Summary

SUMMARY

Introduction

Given the rapid economic development and the increased adoption of western lifestyles over the past few decades, lifestyle diseases seem to have become prevalent as afflictions reaching alarming proportions among Indians of late (Sarkar et al., 2006). In this context, special attention must be focused on Cardio-Vascular Diseases (CVD), and Type 2 Diabetes Mellitus (T2DM). It has been predicted that, by 2020, Non-Communicable Diseases (NCD) such as cancer, diabetes will cause seven out of every ten deaths in developing nations (Boutayeb, 2006). NCDs, particularly the upsurge of diabetes mellitus, hypertension and metabolic syndrome pose grave challenges to India today. Dietary habits and lifestyle factors – especially among the urban Indian population are crucial contributing factors to the incidence and prevalence of such ailments. Hence, it necessitates their consistent and continuous monitoring especially in a developing economy like India, and particularly, within its urban population (Wild et al., 2004; Boutayeb, 2006).

The T2DM as an epidemic is more pronounced in India. This is attested to by the WHO (World Health Organization) reports that show that 32 million people suffered from Diabetes in 2000 (Wild et al., 2004). The Indian Council of Medical Research’s (ICMR) study undertaken in the 1970’s reported a prevalence of 2.3% in urban India (Ahuja et al., 1974; Gupta et al., 1978).

Diabetes is fast gaining the status of a potential epidemic in India with more than 62 million diabetic individuals currently diagnosed with the disease (Kumar et al., 2013). In 2000, India (31.7 million) topped the world with the highest number of people with diabetes mellitus followed by China (20.8 million) with the United States (17.7 million) in second and third place respectively (Wild et al., 2004).

Recent studies on the geographical and ethnic influences on health have shown that people of Indian origin are highly prone to diabetes (King et al., 1998). Asian Indian constitutions manifests insulin resistance and the metabolic syndrome at younger ages.
Summary

and at higher magnitudes than any other ethnic group (Whincup et al., 2002). T2DM is caused by a combination of lifestyle and genetic factors (Ripsin et al., 2009; Risérus et al., 2009). While some of these factors can be controlled by monitoring diet and checking for obesity, other factors such as age, gender and genetics are beyond such scrutiny (Kumar et al., 2013). Long-term complications from high blood sugar and type 2 diabetes, can in fact, include heart disease, stroke, diabetic retinopathy, kidney failure and poor blood flow in the limbs leading to amputations.

The rising burden of hypertension and associated CVD in India merits urgent addressing as a public health priority and the best way to undertake this is by employing an optimal context-specific resource-sensitive combination of the population and the clinical approaches. Hypertension is considered to be one of the main NCDs accounting for considerable deaths and disability worldwide -- 9.4 million deaths and 7% of Disability Adjusted Life Years (DALYs) -- in 2010 (Metabolic Syndrome. International Diabetes Federation, 2014). There are numerous challenges ahead but equally promising are the opportunities for galvanizing efforts to attain the WHO-UN goal of 25% reduction in NCD-related mortality and associated reduction in hypertension by 2025 (Alberti et al., 2005).

In 2000, overall, 26.4% of the world’s population had hypertension and it is expected that by 2025, approximately one in three adults aged over 20 will be afflicted by the disease (Kearney et al., 2005). Prevalence of hypertension is also on the rise in developing countries and it is said to be one of the leading causes of mortality and morbidity among the elderly (Murray et al., 1996). Between 1984 and 1987, studies had reported the prevalence of hypertension in Delhi as 11% among males and 12% among females in the urban areas (Chadha et al., 1997; Gopinath et al., 1994). The prevalence of hypertension was found to be 32.3% for the urban population of Chandigarh in a study conducted in 2005 in a sample ≥ 40 years in age (Kar and Thakur, 2007).

Prevalence of hypertension in India -- over the last three decades has increased by about 30 times among urban India residents and about 10 times among rural Indians (Gupta, 2006).
Summary

There are epidemiological and demographic transitions taking place in developing countries with declining rates of communicable diseases and increasing rates of NCDs (Erdin and Aran, 2004). However, the acute scarcity of health resources and infrastructure enables inadequate control of hypertension (Ghannem and Hadj, 1997; Kornitzer et al., 1999; Erdin and Aran, 2004; Mishra et al., 2006). Lifestyle-related risk factors -- excess body weight, low levels of physical activity, excess consumption of fat and salt and excess alcohol consumption -- have been seen to contribute to the development of hypertension and have been cited as possible risk factors for the north Indian population by research (Yadav et al., 2008; Walia et al., 2014).

Over the last 20 years, the prevalence of the Metabolic Syndrome has also steadily increased among populations across the globe. It has emerged as one of the major global public health challenges (Alberti et al., 2005). The ultimate importance of the metabolic syndrome is that it helps to identify individuals at high risk of developing both T2DM and CVD (IDF, 2014). It is estimated that around 20-25% of the world’s adult population have the metabolic syndrome and they are twice as likely to die from and, three times as likely to have a heart attack or stroke compared with people without the syndrome (Metabolic Syndrome. International Diabetes Federation, 2014). In the present study, the authors have assessed a particular population--the Amritsar Sikh urban community --which has gained particular attention over the last few years because of the rising trend of NCDs among them. Contributing significantly to such an alarm has been rapid urbanization accompanied by lifestyle and dietary changes. Urban Sikhs are involved in various professions like business, traders, service etc. Sikhs constitute 70% of the total population of Amritsar according to the 2011 Census Report (Census Report, 2011). In the absence of any study on the prevalence of such lifestyle disorders in this community -- which has transitioned from the rural agricultural background to the urban one significantly swiftly -- it is hoped that this research can contribute to a meaningful understanding of how the transition in conjunction with a sedentary lifestyle has actually increased the predisposition of this community to lifestyle disorders. Lifestyle disorders negatively impact those afflicted. They are lifelong diseases, with increased morbidity and mortality rates and a decreased quality
Summary

of life. At the same time, the disease and its complications extract a heavy toll economically on the patients themselves, their families and society (Hoskote and Joshi, 2008).

The few studies in existence on the Sikh population emphasizing genetic parameters as predisposing factors for T2DM do not really focus on the prevalence and modifiable risk factors, which play a major role in individuals predisposed to T2DM, hypertension and metabolic syndrome. The study was designed with the primary aim of identifying the prevalence of T2DM, hypertension and metabolic syndrome among the urban Sikh population of Amritsar by means of a door-to-door survey in order to fill the lacunae in the available data. The secondary aim was to determine the awareness about while identifying the risk factors leading to the development of the above-mentioned lifestyle disorders within the same population.

There is also very little data with regard to the levels of awareness about these lifestyle disorders in developing countries like India. Such data is extremely critical when planning public health policies with specific reference to the implementation of national level control programs. A literature search on knowledge about diabetes in developing countries yielded very few studies actually dealing with levels of awareness about the disease among people with the disease and virtually no data on the whole population (Badruddin et al., 2002; Wee et al., 2002). Even in other developing countries, such studies remained significantly focused on diabetic patients and were mostly clinic-based, which introduced referral bias (Badruddin et al., 2002; Ambigapathy et al., 2003; Habib and Aslam, 2003). Low awareness levels have been reported for hypertension in developing countries too. Awareness of hypertension in India for instance, was low (20-54%) with suboptimal control rates in a review study (Devi et al., 2013). This study was instrumental in cementing the choice of studying the prevalence of these lifestyle disorders and an awareness of their risk factors in Amritsar Sikh urban community.
Summary

Methodology

This study focused on urban Sikhs living in Amritsar, Punjab, India as they constituted 70% of the total population of Amritsar according to the 2011 Census Report. Amritsar was arbitrarily divided into five equal zones namely (Z1, Z2, Z3, Z4 and Z5). Each zone constituted of 13 Census Wards. The fieldwork was completed within 20 months, commencing from January 2012. Nearly 215 subjects from each zone were randomly selected. In the selection of the family in a particular ward, the WHO method of sampling was used to prevent any non-uniformity in subject’s selection (Woodard, 2001). A model consent form was constructed to ensure compliance with ICMR guidelines regarding the use of human subjects in research.

The inclusion criteria were (i) males or females aged ≥20 years, (ii) no limitations of physical activity and (iii) those people who had shifted from the rural agricultural background to the urban setup over the last one decade. The exclusion criteria were (i), severe orthopaedic/cardiovascular/respiratory conditions restricting physical activity, (ii) women who were pregnant and lactating at the time of study and (iii) known case of HIV infection.

Two members from each family were randomly selected for the study. A self-designed, professionally validated questionnaire, which included the demographic, physiological and psychological profiling of the subject was given to them and the fasting blood sample was taken for the analysis of biochemical variables. The anthropometric readings of the subjects that were recorded were height, weight, waist and hip circumference.

All the statistical analysis was done using Stata 11.2. The association of the categorical variables with outcomes was seen by the Chi-square test. The p values less than 0.05 were taken as significant. Unadjusted odd’s ratio of the relationship of each factor with outcomes was found using the binary logistic regression test. Factors, which were significant in univariate analysis were included in the multivariate analyses using the multi variable logistic regression test.
Summary

Results

Out of total 1089 subjects, 253 subjects had T2DM, which showed a prevalence rate of 23.2% afflicted by T2DM in the subject population. Similarly, out of a total of 1089 subjects, 391 subjects suffered from hypertension, a prevalence rate of 35.9% in this population. Out of a total of 1089 subjects, 374 subjects had metabolic syndrome -- a prevalence rate of 34.3%.

Our study shows significantly higher rates of T2DM, hypertension and metabolic syndrome in the older age groups. The T2DM rates increased from 4% in the 20-29 year age group peaking to 32.5% in the 60+ year age group. Prevalence rates for hypertension increased from 10% in the 20-29 year age group peaking to 50.6% in the 60+ year age group. Metabolic syndrome prevalence rates increased from 13.3% in the 20-29 year age group peaking to 42.8% in the 60+ year age group.

Our study also indicates that 46.6% of diabetic subjects suffered from hypertension whereas, only 32.6% of the non-diabetics were afflicted by hypertension. Likewise, proportionately more subjects i.e., 67.5% of the diabetics had hypertriglyceridemia as compared to 51.3% of the non-diabetics. About 67.6% of the diabetics had low HDL levels as compared to 51.3% of the non-diabetics, while 59.2% of the diabetics had hypercholesterolemia and 73.1% of the diabetics suffered from the metabolic syndrome.

Detailed correlates of T2DM and hypertension in the univariate analysis and the multivariate logistic regression method showed significant predictors of T2DM and hypertension. Advancing age, medium of cooking (oil used), hypertension, hypercholesterolemia, hypertriglyceridemia and low serum HDL levels significantly contributed to increased T2DM risk. Those with low serum HDL levels had double the risk of developing T2DM as compared to the individuals who had healthy serum HDL levels. Similarly, increased serum cholesterol and serum triglycerides increased the risk of developing T2DM one and half times more than the subjects having normal serum cholesterol and serum triglyceride levels, whereas, advancing age, gender, alcohol intake, T2DM, hypercholesterolemia, hypertriglyceridemia and low serum HDL levels significantly contributed to the increased hypertension risk. With advancing age, the
Summary

risk of developing hypertension in the subject population increased six times in the 60+ age group as compared to those in the 20-29 age group. The increased serum cholesterol and serum triglycerides increased the risk of developing hypertension one and half times more as compared to subjects having normal serum cholesterol and serum triglycerides values.

The study also indicated that 30.2% of the hypertensives suffered from T2DM as compared to 19.3% of the non-hypertensives suffering from T2DM. Likewise, proportionately more subjects i.e., 63.1% of the hypertensives had hypertriglyceridemia compared to 51.1% of the non-hypertensives afflicted by hypertriglyceridemia. Similarly, 50.9% of the hypertensives had low HDL values, while 55.7% of the hypertensives had hypercholesterolemia. It was also found that 57.5% of the hypertensives suffered from metabolic syndrome. Gender-wise comparisons showed that about 60% of the hypertensives were males. This study also indicated that 23% of the hypertensives had a positive family history of hypertension. Also, 63.4% of the hypertensives fell in the pre-obese and obese categories. About 25% of the hypertensives in the subject population were found to be alcoholics.

Inferences drawn from the study pointed to 49.4% of the subjects suffering from metabolic syndrome being afflicted by T2DM compared to 9.5% of the normal subject population. Similarly, 81.5% of the subjects suffering from metabolic syndrome had hypertriglyceridemia as compared to 41.8 % of the normal subject population. Likewise, 81.8% of the population had low HDL levels, while 58.9% had hypercholesterolemia and 60.1% suffered from hypertension.

Detailed correlates of metabolic syndrome in the univariate analysis and the multivariate logistic regression method showed significant predictors of metabolic syndrome -- advancing age, gender, BMI and hypercholesterolemia – which significantly contributed to the increased metabolic syndrome risk. Those with low serum HDL levels had double the risk of developing T2DM as compared to the individuals with healthy serum HDL levels. With advancing age, the risk of developing metabolic syndrome increased 4.7 times in the 60 + year age group compared to the 20-29 year age group. Similarly, the increased serum cholesterol levels increased the risk
Summary

of developing metabolic syndrome two times more for 60+ year age group. The subjects falling in the obese category were at two and half times more risk of developing metabolic syndrome and those who were older in age, of the female sex, generally obese and already suffering from hypercholesterolemia were seen to significantly contribute to an increased metabolic syndrome risk among this subject population.

Discussion

The primary aim of this study is to evaluate the prevalence rate of T2DM, hypertension and metabolic syndrome in the urban Sikh population of Amritsar and assess the awareness of risk factors associated with these lifestyle disorders among them. Since epidemiological field studies of non-communicable diseases are gaining in importance, they are seen to not only contribute to an estimate of the prevalence of a disease but help gain insights into the spectrum of the disease, which is incompletely brought out by hospital-based data (Wander et al., 1994).

The present study placed the overall prevalence of T2DM in urban Sikh population of Amritsar at 23.2% with a slightly higher prevalence among men (25%) compared to women (21.5%). The prevalence rate observed in the present study was higher compared to the other studies, which reported T2DM prevalence rates of various communities and setups ranging from 8.9% to 12.6% in the Indian population as carried out between 2001 and 2006 (Ramachandran et al., 2001; Yajnik, 2004; Deo et al., 2006). Variable prevalence (3–11.2%) of diabetes was also reported from urban India depending upon the region, caste and type of survey, diagnostic tool and diagnostic terminology (Ramachandran et al., 1997). A study of the native South Indians ≥ 40 years also showed a high prevalence of diabetes (21%) in urban areas (Ramachandran et al., 1986).

The prevalence of T2DM was seen to be significantly associated with age, hypertension, high serum cholesterol, low HDL, high triglyceride levels and medium of cooking i.e., oil used. These findings were similar to those reported by (Yadav et al., 2008), which also showed that T2DM had a positive and independent association with hypertension, high serum cholesterol, low high density lipoprotein (HDL) and high triglyceride levels. Various studies conducted among the different urban Indian
Summary

population segments in the last one decade – Several studies reported significant association between increasing age and diabetes (Shah et al., 1999; Ramchandran et al., 2008; Arora and Malik, 2010; Rao et al., 2010; Ravikumar et al., 2011). Another study also found an increase in the prevalence of diabetes as the age increased (Anand et al., 2007).

The current study also shows high prevalence of hypertension (35.9%), with a higher prevalence among males (40%) than females (31%). The prevalence of hypertension defined by the recent World Health Organization criteria has been reported among some urban Indian populations. Gupta and Gupta, (1999) reported hypertension in 44% men and 45% women in Mumbai, Joseph et al., (2000) reported it in 31% men and 41% women in Trivandrum, while Mohan et al., (2001) reported an age-adjusted prevalence of 14% in Chennai. Gupta et al., (2002) reported its prevalence in 36% men and 37% women in Jaipur. Anand (2000) reported hypertension in 34.1% middle-class executives in Mumbai, but after multiple BP measurements, it was confirmed in 26.8% male and 27.6% female officers. These findings are in consonance with other regions of Asia where it has been reported that, at any one time, about half of all individuals have high blood pressure (Rodgers et al., 2000). In addition, studies from Jaipur, through three serial epidemiological studies (Criteria: ≥140/90 mm of Hg) carried out between 1994 and 2003 demonstrated rising prevalence of hypertension (30%, 36% and 51% respectively among males and 34%, 38% and 51% among females (Gupta et al., 1995; Gupta et al., 2002; Gupta et al., 2004).

While focusing on hypertension, the present study also revealed that the prevalence of hypertension increased with age. In the intended population of 20 years and more, this incidence rose to 19.8 % in those in the age bracket 30 - 39 years from 10.7 % in 20-29 year old age group. Additionally, as the age increased to 41% in 50-59 year age group and 50.6% in those aged ≥ 60 years from 32.7% in the 40-49 year age group. The findings seem to be in concurrence with the study conducted among urban and rural adults of Lucknow (Midha et al., 2009). Such changes of blood pressure with age might be due to changes in the vascular system. Extensive evidence has demonstrated that the wall thickening and dilatation are the major structural changes that occur in the large elastic arteries during ageing. The wall thickening involves both
Summary

the tunica intima and the tunica media. As a consequence of this remodeling, there is a reduction in arterial compliance with an increase in vessel stiffness (Ferrari, 2002; Lakatta and Sollott, 2002; Lakatta and Levy, 2003). Cross-sectional surveys, as well as prospective observational cohort studies, have consistently demonstrated a positive relation between age and blood pressure in most populations with diverse geographical, cultural and socioeconomic characteristics. The risk of hypertension increases many fold with increasing age as do other cardiovascular risk factors in both men and women. This increase in the prevalence of hypertension with age is concurrent with the findings of the previous studies conducted among the urban Indian populations (Gupta et al., 2009; Haldiya et al., 2010).

Advancing age, male gender, current diabetic status and central obesity have been identified as significant correlates in the study, based on multivariate analyses, which is in conformity with studies in India and abroad (Jo et al., 2001; Shanthirani et al., 2003; Gus et al., 2004; Das et al., 2005; Mohan et al., 2007; Yadav et al., 2008). In the present study, results revealed that the mean value of serum total cholesterol, triglycerides and serum LDL-cholesterol was significantly higher in hypertensive subjects and they were significantly associated with the development of hypertension. Various studies have shown a strong association between hypertension and dyslipidimia and suggested that both may increase the patient’s susceptibility to the development of coronary heart disease (Snehalatha et al., 1997; Gupta et al., 2009; Ogah et al., 2012; Pagidipati and Gaziano, 2013). A study conducted on hypertensive persons in Nigeria found a significantly higher lipid profile and the findings were similar to the observations of our study (Ogah et al., 2012). A study conducted in India on plasma lipoprotein (a) and lipid profile levels of hypertensive persons showed significantly higher levels of Lp(a), total cholesterol, triglycerides, and LDL-cholesterol as compared to healthy controls (Bhavani et al., 2003). Increasing age and central obesity, is the accumulation of abdominal fat resulting in an increase in waist size are associated with the accumulation of multiple metabolic abnormalities (Snehalatha et al., 1997; Gupta et al., 2009; Pagidipati and Gaziano, 2013). Our study showed a strong association between the prevalence of hypertension and increasing age, obesity, T2DM, low HDL, and hypertriglyceridaemia. Previous studies from India have also reported similar
findings (Ismail et al., 2004). Sedentary lifestyle, obesity and low HDL-C are the most prevalent CV risk factors in subjects in the third and fourth decade of life in this north Indian population and the clustering of these cardiovascular risk factors increases with advancing age (Walia et al., 2014).

In addition, the study also indicated the prevalence of metabolic syndrome in this population to be 34.3% with a higher prevalence among women (41.4%) compared to men (28.2%). A study among the South Indian population found the prevalence of metabolic syndrome to be 41.1% in the 20-75 age group (Ramachandran et al., 2003). Our study is concurrent with the previous studies, which report that from developing countries, the metabolic syndrome and its risk factor clustering emerge as higher in women compared to men, which may be due to women having higher clustering of behavioural risk factors than men (Khuwaja and Kadir, 2010), which may account for their being more at risk for metabolic syndrome. In women, however, the prevalence of the metabolic syndrome has been seen to increase abruptly once they cross 50 years. Menopause may be a contributing factor for this increase. Gender differences in the prevalence of the metabolic syndrome after 50 years may be related to the higher prevalence of abdominal obesity and prominent weight gain associated with ageing in women as compared with men. Another possible explanation for this high prevalence of metabolic syndrome among women could be that since the Punjabi Sikh women studied here, were sedentary housewives, they did not enjoy outdoor activities -- work-related or recreational like exercise and walking -- leading therefore, to such lifestyle behavior rendering them to being more physically inactive compared to men of the same population. Hence, they tended to be more obese than men, which could explain the increased prevalence of metabolic syndrome.

Similarly, a study conducted in Haryana observed the prevalence of the metabolic syndrome to be 9.2%, and reported that it was more prevalent among females at 66.3%, compared to 33.6% in males. It also found that age and sedentary occupation were significantly associated with the metabolic syndrome (Pathania et al., 2013). Recent data shows that about one-third of the urban population in India’s major cities were afflicted by metabolic syndrome (Mishra and Khurana, 2009).
Summary

Further, we also found that the prevalence of metabolic syndrome increased with age among both sexes. It is noteworthy, that in the current study, 13.3% of subjects in the 20-29 year age group were already afflicted by the metabolic syndrome. The higher prevalence of metabolic syndrome in younger Punjabi Sikhs may be a cause of concern as it implies that they might be at a high risk of developing atherosclerosis at an early age.

The various risks factors found to be associated with the metabolic syndrome are age, female gender, BMI and serum cholesterol levels. These findings are supported by various studies which also reported their positive association with the development of metabolic syndrome (Mishra et al., 2007; Tharkar et al., 2008; Dinakar et al., 2014).

In our study, we found that, of the individuals detected with T2DM and hypertension, 23.8% and 23%, respectively, had a positive family history associated with their condition. The rest of the subject population diagnosed with T2DM or hypertension did not show such aggregations. The possible explanation for low prevalence of associated family history could be that a majority of the subjects with T2DM and hypertension had developed these due to the changes in their lifestyle changes and dietary habits.

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 study authors reported that hypertension awareness in sub-Saharan Africa was generally below 40%, consistent with our results (Addo et al., 2007). 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.

Conclusion

The urban Sikh population in Amritsar has a high prevalence of lifestyle diseases with prevalence rates of T2DM, hypertension and metabolic syndrome estimated to engulf 23.2%, 35.9% and 34.3%, respectively. Further, a high prevalence
of multiple modifiable risk factors associated with these lifestyle disorders was found. The management of these lifestyle disorders is possible with a combination of medication and strict lifestyle changes. However, the awareness of T2DM, hypertension and metabolic syndrome is inadequate in urban Sikh population of Amritsar. The main reasons for this inadequate awareness includes demographic characteristics, health beliefs and lack of knowledge about them. Awareness programs are required to manage them in a social dimension. There is a need and scope for health education activity regarding these lifestyle disorders and their risk factors to promote healthy life style among this population. With the alarming increase in prevalence of these lifestyle disorders, the policy-makers and the healthcare providers should implement the measures for prevention and management of these non-communicable disorders to prevent complications and epidemiological outburst in the country.