Diabetes and Depression:
A comparative study of tsunami affected and non affected population in Sri Lanka

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May 2008

Thesis submitted as a part of the
Master of Philosophy Degree in International Community Health

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1. ACKNOWLEDGEMENT

I would like to acknowledge and express my gratitude to the Norwegian Agency of Development Cooperation (NORAD) and the department of International Health, University of Oslo for making this project possible. I also would like to be grateful to the ministry of health, central province of Sri Lanka for the various support rendered to me before and during the period of this research.

I would like to express my gratitude and sincere thanks to my supervisor, Prof. Akthar Hussein for his valuable instructions and guidance given throughout the project.

My exclusive thanks go to Prof. Gunner Bjune and Vibeke Kriste at the department of international community health university of Oslo. I express my unique gratitude to Prof. R. Sivakanesan at the University of Peradeniya Sri Lanka for his support in conducting the laboratory investigations in the biochemistry laboratory.

I further wish to express my sincere thanks and appreciation to all the participants of this project and members of the survey team who helped me a lot to make this possible. I am indebted to Mr. Jayaratne (my uncle) and Ms.Nadee Kulasekara and family, for their constant support and encouragement given throughout the of field work in the midst of security instability in the area.

This project would not have been possible without the support of my wife and little son for their unremitting lacking complaints during the period of my stay away from home.

2. ABBREVIATIONS

ADA -American Diabetes Association

BP -Blood Pressure

BG -Blood Glucose

BMI -Body Mass Index

CI -Confidence Interval

CVD -Cardio Vascular Diseases

CHD -Coronary Heart Disease

CBR -Crude Birth Rate

CDR -Crude Death Rate

DM -Diabetes Mellitus

dHTN -Diastolic Hypertension

sHTN -Systolic Hypertension

FBG -Fasting Blood Glucose

HT -Hypertension

IGT -Impaired Glucose Tolerance

IFG -Impaired Fasting Glucose

LBW -Low Birth Weight

OGTT -Oral Glucose Tolerance Test

OR -Odds Ratio

WHO -World Health Organization

Wt. -Weight

WHR -Waist to Hip Ratio

X^2 -Chi Square Value

1. ABSTRACT

Diabetes and Depression: A comparative study of Tsunami affected and non affected population in Sri Lanka.

Background:

Diabetes and depression are common non communicable diseases increasing rapidly and exert tremendous community health problems in developing countries like Sri Lanka. Disaster related experiences can be traumatic and can have lasting effects on people, resulting increased prevalence of depression and thereby double burden of diabetes.

Objectives:

This study is focussed on the prevalence of diabetes and depression and its relationship in a tsunami affected area and a non affected area in Sri Lanka after 3 years of tsunami catastrophe.

Methods:

A cross sectional population based study was performed in a two analogous communities representing tsunami effected and a non effected population in the Hambantota district of Sri Lanka. A total of 740 people both male and female above 20 years of age participated representing tsunami non effected (425) and effected (315) areas.

Prevalence of diabetes was determined by Fasting Blood Glucose (FBS) values according to the WHO guidelines in1999. Additionally, 2 hour post glucose test. (2h BG) after 75g glucose drink was also measured. The prevalence of depressive symptoms was determined using Montgomery Åsburg Depression Rating Scale (MARDS). Potential socio demographic characteristics measured by interviewer administered questionnaire and anthropometric indicators measured by body measurements according to WHO criteria. (BMI, waist to hip ratio, Blood pressure,)

Results:

In total population studied (740), prevalence of diabetes was 10.5%. Prevalence of diabetes was higher in the tsunami effected (11.7%) than that of tsunami none effected participants. (9.6%), (95% CI=0.77-1.9).

Prevalence of diabetes was increased with increasing age and also with increasing BMI. In both tsunami effected and non effected areas, prevalence of diabetes was higher in females than males. A substantial agreement was found (Kappa 0.628, P <0.001) between FBG values and 2h BG values.

Significant risk factors for development of diabetes were higher age, high BMI, high WHR (in females), high total cholesterol levels, higher weight, and Depression.

Prevalence of Depression was 17.3% in the total population. It was significantly higher in tsunami effected (22.5%) than non effected (13.4%). Prevalence of depression increased with increasing age. In both tsunami effected and non effected population, depression was higher in females than males. Diabetes, tsunami affected people, higher age, higher BMI and higher Systolic Blood pressure were identified as significant risk factors for depression.

There was a strong relationship between prevalence of diabetes and depression.

Conclusion:

Prevalence of Diabetes and depression was higher in the tsunami effected than that of non effected population. There is a significant relationship between depression and diabetes. It is prime important that disaster management plans include management of non communicable diseases including diabetes and depression in developing countries like Sri Lanka. Further, psychiatric interventions may be needed to overt the exponential rise in the prevalence of diabetes mellitus in this population.

4. INTRODUCTION

TOPIC:

Diabetes and Depression: A comparative study of Tsunami affected and a non effected population in Sri Lanka.

BACKGROUND:

Non Communicable Diseases (NCD), known to be increasing alarmingly in the South East Asia region in the recent times. The epidemiological transition in most of these countries including Sri Lanka has reached a stage where the NCDs outweigh the communicable diseases. If the current rapid increase in NCDs is left unattended, it will have significant social, economic, and health consequences in Sri Lanka. (1)

Diabetes and depression are common non communicable diseases widely distributed throughout the world. There are currently about 200 million people with diabetes worldwide. This number will exceed 333 million by the year 2025. (2) Estimated number of diabetics for the South East Asia region is 38,488,650, (1998). Prevalence rate of diabetes in Sri Lankan population is 12.4.% (3)

Currently Sri Lanka has a very high increasing trend of non communicable diseases including diabetes (12-15%) and depression (10-15%). When developing countries are affected with massive destructions like tsunami, NCD burden also increases rapidly.

Diabetes has a long latent asymptomatic period which might lead to high rate of undetected diabetes in a vulnerable population. (4) Substantial proportion of diabetics are undiagnosed, especially after disasters, this number could be increased.

The WHO and international diabetic federation meeting in 2003 revealed that substantial numbers of newly referred diabetics already have micro vascular complications. Since diabetes complications have high health-care costs, poor countries should not wait for the

pandemic. Poor countries cannot afford the increasing cost of management of complications such as chronic renal failure and blindness. Occurrence of complications in the poor countries is higher because of later diagnosis, inaction on risk factors, and poor management. (5)

Moreover, an estimated 121 million people in the world currently suffer from depression: 6% of men and 10% of women will experience a depressive episode in any given year. (2) In Sri Lanka, between 5 to 10% of population are known to suffer from mental disorders that require clinical intervention. Sri Lanka is one of the countries with highest suicidal rate.(6),(7)

Disaster related experiences can be traumatic and can have lasting effects on people. A catastrophic event like tsunami exerts tremendous psychological stress on the effected population. It is important to investigate long term effects of these stressors on conditions like diabetes and depression. (8)

On the 26th December 2004, a giant ocean shockwave, or tsunami, devastated the shorelines of many Asian countries including Sri Lanka. It claimed more than 35,000 lives in Sri Lanka, (2),(9), (10),(11).

Studies conducted in the regional countries after tsunami reveals that prevalence of symptoms of post traumatic stress disorder (PTSD), anxiety and depression among individuals residing in areas affected by tsunami were high compared to other areas. The rates of PTSD, depression and anxiety were higher recently after tsunami and those rates declines with time.(12),(13),(14),(15),

In recent years researchers have found the relationship between diabetes and traumatic stressors like depression and anxiety disorders(16),(17),(18).

Depression being a consequence of diabetes can also be a risk factor for the onset of type 2 diabetes. (19)

The knowledge on prevalence and relationship of diabetes and depression subsequent to a severe stressful situation like tsunami is greatly valuable in health planning and implementation after any kind of natural disaster.

This study is focussed on prevalence of diabetes and depression and its relationship in a tsunami affected area and a non affected area in Sri Lanka.

4.1 Diabetes Mellitus – Classification, Associated factors, Diagnosis and prevalence

4.1.1. Diabetes Mellitus -

Diabetes mellitus is a heterogeneous metabolic disease in which hyperglycaemia is a central feature. Insufficient insulin action on the peripheral target tissues of body gives rise to abnormalities of carbohydrate, protein and fat metabolism. This insufficient insulin action in peripheral tissues occurs as a result of insufficient insulin secretion (type 1), diminished tissue response to insulin (type 2), or as a combination of both. (20),(21)

Pathogenesis of development of diabetes includes several processes. Autoimmune destruction of the ß-cells of the pancreas, and some abnormalities that exert resistance to insulin action are primary courses. The abnormalities in carbohydrate, fat, and protein metabolism are due to the deficient action of insulin on target tissues. The deficient insulin action is a result of inadequate insulin secretion and/ or diminished tissue response to insulin at some point in the complex pathway of hormone action. Both these mechanisms can co exist in the same patient. (22)

The effects of diabetes mellitus include long-term damage, dysfunction and failure of various organs. Common complications of diabetes mellitus include progressive development of the specific complications of retinopathy with potential blindness, nephropathy that may lead to renal failure, and/or neuropathy with risk of foot ulcers, amputation, and features of autonomic dysfunction, including sexual dysfunction. (23). Diabetes is a leading course of non traumatic amputations of the limbs, new cases of end

stage renal disease, and blindness in adults. The aetiology and patho-physiology leading to the hyperglycaemia, however are markedly different among patients with diabetes mellitus. The 5th leading cause of death in Sri Lanka, (24) diabetes further contributes to cardiac and stroke-related morbidity and mortality. It is a major course of functional disability.

4.1.2 Classification of diabetes mellitus

The earlier classification by the National Diabetes Data Group (NDDG) which was published in 1979 was endorsed by WHO in 1980 and it was widely adopted and accepted internationally. It is modified in 1985 and from then, it was updated several times by the expert committees of WHO.

New recommendations for the classification and diagnosis of diabetes mellitus include the preferred use of the terms "type 1" and "type 2" to designate the two major types of diabetes mellitus instead of earlier classification "IDDM" and "NIDDM".

The revised classification of diabetes suggested by Kuzuya and Matsuda (25) encompasses both clinical stages and etiological types of management and other categories of hyperglycemia.

Other specific types of diabetes mellitus includes a vide range of classifications.

4.1.3 Associated/ risk Factors of Diabetes Mellitus

The more the risk factor an individual has the greater his or her likelihood of developing type 2 diabetes mellitus. Randomised clinical trials have demonstrated that type 2 diabetes can largely be prevented through diet and lifestyle modifications or drug treatment. (26)

Obesity:

The number one risk factor for type 2 diabetes is obesity. Greater weight means a higher risk of insulin resistance, because fat interferes with the body's ability to use insulin. Individuals who carry most of the body weight in the trunk of their bodies tend to have higher risk of diabetes than those of similar weight with most of their body weight above the hip. Studies have shown that if weight is reduced it helps greatly to reduce incidence of diabetes. Losing a moderate amount of weight can dramatically slow the progression of the disease.

Sedentary Lifestyle:

Sedentary lifestyles leads to increased weight and then increased BMI. Physical activity reduces BMI while decreasing insulin resistance. Muscle cells have more insulin receptors than fat cells, so a person can decrease insulin resistance by exercising. Being more active also lowers blood sugar levels by helping insulin to be more effective.

Unhealthy eating habits:

Unhealthy eating habits contribute largely to obesity. Too much fat, not enough fiber and too many simple carbohydrates all contribute to increased risk to diabetes. In US, 90% of diabetics are overweight or obese. ( ) Intake of fiber containing foods are very helpful to reduce the risk of developing diabetes. Whole grain breeds and cereals, brown rice, dried beans and peas, fresh fruits and vegetables are rich sources of good dietary fiber.

Family history of Diabetes mellitus and genetics:

Having a family history of diabetes increases the risk of diabetes but it is not essentially a guarantee of diabetes diagnosis. Lifestyle plays an important roll in getting diabetes in this category of people.

(Increased) Age:

Age increases the risk of type 2 diabetes mellitus. With a reduced functionality of the pancreas to pump insulin at the old age it predisposes to develop diabetes.

High blood pressure and high cholesterol levels;

These are two major risk factors of developing diabetes and metabolic syndrome. They also increase the risk of cardio vascular diseases too.

Gestational diabetes mellitus:

Gestational diabetes results when hormones from the placenta makes pregnant women insulin resistant. Many women with gestational diabetes develop type 2 diabetes in their later lives. Babies are also at some risk to develop diabetes later in their lives.

Race or ethnic background:

The risk of type 2 diabetes is greater in Hispanics, blacks, Native Americans and Asians.

4.1.4 Diagnosis of Diabetes Mellitus.

New diagnosis criteria for diabetes by ADA

There are three possible ways of diagnosing diabetes mellitus. But in the absence of unequivocal hyperglycemia, the diagnosis must be confirmed in another later day.

(22)

1.) Symptoms of diabetes plus casual plasma glucose concentration ≥200 mg/dl (11.1 mmol/l). Casual is defined as any time of day without regard to time since last meal. The classic symptoms of diabetes include polyuria, polydipsia, and unexplained weight loss.
Or
2.) FPG ≥126 mg/dl (7.0 mmol/l). Fasting is defined as no caloric intake for at least 8 h.
Or
3.) 2-h postload glucose ≥200 mg/dl (11.1 mmol/l) during an OGTT. The test should be performed as described by WHO, using a glucose load containing the equivalent of 75 g anhydrous glucose dissolved in water

Table 01 A

Values for diagnosis of diabetes mellitus and other categories of hyperglycemia

	Glucose Concentration, mmol/L (mg/100ml)			
	Whole Blood		Plasma	
	Venous	Capillary	Venous	Capillary
Diabetes Mellitus Fasting 2-h. post glucose load	≥ 6.1 (≥110) ≥ 10.0 (≥180)	≥ 6.1 (≥110) ≥11.1 (≥200)	≥7.0 (≥126) ≥11.1 (≥200)	≥7.0 (≥126) ≥12.2(≥220)
Impaired Glucose Tolerance (IGT) Fasting 2-h post glucose load	> 6.1 (<110) ≥6.7 (≥120) and <10.0 (<180)	< 6.1 (<110) 7.8 (≥140) and <10.0 (<180)	<7.0 (<126) 7.8 (≥140) and <11.1 (<200)	<7.0(<126) ≥8.9 (≥160) And <12.2 <220)
Impaired Fasting Glyceamia (IFG) Fasting 2-h post glucose load	≥5.6 (≥100) <6.1 (<110) <6.7 (<120)	≥5.6 (≥100) <6.1 (<110) <7.8 (<140)	≥5.6 (≥100) <7.0 (<126) <7.8 (<140)	≥6.1 (≥110) <7.0 (<126) <8.9 (<160)

Source: An update on Diabetes, including HbA1c and micro albumin, First edition. August 2000; Page no 08, Jak Jervell, University of Oslo Norway.

4.1.5 Prevalence of Diabetes Worldwide, Asia and Sri Lanka

Table 02 A

Estimated prevalence of diabetes mellitus and impaired glucose tolerance in the world in 2003 and 2005

All diabetes and IGT	2003	2025
Total world population (billions)	6.3	8.0
Adult population (20-79 years)	3.8	5.3
Number of people with diabetes (millions) (20-79 years)	194	333
World diabetes prevalence (%) (20-79 years)	5.1	6.3
Number of people with IGT (millions) (20-79 years)	314	472
IGT prevalence (%) (20-79 Years)	8.2	9.0

Source: THE LANCET- Volume 360, Issue 9335, 7 September 2002, Pages 804-805**(27)**

Table 03 A

Prevalence of type 2 diabetes in urban and rural areas of selected Asian countries and male to female ratio

	Prevalence of type 2 diabetes (%)		Male/female rate ratio
	Urban	**Rural**	
Country			
Bangladesh	7·9%	3·8%	1·15
India	12·1%	2·9%	1·05
Nepal	14·1%	2·9%	1·31
Pakistan	10·8%	6·5%	1·32
Sri Lanka	10.5%	5.5%	2·13

Source: THE LANCET- Volume 360, Issue 9335, 7 September 2002, Pages 804-805**(28)**

There are currently about 200 million people with diabetes worldwide, the number will exceed 333 million by the year 2025. (29) Most of the increase will occur in South Asian region. Estimated number of diabetics for the South East Asia region was 38,488,650, for the year 1998. (WHO)

Prevalence of diabetes is rising to western levels and will even higher in the near future. Especially in the newly industrialized countries in Asia Pacific region have vast changes in socio demographic factors, in particular greater age of the population, increased proportion of living in the urban environment and mounting levels of obesity. All these factors likely to rise still further, the burden of diabetes related diseases will continue to increase in Asia at least the next few decades. (30)

Prevalence rate of diabetes in Sri Lankan population is 12.4%. In 2005 the total population in Sri Lanka was 18,700,000 and there were 1,500,000 cases of diabetes.(31)

4.2 Depression

Depression is a syndrome (group of symptoms) that reflects a sad mood exceeding normal sadness or grief. More specifically, the sadness of depression is characterized by a greater intensity and duration and by more severe symptoms and functional disabilities than is normal.

Depression is thought to result from disruption of the normal brain neurochemistry. Depression symptoms are characterized by negative thoughts, moods, and behaviors, and also it can give rise to specific changes in bodily functions (for example, irregular eating, sleeping, crying spells, and decreased libido). The functional changes of clinical depression are often called neurovegetative signs. This means that the nervous system changes in the brain cause many physical changes that result in diminished activity and participation.

Certain people with depressive disorder, especially bipolar depression (manic depression), seem to have an inherited vulnerability to this condition. Depressive disorders are a huge public health problem in the developing countries.

Depressive disorders are associated with poor work productivity, as indicated by a 3-fold increase in the number of sick days in the month preceding the illness for workers with a depressive illness compared with coworkers who did not have such an illness.

Depressive illnesses also affect family members and caregivers in many different ways. There is increasing evidence that children of women with depression have increased rates of problems in school and with behavior, and have lower levels of social competence and self-esteem than their classmates with mothers who do not have depression.(32) Depression is the leading cause of disability and premature death among people aged 18 to 44 years, and it is expected to be the second leading cause of disability for people of all ages by 2020. (33)

.**Depression Classification**

The classification of depression is a controversial issue that has caused debate amongst psychiatrists

Currently accepted classification includes several types.

1).Primary versus secondary depression. Primary depression is not as a result of any other medical condition or psychological cause. Secondary depression is caused by a medical condition or other psychiatric illness.

2). Unipolar versus bipolar depression.- Persons only ever had episodes of depression (recurrent depressive illness) If a patient has had at lest one episode of elevated mood, (mania) along with episodes of depression, they are called as bipolar effective disorder. (Mania depression) both can be inherited.

3). Depressive illness versus depressive symptoms.

4). Dysthymia (chronic mild depression) versus depressive illness. Dysthymia is defined by the presence of depressive symptoms for at least two years.

Depressive illness versus depressive symptoms

Diagnosis of depression needs fulfilling the arbitrary diagnostic criteria with certain number of depressive symptoms persisting consistently over a couple of weeks or more. But everybody can have a low mood from time to time which is different from suffering from a depressive illness. Depressive symptoms can be found in a person without concluding the diagnosis of depressive illness. (could be a milder form of depression.)

4.2.1 Associated factors of Depression

Depression is twice as common in women as in men. The risk of a major depression increases 1.5 to 3.0 times if the illness is present in a first-degree relative as compared with no such illness in a first-degree relative.

4.2.2 Diagnosis of Depression

Diagnosis of depression is simply based on the presence of certain arbitrarily defined symptoms. There is still no diagnostic test for depression, such as a blood test or scan, which is able to confirm whether somebody has the illness.

The thorough diagnostic evaluation includes a complex history of the patient's symptoms and physical examination.

A complete psychological diagnostic evaluation will include a complete history of the symptoms i.e., time of start of symptoms, how long they lasted, how severe they are, and any past symptoms and treatments for depression, alcohol or drug use, and suicidal thoughts. Further more it is important to have information on depressive disorders in the family members and if they were treated for depression.

The diagnosis made after the evaluation of history and mental status examination to determine the effects on persons speech, thought pattern, or memory as often these will be effected in depressive and manic disorders.

The psychological diagnostic evaluation will include a mental status examination to assess the full range of psychological symptoms and problems to determine the most appropriate treatment regime.

4.2.3 Prevalence of Depression Worldwide, Asia, and Sri Lanka

An estimated 121 million people currently suffer from depression globally. In many societies, 6% of men and 10% of women will experience a depressive episode in any given year. (34) From 1998 to 2001, there was a 9.2% increase in the number of children and adolescents in Sri Lanka who sought medical advice for behavioral and emotional disorders. Higher rates of depression were reported in the areas effected by long time civil war, and most of them are youngsters. Other factors contributing to the high prevalence could be drug abuse, risky sexual behavior, and other adolescent problems.

(35) Prevalence of depression in Sri Lanka is high due to a combination of socio-cultural and economical factors.

Between 5 to 10% of population in Sri Lanka are known to suffer from mental disorders that require clinical intervention(6). Two percent of the 19.0 million populations suffer from serious mental disorders. The most recent figures show that the suicide rate in Sri Lanka is 44.6 for men and 16.8 per 100,000 for women. Some 6,000 people commit suicide annually in Sri Lanka and at least half of them could be treated for mental disorders and their lives could be saved. Further,WHO statistics indicate that 25 percent of work absenteeism is due to mental disorders.(36) Despite its high prevalence, most of the mental health problems including depression is not treated adequately in Sri Lanka due to various reasons. Only one-third of all patients with depression receive adequate treatment.(37).

Since the cost spent on NCDs will be even higher in the future, this is likely to impact on the total health care system in countries with limited resources like Sri Lanka.

4.3 Relationship of diabetes and depression

Diabetes and depression are both commonly occurring conditions in population. Both diabetes and depression are associated with the modern lifestyles of today's society. It is important to identify factors influencing both the occurrence and control of diabetes at a time when health care use and cost related to NCDs are increasing rapidly.

Research reveals that traumatic stressors which caused by exposures to natural disasters, could lead to adverse health outcomes including development of non communicable disease.

In recent years many researchers have found the relationship between diabetes and traumatic stressors like depression and anxiety disorders. (38) (39)

The prevalence of depression is higher in people with diabetes than it is in people without diabetes**.** Approximately 30% of people with diabetes have depressive

symptoms. Epidemiological data on the relationship between depression and diabetes mellitus is well established, (40) but the pathophysiology of the phenomenon is yet to be established. The cause for the temporal relationship between diabetes and depression could be multi factorial since both diabetes type 2 and depression are subjected to multi factorial aetiology.

The association between depression and glucose tolerance status was measured by a multiethnic study, and depression was significantly associated with treated diabetes. (41)

A literature search done in 48 studies that reported prevalence of depression in diabetes published in MEDLINE and psycINFO databases was analysed to estimate the odds and prevalence of clinically relevant depression in adults with type I or type II diabetes. It was found that the presence of diabetes doubles the odds of comorbid depression. (42)

When a large number of reports of diabetes and depressive patients analysed, the individuals with diabetes and comorbid condition of depression had higher odds of functional disability compared with individuals with either diabetes or depression alone.(43)

Clinical studies have suggested possible explanations for the stressor induced diseases by biological pathways such as the hypothalamic-pituitary-adrenal (HPA) and the sympathetic-adrenal-medullary (SAM) stress axes as key in this pathogenic process. But there could be other risk factors involved in the process, such as behavioural and psychological risk factors.(44)

Depression as a risk factor of diabetes.

Recent research has shown that depression may predict incident of diabetes. A population based study investigating the association between symptoms of depression/anxiety and diabetes was conducted by Anne Engum et al. of Norway showed that Diabetes did not predict symptoms of depression or anxiety. But Symptoms of

depression and anxiety emerged as significant risk factors for onset of type 2 diabetes. This was independent of other risk factors of diabetes such as socioeconomic factors, lifestyle factors, and markers of the metabolic syndrome. The comorbidity between depression and anxiety may be the most important factor. (45)

Development of diabetes in depressed population could be due to the increased weight gain either as a result of the disorder or in relation to antidepressant treatment. Depressed people have decreased self care measures such as lack of exercise, more likelihood of alcohol abuse, and increased smoking compared with individuals without depression. (46) Depression for those with diabetes is an important comorbidity that requires careful management because of its severe impact on quality of life.(47)

However the literature evaluating depression as a risk factor for diabetes is quite inconsistent.

A population based study reported that the people who has not educated beyond high school, reported the highest numbers of symptoms of depression and were at higher risk to develop diabetes. The risk of developing diabetes was three times higher than those who had an education more than high school level. (48)

A follow up study carried out in Japan, shows that after controlling for the known risk factors for diabetes mellitus, People who had moderate or severe depressive symptoms, has a higher risk of developing diabetes than those who are not depressed. (49)

In a population based case control study conducted by Canadian research group concludes that Depression appears to increase the risk of developing diabetes by ~23% in younger adults. This provides information regarding the temporality of the relationship between diabetes and depression.(50)

A Meta analysis of nine longitudinal studies on depression as a risk factor for the onset of type 2 diabetes mellitus, strongly suggests that depression and type 2 diabetes are

associated, but the direction of association is still unclear (51). The results suggest that adults with depression or high-depressive symptoms have a 37% increased risk of developing type 2 diabetes compared with those who are not depressed or have low-depressive symptoms:"(52).

A similar Meta analysis shows that the presence of diabetes doubles the odds of comorbid depression. Prevalence estimates are affected by several clinical and methodological variables that do not affect the stability of the ORs.(53)

In a large prospective cohort study, conducted to find the association between depression and diabetes among women, it was found that the presence of depressive symptoms was associated with a modest increase in the risk of type 2 diabetes. (54)

4.4. COUNTRY PROFILE- SRI LANKA

Sri Lanka is a small island with the land area of 65000 square Km, located in the Indian Ocean close to the Southern end of the Sub Continent of India. Sri Lanka is basically an agricultural country whose people are dependant on paddy Cultivation. The open economy witnessed the decline in the agricultural sector while industrial sector showed upward trends from recent past.

Sri Lanka is divided in to 08 Provinces, 25 Districts and 321 Divisional Secretaries for the purpose of administration. Since 1983, provincial administration is done by the provincial councils composed of elected representatives of the people.

Demography

The last census in 1981 recorded a population of 14.85 million. The population in 2005 was estimated to be 19.67 million. The annual population growth rate in 2004 was 1.2 percent. The Total Fertility Rate in 2000 was 1.9. During the past five decades the rate of growth of population in Sri Lanka has shown a continuous decline. Sri Lanka has passed the classical phases of demographic transition and reached the third phase of

declining and stabilizing in low birth and death rates. It is projected that by 2020, 20% of Sri Lankan population will have reached the age of 60 or over-Sri Lanka is aging rapidly.(55) (56)

Health

The primary health service of Sri Lanka has reached to an excellent performance in the recent past, 97% of pregnant women, 98% of deliveries, and 98% of newborn are attended by trained medical staff. Over 70% of women of childbearing age use family planning methods.

Under 5 year mortality males 16, female 12 both 14, (per 1000 live births)(57)

The mortality rates in Sri Lanka during the past five decades have shown a continuous downward trend. The crude death rate which was 12.6 per thousand of the population in 1950 has declined to 5.9 in 2000. Similarly, the infant mortality rate which was 82 per thousand live births has dropped to 13 during the same period. As a result, life expectancy at birth has increased from 43.9 years for males and 41.6 years for females in 1946 to 70.7 and 75.9 years respectively in 1995. The life expectancy in 2001 for males was 70.7 years; for females, it was 75.4 years.

Among the top ten causes of death in all ages of Sri Lanka, diabetes is the fourth amounting to 4% of all deaths. (2002) (57)

(Ischaemic heart disease =11%, CVD = 9%, Hypertensive Heart disease =7%, Chronic Obstructive Pulmonary Disease= 7%, Diabetes Mellitus= 4%, Self Inflicted Injuries= 4%, Lower respiratory infections= 4%, Cirrhosis of the liver=4%, Nephritis and nephrosis=3%, Asthma=2%.)

From 1946 Education in Sri Lanka is free from grade one up to university level. A great progress in literacy rate was achieved by Sri Lanka as a result of free education. The national literacy rate in 1994 was 90.1 percent while rates for males and females were 92.5 percent and 87.9 percent respectively.

The demographic, nutritional and epidemiological transition occurring in most of the Asian countries nowadays are accompanied with development and urbanization. With increasing population in the sub urban areas, lack of jobs, insufficient lands for housing and farming has contributed to migration to urban areas. The incidence of over-nutrition and diet related degenerative diseases such as obesity, hypertension, diabetes, coronary heart disease and stroke are on the increase. Working in the paddy fields, fishing, labor work, and other hard work are shifted into office or more sedentary work in the urban areas of the country. Stressful lifestyles, time constraints, and lower physical activity contribute to the development of the metabolic syndromes in an urbanized population.

The unemployment rate in 2003 was around 8.4 percent as against 13.8 percent in 1991. There has been steady decline in poverty in Sri Lanka, as 26.1 percent of population was below poverty line in 1990-91 whereas 22.7 percent population was suffering with extreme poverty in 2002. Ascertaining level of nutrition in the school children is done by the school medical inspections, anthropometric measurements such as height for age, weight for height, and weight for age is measured. The DHS 2000 reports national percentage for stunting as 14 percent, with highest percentage reported in estate sector (33.5 percent).

In Sri Lanka, due to the civil war and terrorist activities, more than 2.5 million were affected and more than 60,000 deaths were resulted. According to the international displacement monitoring centre, as of mid 2005, 350,000 people remained displaced from civil war and 450,000 were displaced in tsunami 2004.

Effects of Tsunami

On December 26, 2004, a massive undersea earthquake northwest of Sumatra, Indonesia, with a Richter-scale magnitude of 9.3, caused a giant ocean shockwave, or tsunami, that devastated the shorelines of Indonesia, Sri Lanka, India, Thailand, and several other

countries. (2) A catastrophic event like tsunami exerts tremendous psychological stress on the effected population. Tsunami, claimed more than 35,000 lives in Sri Lanka, injured more than 25,000 and displaced more than one million people initially and swept over two third of the islands coastline.(58), (59),(60).

13 districts out of 14 districts in the costal belt of Sri Lanka had serious effects by the tsunami. Since many Sri Lankan didn't have any previous experience of this kind of catastrophe, the damage caused to their lives was unbelievable. Thousands of people were displaced, and disappeared or killed within few moments. One year after the tsunami, an estimated 400,000 people have yet to be resettled and more than 275,000 are still without any means of supporting themselves.

A catastrophic event like tsunami has never been experienced before by the Sri Lankan population. At an unexpected time, it effected on unprepared people and caused unimaginable destruction. Traumatic events experienced during the tsunami were significantly associated with symptoms of PTSD and depression. (61) disaster exposure (for example experiences of property destruction and deaths of close others) contributes to depressive and PTSD symptoms in adolescents (62)

5. RATIONALE AND OBJECTIVES

5.1 RATIONALE

Tsunami and its effects on diabetes and depression

Prevalence of diabetes and depression can be triggered by extreme mental stressors. Undoubtedly, tsunami coursed an enormous mental stress to the effected population in Sri Lanka. Post traumatic mental stress can lead to depression in the long run. Relationship between diabetes and depression are being studied widely, but not thoroughly understood yet. This study is focused to describe the relationship between diabetes and depression after three years of the tsunami catastrophe.

Considering the facts that high rising trend of diabetes in Sri Lanka, seriousness of its complications, ability to control by intervention, and its relationship to depression, it would be highly beneficial to carry out a research in a tsunami affected area.

Although there are strong evidences to the association of depression and diabetes, the direction of the association between Diabetes Mellitus and depression is yet to be described. In a situation where long term follow-up study is complicated by many organizational and economical factors, we possibly can employ this cross-sectional design where tsunami affected area is compared with a non tsunami area as surrogate for the initiation of depression as a possible cause for increased occurrence of diabetes.

Depression being a consequence of diabetes can also be a risk factor to develop diabetes. The pathology behind the causative relationship is still not clearly defined. Research conducted recently after catastrophic events reveal that there is a higher prevalence of Post Traumatic Stress Disease (PTSD) in the effected population. Development of depression in the same population can take a longer time compared to the immediate effects of psychological stress reactions, like PTSD.

The long lasting effects of PTSD and depression caused by or aggravated by the tsunami disaster, needs to be investigated to observe the consequence of depression on the

development of chronic diseases like diabetes. Metabolic changes occur in human body preceding stressful events by mechanisms which are not fully understood yet. (63)

Therefore we have selected to investigate one tsunami affected area after 3 years of the disaster compared with an area which is comparable related to socio-demographic and economical factors but was not hit by tsunami. The results will also help in planning to congregate major disastrous events in future.

The diabetic associations of Asian countries including China, Pakistan, Bangladesh and Sri Lanka plan to initiate collaborative efforts in diabetes related research. This research would strengthen the diabetic network in Asian region.

5. 2 OBJECTIVES

General Objective-

To assess the occurrence of type 2 diabetes mellitus and depression: and its association in Sri Lanka.

Specific Objectives

1. To assess the prevalence of type 2 diabetes in a tsunami affected area compared to a non effected area of Sri Lanka.
2. To assess the prevalence of depression measured by the MADRS depression scale in tsunami affected area compared to a non effected area in Sri Lanka.
3. To assess the association between diabetes and depression in tsunami effected and none affected areas.
4. To assess the associated risk factors for type 2 diabetes in tsunami affected and non effected areas of Sri Lanka.
5. To assess the associated risk factors for depression in tsunami affected and none affected areas of Sri Lanka.

6. MATERIALS AND METHODS

HYPOTHESIS:

High stress caused by natural catastrophic events like tsunami leads to metabolic disturbances resulting diabetes and depression.

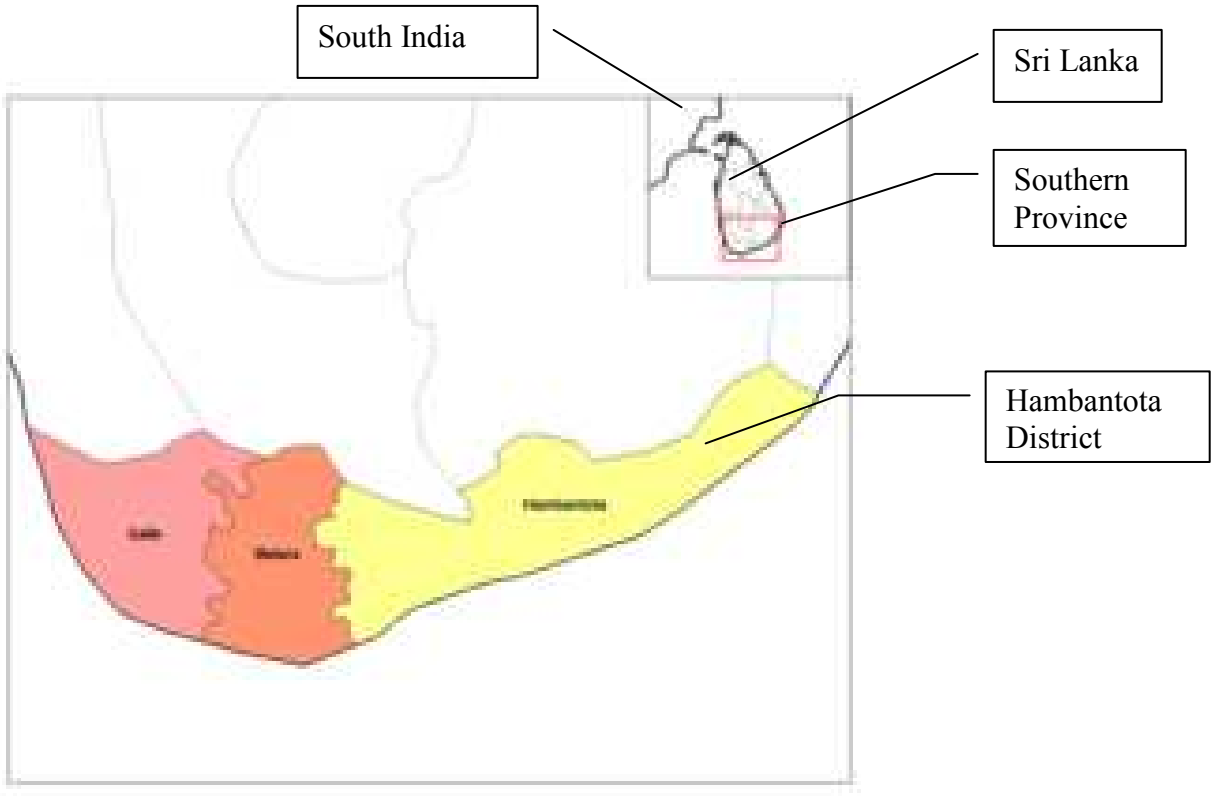
METHODOLOGY:

6.1 Design-

This study was based on a cross sectional design comparing two analogous communities in two different areas.

6.2 Study Area-

Figure 01 Geographic Location of Hambantota district in the southern province of Sri Lanka.



Source – Statistical Department of Sri Lanka 2000.

Sri Lanka has been divided into 9 administrative provinces. These provinces are again sub divided into 25 districts and each district is divided into divisional secretariat (DS) division depending on the population size of the area. Each DS division consists of several Grama Niladhari (GN) divisions which is the lowest level of administrative area. Currently there are 324 DS divisions and 14,008 GN divisions. (64)

Out of 25 districts in Sri Lanka 14 have been affected by the tsunami and of the 19.3 Million population 11 Million live in those affected districts, i.e. 57.4% of Sri Lankan total population

Tsunami impact was measured using some parameters like death toll, number of houses destructed, or number of persons displaced. (64)

We selected the southern province of Sri Lanka for our study as it is one of the provinces effected severely by tsunami. In Hambantota district, there are 4 DS divisions and we randomly selected Tissamaharama DS division. In this area there were two mostly effected GN divisions called Kirinda and Andaragasyaya.

Kirinda and Andaragasyaya GN divisions are situated about 10- 15 Km away from the main town, about 4-10 Km from the seashore. The public transport system is operated in these areas with government and private bus services though they do not fulfill the total demand.

Also we selected one area which has not been effected by tsunami as a control. The socio economic and ethnic diversity is mostly same in all this area to the tsunami effected region.

6.3 Subjects / participants-

1. To alleviate the bias caused by different socioeconomic parameters, we selected the two areas (communities) with the same socio demographic conditions. Majority of the population earns from fishing industry, farming and small scale self industry. Their socioeconomic conditions were similar in education,

earnings, physical activity; food habits, nutrition consumption and leisure time activities.

2. The age compositions of the two groups also matched since both Diabetes and depression is influenced by age.
3. We selected people from the same ethnic background because the concerned diseases have relationships to the genetic predisposition.

6.4 Sampling-

Number of Study participants,

This was calculated using the Epi info program, as a population based study which gave a result of 600 participants.

It was again calculated by using the following formula for sample size calculation.

$$N = \frac{4 (Z_{crt})^2 P (1-P)}{D^2}$$

Where, *N* is the sample size of the single study group, P is pre study estimate of the proportion to be measured, Zcrit is Standard Normal Deviate (z_{crit}) (Corresponding to Selected Significance Criteria and CIs) *D* is the total width of the expected Confidence Interval.

Z= 1.96, P= 10%, D= 12.5%-7.5% = 5%

So the result is = **553. (**Calculated sample size)

The sample was drawn in population 20 years of age and above in both genders. All the selected subjects were randomized by following simple randomization methods.

The estimated sample size was randomly selected using the voter's lists from the divisional secretariat office and village headman's register. The control group/ comparative group of people were also selected adopting same method.

6.5 Inclusion Criteria

Subjects were selected from both tsunami affected and non affected areas.

Permanent residents both male and female subjects over 20 years were selected.

6.6 Exclusion Criteria

Residents who came there after tsunami

Subjects below 20 years

6.7. Preparation for data collection at field

Two groups were prepared to collect data from the two areas. Each group consists of one qualified medical doctor, one nurse, two PHMs and several health volunteers from the area.

A session was conducted with the local supervisor and main investigator to discuss the objectives and methods of the study. Prior to the study, one field work has been practiced inviting some of the local residents outside the selected population. All procedures practiced with the team and methods of efficient data collection were discussed.

All the questionnaires were translated into Sinhalese language by an official translator. This questionnaire was sent to the epidemiological department and health education department of the health ministry for correction of any translation errors. A simplified version of MADRS depression scale was also prepared. All these were revised after pre

testing. All field work assistants were trained for data collection and recording using prepared forms.

Questionnaire 1 –(Diagnosis of depression)

To assess the prevalence of depression in the study group, a standard questionnaire Montgomery Åsburg Depression Rating Scale (MADRS) was used. This is a simple and recommended way of using 10 questions and answers with a rating scale.

MADRS depression scale.(65)

MADRS scale is designed to measure the degree of severity of depressive symptoms and as a sensitive measure of change in symptom severity during treatment of depression.

This depression scale is widely used in drug treatment trials. It is a 10 item list of check list which takes average 10 to 15 minutes to perform the test. This scale measures the clinical condition at the time of interview. The mean scores correlated with global severity measures. (66) The first item of MADRS is a subjective assessment of the participant. This should be done by a trained and qualified person. The scores of each item can range from 0 to 6: therefore a subject can get scores ranging from 0 to 60. MADRS score categorized into four groups according to the depression scale. 0 – 12 (Healthy) 13 – 19 (mild Depression) 20 – 34 (moderate Depression) , and 35 – 60 (Severe Depression) We decided to use two groups as non depressed and depressed keeping the cut off value as 20.

The MARDS depression scale is the most suitable depression scale in this study situation when compared to the other depression scales.

Since MADRS depression scales development in 1979, it has been widely used in the world to assess the depressive symptoms. It is being used in the regional countries including Bangladesh, Pakistan , and India. However, publications which used MADRS

depression scale in Sri Lankan studies are scanty. It has been used in Sri Lanka at the post graduate institute of medicine in Masters and MD level researches.

We used MADRS depression scale after proper training of medical doctors at University of Peradeniya. It was translated to Sinhalese with the support of an authorized translator in the health department. Only trained medical doctors engaged in completing MADRS depression scale after interviews with participants.

Questionnaire 2- (General information, Demographic, socio economic and medical Data)

To evaluate the associated factors of diabetes and depression, we collected general information, demographic socio economic and medical data by using Interviewer guided questionnaires.

General information, Demographic and socio economic data-

This includes name, age, sex, race, religion, marital status etc. Some variables are categorized accordingly to suit the data collection and analysis procedures.

Level of education included four categories according to the years of school education, grade 1-5, grade 5- O/L, O/L-A/L, >A/L and University level.

Occupation is categorized by type, which includes -unemployed, administration/clerical work, business, industry and labour work. Occupation was recorded as full time if a participant was engaged in a job with a regular monthly salary in the government or private sector. Other employments including self employment, business, and cultivation was considered as part time employment. If a participant is not engaged in active earning, as in disability or elderly, they were included into “not occupied” category.

Monthly income was categorized into four groups according to the net income ranging from Rs. 3000 to 10,000.

Family history of other medical illnesses includes hypertension, cardiovascular diseases, mental illnesses, combination of hypertension and cardiovascular diseases.

Family history of diabetes was recorded as diabetes in parents and diabetes in siblings, type of and length of treatment.

Information on smoking included four categories measured by frequency, amount, and duration of smoking namely -never smoked, previous mild, previous heavy, current mild and current heavy.

Alcohol consumption categorized into four groups, by frequency quantity and duration, no alcohol consumption, 1-3 times a month, 1-3 times a week, and daily.

Nutrition and dietary habits includes frequency of intake of various kinds of foods and beverages, tea, sugar etc. Frequency of food intake was measured using four categories, ranging from "never" to "daily.". Amount of each food consumed on average per day was estimated by using the frequency and portion.

Physical Activity was measured by frequency and intensity of activity. The questionnaire consisted of items on the frequency, durations, of sedentary activities, pace of walking and bicycling during the previous week/month, the average amount of time spent weekly on hobbies and gardening, physical exercise, sports, heavy work (heavy gardening) etc.

Permission to carry out the research was sought from the health authorities and administrative authorities of the area. With the help of provincial director of health and divisional director of health services of the area, arrangements were made to meet the village headman (Gramasewaka), Public Health Inspectors (PHI), Public Health Midwifes (PHM), and volunteer health workers of the selected area and discussed about the planning of the project.

Prior arrangements made to gather participants to investigation centres with the help of the divisional director of the health services in the area. The place ideally was a government health institution. (Hospital, clinic or office of a medical officer of health) but in some places where government health institution did not permit maximum participation of people, alternative camps have been set-up in the villages.

Randomly selected participants were informed via Public Health Midwives **(PHM)** of the area, and volunteer health workers of the area, one week prior to the tests. The village headman accompanied the team whenever it was possible. Volunteer health workers went house to house the previous night prior to investigations, and reminded and advised about fasting.

6.8 SURVEY PROCEDURES

Health volunteers along with the research team visited participants in the afternoon 5 to 7 PM. The selected participants were requested to appear in the morning after fasting overnight for 8-10 hours. Investigations were carried out between 7 am to 9 am.

The examination and interview process conducted within a limited time period. There were following steps in the proceedings.

1. First, subjects welcomed and the whole procedure was explained by a PHM. The purpose of the project was described, method of examinations and investigations were described. A Number was given to each participant.
2. Collection of blood samples for fasting blood sugar measurements.
3. Preparation of subjects to OGTT. (75g oral glucose drink)
4. Then the subjects were interviewed – all the questionnaires regarding socio-demographic and economic information collected.

5. Anthropometric measurements taken. Weight, Height, Waist circumference, Hip circumference, BP, measured.
6. Collection of blood for the 2hr. glucose measurement.
7. Morning meal with a drink given to all participants.
8. Distribution of brochures including health messages on diabetes and depression among participants.

6.9 . Data collection-

6.9.1 Questionnaire part 1 and part 2 diagnosis of depression and socio demographic data.

The questionnaire on diagnosis of depression (MADRS depression scale) was filled only by the medical doctors. The main investigator trained to use MADRS depression scale to diagnose depression. Other medical doctors were also trained to diagnose depression by using MADRS depression scale prior to the study.

Questionnaire on general information, demographic, socio economic information was filled by the other supportive team after a thorough training to carry out the task. A pre test using questionnaires was conducted prior to the data collection and discussed results with members of the research team.

6.9.2 Anthropometric Measurements

Measurements-

All physical measures were done protecting the privacy of the subjects. A separate room for examinations was chosen. When separate room was not available at the field investigation centres, screens used to maintain privacy of the participants.

All anthropometric measurements were taken according to the WHO guidelines. The sequences of taking measurements are as follows. (67)

Weight, Height, Waist Circumference, Hip Circumference, and Blood Pressure

Weight- Weight was measured using a portable electronic weighing scale. It was measured with light cloths, without shoes or slippers, standing on foot each side of the scale balanced, placing the arms by side, face forward, waiting still, weight is recorded in kilograms and grams.(to the nearest 0.1 Kg)

Height- height was measured by using a standard portable height length measuring board. (Local) After removing foot and head wear, subject stands on the board facing forward; foot together, heals against back board, and knees straight. Height is marked by moving the measure arm down, when subject is looking straight, standing still with eyes at the same level as ears. Height measured in centimetres at exact point.

Body Mass Index (BMI)- The most common measure of excess body weight in clinical practice and population surveys is the body mass index (BMI), defined as weight in kilograms divided by the square of height in meters. Conventional BMI classifications are overweight (25.0 kg/m^2≤BMI<30.0 kg/m^2) and obese (BMI ≥30.0 kg/m^2). Also there are evidences in research that South Asians and Chinese suffer from an elevated risk of type 2 diabetes, hypertension, and dyslipidemia even if their BMI is low (ie, <25.0 kg/m^2). (68) However, previous research in Sri Lanka reveals that cut off values of BMI for overweight and obesity in Asians is lower than that of western countries. It was considered Overweight if BMI was (> or =23 kg/m2) and obesity (> or = 25 kg/m2). (69).

- Normal weight = 18.5-22.9
- Overweight = 23-25.
- Obesity = >25 or greater.

Waist Circumference- Measurements were taken over the skin, removing cloths, or if not possible with light cloths- not with thick cloths. It was measured at the end of normal expiration, with the arms relaxed by the sides, under the midline of subject's armpit, at the midpoint between the lower part of the last rib and top of hip-iliac crest. Standing to the side of the participant, the inferior margin (lowest point) of the last rib, the crest of the ileum (top of the hip bone) and midpoint of these two is marked with a fine pen. Alone the marked midpoint, waist circumference is measured by a tension tape horizontally to the nearest 0.1 cm.

Hip Circumference- measured at the maximum circumference over the buttocks. Examiner stands by the side of the subject, and places the tape around below the hip with the help of subject. Measuring tape was positioned to the maximum circumference around the buttock, subject stands straight, keeping feet together, keeping hands by the sides facing palms inward and breath out well, check the tape position, horizontally all round the body, hip circumference is measured to the nearest 0.1 cm.

Waist to Hip Ratio:- For men, a ratio of .90 or less is considered normal. For women, a ratio of .80 or less is considered normal.

Blood Pressure- Measurement of blood pressure was done only by the trained personals. Medical doctors were trained for blood pressure measurement and they had more than 5 years experience in practising the procedure.

BP was measured using a standard mercury sphygmomanometer (Blood Pressure Monitor) (clinically validated – OMRON- type.) and Appropriate size cuffs were used (medium or large size cuffs according the mid arm circumference) . BP is measured at least 15 minutes sitting legs uncrossed, the subject in the sitting position, adopting the WHO standard procedure of measuring BP.

It was measured to the nearest 2mm Hg from the top of the mercury meniscus. Systolic pressure was measured at the first appearance of sound in the stethoscope, on the pulsatile brachial artery and diastolic pressure was measured at phase V, disappearance of sounds.

6.9.3 Biological Data-

Collection of blood samples-

Biological data includes blood pressure (BP), Fasting blood sugar (FBS), total cholesterol (TC), triglycerides (TG), low density lipoprotein-cholesterol (LDL-C), high density lipoprotein-cholesterol (HDL-C),

Fasting Blood Glucose Level Estimation-

Prevalence of diabetes was determined mainly by Fasting Blood Sugar levels (FBS) in both study areas. In addition to that, Oral Glucose Tolerance Test (OGTT) was also performed following WHO guidelines.

All the randomly selected participants were informed and instructed about the importance of fasting status at least two times prior to the investigations.

Diabetes was diagnosed if the (venous) fasting plasma glucose (FPG) value was >= 7.0 mmol l-1 (126 mg dl-1), or if the plasma glucose value 2 hours after a 75g oral load of glucose was >= 11.1 mmol l-1 (200 mg dl-1). (4)

Participants who are fasting from 8 pm previous night, informed to come to the government hospital Kirinda, in Thissamaharamaya and only about 20 people facilitated during one day.

Blood drawing was done only by the principal investigator and nursing staff, who are qualified and trained to carry out procedures like blood drawing and investigation. Blood was drawn from the selected participants with the informed consent.

Venous blood samples were collected using 18-20 gauge sterile disposable syringes, taking precautions to prevent infection or injury. Collected blood transferred to a sterile container and stored immediately over ice and centrifuged at 500-1000 rpm for 2-3 minutes within half an hour of blood draw. Serum was subsequently frozen and transferred on dry ice in vaccine carriers to the central laboratory where they stored at (–) minus 70 Celsius until analysed at department of biochemistry, University of Peradeniya. Cold chain was maintained until investigations done at the laboratory. The used syringes, containers and other material disposed according to the hospital safety procedures. Serum total and triglyceride cholesterol were measured by enzymatic methods.

7. Ethical Considerations

The complete information sent to the subjects describing purpose and methods of investigation. Informed consent sought. They were informed of their free right to participate and to withdraw at any stage or to with held their data from analysis. Information on all investigations and examinations were given to the subjects by explaining them in mother tongue. The protocol was approved by the Ethical committees for medical research in Norway and in Sri-Lanka.

Information was given by posting letters to the selected people one week prior to the tests. Information sent via Public Health Inspectors (PHI) and Public Health Midwives (PHM). Methods of Measurement of blood pressure, other anthropometric measurements such as weight, height, and waste to hip ratio, were informed. It was emphasized on fasting from 10pm previous night before the blood glucose levels measurement. .

Then investigations and examinations carried out between 7 am to 9 am.

In the examination of people for height, weight and waste to hip ratios, privacy was maintained. To alleviate the problems, the participants were given their choice to be examined in a separate room, or a place with screens. When examining female participants, a female investigator was accompanied whenever possible. Removing of hats, cloths, or scarffs were not thoroughly followed if the participants are not willing.

Questioning on mental status was handled sensibly. Bursting out with emotional feelings handled sensibly with the help of medical staff at the MOH office.

The subjects are to be convinced on the usage of blood is **only to** find out the related investigations. Like FBS, Cholesterol etc.

Assurance of the results and their privacy was maintained by limiting the accessibility of data to the main investigators. Collection of blood samples done, causing minimal discomfort to the subjects.

Researchers, assistants and participants possible risk of getting blood born diseases was minimized using good hygienic and protective measures while investigating, and collecting blood samples.

Contact risk of any other communicable disease was minimized.

Diagnosing and referrals were made whenever it is necessary. All the participants who were diagnosed of having any medical condition were referred to the respective district medical officer of health for further follow up.

Permission:

Permission for the research was obtained by the following officials and they were informed of the project prior to the data collection. The directors of heath services, Medical Officer of health in the region, the office and staff including Public Health Inspectors, and Public Health Midwives, Village Headman, Diabetic association of Sri Lanka, Psychiatric association of Sri Lanka.

Statistical methods-

Prevalence rates of, diabetes, and depression, and other characteristics were calculated and analyzed using SPSS version 14.0 (SPSS Inc, Chicago, Ill)

Estimates of mean ± SEM or percentage and risk factor levels in the overall population, tsunami effected and non effected population for diabetes and depression were calculated. Chi square -χ^2 Tests were used to evaluate differences in categorical variables and *t* tests and 1-way analysis of variance tests were used to evaluate differences in continuous variables, correcting for multiple comparisons if necessary. Comparisons of risk factor levels between population subgroups were performed. If continuous variables were not normally distributed, nonparametric tests were applied.

Initial univariate analysis was carried out to determine crude odds ratios (ORs) and 95% confidence intervals (CI). Effect modification was evaluated in multivariate logistic regression models. Multiple logistic regressions were used to determine whether selected independent variables were associated with prevalence of diabetes mellitus. The model was controlled for Gender, Tsunami effect, Age, BMI, systolic hypertension, Total Cholesterol levels, Depression, and Family history of Diabetes mellitus (8 variables). Same method was applied to determine whether selected variables were associated with diagnosed depression. This model was controlled for Gender, Tsunami effect, Diabetes mellitus, Age, BMI, and Systolic Hypertension.

9. Results:

1. Overall population
2. Diabetes
3. Depression
4. Risk Factors

9.0 Summery of the results:

In this research, we investigated a total number of 740 subjects, consisting of 255 male subjects and 485 female subjects over 20 years of age. 315 of participants were from tsunami affected area and 425 from a control area which is not effected by tsunami.

In total population studied (740), prevalence of diabetes was 10.5%. Prevalence of diabetes was higher in the tsunami effected (11.7%) than that of tsunami none effected participants. (9.6%), (95% CI=0.77-1.9).

Prevalence of diabetes was increased with increasing age and also with increasing BMI.

In both tsunami effected and non effected areas, prevalence of diabetes was higher in females than males. A substantial agreement was found (Kappa 0.628, P <0.001) between FBG values and 2h BG values.

Significant risk factors for development of diabetes were higher age, high BMI, high WHR (in females), high total cholesterol levels, higher weight, and Depression.

Prevalence of Depression was 17.3% in the total population. It was significantly higher in tsunami effected (22.5%) than non effected (13.4%). Prevalence of depression increased with increasing age. In both tsunami effected and non effected population, depression was higher in females than males. Diabetes, tsunami affected people, higher age, higher BMI and higher Systolic Blood pressure were identified as significant risk factors for depression.

Baseline Characteristics of Tsunami Effected and non effected population

Analysis of the results by the Tsunami Effected and none affected population reveals that the tsunami effected population had statistically significant higher BMI, WHR, and MADRS depression score compared to the tsunami non effected population in Sri Lanka. Fasting Blood Glucose, OGTT, total cholesterol, systolic blood pressure mean values were also higher, though not significant in the tsunami effected population. The Mean values of Age and Waist to hip ratio was higher in non tsunami affected population.

There was a significant different between the proportions of depression score between the two groups. Proportions of diabetes, overweight, obesity, smoking, and alcohol consumption were higher amongst the tsunami effected population than that of the none effected, though they were not significant. Other measured socio economic and anthropometric measurements didn't have a significant difference. (Table 01)

Table 01

Baseline Characteristics of the population; Numbers and percentages of following variables by Tsunami non effected and tsunami effected areas of Sri Lanka 2008

	Variable	Tsunami Not Effected N=425	Tsunami Effected N=315	P value	
	Continuous Variables				
	Age	48.37	47.53	0.423	
	BMI	22.8	23.61	0.015	
	WHR	0.84	0.83	0.016	
	Fasting Blood Glucose Level	104.38	105.86	0.576	
	2h P. Glucose	148.94	154.29	0.136	
	Total Cholesterol	197.73	201.4	0.232	
	Systolic BP	123.8	124.4	0.497	
	Diastolic BP	79.8	79.6	0.676	
	MADRS score	7.95	10.64	0.002	
	Categorical Variables- (Numbers and percentages)	Tsunami Not Effected	Tsunami Effected	Total	P Value
	Age Cat.				

	20-30	65(15.3)	40(12.7)	105(14.2)	0.345
	31-40	65(15.3)	62(19.7)	127(17.2)	
	41-50	106 (24.9)	82(26)	188(25.4)	
	>50	189 (44.5)	131(41.6)	320(43.2)	
	Diabetes				
	No DM	384(90.4)	278(88.3)	662(89.5)	0.359
	Diabetics	41(9.6)	37(11.7)	78(10.5)	
	IFG	101(23.8)	80(25.4)	181(24.5)	
	Depression				
	No Depress	368(86.6)	244(77.5)	612(82.7)	0.001
	Depressed	57(13.4)	71(22.5)	128(17.3)	
	BMI Category				
	<18	62(14.6)	35(11.1)	97(13.1)	0.30
	18-23	242(56.9)	167(53)	409(55.3)	
	23-25	96(22.6)	90(28.6)	186(25.1)	
	>25	25(5.9)	23(7.3)	48(6,5)	
	SBP				
	SBP >140	368(86.6)	268(85.1)	636(85.9)	0.560
	SBP< 140	57(13.4)	47(14.9)	104(14.1)	
	DBP				
	DBP <90	356(83.8)	262(83.8)	618(83.5)	0.831
	DBP >90	69(16.8)	53(16.8)	122(16.5)	
	Level of Ed				
	Grade 1-5	123(28.9)	89(28.3)	212(28.6)	0.888
	5- O/L	220(51.8)	161(51.1)	381(51.5)	
	O/L - A/L	70(16.5)	59(18.7)	129(17.4)	
	A/L+ University	11(2.6)	5(1.6)	16(2.2)	
	Occupation				
	Not employed	54(12.7)	55(17.5)	109(14.7)	0.042
	Admin.	31(7.3)	25(7.9)	56(7.6)	
	Business	29(6.8)	21(6.7)	50(6.8)	
	Industry	26(6.1)	27(8.6)	53(7.2)	
	Labour work	285(67.1)	187(59.4)	472(63.8)	
	Monthly Income				
	<3000	73(17.2)	66(21)	139(18.8)	0.414
	3000-6000	260(61.2)	182(57.8)	442(59.7)	
	6000-10000	81(19.1)	59(18.7)	140(18.9)	
	>10000	11(2.6)	8(2.5)	19(2.6)	
	Health				
	Weak	74(17.4)	58(18.4)	132(17.8)	0.984
	Normal	249(58.6)	179(56.8)	428(57.8)	
	Good	102(24)	75(23.8)	177(23.9)	
	Very good	0	2(.6)	2(0.3)	
	Family Hist DM				
	No DM	381(89.6)	281(89.2)	662(89.5)	0.847
	DM	44(10.4)	34(10.8)	78(10.5)	
	Smoking				
	Never	373(87.8)	289(91.7)	662(89.5)	0.078
	Previous Mild	6(1.4)	6(1.9)	12(1.6)	
	Previous Heavy	16(3.8)	3(1)	19(2.6)	
	Constant Mild	25(5.9)	12(3.8)	37(5)	

	Constant Heavy	5(1.2)	4(1.3)	9(1.2)	
	Alcohol				
	No	396(93.2)	302(95.9)	698(94.3)	0.065
	1-3times Month	17(4)	11(3.5)	28(3.8)	
	1-3 imes / Week	7(1.6)	1(.3)	8(1.1)	
	Daily	4(.9)	1(.3)	5(0.7)	
	WHR				
	Male > 0.90	48(31.4)	32(32.4)	175	1.00
	Male <0.90	105(68.6)	70(68.6)		
	Female >0.80	172(63.2)	126(59.2)	298	0.398
	Female< 0.90	100(36.8)	87(40.8)	197	
	TC				
	Low risk	235(55.3)	167(53)	402(54.3)	0.088
	Borderline high	126(29.6)	82(26)	208(28.1)	
	High risk	62(14.6)	65(20)	127(17.2)	

BMI= Body Mass Index, WHR= Waist to Hip Ratio, FBG=Fasting Blood Glucose, 2h PG= 2 hour post glucose test (oral glucose tolerance) BP= Blood Pressure, MADRS score= Montgomery Asburg Depression Rating Scale, DM= Diabetes Mellitus, SBP=Systolic Blood Pressure, DBP= Diastolic Blood Pressure,

Diabetes:

Estimation of diabetes was done by performing Fasting Blood Glucose levels (FBG). Estimation of diabetes was also done by conducting 2 hour fasting glucose tests In addition to FBG. (Oral Glucose Tolerance Test OGTT) in all participants. Diabetes was diagnosed if the (venous) fasting plasma glucose (FPG) value was >= 7.0 mmol l-1 (126 mg dl-1), or if the plasma glucose value 2 hours after a 75g oral load of glucose was >= 11.1 mmol l-1 (200 mg dl-1). (According to the WHO classification of diagnosis of diabetes in 1999) (4)

In total population studied (740), prevalence of diabetes was 10.5%. Prevalence of diabetes was higher in the tsunami effected (11.7%) than that of tsunami none effected (9.6%) participants (95% CI=0.77-1.9). When DM was measured by OGTT levels, 12.4% of total population was diagnosed as diabetics. . A substantial agreement was found (Kappa 0.628, P <0.001) between FBG values and 2h BG values.

Prevalence of impaired fasting glucose was 24.5% in the total population. It was higher in tsunami affected population 25.4% (80) than non effected 23.8% (101) population. IFG was slightly higher in females' 25.6% than that of males 22.4%.

A higher prevalence of diabetes was observed among the females than males in both tsunami effected and non effected areas. In the tsunami non effected area, 7.2% males and 11 % females had diabetes compared to 10.8% males and 12.2% females in the tsunami effected area. Females had a higher prevalence of diabetes than males in all strata of age category, in tsunami non effected area. In both tsunami effected and non effected areas, prevalence of diabetes was highest in the oldest age group (>50 years), compared to the younger age groups ie. Prevalence of diabetes increases with increasing age. 10.5% of the total population had a positive family history of diabetes mellitus. Risk of development of diabetes is highest in the obese and lowest in the underweight. Prevalence of diabetes increases with the increasing BMI . (Table 02)

Figure 02
Distribution of Diabetes by gender in total population (740)

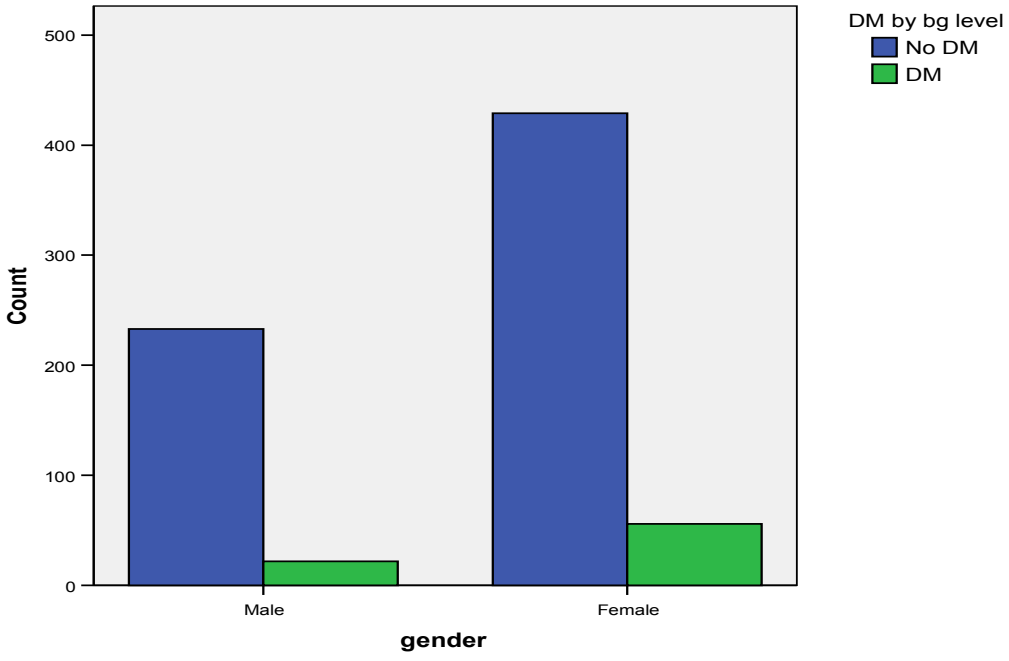


Table 02

Prevalence of Diabetes by gender in Tsunami non effected and effected population in Sri Lanka.

	Tsunami none effected			Tsunami effected		
Age Group	**n**	**Diabetes cases**	**Prevalence Per 100**	**n**	**Diabetes cases**	**Prevalence Per 100**
Male						
20-30	24	0	0	14	0	0
31-40	15	1	6.7	16	0	0
41-50	36	2	5.6	30	3	10.1
>50	78	8	10.3	42	8	19.0
Total	**153**	**11**	**7.2**	**102**	**11**	**10.8**
Female						
20-30	41	0	0	25	1	3.8
31-40	50	5	10.0	46	6	13
41-50	70	10	14.3	52	5	9.6
>50	11	15	13.5	89	14	15.7
Total	**272**	**30**	**11**	**213**	**26**	**12.2**

There was a significant difference between the mean values of BMI, Waist to Hip Ratio, Fasting Blood Glucose, OGTT, Total Cholesterol, and MADRS score, in those who diagnosed to have diabetes and those without diabetes in both tsunami effected and not effected population. There was a significant difference in mean values of age between diabetic and non diabetic subjects only in tsunami non effected population. (Table 03)

Table 03
Mean and Standard Deviation of selected variables by diagnosis of diabetes in Tsunami Effected and Non Effected areas of Sri Lanka

Tsunami Non Effected			Tsunami Effected			
Variable	**No Diabetes** Mean±SD	**Diabetes** Mean±SD	**P Value**	**No Diabetes** Mean±SD	**Diabetes** Mean±SD	**P Value**
Age	47.9±14	52.8±11	0.037	47.1±14	50.7±10	0.138
BMI	22.5±4	25.4±5.2	<0.001	23.3±4.1	25.4±4.3	0.005
WHR	0.84±0.06	0.87±0.04	0.001	0.82±0.05	0.85±0.06	0.007
SBP	123.±11	126±14	0.130	124±11	125±13	0.616
DBP	79±8	82±10	0.108	79±4	80±7	0.573
FBG	95±10	189±55	<0.001	95±11	184±60	<0.001
2hPG	140±32	231±59	<0.001	141±32	249±58	<0.001
TC	195±38	222±45	<0.001	199±42	220±43	0.005
MADRS	7.3±10	13±13	<0.001	9.7±12	17±12	0.001
WT	54±10	60±12	<0.001	57±11	61±10	0.026

BMI= Body Mass Index, WHR= Waist to Hip Ratio, FBG=Fasting Blood Glucose, 2h PG= 2 hour post glucose test (oral glucose tolerance) BP= Blood Pressure, MADRS score= Montgomery Asburg Depression Rating Scale, DM= Diabetes Mellitus, SBP=Systolic Blood Pressure, DBP= Diastolic Blood Pressure, TC= Total Cholesterol

Risk factors of diabetes:

Significant risk factors for development of diabetes were identified as, Depression, high BMI >25 (obesity), (high) >0.80 WHR in females, high Total Cholesterol levels, and family history of Diabetes mellitus, both in tsunami effected and tsunami non effected population.

Non Significant risk factors for development of diabetes were identified as, Female gender, high Systolic Hypertension, and higher Age of subjects, and (high) >0.90 WHR of males, both in tsunami effected and non effected population.

High Diastolic blood pressure was recognized as a non significant risk factor only in the tsunami non effected population.

With the increasing BMI and increasing Total Cholesterol levels, risk of diabetes also increases accordingly. (Table 04)

Table 04

Odds Ratio (OR) with 95% Confidence Interval (CI) of diabetes by following risk factors in tsunami effected and non effected population in Sri Lanka.

	Tsunami non Effected				Tsunami Effected			
Variables	**n**	**OR**	**95% CI**	**OR²**	**n**	**OR**	**95%CI**	**OR³**
Age	425	1.02	1.0-1.04	1.0(0.9-1)	315	1.01	0.99-1.04	1.1(0.9-1.0)
Gender								
Male	153				102			
Female	272	1.6	0.7-3.2	1.4(0.5-3.6)	213	1.15	0.54-2.4	0.76(0.2-1.9)
BMI								
<18	62				35			
18-23	242	1.09	0.3-3.3	0.7(0.1-3.1)	167	4.3	0.56-33.7	3.3(0.3-28)
23-25	96	1.8	0.5-6.1	1.2(0.2-5.7)	90	4.2	0.52-34.5	3.6(0.3-32)
>25	25	8.15	2.2-29.9	9.5(1.7-51)	23	14.8	1.6-131.3	11.2(1-1.06)
SHT								
<140	368				268			
>140	57	1.6	0.72-3.7	1.2(0.3-4.5)	47	1.1	0.43-2.8	1.0(0.2-5.3)
DHT								
<90	356				262			
>90	69	1.51	0.69-3.3		53	0.95	0.37-2.4	
WHR male								
< 0.9	105				70			
> 0.9	48	1.91	0.5-.6.6		32	1.97	0.5-0.7	
WHR female								
<0.80	100				87			
>0.80	172	3.2	1.1-8.7		126	2.5	0.9-6.6	
Total Choles								
Low	235				167			
B.High	126	2.3	1.0-5	1.9(0.7-5.3)	82	1.8	0.7-4.2	1.6(0.6-4.6)
High	62	4.0	1.7-9.5	3.1(1-9.1)	65	2.6	1.1-6.2	2.2(0.8-6.3)
Depression								
Depressed	368				244			
Not depress	57	4.1	2-8.4	1.7(0.6-4.9)	71	3.5	1.7-7.1	2.7(1.2-7.1)
FH of DM								
FH +	381				281			
No FH	44	35.2	15.9-77	36(14-94)	34	15.5	6.8-35.1	13.8(5.3-33)

OR = Crude Odds Ratio
OR[2] = Adjusted Odds Ratios for Age, Gender, BMI, Systolic Hypertension, Total Cholesterol, Depression and Family history of Diabetes.
OR[3] = Adjusted Odds Ratios for Age, Gender, BMI, Systolic Hypertension, Total Cholesterol, Depression and Family history of Diabetes.

BMI= Body Mass Index, WHR= Waist to Hip Ratio, FBG=Fasting Blood Glucose, 2h PG= 2 hour post glucose test (oral glucose tolerance) BP= Blood Pressure, MADRS score= Montgomery Asburg Depression Rating Scale, DM= Diabetes Mellitus, SBP=Systolic Blood Pressure, DBP= Diastolic Blood Pressure,

Figure 03

Percentage distribution of Diabetes by BMI categories in rural costal village of Sri Lanka

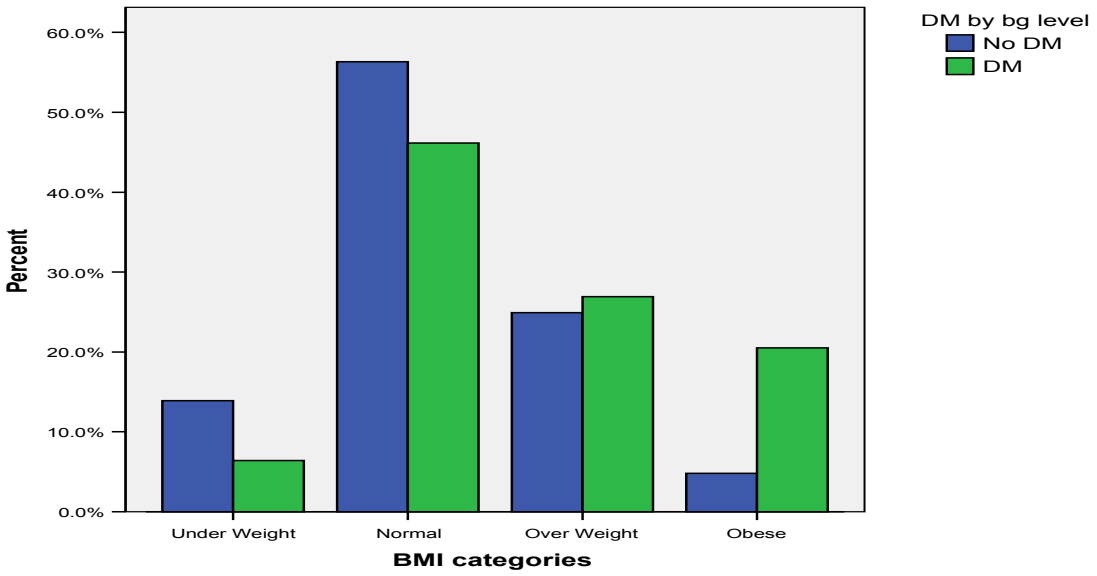
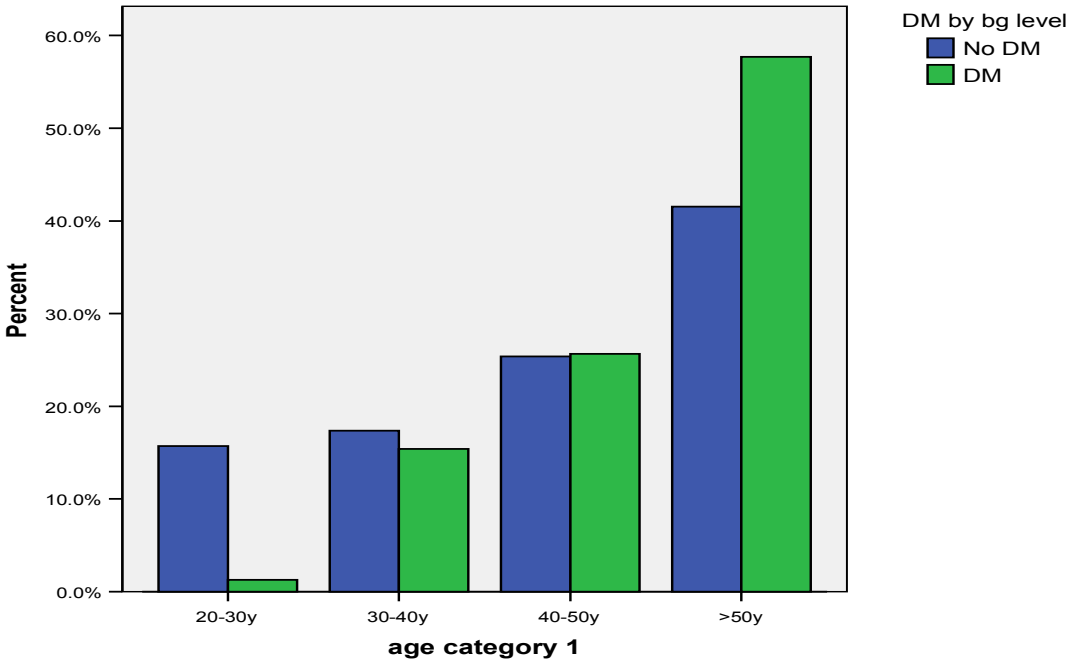


Figure 04;

Percentage Distribution of Diabetes Mellitus by Age categories in a rural costal village of Sri Lanka



Depression:

Depression was measured by MADRS depression scale. If the MADRS score was more than 20, those participants were considered as depressed and MADRS score less than 20 were considered as normal.

Prevalence of Depression was 17.3% in the total population. It was significantly higher in tsunami effected (22.5%) than non effected (13.4%) population. Prevalence of depression was higher in females than males in both areas. In tsunami non effected areas 8.5% males and 16.2% females had depression compared to 23.5% males and 22.1% females in tsunami effected areas.

The highest depression rate was found in the oldest age group (12.6 in males and 24.3 in females) and lowest in the youngest age group, (4.2 for males and 4.9 for females) of the

tsunami non affected area. Prevalence of depression was increased with increasing age. (Table 05)

Table 05;

Prevalence of Depression by gender in Tsunami effected and none effected population in Sri Lanka.

	Tsunami none effected			***Tsunami effected***		
Age Group	**n**	**Depression cases**	**Prevalence Per 100**	**n**	**Depression cases**	***Prevalence Per 100***
Male						
20-30	24	1	4.2	14	3	*21.4*
31-40	15	0	0	16	3	*18.8*
41-50	36	2	5.6	30	8	*26.7*
>50	78	10	12.6	42	10	*23.8*
Total	**153**	**13**	**8.5**	**102**	**24**	***23.5***
Female						
20-30	41	2	4.9	26	4	*15.4*
31-40	50	5	10	46	11	*23.9*
41-50	70	10	14.3	52	9	*17.3*
>50	111	27	24.3	89	23	*25.8*
Total	**272**	**44**	**16.2**	**213**	**47**	***22.1***

The mean values of Diastolic blood pressure, Blood glucose levels, OGTT and MADRS depression score were significantly higher in depressed subjects than that of non depressed subjects, both in tsunami effected and non effected population. Mean values of age was significantly higher in depressed subjects than that of non depressed in tsunami non effected area. Mean values of Systolic blood pressure was significantly higher in depressed subjects than that of non depressed subjects in tsunami effected population. (Table 06)

Figure 05

Mean MADRS scores by gender in Tsunami not effected and effected population in Sri Lanka.

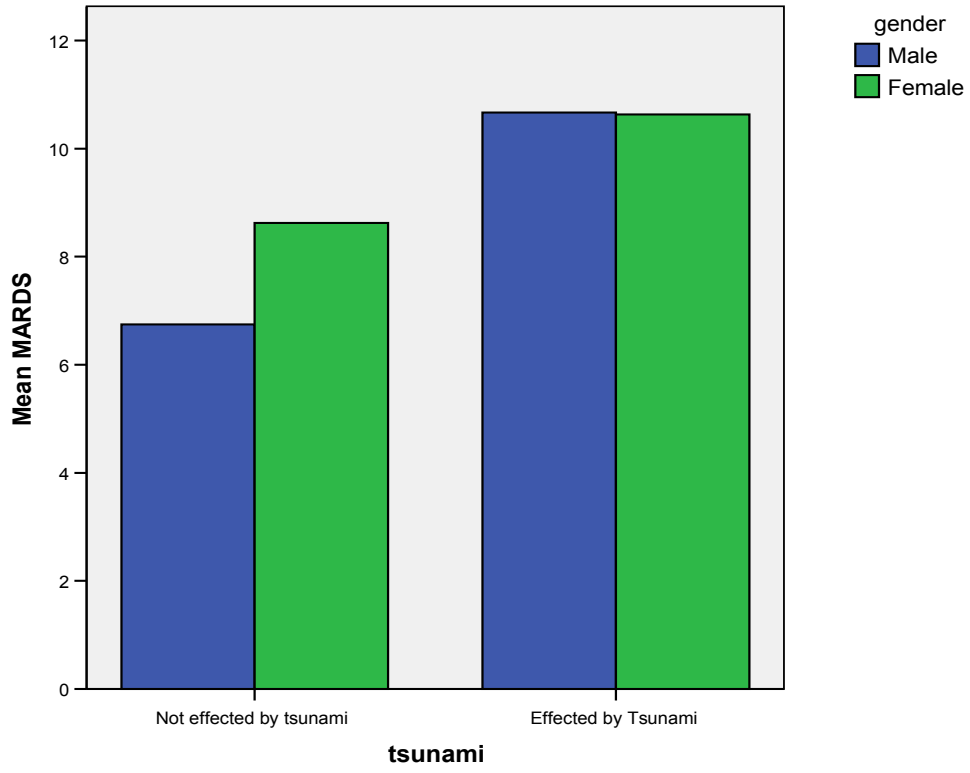


Table 06

Mean and Standard Deviation of selected variables by diagnosis of depression in Tsunami Effected and Non Effected areas of Sri Lanka

Tsunami Non Effected			**Tsunami Effected**			
Variable	**No Depression** Mean±SD	**Depressed** Mean±SD	**P Value**	**No Depression** Mean±SD	**Depressed** Mean±SD	**P Value**
Age	47.23±14.2	55.7±13	<0.001	46.8±15	49.9±15	0.096
BMI	22.6±4	23.8±4.9	0.050	23.5±4	23.9±4.6	0.416
WHR	0.84±0.06	0.83±0.05	0.11	0.83±0.05	0.83±0.06	0.389
SBP	123±11	126±12	0.078	123±11	127±12	0.021
DBP	79±8.5	82±8.6	0.016	78±8	82±10	0.005
FBG	100±24	128±64	<0.001	101±29	121±51	<0.001
OGTT	141±34	198±66	<0.001	145±41	185±65	<0.001
TC	197±39	200±43	0.52	201±42	201±44	0.943
MADRS	4.6.±6	29.3±5.4	<0.001	5.08±7	29±6	<0.001
WT	55.2±10	56±11	0.630	78.5±10	78±10	0.385

Categorical Variables

Tsunami not Effected				Tsunami Effected		
	No Depression	**Depressed**	**P Value**	**No Depression**	**Depressed**	**P Value**
Gender						
Male	140(32.9)	13(3.1)	0.026	78(24.8)	24(7.6)	0.771
female	228(53.6)	44(10.4)		166(52.7)	47(14.9)	
Diabetes						
No DM	341(80.2)	43(10.1)	<0.001	224(71.1)	54(17.1)	<0.001
DM	27(6.4)	14(3.3)		20(6.3)	17(5.4)	
Age						
20-30	62(14.6)	3(0.7)	0.005	33(10.5)	7(2.2)	0.738
31-40	60(14.1)	5(1.2)		48(15.2)	14(4.4)	
41-50	94(22.1)	12(2.8)		65(20.6)	17(5.4)	
>50	152(35.8)	37(8.7)		98(31.1)	33(10.5)	
BMI						
<18	55(12.9)	7(1.6)	0.038	27(8.6)	8(2.5)	0.528
18-23	210(49.4)	32(7.5)		132(41.9)	35(21)	
23-25	86(20.2)	10(2.4)		70(22.2)	20(6.2)	
>25	17(4)	8(1.9)		15(4.8)	8(2.5)	
SBP						0.001
<140	325(76)	43(10.1)	0.008	213(67.6)	57(21.3)	
>140	43(10.1)	14(3.3)		31(9.8)	14(4.4)	
DBP						
<90	313(73.6)	43(10.1)	0.005	213(67.6)	49(15.6)	0.001
>90	55(12.9)	14(3.3)		31(9.8)	22(7)	
T.Choles						
Low	209(49.4)	26(6.1)	0.251	136(43.3)	31(9.9)	0.103
Border	106(25.1)	20(4.7)		57(18.2)	25(8)	
High	51(12.6)	11(2.6)		51(16.1)	14(4.5)	
FH- DM						
No DM	339(79.8)	42(9.9)	<0.001	223(70.8)	58(18.4)	0.020
DM	29(6.8)	15(3.5)		21(6.7)	13(4.1)	

BMI= Body Mass Index, WHR= Waist to Hip Ratio, FBG=Fasting Blood Glucose, 2h PG= 2 hour post glucose test (oral glucose tolerance) BP= Blood Pressure, MADRS score= Montgomery Asburg Depression Rating Scale, DM= Diabetes Mellitus, SBP=Systolic Blood Pressure, DBP= Diastolic Blood Pressure,

Risk factors of depression

Female gender, Diabetes Mellitus, BMI, OGTT, Diastolic hypertension, Systolic Hypertension, Family history of Diabetes were identified as significant risk factors for development of depression in tsunami non effected population. When adjusted for potential confounding factors, age, OGTT and Waist to hip ratio, remained as significant risk factors for development of depression in the tsunami non effected population.

Diabetes mellitus, systolic and diastolic hypertension, OGTT, Total Cholesterol levels, and family history of diabetes mellitus were identified as significant risk factors for development of depression in the tsunami effected population. When adjusted for potential confounding factors, OGTT and diastolic blood pressure remained as significant risk factors of development of depression in tsunami effected population. (Table 07)

Table 07

Crude Odds Ratio with 95% confidence intervals and adjusted Odds ratios for potential confounding factors, of diabetes by following risk factors in tsunami effected and non effected areas of Sri Lanka

Tsunami non effected				**Effected by Tsunami**		
	OR (95% CI)	**Sig**	**OR²(95%CI)**	**OR (95% CI)**	**Sig**	**OR³(95%CI)**
Gender						
Male	1					
Female	2(1.0-3.9)	0.028	0.902(0.4-2.5)	0.92(0.5-1.6)	0.77	1.45(0.3-1.3)
Age	1.04(1.0-1.06)	<0.001	1.03(1-1.6)	1.01(0.9-1.0)	0.77	1.002(0.9-1)
BMI	1.06(1-1.1)	0.05	1.05(0.9-1.1)	1.02(0.9-1.09)	0.415	1.023(0.9-1)
SBP	1.02(0.99-1.0)	0.07	0.98(0.9-1.0)	1.02(1-1.04)	0.022	1.00(0.9-1)
DBP	1.04(1-1.07)	0.017	1.023(0.9-1.0)	1.04(1-1.07)	0.006	1.054(1-1.1)
OGTT	1.02(1.-1.02)	<0.001	1.025(1.0-1.03)	1.01(1-1.01)	<0.001	1.018(1-1.0)
TC	1.02(0.9-1)	0.528	0.99(0.9-1.0)	1(0.9-1.06)	0.047	0.99(0.9-1)
WHR	0.029(1-2.4)	0.119	0.001(0.-0.24)	1.02(0.84-5.5)	0.388	0.24(0-75)

DM	4.11(2-8.4)	<0.001	3.15(0.7-12.7)	3.52(1.7-7.1)	0.001	1.52(0.4-4)
SHTN **<140** **>140**	 1 2.46(1.2-4.8)	 0.010	 2.91(0.9-1.1)	 1.57(0.7-3.1)	 0.20	 0.71(0.4-4)
FH DM **NoDM** **DM**	 1 4.17(2-8.4)	 <0.001	 1.89(0.1-1.5)	 2.3(1.12-5.0)	 0.02	 0.92(0.3-2.9)

OR = Crude Odds Ratio for depression.

OR² = Odds Ratio Adjusted for gender, Age, BMI, Systolic Blood pressure, Diastolic Blood pressure, OGTT, Total Cholesterol, Waist to hip ratio, Diabetes mellitus and Family history of Diabetes in tsunami non effected population.

OR³ = Odds Ratio Adjusted for gender, Age, BMI, Systolic Blood pressure, Diastolic Blood pressure, OGTT, Total Cholesterol, Waist to hip ratio, Diabetes mellitus and Family history of Diabetes in tsunami effected population**.**

BMI= Body Mass Index, WHR= Waist to Hip Ratio, FBG=Fasting Blood Glucose, 2h PG= 2 hour post glucose test (oral glucose tolerance) BP= Blood Pressure, MADRS score= Montgomery Asburg Depression Rating Scale, DM= Diabetes Mellitus, SBP=Systolic Blood Pressure, DBP= Diastolic Blood Pressure,

Characteristics of the population by disease

Analysis of the total population by healthy subjects, subjects with "diabetes only," subjects with "depression only" and subjects with combination of "both diabetes and depression" in tsunami non effected and effected areas is shown in table 08.

There was a similar prevalence of subjects with "only diabetes" (6.4%) in both tsunami effected and non effected areas. There was a higher prevalence of subjects with "only Depression" in the tsunami effected population (17.1%) than that of tsunami non effected (10.1%) Moreover, there was a higher prevalence of subjects with combination of "both diabetes and depression" in the tsunami effected population (5.4%) than that of non effected (3.3%).

Table 08;

Characteristics of population with or without diabetes and depression (Frequencies and Percentages) in tsunami effected and non effected population of Sri Lanka after 3 years of tsunami

Variable Frequency(%)	Tsunami Not effected	Tsunami Effected	Total
Healthy	341(80.2)	224(71.4)	565 (76.4)
Only DM	27(6.4)	20(6.4)	47(6.4)
Only Depression	43(10.1)	54(17.1)	97(13.1)
Both DM and Depression	14(3.3)	17(5.4)	31(4.2)

Some of the important risk factors were compared within positive and negative diagnosis of

(1.) Depression
(2) Diabetes
(3) (Depression + Diabetes) both conditions together.

Age, BMI, MADRS score, Blood Glucose, 2HPG, values had significant differences between positive and negative diagnosis of all three groups.

Total cholesterol level was significant between positive and negative diagnosis of diabetes, and (diabetes +depression). WHR was significant only in diagnosis of diabetes, systolic and diastolic blood pressure significant only in diagnosis of depression group.

When subjects with both diabetes and depression compared with healthy subjects, we observed significant differences in Age, BMI, MADRS, BG level, Total Cholesterol and 2HPG values. (Table 09)

Table 09.

Socio Demographic Characteristics and clinical data of the study population with or without diabetes and depression in Sri Lanka 2008.

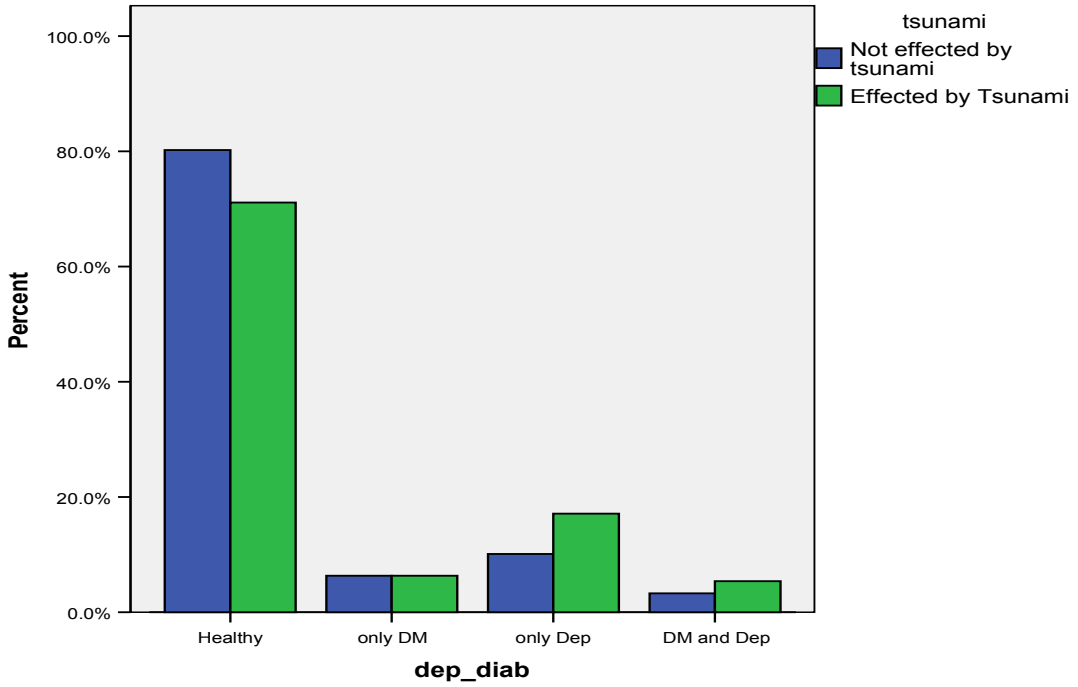
VARIABLE		Depression			Diabetes			DM and Depression		
	Total mean	No	Yes	P Value	No	Yes	P Value	No	Yes	P value
Age	48.01	47.07	52.54	<0.001	47.56	51.85	0.002	46.6	51.1	0.046
BMI	23.17	23.01	23.92	0.047	22.90	25.43	<0.001	22.9	26.6	<0.001
MADR	9.09	4.81	29.58	<0.001	8.36	15.31	<0.001	4.7	28.8	<0.001
BG	105.01	100.9	124.3	<0.001	95.36	186.92	<0.001	95.93	209.8	<0.001
TC	199.33	198.9	201.3	0.556	196.7	221.59	<0.001	196.8	218.1	0.011
WHR	.833	.839	.835	0.450	.83	.87	<0.001	.836	.857	0.68
SBP	124.15	123.6	126.9	0.005	123.9	126	0.207	123	129	0.37
DBP	79.75	79.20	82.38	<0.001	79.6	81.2	0.152	79.13	83.0	0.45
2HPG	151.22	140.7	240.0	<0.001	142.8	191.40	<0.001	136.0	263.7	<0.001

Percentage of Cases by disease, in tsunami effected and none affected areas of Sri Lanka after 3 years of tsunami.

BMI= Body Mass Index, WHR= Waist to Hip Ratio, FBG=Fasting Blood Glucose, 2h PG= 2 hour post glucose test (oral glucose tolerance) BP= Blood Pressure, MADRS score= Montgomery Asburg Depression Rating Scale, DM= Diabetes Mellitus, SBP=Systolic Blood Pressure, DBP= Diastolic Blood Pressure,

Figure 06.

Percentage distribution of healthy subjects and disease categories (only Diabetes, only Depression, and Both Diabetes + depression) in tsunami effected and none affected areas in Sri Lanka 2008



Relationship between diabetes and depression

Diabetes and depression had a significant relationship P Value <0.001, both in tsunami effected and non effected areas in Sri Lanka. Odds ratio for diabetes in tsunami effected and non effected areas were 4.11(95% CI 2.0-8.4) and 3.52 (95%CI 1.7-7.1) respectively.

Table 10

Characteristics of diabetes and depression; Numbers and percentages and Chi-square for diabetes and depression in tsunami effected and non effected areas of Sri Lanka.

	Tsunami not effected				**Tsunami Effected**			
	No Diabetes	Diabetic	Total	P Value	No Diabetes	Diabetic	Total	P Value
No Depression	341 (80.2%)	27 (6.4%)	368 (86.6%)	<0.001	224 (71.1%)	20 (6.3%)	244 (77.5)	<0.001
Depressed	43 (10.1%)	14 (3.3%)	57 (13.4%)		54 (17.1%)	17 (5.4%)	71 (22.5%)	
Total	384 (90.4%)	41 (9.6%)	425 (100%)		278 (88.3%)	37 (11.7%)	315 (100%)	

10. Discussion

This study was focussed on prevalence of diabetes and depression and its relationship in a tsunami affected area and a non affected area in Sri Lanka after 3 years of tsunami catastrophe.

We observed that the prevalence of diabetes was 10.5% in the total population (740) studied. The prevalence of diabetes was higher in the tsunami effected population (11.7%) than that of (9.6%), non effected (OR= 1.24, 95% CI=0.77-1.9). Prevalence of depression was significantly higher in tsunami effected (22.5%) than non effected (13.4%) population. (OR=3.84 95%CI= 2.3-6.3) P=<0.001.

High prevalence of diabetes and depression in tsunami effected population;

The high prevalence of diabetes and depression in the tsunami affected population could be due to multiple aggravating factors of diabetes and depression, which has been exerted on the tsunami effected population than that of the tsunami non effected population. Tsunami has exerted a tremendous pressure on lifestyles of effected population. Disaster related experiences can be traumatic and can have lasting effects on people.

The impact on people immediately after the tsunami disaster has been assessed by many researchers, revealing the fact that it caused heavy psycho somatic derangements in effected people. These high levels of Post Traumatic Stress Disease (PTSD) and its consequences preceding tsunami can lead to metabolic derangements in effected population. To date, studies have linked traumatic stress exposures and Post Traumatic Stress Disease (PTSD) to such conditions as cardiovascular disease, diabetes, gastrointestinal disease, fibromyalgia, chronic fatigue syndrome, musculoskeletal disorders, and other diseases.(70)

Our observation, high prevalence of diabetes and depression in tsunami affected population is consistence with similar studies done in Asia after the tsunami incident.

The prevalence of diabetes was 10.5% in the total population we studied. This prevalence rate is consistent with the previous studies conducted in Sri Lanka.

Prevalence of diabetes in Sri Lanka shows an increasing trend in the recent time. Study on rural community of Sri Lanka shows that the prevalence of diabetes is 2.5% in 1990(71). The largest ever study done in Sri Lanka shows a prevalence of diabetes in Sri Lanka 14.2% among males and 13.5% in females. (72),(73). In the rural community of Sri Lanka prevalence of diabetes has increased from 2.5% in 1990 to 8.5% in 2000 (P = 0.008) this was accompanied by increase in monthly income, level of education, and body mass indices (74). Estimated national prevalence in of type 2 diabetes is 9.6% in Sri Lanka. (75) In the regional setup, some countries have similar prevalence in urban and rural areas. Crude prevalence of type 2 diabetes was 4.3% and IFG was 12.4% in Bangladesh. (76).

Most risk factors of diabetes are dietary and lifestyle factors, suggesting that their change substantially reduces the risk of developing type 2 diabetes. Although only the modifiable risk factors can be addressed by interventions, non modifiable risk factors like age are important components to determine an individual's risk for diabetes.(77)

Female preponderance of Diabetes

Interestingly in our study, there was a higher occurrence of diabetes in females in all the age categories. In the tsunami non effected area, 7.2% males and 11 % females had diabetes compared to 10.8% males and 12.2% females in the tsunami effected area.

The female preponderance of increased prevalence of diabetes is consistent with the many studies done in the region. The same phenomenon was described in an Indian study as it could possibly be due to the childhood under nutrition in females (78) A Diabetes prevalence study in Bangladesh showed that higher prevalence of disease in all

categories of ages in females than males. (79). High female preponderance of diabetes in females also found in Mexican Indians(80) (81).

Nevertheless, One Study in SAARC region involving India, Pakistan, Bangladesh, Nepal and Sri Lanka, has shown that generally there is a male preponderance of type 2 diabetes in SAARC region compared to a ratio of 1;1 in developing countries as a whole and 1:1.5 in developed countries. (82), (83),

Increased prevalence of diabetes with increasing age;

We observed that Most of the participants were included in the highest age group (> 50 years) comprising 43% of the total. Mean age of the tsunami none affected and effected population was 48.3 and 47.53 respectively. Time availability and more health concern by elders could be explanations for higher participation by elders. Life expectancy of the males are higher than females in Sri Lanka.

We also observed that there was an increasing trend of diabetes with the increasing age. Both males and females had a higher prevalence of diabetes in the higher age groups. Another Post tsunami study done in Sri Lanka revealed that the prevalence of diabetes increased with increasing age both for tsunami effected and non effected population. (84)

High prevalence of diabetes with the increasing age is evident in many studies conducted in the region. A cross sectional study conducted in Nepal reveals that the overall prevalence of T2DM and IFG increases with age. Prevalence of IFG is highest among middle age men where as the prevalence of T2DM is highest among older men.(85) the same observation was found at a cross sectional population survey done in Kashmir valley of India (86) and a study in a rural area of Bangladesh (87). A study in india reveals that prevalence of undetected diabetes and impaired glucose tolerance was higher in the tsunami area. (88)

Increasing prevalence of diabetes with increasing BMI;

In our study, Mean BMI values for the tsunami not effected population was 22.8 and 23.6 for tsunami effected population. Obesity in the total population was 6.5% and it is lower than most of the previous studies. The difference between the mean BMI values of diabetic and non diabetic subjects were significant both in tsunami effected and non effected population.

However, our BMI values, in different age groups and in different strata of BMI were very much similar to the largest study on diabetes conducted in Sri Lanka in 2005. It revealed that the mean body mass index was 22 kg/m2 in men and it was lower than that in women, 23.3 kg/m2 and the prevalence of obesity was 20.3% in men and 36.5 % in women. In the same study, the prevalence of diabetes was lowest in the southern province. (89)

Study in adolescent Sri Lankans revealed that prevalence of underweight and overweight were 47.2%, and 2.2%, respectively. (90). Obesity prevalence among boys (4.3%) was higher than in girls (3.1%) in schoolchildren in urban areas of Sri Lanka. Further, 7.0% of boys and 6.8% of girls were underweight and they were from the high income group. (91) Higher BMI among women compared to men also observed in Indians and Pima Indians study(81).

We observed that the prevalence of diabetes was increased with increasing age and also with increasing BMI in both tsunami affected and not effected subjects. Obesity is a major risk factor of development of diabetes.

With the high rate of urbanization in process, populations that have been continually exposed to under nutrition and now have easy access to energy-rich foods and a lifestyle which does not demand such high energy expenditure, ultimately end up in obesity. Population living in the harsh environments of rural agricultural villages of Sri Lanka has led a life style with much physical activity and traditional diet habits in the past. This traditional culture was changed with the rapid demographic transition and urbanization took place after 1970s. Rural populations with more traditional lifestyles exhibit lower

rates of diabetes risk factors and diabetes, whereas urban populations, and particularly those of a higher socioeconomic status, have higher rates of both risk factors and diabetes.

It is well established that obesity is an important risk factor for type 2 diabetes, and randomized trials have shown that weight reduction as the primary target of diet and lifestyle interventions can prevent or delay the development of type 2 diabetes.

High prevalence of Depression in tsunami effected population:

The observed prevalence of depression, 17.3% (in total study population) is higher than the estimated prevalence of depression (5 to 10%) in Sri Lanka. (92)

We found that prevalence of depression was significantly higher among the tsunami affected population 22.5% than non effected population 13.4%. In the total population, Development of depression in tsunami effected individuals was almost four times higher than that of non effected population OR=3.84 (95%CI -2.3-6.3).

Females (16.2%) had a significantly higher prevalence of depression than men (8.5%) in the tsunami not affected area. Depression was a significant risk factor of development of diabetes in both tsunami not effected (OR=4.1:95% CI= 2.0- 8.4) and effected (OR= 3.5 95% CI= 1.7-7.1) population. It remained significant after controlling for all the significant confounding factors for depression in both areas. Post tsunami studies in south East Asia region have observed high prevalence of depression in the tsunami effected people than the non effected.

Our results are consistent with most of the studies done in tsunami affected population in Sri Lanka and regional countries.

Several studies show that the prevalence of symptoms of post traumatic stress disorder; anxiety and depression among individuals residing in areas affected by tsunami were high compared to other areas. The rates of PTSD, depression and anxiety were higher

just after tsunami and those rates declines over time.(12),(93),(94),(95), Most recently published research in the tsunami effected areas of Sri Lanka reveal that the prevalence of clinically significant PTSD, depression and anxiety was 21%, 16% and 30% respectively after 20-21 months of tsunami disaster in Sri Lanka. (96)

A comparative study performed in tsunami effected and non effected population in India revealed that the stress score was significantly higher in tsunami effected population. Prevalence of undetected diabetes and impaired glucose tolerance was higher in the tsunami area. (88)

A study carried out to assess the prevalence of symptoms of post traumatic stress disorder, anxiety and depression among individuals residing in areas effected by tsunami in Thailand after 2 months of the disaster, have shown that depression were reported by 30% of displaced and 21% of non displaced persons in one area (Phang Nga) and 10% of non displaced persons in another area (Krabi and Phuket). "In multivariate analysis, loss of livelihood was independently and significantly associated with symptoms of all 3 mental health outcomes (PTSD, anxiety, and depression)."(12).

Traumatic events experienced during the tsunami were significantly associated with symptoms of PTSD and depression. A study in India reveals that stress scores were significantly higher in tsunami effected population than that of non effected and the prevalence of undetected diabetes and impaired glucose tolerance higher in the tsunami effected area. (97)

After 3 to 4 weeks of tsunami, symptoms of PTSD were measured in effected children of costal villages of Sri Lanka. The prevalence rate of tsunami-related posttraumatic stress disorder ranged between 14% and 39% . (98), In Tamilnadu India, after two months of tsunami, prevalence of Post traumatic stress disorder was 12.7% (99)

WHO bulletin on tsunami stated that the prevalence of mild and moderate common mental disorders in general population is 10%, can be increased up to 20% after the disaster. Severe mental health problems, such as psychosis or severe depression typically affect 2-3 % of any given population but can increase to 3-4 % after a disaster. (92)

Higher prevalence of Depression in women;

We observed a higher prevalence of depression in females (16.2%) than male (8.5%) subjects in tsunami not effected population. It has been shown that women exposed to trauma are more likely than men with such exposure to develop PTSD and apart from biological factors, cultural and social issues could explain this difference in women's vulnerability to PTSD. (99) Females had a higher risk of getting cardiovascular and metabolic diseases than men.

It has been shown that women exposed to trauma are more likely than men with such exposure to develop PTSD, and, apart from biological factors, cultural and social issues could explain this difference in women's vulnerability to PTSD.

A significantly high mortality was observed in women and children among the displaced population in the eastern coastal district of Sri Lanka (17.5% females vs. 8.2% males). (84). Six months after tsunami, in an affected village of Sri Lanka, 56% had PTSD, females 64% and males 42%. Females had twice risk of experiencing PTSD. Depression was significantly associated with PTSD (100). Studies reveal that Depression is twice as common in women than in men(101). Presence of comorbid depression was significantly higher in diabetic women than diabetic men. (102).

Our population had a lower depression rate in the younger age groups and higher depression rate with the increasing age. But in contrasting results found in a Canadian study using the data from national health survey suggests that the highest rate of onset of depression occurs in young adults aged 12 to 24 and lower rates occur among people 65 years or more(101). Diabetes complications were associated with major depression

among demographic subgroups. Older patients with a higher number of complications had an increased likelihood of minor depression. (103))

Depression as a risk factor of diabetes

We observed depression as a significant factor of development of diabetes. In our study we observed that depression was a significant risk factor of development of diabetes (OR=3.84 95% CI= 2.3-6.3). Similar findings were demonstrated in recent studies conducted in other countries.

In rural Pakistan, prevalence of depression was found to be 5.4%. Diabetics had three times higher depression rate compared to the entire cohort. Conversely, prevalence of diabetes was three times higher in depressed subjects compared to entire sample(104).

Recent studies have documented two fold odds of depression in individuals with diabetes compared to individuals without diabetes (105;106)

In a study which compared psychiatric morbidity among diabetic patients, asthmatics and healthy individuals, it was concluded that depression was more prevalent among diabetic patients compared with asthmatics and healthy individuals. (107) Depressive illnesses have also been shown to be associated with increased rates of death and disability from cardiovascular disease. (108)

Studies have documented that depression increases the risk of development of diabetes (109),(110),(111) Some studies suggest that the depressive symptoms might be a consequence of the burden of diabetes. (112)

However, temporal relationship between diabetes and depression is not being clearly defined, as majority of studies have been cross sectional. In a recent meta analysis prevalence of comorbid depression in adults reveals that presence of diabetes doubles the odds of comorbid depression. Presence of comorbid depression was significantly higher in diabetic women than diabetic men. (102)

Longitudinal studies on diabetes and depression are scanty. In one longitudinal study carried out in Japan, to examine the relationship between depressive symptoms and the incident of type 2 diabetes, they found that the subjects who had depressive symptoms, (moderate to severe level) had a 2.3 times higher risk of having type 2 diabetes at the follow up survey than who were not depressed. (113)

A study investigating the prospective relationship between DM and depressive symptoms in an elderly population revealed that Diabetes mellitus was associated with a 30% increased risk of incident depressed mood.(114)

Prospective studies indicate that a single self-report of high depressive symptoms is associated with an increased risk of developing type 2 diabetes mellitus. A study done on adults over 65 years revealed that depressive symptoms were significantly associated with incident diabetes in older people(115). Conversely, Another longitudinal study revealed that there was no increased incident of diabetes for those with high or moderate depressive symptoms compared to those with no depressive symptoms. These results do not support the etiologic relationship of depression predisposing individuals to diabetes.(116)

A four year follow up study analyzing of 72,178 female nurses aged 45-72 years revealed that depressive symptoms are associated with modest increase in the risk of type 2 diabetes mellitus.(117)

Risk factors of depression;

In our study, we observed that Age, BMI, Systolic BP, Diastolic BP, Blood glucose levels, OGTT, and MADRS depression score, Family history of DM and Level of education were significantly higher in depressed subjects than not depressed subjects. (P value < 0.05)

Our study reveals that prevalence of depression was increasing with increasing age. The lowest prevalence was in the lowest age group while highest prevalence was in the oldest

age group. Highest prevalence of depression was found in normal BMI group. Interestingly, prevalence of depression in the obese group is 2.7 times higher than that of the non obese population.

We didn't find an association between total cholesterol and depression. But studies suggest depressive symptoms are significantly associated with suboptimal levels of total cholesterol and Triglyceride levels in a cross sectional study of African American adults aged 35-75 years with type 2 diabetes (118). We observed a strong relationship between diabetes and depression.

Smoking and alcohol consumption;

It has previously been shown that and moderate alcohol consumption is inversely associated with diabetes risk, whereas smoking increases the risk of developing diabetes.

We observed a significant difference between male to female groups, in smoking and alcohol consumption. It is obvious that females very rarely smoke or consume alcohol in the rural villages of Sri Lanka and it is very rare that females declare that they consume alcohol or smoke.

Both smoking and alcohol consumption was higher in the tsunami non effected area than the effected area.

11. Strengths of the study:

We conducted a cross sectional study in two analogous communities one effected by tsunami and the other was not effected. We could match the two communities with similar socio economic characteristics.

Our study included anthropometric measurements as well as biological and biophysical measurements. When taking and recording the anthropometric measurements, we maintained the quality of data by various measures. Always we used the trained qualified health personals to obtain measurements following WHO guidelines. The instruments were calibrated correctly before they used. Laboratory investigations were done in the quality controlled university laboratory under the direct supervision of head of the biochemistry department. When conducting interviews we used the assistants selected from the same village so the message is converted conveyed correctly to the subjects.

Limitations

Potential limitations of our study include the fact that some of the data collected were based on self-report, making them prone to recall bias and overestimation of actual behavior to provide socially desirable responses. In answering the questions of family history of diabetes mellitus, we observed some unanswered responses. Recalling the food intake in the previous days had lacking information in some cases. Few cases had emotional instability to recall the losses in tsunami and were not able to get all details about depressive symptoms. There were reports that some people in tsunami effected population tried to overestimate the lost properties.

Studies have shown, however, that self-reported data on diabetes, chronic diseases, and several cardiovascular risk factors are reliable. It is possible that some statistical significance was not observed due to the low distribution of samples in some categories when variables were categorized. Presence of depression unrelated to tsunami could not be explained.

12. Recommendations;

We observed that the prevalence of diabetes as well as depression were significantly high in the tsunami effected population. This increase in depression and diabetes explains the extreme mental health strain on population subsequent to natural disasters.

Diabetes is common in Sri Lanka, but nearly one-half of all cases are undiagnosed.

If diagnosed early, it is treatable with low cost therapies, and reduces the burden of complications. Initiatives that increase diagnosis rates would be expected to produce substantial health benefits in Sri Lanka.

On the other hand, depression is increasing rapidly in the society generating immense public health problems. Depression has a negative impact on quality of life. Mental health problems must be addressed more vehemently specially after huge natural disasters.

Combination of both diseases increases health cost of the country unbearably. Comprehensive strategies to address the problem of diabetes and depression in Sri Lanka are needed including management in natural disasters.

Women have higher prevalence of depression and diabetes than men. Women with low income had higher prevalence of PTSD, depression and diabetes. Implementing social interventions such as income-generating activities and facilitating early return to work after disasters are critical. Special mental health efforts should be targeted at women exposed to trauma.

Training primary care doctors and other health staff in the management of common psychiatric disorders are important.

Our data and results could be used to conduct further investigations as well as to plan social and mental health interventions for individuals affected by such disasters.

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Questionnaire

ID Number:

Date :

Interviewer:

Personal data:

1. Name: …….
2. Whether Tsunami effected. 0= not effected 1= effected
3. Sex: Male= 1, Female= 2
4. Date of birth: ……Age….
5. Place of birth: …….
6. Religion: 1=Buddhist 2=Christian 3=Hindu 4= Islam
7. Level of education: 1=Grade 1-5 2=5-O/L 3=O/L- A/L 4=>A/L - >
8. Occupation: …….
   8.1 Current Employment …….
   1= No 2=Part time 3=Full time 4=Other
   8.2 Describe Occupation Category 1-4
   1= Clerical, Administration 2=Business 3=Industry +Self emp 4=Labor, faming, fishing.
9. What is your monthly income?
   1=<3000 2=3000-6000 3=6000-10000 4=>10000
10. How many members are there in your family? A) >18 yrs. B) <18yrs
11. Health

11.1 How would you describe your present state of health?

1=Poor

2=Normal

3=Good

4=Very good

11.2.2 Do you have any of **these illnesses** or have you suffered from them in the past? Are you on treatment? How long? What type of treatment? Regularly?

.	Age Of	Suffered	On treatment	How long	What type of treatment	Regular treatment

	onset	Yes	No	Yes	No	Rx Years	Allopath	Ayurved	Yes	No
Diabetes										
Heart Disease										
Hypertension										
Stroke/TIA										

12 family history

12.2.2 Has either of your parents or any of your siblings suffered from following illnesses?

	Parents		Age of onset	Siblings		Age of onset
	Yes	No		Yes	No	
Heart disease MI						
Hypertension						
Diabetes mellitus						
Stroke/TIA						

13. Smoking

13.1 Smoking –

0=Never 1=Previous Mild 2=Previous Heavy 3=Constant Mild

4=Constant Heavy

13.2 If you smoke daily at present, do you smoke?

- Cigarettes Yes ☐ No ☐
- Cigars Yes ☐ No ☐
- Beedee Yes ☐ No ☐
- Other Yes ☐ No ☐

13.3 How many cigarettes do you or did you smoke daily? _____/day

13.4 How old were you when you started smoking daily? _____years

13.5 How many years altogether have you smoked daily? _____years

14.. **Food and drink**

	Seldom/never	1-3 times per month	1-3 times per week	Daily
White Rice /white rice flour products				
Red Rice /red rice flour products				
Wheat flour products - Bread/Roti/				
Vegetable dishes that are cooked				
Raw vegetables/salad/greens				
Fruits				
Pulses (cooked/boiled/wadai)				
Intake of fish.. & meat.				
Home made sweets/desserts				
Toffees/chocolates				

14.2 What kind of fat do you use usually?

	Dairy butter	Margarine	Coconut/palm oil	Soya/ Vegetable oil	Non
On bread/ Roti/hoppers/thosai					
For cooking					

How often?

	Seldom/never	1-3 times a month	1-3 times per week	Daily
On bread/ Roti/ hoppers/thosai				
For cooking				

14.3 How often do you use coconut in food?

	Seldom/never	1-3 times a month	1-3 times per week	Daily

15 you take Short eats? Frequency

	Seldom/never	1-3 times a month	1-3 times per week	Daily

15.1 How often do you drink cola or carbonated drinks per day? Glasses……..

15.2 How many cups of tea or coffee do you drink daily?

Number cups tea—0=No 1=1-32=3-53=>5

Do you take sugar with tea or coffee? 1=1-32=3-53=>5

15.3 Do you take milk / milk powder with tea or coffee?

How many times per day? 1=1-3 2=3-53=>5

15.4 What Milk ? 1=Full Cream 2=Non fat 3=Fresh Milk

15.5 How often have you **consumed alcohol** in the course of the past year? (Low alcohol beer and non alcoholic beer are not included)

Never	1-3 times a month	1-3 times per week	Daily

To those who have consumed alcohol during the past year

16. **Physical activity**

16.1 On average how many hours a day do you spend ACTIVE?

0= Not active 1=1-4 hours 2=4-8hours 3=>8hours

16.2 Describe the extent of movement and bodily exertion in <u>your spare time</u> during the last week/month. (From home to work regarded as spare time) Select one,

1=Read, watch TV or other sedentary activity……..

2=Walk, cycle or move about in some other way at least <u>4 times per week</u>

3=Take part in physical exercise/ sport, do heavy gardening

4=Exercise hard and take part in competitive sport

regularly and several times a week……

17. To be filled by the Doctors.

18. Blood test : Fasting Blood sample… Date and Time……
Time of last meal……..

19. Glucose Drink.—Time consumed glucose…….

20 **Anthropometrics**

Height (cm)____Weight (Kg)_____Hip circumference (cm)___Waist circumference (cm)_____

21. Blood pressure (SBP/DBP)1. _____2._____ 3._____

22 Second Blood sample-- After 2 hours:

Date of collection __/___/_2007 Time since last meal/drink _____ hours 8

Montgomery-Åsberg Depression Rating Scale (MADRS)

1. Apparent sadness Representing despondency, gloom and despair (more than just ordinary transient low spirits), reflected in speech, facial expression, and posture. Rate by depth and inability to brighten up.
0 = No sadness.
2 = Looks dispirited but does brighten up without difficulty.
4 = Appears sad and unhappy most of the time.
6 = Looks miserable all the time. Extremely despondent

2. Reported sadness Representing reports of depressed mood, regardless of whether it is reflected in appearance or not. Includes low spirits, despondency or the feeling of being beyond help and without hope.
0 = Occasional sadness in keeping with the circumstances.
2 = Sad or low but brightens up without difficulty.
4 = Pervasive feelings of sadness or gloominess. The mood is still influenced by external circumstances.
6 = Continuous or unvarying sadness, misery or despondency.

3. Inner tension Representing feelings of ill-defined discomfort, edginess, inner turmoil, mental tension mounting to either panic, dread or anguish. Rate according to intensity, frequency, duration and the extent of reassurance called for.
0 = Placid. Only fleeting inner tension.
2 = Occasional feelings of edginess and ill-defined discomfort.
4 = Continuous feelings of inner tension or intermittent panic which the patient can only master with some difficulty.
6 = Unrelenting dread or anguish. Overwhelming panic.

4. Reduced sleep Representing the experience of reduced duration or depth of sleep compared to the subject's own normal pattern when well.
0 = Sleeps as normal.

2 = Slight difficulty dropping off to sleep or slightly reduced, light or fitful sleep.
4 = Moderate stiffness and resistance
6 = Sleep reduced or broken by at least 2 hours.

5. Reduced appetite Representing the feeling of a loss of appetite compared with when-well. Rate by loss of desire for food or the need to force oneself to eat.
0 = Normal or increased appetite.
2 = Slightly reduced appetite.
4 = No appetite. Food is tasteless.
6 = Needs persuasion to eat at all.

6. Concentration difficulties Representing difficulties in collecting one's thoughts mounting to an incapacitating lack of concentration. Rate according to intensity, frequency, and degree of incapacity produced.
0 = No difficulties in concentrating.
2 = Occasional difficulties in collecting one's thoughts.
4 = Difficulties in concentrating and sustaining thought which reduced ability to read or hold a conversation.
6 = Unable to read or converse without great difficulty.

7. Lassitude Representing difficulty in getting started or slowness in initiating and performing everyday activities.
0 = Hardly any difficulty in getting started. No sluggishness.
2 = Difficulties in starting activities.
4 = Difficulties in starting simple routine activities which are carried out with effort.
6 = Complete lassitude. Unable to do anything without help.

8. Inability to feel Representing the subjective experience of reduced interest in the surroundings, or activities that normally give pleasure. The ability to react with adequate emotion to circumstances or people is reduced.
0 = Normal interest in the surroundings and in other people.
2 = Reduced ability to enjoy usual interests.
4 = Loss of interest in the surroundings. Loss of feelings for friends and acquaintances.
6 = The experience of being emotionally paralysed, inability to feel anger, grief or pleasure and a complete or even painful failure

9. Pessimistic thoughts Representing thoughts of guilt, inferiority, self-reproach, sinfulness, remorse and ruin.
0 = No pessimistic thoughts.
2 = Fluctuating ideas of failure, self-reproach or self- depreciation.
4 = Persistent self-accusations, or definite but still rational ideas of guilt or sin. Increasingly pessimistic about the future.
6 = Delusions of ruin, remorse or irredeemable sin. Self- accusations which are absurd and unshakable.

10. Suicidal thoughts Representing the feeling that life is not worth living, that a natural death would be welcome, suicidal thoughts, and preparations for suicide. Suicide attempts should not in themselves influence the rating.
0 = Enjoys life or takes it as it comes.
2 = Weary of life. Only fleeting suicidal thoughts.
4 = Probably better off dead. Suicidal thoughts are common, and suicide is considered as a possible solution, but without specific plans or intenstion.
6 = Explicit plans for suicide when there is an opportunity. Active preparations for suicide.

Declaration of consent

I have received information about the Diabetes and Depression study in tsunami affected and none affected areas of Sri Lanka. I am therefore informed about the purpose of the study. I know that my blood sample can be analyzed for various substances.

I am further aware that all information pertaining to my self will be treated strictly confidentially. I know that the research ethics committee of the University of Peradeniya has approved the study. I also know that no specific time limit has been set for how long the information on my self can be stored, but that I can withdraw from the study at any moment and be deleted from the register. I have been informed that such a request must be submitted in writing to Dr. Sarath Nettasinghe of Department of health, Central Province. In that case my blood sample will be destroyed.

1. I agree that I can be contacted and offered follow up examination, for treatment or for illness prevention.
2. I agree that I can be contacted and invited to attend a similar health check in the future.
3. I agree that the results of my health check can be used in medical research.
4. I agree that my results (after approval has been obtained from relevant authorities in Sri Lanka and Norway) can be compared with information in other registers. These could be registers containing data on health, national insurance and disease. They could also be registers pertaining to income, education and occupation or information from other health studies in Oslo and Sri Lanka.
5. I agree that my blood sample can be stored and used in medical research. Any use of this sample is subject to permission from the Regional Committee for Medical Research Ethics of Norway and/or Higher Degrees and Research Ethics committee of the University Of Peradeniya, Sri Lanka.

Please cross out any item or items to which you do not give your consent.

(After knowing all these about the research, if you still have some other questions you should feel free to ask. If you don't like to participate, you have the full right to do that. If you agree your verbal consent will be taken.)

_____ _____

Place and date Signature of the participant

_____

Signature of the witness