DISCUSSION

5.1 Prevalence of Type 2 Diabetes Mellitus

Non-communicable Diseases (NCDs), especially the rise of Type 2 diabetes mellitus, hypertension and Cardiac Heart Disease (CHD) are resulting in a depressing issue that India as a nation has to deal with. The increased prevalence of obesity and diabetes mellitus are considerably more amongst the urban populace due to the poor dietary customs and aspects linked to way of living. Thus, In India, it is essential to keep an eye on the rising prevalence of Type 2 Diabetes mellitus, especially between the populace in urban locales (Ramachandran et al., 1997; King et al., 1998). Millar and Wigle (1986) show that the occurrence of the recognised danger aspects comprising of obesity and diabetes mellitus are much more amongst men and women who are less educated due to a degree of socioeconomic ranking.

In the present study, the overall prevalence of type 2 diabetes mellitus in the urban Sikh population of Amritsar was estimated at 23.2% with a slightly higher prevalence among the men (25%) compared to the women (21.5%). The prevalence rate observed in the present study was higher compared to the other studies, which reported the T2DM prevalence rate within various communities and setups as ranging from 8.9% to 12.6% for the Indian population (Ramachandran, 2001; Yagnik, 2004; Deo et al., 2006). Some of the studies based on the South Indian people also show a high prevalence of diabetes in the urban areas (Ramachandran, 1986).

Variable prevalence (3-11.2%) of diabetes has been reported from urban areas of India depending upon on the region, caste and type of survey, diagnostic tool and diagnostic terminology (Ramachandran, 1997). Among the urban population in Delhi, the prevalence of diabetes mellitus ranged from 1.6% to 9%, and was observed as being more common among obese subjects (Gopinath, 1994). Among the urban South Indian population, it was reported to be in the range of 1% to 5% (Gupta et al., 1978; Patandin et al., 1994; Tripathy et al., 1997). Also, in one of the well-designed studies on the urban areas of the north Arcot District in South India, the prevalence of impaired glucose tolerance (IGT) and diabetes mellitus was 6.6% and 4.9%, respectively, as
investigated by 2 hour post-75 gm oral glucose load values (Patandin et al., 1994). However, it is difficult to compare most of the studies done in India, since diagnostic criteria of diabetes, methodology of tests, and sampling modes are all different. Further, among the urban Indian population, prevalence was reported in the range of 1-5% (Gupta et al., 1978; Patandin et al., 1994; Tripathy et al., 1997). Similarly in a urban community of Punjab state, only 4.6% were deemed diabetic (Wander et al., 1994).

Various studies observed a similar prevalence trend among the urban populations (Deo et al., 2006); Kim et al., 2006). Low socioeconomic status and malnutrition have been deemed possible reasons of low prevalence rate of T2DM in rural populations. Type 2 diabetes, obesity and hyperlipidaemia have been traditionally considered as diseases of affluence. Our study results also show the influence of these traditional factors on the urban Sikh population of Amritsar. A wealth of data indicates that Asian Indian people abdominal obesity and insulin resistance, and develop glucose intolerance more often (McKeigue et al., 1991). The prevalence of diabetes is higher in migrant Asian Indians as compared to other ethnic groups (Ramaiya et al., 1990). The reason for high prevalence in the urban population might be due to their migration to metropolitan cities, an act that exposes them to several adverse lifestyle and environmental influences. In cities, they are usually seen to settle down in urban and take up jobs. Several lifestyle alterations result from this transition: changes in their traditional penurious eating habits, exposure to severe stress, decreased physical activity, increase in alcohol intake etc (Mishra et al., 2001).

In the bivariate analysis, the prevalence of T2DM was found to be significantly associated with age, hypertension, high serum cholesterol, low high density lipoprotein, high serum triglycerides levels and medium of cooking i.e., oil used. Multiple logistic regression analysis identified age, hypertension, serum cholesterol, serum triglycerides as independent factors associated with diabetes. These findings were similar to those reported by Ramachandran et al., (2001).

5.2 Age as an Independent Risk Factor for T2DM

The present study also revealed that the prevalence of T2DM increased with age. In the target population that was 20 years and above, the prevalence of T2DM
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increased with age from 4% in the age group 20-29 years to 8% for those in the age group 30-39 years. Further, the prevalence increased to 20.5% for those in the age group 40-49 years, and 31.9% for those in the group 50-59 years, while it was 32.5% for those in the age group ≥ 60 years.

These findings are quite consistent with the studies done outside the Indian subcontinent like in the USA, where studies reported an estimated 3.4% prevalence of diabetes. Total estimates for those afflicted with diabetes increased with age from 2.0% for those in the age group 20-44 years to 17.7% for those in the age group 65-74 years. The rates were approximately equal for both the sexes (Harris et al., 1987). In Denmark, the prevalence of type 2 diabetes mellitus (T2DM) and impaired glucose tolerance (IGT) were 10% and 26% at 70 and 12% and 35% at 80 in men and women. Excess 10-yr mortality was seen in both sexes when T2DM existed at 70 and in men also when IGT existed at this age. This study explained the excess mortality in men solely—and in women partly—be by cardiovascular diseases. The 10-yr incidence of T2DM was 20% if IGT existed at 70, but only 4% when normal glucose tolerance was present at 70 (Anger et al., 1989). In Hong Kong, the prevalence of DM in a group of elderly Chinese subjects aged 60 and above and living in the community was found to be 9.8% (Woo et al., 1987). Hence age was considered the most consistent risk factor the world over for a rise in T2DM prevalence.

5.3 Dietary Habits and Lipid Profile as an Independent Risk Factor for T2DM

Disturbance of lipid metabolism appears to be an early event in the development of type 2 diabetes, potentially preceding the disease by several years (Adiels et al., 2008). In addition, the different components of diabetic dyslipidemia are believed to be metabolically linked (Taskinen, 2005; Adiels et al., 2006). Dyslipidemia associated with insulin resistance is characterized by moderately increased triglyceride levels carried in very-low-density lipoprotein particles, reduced high-density lipoprotein cholesterol levels carried in small HDL particles, and LDL-C levels that do not differ substantially from those of individuals without type 2 diabetes (Krentz, 2003; Taskinen, 2005; Adiels et al., 2006). Prabhakaran et al. (2007) reported the association between T2DM and hypertension, hypercholesterolemia and hypertriglyridemia.
Vikram et al. (2003), in their study in North India observed a strikingly high prevalence of abdominal obesity and generalized obesity in T2DM cases. Although Mohan et al. (2003) reported an association between physical activity and diabetes, we did not find an association.

Unfavourable blood lipids have been reported as a risk factor for type 2 diabetes by several prospective studies (Knowler et al., 1991; Haffner et al., 1997; Njolstad et al., 1998; Meisinger et al., 2002). An inverse relationship between HDL cholesterol and risk of type 2 diabetes have been documented in several of these (Fagot et al., 1997; Meisinger et al., 2002). Some prospective studies found low HDL cholesterol to be a stronger risk factor for type 2 diabetes in women only (Fagot et al., 1997; Njolstad et al., 1998). Only one previous study measuring non-fasting triglycerides found an independent risk of type 2 diabetes connected to elevated triglyceride levels (Almdal et al., 2008). High serum triglycerides and low serum HDL cholesterol levels were both seen in the insulin resistance syndrome, which was deemed a pre-diabetic state and suggested that non-fasting triglycerides and HDL levels did reflect a degree of insulin resistance (Taskinen, 2003). The mechanisms suggested are increased circulating levels of free fatty acids due to increased insulin levels and increased chylomicron assembly and secretion in the gut, the latter process being a result of localized insulin resistance in the intestine. Cross-sectional studies have shown that high BMI is associated with a higher level of total cholesterol and unfavourable lipids pattern, with low concentrations of HDL cholesterol and high triglycerides concentrations (Tsai et al., 2004; Wild et al., 2006). Various longitudinal studies have also shown BMI change over time to be positively associated with changes in total cholesterol, triglycerides and low density lipoprotein (LDL) cholesterol and negatively associated with HDL cholesterol change (Rainwater et al., 2000; Czernichow et al., 2002). Apart from triglycerides, all these lipids have been shown to convey diabetes risks independent of BMI. The issue that has not be emphasized though, is on how they are interrelated.

5.4 Hypertension as an Independent Risk Factor for T2DM

Previous prospective and case control studies have shown that hypertension progression is an independent predictor of type 2 diabetes mellitus (Gress et al., 2000;
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Kumari et al., 2004; Conen et al., 2007; Movahed et al., 2010). Several possible factors are likely causes of the association between type 2 diabetes mellitus and hypertension. Endothelial dysfunction could be one of the common pathophysiological pathways explaining the strong association between blood pressure and incident type 2 diabetes. Studies have shown that markers of endothelial dysfunction are associated with new-onset of diabetes, it is closely related to blood pressure and hypertension (Gokce et al., 2001; Meigs et al., 2004; Meigs et al., 2006). Markers of inflammation such as C-reactive protein have been consistently related to incidence of type 2 diabetes and to increasing blood pressure levels suggesting that inflammation might be another explanatory factor for the association between blood pressure, the metabolic syndrome, and the incident type 2 diabetes (Blake et al., 2003; Ridker et al., 2003; Hu et al., 2004).

In addition, insulin resistance could be another potential link between blood pressure levels and the incidence of type 2 diabetes mellitus (Ferrannini et al., 1987). Also, evidence from cross-sectional and cohort studies suggest a strong relation between blood pressure, basal metabolic index and risk of type 2 diabetes (Must et al., 1999; Wilsgaard et al., 2000; Czerichow et al., 2002; Wild and Byrne, 2006) Although studies show that blood pressure increases with increasing BMI, the risk of type 2 diabetes associated with hypertension is independent of BMI and BMI change. A causal relationship between hypertension and type 2 diabetes is further strengthened by a recent randomized clinical trial study showing a 14% reduction of risk of diabetes in subjects with glucose intolerance by allocation to 5 year treatment with Valsartan, an angiotensin II blocker with antihypertensive properties (McMurray et al., 2010).

Hypertension affects approximately 70% of patients with diabetes and is approximately twice as common in persons with diabetes as in those without. The prevalence of coexistent hypertension and diabetes varies across different ethnic, racial and social groups. Importantly, hypertension in patients with diabetes causes a significant increase in the risk of vascular complications in this population, and together, both conditions predispose patients to chronic kidney disease. The overlap between hypertension and diabetes substantially increases the risk of ischemic cerebrovascular disease, retinopathy and sexual dysfunction. Diabetes Mellitus is an
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independent risk factor for coronary artery disease, and the risk is markedly increased when hypertension is present (Rahilly et al., 2005).

Hypertension and diabetes have genetic determinants as well, as is suggested by Modan et al. (1985) and Lago et al. (2007) showing a higher strength of associations of genetic factors compared with environmental factors or lifestyle behavioural factors. It confirmed that having genetic factors with hypertension and T2DM should be one among other screening criteria.

Literature suggests that hypertension and T2DM comprise of ubiquitous association, as well as diabetes that can be connected to increased mode of peripheral vascular hypertension resistance or otherwise anti-hypertensive drugs is liable to lay impact over probability occurrence of metabolic syndrome. The process of connectivity can remain undesirable in context of waist circumference and BMI along with hypertension and T2DM being significantly high, yet not that high as the genetic predisposing (Mancia, 2005).

The estimations are implied in terms of epidemiological models as per demographic changes, some researches followed assumptions that is prevalence to age-specific remain constant as well as remained close to other factors of risk being stable (prevalence to obesity, physical activity and the instance of urbanization). They remain conservative and get considered as per minimal expected instances. Still, prevalence never add data to the diabetic reasons that grows very slowly in the form of epidemic, or otherwise remain important as the result of assessment based on evaluation of the way healthcare system manages diabetes. Apart from this, demographic factors that are prevalence to other factors like incidence, gains improvements in the treatment under longer survival strategy for the patients having diabetes (that reduces mortality), and ratio attained between diagnosed and the case of undiagnosed diabetes, added by the age related to diabetes onset (Colagiuri et al., 2005).

Overall, Asian Indians appear to have a greater predilection for cardiovascular complications whereas the prevalence of microvascular complications appears to be lower among them than among the Europeans. Findings of the present study are particularly ominous, and suggest that the policies are needed to be made pertaining to
the non communicable diseases with reference to the urban population (Mishra et al., 2001).

5.5 Prevalence of Hypertension

Hypertension is considered to be one of the main non-communicable disease (NCD) risk factors. It is currently the leading risk resulting in considerable death and disability worldwide and has accounted for 9.4 million deaths and 7% of disability-adjusted life years (DALYs) in 2010 (Lim et al., 2010).

Hypertension is increasing rapidly in most low and middle income countries (LMICs) driven by diverse health transitions. In 2001, it accounted for 10% of global healthcare expenditure underlining the considerable economic implications to resource constrained health systems, particularly those in LMICs (Gaziona et al., 2009). Apart from health implications, it has huge societal, developmental and economic costs.

The rising burden of hypertension, associated CVD and NCDs in India needs to be addressed as a public health priority employing an optimal context specific resource sensitive combination of the population and the clinical approach. There are numerous challenges ahead but also promising opportunities to galvanize efforts towards attaining the WHO-UN goal of 25% reduction in NCD related mortality and associated reduction in hypertension and salt intake by 2025 (Mohan et al., 2013).

As per the study conducted by Padmavati (2002), the prevalence of hypertension has increased during the last decade. This trend corroborates findings of the current study, which show high prevalence of hypertension (35.9%), with a higher prevalence among males (40%) compared to females (31%). Rapid urbanization, lifestyle changes, dietary changes are the factors attributable to this rising trend. Further, Gupta et al. (1995) Gupta et al.(2002) from Jaipur, through three serial epidemiological studies carried out during 1994 and 2003. Gupta et al.(2004) demonstrated rising prevalence of hypertension (30%, 36%, and 51% respectively among males and 34%, 38% and 51% among females). Previous studies by Gopinath et al.(1994) and Chadha et al.(1997) reported the prevalence of hypertension in Delhi to be 11% among males and 12% among females in the urban areas and 4% and 3% among the males and females respectively, in rural areas.
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Two of the researches initiated in the rural areas from Haryana (1994-95) derives that 4.5% of the population remain prevalence of hypertension (under JNC V criteria), whereas urban areas noted under Chandigarh reflects higher prevalence with an assessed 45% in the years 1996 and 1997 (Malhotra et al., 1999; Ahlawat et al., 2002). ICMR research notes that during 1994, there was the participation of 5537 people (where 3050 were urban residents and rest 2487 were rural residents), comprising 25% and 29% of prevalence related to hypertension (under the Criteria: \( \geq 140/90 \) mm of Hg) in males and females, respectively. This adds Chandigarh and an assessed 13% and 10% from rural Haryana being demonstrated well.

Increased prevalence of hypertension observed in this study was also similar to that reported in Himachal Pradesh with an overall prevalence of 35.8% with 34.8% in males and 33.1% in females (Bhardwaj et al., 2010) and in Kerala overall prevalence was 36.7% with 36% in males and 37.2% in females (Thankappan et al., 2006) whereas in Central India overall prevalence of hypertension is 19%, with 23.4% in males and 14.4 in females (Kokiar 2012).

Kutty et al. (1993) carried out prevalence for hypertension in the Southern part of India in Kerala in the year 1991 among adults above 20 years of age and prevalence was noted as 18%. In later studies conducted in Kerala, derived that 37% prevalence for hypertension in people of age 30 to 64 years in the year 1998 and an estimated 55% among those within 40 to 60 years of age by 2000 (Kutty et al., 2002; Zachariah et al., 2003). Higher prevalence has been noted as 69% and further 55% among elderly population within the age above 60 years in urban areas and rural areas, respectively by 2000 (WHO Bulletin 2001).

As per Reddy et al. (2005) “overall prevalence has been noted as 8.6% in urban slum population of Tirupathi. Among 86 hypertensive patients, a total of 72 (that is 83.7%) are conscious of hypertension; and were under treatment; or treated are 30 (that is 41.7%) with satisfactory control over hypertension. Estimated higher prevalence for hypertension were with cerebrovascular or the cardiovascular events (50.0%), wherein diabetes mellitus (33.3%), hypertension in family history (23.3%), smoking (22.4%), age above 50 years (22.2%), got the alcohol intake (20.0%), without physical exercise.
(15.8%), estimated B.M.I.>25 (14.9%), wherein male (9.6 %), non-vegetarian diet (8.8%) and calculated saturated fat intake (8.8%). Mean systolic and diastolic blood pressure are derived to be of higher count among men, especially in the elderly population”.

Few studies on the prevalence of hypertension are available from the Eastern Indian Population. India. In the year 2002, as per the study led by Hazarika *et al.* (2002), 61% prevalence was reported in men and women at 30 or above years in Assam.

Recent studies conducted over Western India reported prevalence for hypertension to remain within the range of 3.4% to 8.6%. Todkar *et al.* (2009) noted this prevalence as of 7.24% in case of rural Maharashtra (2007), whereas Jajo *et al.* (1993) marked 3.41% prevalence in rural Sevagram. Prevalence rate as derived by Joshi *et al.* (2000) in case of hospitals of Mumbai was derived as 7.8% (2000).

### 5.6 Age as an Independent Risk Factor for Hypertension

The present study also revealed that the prevalence of hypertension increased with age. In the target population of 20 years and above, the prevalence of hypertension increased with age from 10.7 % in the age group 20-29 years to 19.8 % for those aged 30-39 years. Further, as the age progressed, to the prevalence of hypertension went up to 32.7% for the age group 40-49 years, to 41% in the 50-59 years age group and 50.6% for those aged ≥ 60 years.

These findings are coherent with those reported in the study conducted among urban and rural adults of Lucknow (*Midha et al.*, 2006). Previous literature has consistently demonstrated a positive relation between age and blood pressure in most populations with diverse geographical, cultural and socioeconomic characteristics. *WHO* (1996).

In the present study, significant positive association was found between age and prevalence of hypertension. In the target population comprising those aged 20 years and above, the prevalence of hypertension increased with age from 10.7% in the 20-29 years age group through 19.8% for those aged 30-39 years, to 32.7% in the age group 40-49 years, 41% in the 50-59 years age group to 50.6% among those aged ≥ 60 years. Kumar
et al. (1995) also reported an increase in the prevalence of hypertension with increasing age.

The Sentinel Surveillance Project by WHO documented 28% overall prevalence of hypertension based on data from 10 regions of the country for those in the age group 20-69 years. Elevated blood pressure is marked in past few years without and determined reason. This withstand the deemed state of being significant towards the factor of risk. Still, there are some medical causes like medications, thyroid/adrenal problems, or kidney disease that needs to be excluded. High BP develops in due course of time without any determined reason benign or remains essential to hypertension. (Srinivas et al., 2013).

On a hypothetical note, the increase in blood pressure with age is integral to the ageing process and the same is attributed to atherosclerotic changes present in blood vessels, particularly those under stress as well as unknown factors. There is one more possibility and that is the sedentary lifestyle of people above 55 years and face increase in BMI. Moreover, increased stress in family caused by social factors like offering higher level of education, children marriages, etc. also cause high BP. The case of hypertension can be noted by the 25 years of age and the same shifts among younger generation (Madhukumar et al., 2012).

5.7 Gender as an Independent Factor of Risk for Hypertension

As against age factor, the specification of gender show that hypertension remain higher in males (40%), as that of females (31%). Further, every group, has the prevalence of hypertension being higher among males against females except those between 20 to 29 years of age and those between 50 to 59 years.

Few studies were carried out comparing different socioeconomic groups. The initial study from urban Chennai by Mohan et al.(2001) reported 8.4% as the estimated prevalence of hypertension among men and women aged 20 years and above and belonging to the lower socioeconomic strata of society.

Compared to the age aspect, the pattern of gender indicated that more males (60.1%), compared to females (39.9%), suffered from hypertension. Further, with the
sole exception being the age group of 20 to 29 years and those belonging to the age bracket 50 to 59 years, it was males who suffered from hypertension compared to females. According to the other literature, even the current study indicated it more males on an age-wise basis suffered from hypertension (Jo et al., 2001; Zachariah 2003; Macedo et al., 2005; Mohan et al., 2007).

Furthermore, the above was reiterated by the study that proved that during the early adulthood, women suffered from lower systolic blood pressure (SBP) levels compared to men; however the contrary was correct post the sixth decade of their lives (Pemu and Ofili, 2008). However, diastolic blood pressure (DBP) was found to be slightly less in women compared to men, irrespective of their age group. Likewise, women post 60 years of age were more likely to suffer from hypertension. It was chiefly elderly black women (>75%), aged >75 years who suffered from hypertension.

Some researches undertaken also compared varied socioeconomic groups. An early research conducted in urban Chennai by Mohan et al. (2001) indicated 8.4% as the approximate prevalence of hypertension between men and women aged 20 years and above and those belonging to the lower socioeconomic group of society.

5.8 Consumption of Alcohol as an Independent Factor of Risk for Hypertension

As per the present research, 25% of hypersensitive male patients belonging to the Sikh community are alcoholics. Individuals, who consume alcohol, are 1.3 times more likely to suffer from hypertension compared to those who do not consume alcohol. Thus, having alcohol is likely to lead to hypertension, cardiovascular disorders and even chances of stroke.

Hypertension has even been found to be present in people having additional salt intake, alcohol consumption and smoking. People who consume low or moderate alcohol suffer from lowered mortality, chiefly on account of lowering of coronary heart disease (CHD). On contrary, heavy drinking enhances mortality chiefly due to hemorrhagic stroke and non-cardiovascular illnesses.

There is a causal link established amongst the course of alcohol intake and occurrence of hypertension as reconciled by way of humoral, neural and direct mode of
vascular mechanisms (Marmot et al., 1994; Moreira et al., 1998). However, such methods are ambiguous and there is doubt that can be seen related to the alcohol consumption level, whereby the strong press or is liable to impact of alcohol being obvious (Keil et al., 1993).

Alcohol consumption is known to have both beneficial and adverse survival impacts and examples of ill health. Varied studies have indicated that low-to-moderate type of alcohol consumption result in 20% to 25% reduction in terms of all-cause mortality (Verschuren et al., 1993; English et al., 1996; Power et al., 1998).

Cardiac heart disease reduction can be related to low-to-moderate consumption of alcohol that seems to be partially mediated in context of rise in dose-linked facets within high-density-lipoprotein cholesterol (Gaziano et al., 1993; Keil et al., 1997). This on the other hand, indicates merely 50% protective impacts (Langer et al., 1992; Suh et al., 1992).

It is also seen that pertinent reduction in TC/HDL-C ratio in addition to enhanced alcohol consumption, except highest intake consumers and a steady declination of LDL-C along with increased negative link with alcohol consumption have been reported. Alcohol consumption is also noted to be adversely linked with both TC/HDL-C ratio and additionally in connection to LDL-C. (Namekata et al., 1997).

The study by English et al. (1996) showed a J-Shaped link between alcohol and hypertension was similar which concurs with a report presented by Moreira et al. (1998) who derived a nonlinear link between alcohol and BP and commonness of hypertension. Compared to this, heavy consumption of alcohol is also linked to a rise in mortality due to stroke and non-cardiovascular reasons (English et al., 1996; Rehm et al., 1997).

The current research also indicated a higher ratio of males suffering from hypertension, especially those who were overweight and obese with BMI >25, alcoholics. Being obese, as per the study enhances the chances to suffer from hypertension. The studies by Jajoo et al. (1993) in 1993, Malhotra et al. (1999) in 1998 and Todkar et al. (2009) in 2007 showed similar results.


## 5.9 Lipid Profile as an Independent Risk Factor for Hypertension

In this study the concentrations of serum cholesterol, serum triglycerides and low density lipo protein cholesterol are found to be higher in hypertensive patients rather than normotensive subjects. This is in consistent with the studies done all over the world. (Pelkonen et al., 1977; Harvey and Beevers, 1990; Oghagbon and Okesina, 2006; Apka et al., 2006; Pavithran et al., 2007; Ukoh and Oforofuo, 2007). Unlike the derivations of Akintunde (2010), studies by Kesteloot et al. (1982) and Lepira et al. (2005) reported serum cholesterol, serum triglycerides and low density lipo protein cholesterol in terms of newly diagnosed hypertensive patients without any difference noted from determined control subjects, yet newly diagnosed hypertensive tend to have higher level of serum cholesterol, serum triglycerides and low density lipo protein cholesterol.

High-level serum cholesterol is known for increasing risk in the process of developing macrovascular complications like Coronary Heart Disease and heart stroke (Albucher et al., 2000). Various epidemiological research works show progressive increase of CHD risks, in an instance when the serum cholesterol crosses 5.0 mmol/L (McGill, 1968), that gets prompted by (Lewis, 1986) in terms of suggesting serum cholesterol levels in a range 5.0-6.5 mmol/L. This is subject to be considered as an undesirable status. There are some positive as well as important connection among serum triglycerides and, systolic and diastolic blood pressure; in context of both hypertensive patients and management of normotensive controls. In the same way, statistically marked connections between the serum cholesterol and BMI are noted for hypertensive and normotensive groups. Hypertensive patients in general comprises of higher BMI and waist hip ratio as against the noted controls. As per the noted observation, the reason can be the common factor of risk meant for hypertension, condition of obesity and dyslipidaemia, since obesity gets marked to remain central to the sustenance and causation of insulin resistance (Pelkonen et al., 1977). Exact kind of pathogenetic mechanisms noted under risk of cardiovascular disease gets mediated through dyslipidemia that are not fully illustrated yet high levels serum cholesterol get identified in terms of increasing risk meant for developing complications macrovascular system, like CHD and stroke (Albucher et al., 2000). This in general has been noted and
further recommended as a treatment of hypertension that must be about lowering blood pressure, correction of target of dyslipidemia (factors of CVD risk), in case it exists, reduce cardiovascular disease risk and increase therapy under cost-effective ventures.

Isolated low HDL-C is marked as the commonest individual lipid abnormality by many participants, particulars in context of controls whereby it gets marked for 71.4% in all possible forms of dyslipidaemia. Akintunde (2010) reported similar derivation in Osogbo. As per Odenigbo et al. (2008), high rate noted for low HDL-C in between healthy professionals in Asaba. Guidelines ATP III identifies isolated HDL-C as a notable atherogenic dyslipidaemia, yet comment that it is not common for population, in general. The data collected by us and Odenigbo et al. (2008) suggest isolated low HDL-C being relatively common as a baseline lipid abnormality in common people, in the selected part of India and hypertension only escalates the same. HDL-C can cause endothelial damage as well as trigger increase in blood pressure. Exact way through which low HDL-C is liable to increase risk of CVD are yet to get elucidated completely. However, there are experimental studies that declare about significance of HDL-C in the process of promoting cholesterol efflux (reverse cholesterol transport) from the existing foam cells in the depots of atherosclerotic plaque in blood vessels to liver for the purpose of excretion. HDL-C further exhibits potent mode of anti-inflammatory as well as antioxidant effects, which are subject to inhibit the atherogenic process (Mackness et al., 2000; Barter et al., 2004). Moreover, low levels of HDL-C get connected to the presence of some other factors of atherogenic risk (few of them are emerging factors of risk that are not considered on any separate note in the prevalent term). Pavithran et al. (2007) stated about the lipid metabolism alteration, along with decreased HDL-C can consequently lead to endothelial damage and is subject to trigger increase in BP that is partially meant for CHD’s strong predictive power.

It gets noted as a low level of HDL cholesterol that is powerful predictor for the act of increased mode of cardiovascular risk (Gordon et al., 1977; Assmann et al., 1996; Curb et al., 2004). According to Eapen et al. (2009) male patients and female patients who have low levels of HDL-C (<35mg/dL) and normal count of cholesterol levels are closer to cardiovascular events (like, heart attacks and unstable condition of chest pain),
against adults having high level of HDL-C. Strong epidemiological instances related to low HDL-C gets noted as independent factor for risk for CVD. Assmann et al.,(1996); Sharrett et al., (2001) and Curb et al., (2004) added by strong recommendations about the interventions in terms of increased HDL-cholesterol that can yield clinically noted benefits. Multiple Risk Factor Intervention Trial marked decrease in HDL-cholesterol by a rate of 1mg/dL (0.03 mmol/L) and has been connected to increased risk related to coronary heart disease that is assessed as 2% in case of men and 3% in case of women (Gordon et al., 1989). It has 1% reduction in relation with HDL-C that gets connected to 2-3% increase of CHD based risk. Mounting over clinical as well as experimental evidence marks HDL-Cs in terms of exerting multiple anti-atherogenic along with effects of antithrombotic, that together remain consistent to the mode of reduction in terms of risk related to morbid cardiovascular event. This further supports an anti-atherogenic participation for HDL-cholesterol (Gordon et al.,1989 and Barter 2005). Thus, factors related to CVD risk, get ATP III recommendation for low HDL-C (≤40mg/dL) must have a secondary therapy target aimed over lipid that gets lowered for the reduction of CVD risk. However, very least count of studies are done to get the necessary information (The Accord Study Group 2010).

Hypertension and dyslipidaemia are marked for coexisting frequently. This coexistence has multidimensional clinical mode of implications. Firstly, risk of CVD gets synergistically enhanced and both conditions must get treated aggressively (Williams et al.,1988). This gets connected to background of central obesity within the history of the family. Consequently, manages resistance to insulin that stands as an underlying factor for pathogenesis meant for hypertension and dyslipidaemia. As a result of seven years of research over Finnish men, there is the suggestion about dyslipidemia being featured as a metabolic syndrome that is subject to get predicted for the development of hypertension (Laaksonen et al., 2008). According to Halperin et al. (2006) dyslipidemia is about a healthy person leading to hypertension. As per Hausmann et al. (1996) in the intravascular ultrasound researches demonstrate patients having low HDL cholesterol and those with high levels TG levels are liable to have extensive coronary atheromas as against those having isolated elevation of the LDL cholesterol.
Discussion

One more risk factor is about the development of hypertension in case of obesity. There are some subjects in this study that are about healthy BMI. Just 32.6% (n= 355) of relevant subjects are presented in terms of healthy BMI, in accordance to guidelines of WHO guidelines. An assessed 6.7% (that is n= 73) has been reported to remain underweight. On the other hand, 36.7% (that is n= 400) has been reported in the form of a pre-obese as well as 24% (that is n=261) noted as obese. The selected population has been noted under general rate of obesity in terms of central obesity that was not necessarily presented in respective population. The aspect of general obesity gets marked to the abnormal value of the lipid profile that is meant for the increased serum cholesterol, count of serum triglyceride, instances of LDL and decreased values of HDL.

5.10 T2DM as an Independent Risk Hypertension Factor

In this research, we have inferred 30.2% hypertensive patients also had concurrent T2DM. This odd’s ratio of T2DM as an independent risk factor in quite great, more than that reported in previous studies (Adler et al., 2000). It has been found in this study that T2DM is an independent risk factor for the development of hypertension. Patients with T2DM are 1.4 times more at risk/likely to develop hypertension. Previous studies indicate that this risk added by T2DM is subject to vary across varied ethnic, social, and racial origins. Most importantly, patients’ hypertension and type 2 diabetes is liable to cause determined increase in vascular complications in respective population (Wannamethee, 2005). Overlap between hypertension and instance of diabetes remains substantially noted and increasing the risk of developing ischemic cerebrovascular disease, retinopathy and sexual dysfunction (Najarian et al., 2006). Diabetes mellitus has been noted as an independent factor of risk in terms of coronary artery disease.

5.11 Prevalence of Metabolic Syndrome

Metabolic syndrome has been identified to be a multiplex factor of risk in context to atherosclerotic cardiovascular disease (or the ASCVD). ASCVD risks in addition to metabolic syndrome are liable to get doubled as against a condition without a syndrome. Metabolic syndrome is associated with co morbidities with serious
implications such as dyslipidemia, abdominal obesity, elevated blood pressure and impaired tolerance to glucose. (Reaven, 1988).

It has been proved that Asian Indians are more likely to suffer from higher risks of CVD and diabetes (Enas et al., 2007). Further a perusal of relevant literature clearly indicates that the metabolic syndrome in Asian Indians varies according to the demographical presence, urbanization and lifestyle as well as socioeconomic or the cultural factors.

This study proves that Metabolic syndrome among urban Sikh community from Amritsar has been noted as 34.3 %, with women suffering more (41.4%) compared to men (28.2%). Further it is also clear that the prevalence of metabolic syndrome increases with age.

According to Ford report (2005), the unadjusted prevalence of metabolic syndrome in the United States as per the NCEP criteria of diagnosis was 34.5% with 33.7 % men and 33.7 % women suffering from metabolic syndrome. In the same population the prevalence of metabolic syndrome as per the IDF norms was reported to be 39% overall with 39.9 % in men and 38.1% in women. In an other study metabolic syndrome diagnosed using the NCEP-ATP III norms reported the prevalence of 22.3% among men and 27.2% among women in case of adult population of Italy. (Scholze et al., 2010).

In India almost 32 million people suffer from diabetes and it is expected to rise to 69.8 million by the year 2025 (Enas et al., 2007). Various other studies have also reported a high metabolic syndrome among different regions of India,(Mohan and Rao, 2007 ; Mishra and Khurana, 2009).

Previous literature shows that in urban India, prevalence has ranged from 22.1 - 41%, (Ramachandran et al.,2003 ;Tharkar and Vishwanathan 2010 ; Vasan et al., 2011) in comparison to our observation estimated as 34.3%. In the same way, study on prevalence in urban community of Northern India rates 22.37% for metabolic syndrome (Ravikiran et al., 2010). As against this, lower prevalence gets noted as 19.52% among urban population from western India, like Maharashtra (Sawat et al., 2011). Moreover, by the representation of Asian Indians for metabolical obesity, there is the instance of
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being physically non-obese (Ruderman et al., 1998; Manoria et al., 2010). In a study conducted by Ramachandran showed the prevalence of metabolic syndrome in Indians of age group of 20 to 75 years as 41.1% by using modified NCEP-ATP III criteria. (Ramachandran et al., 2003).

Prevalence of Metabolic syndrome in our study among females appeared to have twice higher risks than noted in other studies in India. This prevalence among the women gets noted to be 1.5–2 times more than males (Prabhakaran et al., 2007; Mishra et al., 2009). This higher prevalence among the female population may be due to greater BMI’s, high TG and cases of lower levels of HDL-C. However Chow et al. (2008) indicated that metabolic syndrome prevalence of 26.9% has been noted among males and 18.4% among females in the Southern India. Further a greater fat to muscle ratio in women may also predispose them to greater impaired insulin sentivity.

Chronic diseases like cardiovascular disease and instances of diabetes are becoming increasingly common across the globe. Indian epidemiologists and global agencies such as WHO are repeatedly highlighting how the CVD diseases are rising rapidly, especially in the last decade and a half. According to estimations, it is evaluated that 2.6 million Indians would die due to CVD by the year 2020 (Reddy et al., 2006; Goenka et al., 2009).

5.12 Age and Gender as Independent Risk Factor for Metabolic Syndrome

Our study reported that the risk of developing metabolic syndrome increases gradually with age. The risk is 4.7 times more in >60 years age group as compared to 20-29 years age group. Also the risk is double in females as compared to male gender.

Various researches noted that age and sex are the most determinant factors in terms of developing metabolic syndrome. With individual growth, increase in risk and among female happens obviously and so the syndrome chances. China declared standardized metabolic syndrome prevalence rate to remain lower in case of men (11.4%) as against women (with 21.6%) (Xu et al., 2009). In case of Botswana, females is reported to be strongly associated to metabolic syndrome and the age group affected is 34 to 54 years in general (Garrido et al., 2009).
Irrespective to various research works, metabolic syndrome increase by age and among female is heavily noted. For Taiwan and Karachi, researches showed males being at higher MS risk with prevalence of 21.8%, in contrast to 7.0% in females. (Groop, 2000). Mishra et al. reported in context of Indian population by means of criterion of MS-4 that is Metabolic syndrome prevalence with an assessed 29.9% (Mishra et al., 2005).

This study shows that categorisation of age groups are derived to show stronger statistical importance (as p≤0.01). In accordance to the definition of MS-4, metabolic syndrome prevalence was low as 18% in case of 20 to 29 years of age and went up to 47% for people from 40 to 50 years of age. Thus criteria for age had important connection with metabolic syndrome, since the same is marked by the literature (Gogia and Aggarwal 2006), added by metabolic syndrome prevalence depending on age factor (Mishra et al., 2005; Ramachandran et al., 2003). Increased metabolic syndrome prevalence is noted by literature (Mishra et al., 2005). Moreover, higher metabolic syndrome prevalence was derived in people from 40 to 50 years of age (47%) and is same as derivation of Mishra et al., (2005) that marked prevalence to remain higher for among 40 to 49 years aged population.

5.13 BMI as an Independent Factor of Risk for Metabolic Syndrome

We infer from our study that the risk increases 2.6 times more in subjects who were classified as obese in comparison to subjects who had a normal BMI. The subjects placed in pre obese category had 1.6 times more risk of developing the metabolic syndrome in comparison to normal subjects.

Obesity or an increase in individual’s abdominal fat, is considered as a primary event for a progressive state of metabolic syndrome. Tendency to gain excessive fat in abdomen, against buttock, hip or the limb areas, is connected to the increase of fatty acids in blood. This can lead to resistance towards insulin, high blood pressure, blood lipids in abdomen, and diabetes. Indians are more with the tendency of central obesity, instead of generalized obesity. Almost 3/4\textsuperscript{th} of the participants in this study are noted to be overweight or obese (BMI ≥ 23kg/m\textsuperscript{2}), and thus the prime subject to get prevalence of metabolic syndrome. Among these participants, 1/3\textsuperscript{rd} of the population are
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overweight or obese and comprises of impaired tolerance to glucose, and even most of them exhibited metabolic syndrome features.

The physical structure of the Indians appeared less as against western population and the calculated BMI remain more optimal tool for the purpose of evaluating risk. Many Indians are having high body fat with lower mass of muscle. This is irrespective of having lower BMI average as against White Caucasians and the Black population. Instance of abdominal obesity has been recorded as BMI < 25 kg/m2.

The current study noted that the young adults from Sikh communities <40 years are having high BMI, waist circumference and waist hip ratio against those from older adults >40 years.

A total of 1005/1089 participants contained 1 or more abnormal component marking the specific population with highly predisposed metabolic syndrome developments at some determined stage. Such disorders are connected to increased risk in terms of developing changes in atherosclerotic instances of the body that leads to cardiovascular disorders and the instance of T2DM. Condition of central obesity and resistance to insulin were common factors for metabolic syndrome (Paoletti et al., 2006). Atherosclerosis is for most of the cardiovascular disease as well as count of mortality. There are clinical manifestations related to atherosclerosis, not visible until middle age, whereas development of atherosclerosis can happen at an early age. Various researches derived connection of metabolic syndrome and more risk for cardiovascular disease. (Lakka et al., 2002; Iglseder et al., 2005; Guize et al., 2008; Sipila et al., 2009; Eckel et al., 2010).

This research notes the prevalence of metabolic syndrome in accordance to MS-4 definition that holds 33.3% being very close to the research of Shah et al., (2008). There is notable advantage of prevalence Metabolic syndrome in accordance to MS-4 on NCEP ATP III based definition with 21.4%, that is same as the derivations of Shah et al., (2008). They reported data as 20.7%, whereby the prevalence of metabolic syndrome remain higher as per MS-4 definition. The reason is that the definition for MS-4 gets incorporated to lower cut-off in the waist circumference (that is > 90 cm in case of men and > 80 cm in case of women) with rates of BMI and SFT within
determined parameters related to NCEP-ATP III criteria. International Diabetes Federation recommends ethnic specification for cut-off at waist circumference. The skin-fold thickness has been suggested to remain significant marker for obesity. As a whole, there are thick truncal subcutaneous tissue as a notable feature for obesity phenotype among South Asians and in correlation with resistance for insulin as in ethnic group (Shah et al., 2008).

5.14 Lipid Profile (Serum Cholesterol) as an Independent Factor of Risk for Metabolic Syndrome

The subjects who had abnormal serum cholesterol levels in the body were 1.9 times more at risk for developing metabolic syndrome in some part of their life time in reference to their normal counterparts. Increased prevalence related to low HDL-C got noted initially by (Enas et al., 1992), who further derived that just 4% Indian men and 5% Indian women are having optimal levels of HDL-C. Low levels of HDL-C remain as strong predictors for occurrence as well as reoccurrence of the myocardial infarction and instances of strokes in relation with premature as well as severe CAD. Half of total population comprises of lower levels of HDL-C, which is 23% within the age group of 20 to 40 years or the young adults. Sawant et al. (2008) too noted similar derivations based on 9000 subjects (who were <40 years age) and were attending health check program at the premises of P. D. Hinduja National Hospital. The results showed 64.2% men, added by 33.8% women being normally having low HDL-C levels. Reduced instances of obesity in HDL-C levels, and count of obese patients having metabolic syndrome as well as atherogenic dyslipidemia are usually having lower levels of HDL-C.

Derivations from this research assures dyslipidemic pattern in relation with metabolic syndrome as in literature (NCEP Report, 2001; Bhalwar et al., 2006)

It is important to follow appropriate kind of preventive approaches and interventions in case of highly risked people and assist in curbing the epidemic growth of metabolic syndrome.

The clustering of risk factors that constitute the metabolic syndrome is found to be common in most countries of the world. In the Americas, in Europe, and in India, at
least one-fourth of the adults carry the syndrome. Since the metabolic syndrome at least doubles the risk for ASCVD, compared with the population without the syndrome, the metabolic syndrome likely accounts for up to half of all ASCVD cases. But because it also is associated with a very high risk for type 2 diabetes, or with diabetes itself, the cardiovascular risk imparted by the metabolic syndrome may be even greater than current estimates indicate. For this reason, it is imperative to develop better approaches to the prevention and management of the syndrome. It is not enough to say “just treat the established risk factors.” More importantly, an effort must be made to strike at the underlying causes of the syndrome. Certainly reversal of the worldwide epidemic of obesity and physical inactivity must be a high priority. But in addition, better means to treat underlying susceptibility to the syndrome are needed. Both approaches represent a great challenge to research in the cardiovascular and diabetes fields (Grundy, 2008).

In the study, we found a low rate of awareness among the subject population. Among individuals aware of the T2DM/ hypertension, we found low rates of the compliance with the treatment administrated. In a review, Addo et al. (2007) reported that hypertension awareness in sub-Saharan Africa was generally below 40%, consistent with our results. Despite being aware, however, only one out of five known hypertensive’s was receiving treatment. Addressing these gaps required a strengthening of the health system and well thought out community health campaigns which could be key components of new strategies that could build both, the individual and community level awareness of T2DM, hypertension and metabolic syndrome.

Limitations

1. One major limitation was that we did not estimate the prevalence of impaired glucose tolerance. There is evidence that the proportion of people with impaired fasting glucose is different from that of those with impaired glucose tolerance and would have given us a more accurate picture. However this was not possible because of the epidemiological nature of this study.

2. The study was delimited to only urban Sikh population of Amritsar.

3. We relied on the physician’s diagnosis for the already diagnosed cases, as there may be a case of under diagnosis or over diagnosis in the subject population.
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4. Visceral and abdominal fat diagnosed by ultrasonography were not assessed as they are considered to be independent risk factors of T2DM.

5. The questions in the awareness questionnaire were broad based questions and could have been more specific.

Recommendations

It is clear that the population studied has a high prevalence of the lifestyle diseases. Further this population on an average has a high BMI of 26.4 ± 5.3. Thus coming under the category of pre obese as per classification for Asian Indians. This population thus needs to be made aware of the importance of physical activity and maintaining a low body weight and awareness of nutritional factors as well. Public health policy should give importance on generating advertisements and pamphlets for distribution from primary health care centres to government hospitals as well as NGO’s working in local areas for increased awareness regarding associated risk factors for education, prevention and early detection of lifestyle diseases.