakers.

It remains unknown whether the brief instruments validated in lower and middle income counties are as accurate as the long ones [28]. Nineteen studies met the inclusion criteria. The reported prevalence of depression in low and middle income countries ranged from 11.1 to 53% which is higher than the prevalence of 8.2% observed in our study. The lower prevalence of depression in our study may be because we considered only those victims who had available, a record of treatment or definite history of diagnosis and treatment of depression, given by the spouse.The area under curve (AUC) scores of the validated instruments ranged from 0.69-0.99. The accuracy of brief as well as long screening instruments was acceptable (AUC $\geq$0.7). Five of the 19 instruments were validated within HIV settings. There was statistically significant heterogeneity between the studies, and hence a meta-analysis could not be conducted to completion. It is possible that brief depression screening instruments in both general and HIV-PHC are as accurate as the long ones and brief scales can be administered in a much shorter time. However, diagnostic interview may be necessary for final diagnosis of depression.

Verbal autopsy questionnaire allowed the interviewer to ascertain the clinical presentation of the victim during illness and up to death, as well as the presence of risk factors of CVDs, diabetes, suicides and depression. These characteristics of behaviour may be available in the medical records or may be obtained from the family members and doctors of the decedents. This information on probable presence of depression or risky behaviour and CVDs and diabetes, related to each body system was reviewed to assess the final diagnosis with a view on cause of death among all the victims by the internist physician (RBS). Verbal autopsy extended to examine depression pattern, appears to be a valid and reliable supplemental method to assess the role of depression and risky behaviour which may be important in the pathogenesis of the causes of death in a population where records of death are maintained in a municipal corporation in any country of the world. The most important reason for the success of our extended verbal autopsy may be the appropriate modifications made to adapt it to the local setting, in the adult questionnaire [29].

In a further study, 536 consecutive adult patients with depression without mania or schizophrenia were examined [16]. The measurements included two questions from the Primary Care Evaluation of Mental Disorders patient questionnaire.The case-finding instruments had sensitivities of 89% to 96% and specificities of 51% to 72% for diagnosing major depression. A positive response to the two-item instrument had a sensitivity of 96% (95% confidence interval CI, 90-99%) and a specificity of 57% (95% CI 53-62%). Areas under the receiver operating characteristic curves were similar for all of the instruments, with a range of 0.82 to 0.89.The prevalence of depression, as determined by the standardized interview, was 18% (97 of 536). It is possible that the two-question case-finding instrument is a useful measure for detecting depression in primary care. It has similar test characteristics to other case-finding instruments and is less time-consuming. Our questionnaire included attributes of five questions which indicated its comprehensiveness but it is important because it is administered to spouse not the victim (Appendix **II**).

In many developing countries, verbal autopsy has been found to provide more valid causes of death compared to routine death certificates issued by the doctors [11-15]. In low resource countries like India, verbal autopsy methodology was developed for national mortality surveillance systems [11-15] as well as for body weight autopsy, social autopsy, tobacco consumption autopsy and dietary autopsy [11]. It ispossible that extended verbal autopsy to find out depression associated with causes of death can be obtained with accuracy, which may be useful in the assessment of causes of deaths that can be used for prevention of diseases.

All studies using verbal autopsy for finding out the causes of death among adults, did not find similar results [11-15]. It is likely that verbal autopsy is a developing method which needs further refinement to improve its accuracy. Therefore lack of accuracy in the questionnaires may be an important cause of inconsistency in results in some of the studies [27,28]. Verbal autopsy methodology and questionnaires appear to have many variations depending upon the responder's education, investigator's qualification and knowledge of the experts [11-15]. In some of the studies, ICD coding system for the causes of death may not have been used and hence WHO has recently published instructions to improve the quality and standards for application of this method [14,29]. The advantage of medical records and death certificates during the completion of verbal autopsy questionnaire is that in majority of these decedents, a prior hospital-based diagnosis of the primary cause of death and some of the risk factors may be available. In many cases, leading questions may be asked to find out the psychological behaviour patterns in association with the cause of death. It is possible that this extended verbal autopsy method may be a promising approach and of gold standard in identifying most precisely the exact risk factors and cause of death which may be as good as history of present illness in a living patient and post-mortem after death.

Our verbal autopsy questionnaire extended to study depression also provide information about social class, tobacco intake, sedentary behaviour and dietary patterns of the decedents, which may be of great help in planning the prevention programs in the populations, because CVDs and diabetes have become major causes of mortality in the world [30]. Further studies indicate that modification of risky behaviour may be important in the prevention of diseases [31-36]. Recent studies also confirm the role of health behaviour pattern in the pathogenesis of deaths due to various diseases [16].

LIMITATIONS

In our study, an important limitation is that we could not compare our results with depression and risky behaviour pattern and causes of death obtained by death certificate alone versus verbal autopsy combined with medical records by using kappa statistics. Other weaknesses are that only one internist physician reviewed the records of all the victims and incase the diagnosis of cause was doubtful, a second opinion was taken from a psychologist. It seems that availability of at least 3 internist physicians including a psychologist to review the records to finalize the diagnosis of depression and cause of death, may be more useful, if adequate resources are available. In future, use of MP3 players to compare audio (observed on computer) with paper record on a 5% population to determine the degree of concordance of the autopsy questionnaire can further improve the verbal autopsy. Our results may also underestimate the potential sensitivity and specificity of the verbal autopsy methods because questionnaires were completed by only one interviewer. Recently mental, social and physical well being of the population has been studied by questionnaires in which spritual and environmental wellbeing have not been given due consideration [37]. Such questionnaires can be updated for verbal autopsy, after finding out the invariance for accuracy [38].

In brief, our results indicate that extended verbal autopsy for assessment of depression and risky behaviours; western dietary pattern, sedentary behaviour, tobacco intake, social class and causes of death of the victims, appears to be reliable and valid. These methods of extended verbal autopsy for the assessment of depression can be used in a large scale cohort study for further validity, in any country of the world.

APPENDIX I

HALBERG HOSPITAL & RESEARCH INSTITUTE/ICN/ICC/TTI

VERBAL AUTOPSY QUESTIONNAIRE BASED ON DEATH CERTIFICATE, MEDICAL RECORDS AND INTERVIEW.

Name and post of expert filling the Questionnaire ……Tel….

History Given By: Spouse/Father/Mother/Sister/Son/Daughter/Inlaws (tick) Education of person..... Date……..Place…….Time……

of Interview……. Unique ID……..

GENERAL DATA:

Name of Victim……..……Surname…… Sex……Age…
Address……
……Tel No……

1. Religion: (a) Hindu (b) Moslem (c) Christian (d) Sikh

2. Final education of victim……Occupation of victim……Family Type……

3. The date…… Place ……. and Time of Death……..

4. Physically Matching subject with victim/Name, address……

CLINICAL DATA OF VICTIM. (By Medical Records)

5. Family history of diabetes, hypertension, cholesterol, heart attack, stroke, cancer, bronchitis, asthma, obesity, suicide, HIV, depression, psychosis, anxiety, Type Abehaviour, alcohol intake, tobacco.

6. Any past history of above, illnesses (Name)

7. Height ……cm ….Weight ….Kg, BMI… (Kg/M 2)

8. Waist circumference…… cm, maximum hip circumference……WHR……

9. Blood pressure…….. mmHg, Grey hair/Cataract/Wrinkles. (Tick)

10. History of surgery……

11. Chest Pain. ……..……..

Table: Causes of deaths reported based on available records and verbal autopsy (modified from WHO) (Ask leading questions to know the system involved).

Cause of death	**Death Certificate**	**Spouse**	**Doctor**	**Final**

1. Circulatory diseases; Coronary artery disease, stroke, Sudden cardiac death, Diabetes, Vascular disease, Valvular heart disease, Inflammatory cardiac disease.

2. Nervous system diseases; Meningitis, encephalitis, degenerative brain disease.

3. Malignant neoplasm; Lung, oral, liver, stomach, breast, uterus, cervix, ovary.

4. Injury- accidents; Unintentional, road accidents, poisonings, fires, falls, drowning.

5. Renal diseases. Acute renal failure, chronic renal failure.

6. Pulmonary diseases; Chronic bronchitis, asthma, tuberculosis, acute pulmonary infection.

7. Liver diseases; Hepatitis, cirrhosis

8. Suicides; causes- fall, poisoning, burning, insecticides, drugs, alcoholism.

9. Miscellaneous; Pregnancy and perinatal, suicide, congenital anomalies, HIV,burns, Diarrhoea/dysentery.

Modified from reference [11].

APPENDIX II

DEPRESSION AUTOPSY QUESTIONNAIRE. BASED ON DEATH CERTIFICATE, MEDICAL RECORDS AND INTERVIEW.

DEPRESSION AUTOPSY (Score constructed 1-4 based on each attribute of depression).

A). No desire to get up in the morning.

4 If the victim had definite history of no desire to get up in the morning.

3 If victim did not respond to command by the spouse to get up.

2 If victim was obeying to get up on suggestion by the spouse.

1 If victim had difficulty in getting up in the morning.

B). No desire to work

4 If victims had definite history of no desire to work and not going for working.

3If victim did not respond to suggestion by the spouse to go for daily activities.

2 If victim was obeying to go for work on suggestion by the spouse.

1 If victim had difficulty in getting ready in the morning to go for work.

C). Excess of thinking.

4 If victim is thinking too much which is amounting to self talking?

3 If victim is complaining that he is thinking too much.

2 If victim follows the advice of the spouse to avoid too much of thinking.

1 If victim is able to avoid excess of thinking in taking decision.

D). Tingling and heaviness on head.

4 If victim had severe tingling and heaviness in head.

3 If victim has moderate tingling or heaviness in head.

2 If victim has mild tingling or heaviness on head.

1 If victim has off and on these symptoms.

E). Anxiety, Memory dysfunction, Agitation, Fear and Weeping.

4 If victim had all above complains.

3 If victim had 4-5 of above complaints.

2 If victim had anxiety and memory dysfunction.

1 If victim had only anxiety or memory dysfunction.

Total score 5-9= possible depression, Score 10-14= moderate depression, Score 15-20 = Severe depression.

Modified from reference [16].

CONFLICT OF INTEREST

None declared.

ACKNOWLEDGEMENTS

These are due to the International College of Nutrition, International College of Cardiology and The Tsim Tsoum Institute, Krakow, Poland for logistic support in preparing this article.

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Received: October 24, 2014 Revised: November 01, 2014 Accepted: November 01, 2014