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SCHOOL OF GRADUATE STUDIES

PREVALENCE AND DETERMINANTS OF DIABETES MELLITUS AND IMPAIRED FASTING GLUCOSE AMONG WORKERS AT THE SPARE PARTS SHARE COMPANY, AKAKI, ETHIOPIA

BY

PERPETUA EGONMWAN UHOMOIBHI, MD.

A THESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES, ADDIS ABABA UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTERS IN PUBLIC HEALTH IN THE DEPARTMENT OF COMMUNITY HEALTH

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A Thesis Submitted to the School of Graduate Studies, Addis Ababa University in Partial Fulfillment of the Requirements for the Degree of Masters in Public Health in the Department of Community Health

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Prevalence and Determinants of Diabetes Mellitus and Impaired Fasting Glucose among workers at the Spare Parts Share Company, Akaki, Ethiopia

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Dedication

In fondest memory of my parents, Mr. B.O.E Irusota and Mrs. J.O. Irusota who gave their all, to ensure the best future for their children.

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Table of Contents. **Page**

List of Tables Page

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List of Figures Page

ACRONYMS

ADA	**American Diabetes Association**
AOR	**Adjusted Odds Ratio**
CI	**Confidence Interval**
COR	**Crude Odds Ratio**
DM	**Diabetes Mellitus**
FBG	**Fasting blood glucose**
HANES	**Hispanic Health and Nutrition Examination Survey**
ICD	**International Classification of Diseases**
IDDM	**Insulin-dependent Diabetes Mellitus**
IFG	**Impaired Fasting Glucose**
IGH	**Impaired Glucose Homeostasis**
IGT	**Impaired Glucose Tolerance**
NCDs	**Noncommunicable diseases**
NHANES	**National Health and Nutrition Examination Survey**
NIDDM	**Non insulin-dependent Diabetes Mellitus**
OGTT	**Oral glucose tolerance test**
OR	**Odds Ratio**
PAHO	**Pan-American Health Organization**
SSA	**Sub-Saharan Africa**
SPSC	**Spare Parts Share Company, Akaki Ethiopia**
USA	**United States of America**
WHO	**World Health Organization**
WHR	**Waist-to-hip ratio**

ABSTRACT

The study investigates the prevalence of diabetes mellitus and impaired fasting glucose among workers at the Spare Parts Share Company in Akaki, a suburb of Addis Ababa, Ethiopia. The choice of the Akaki factory, with its 600-strong workers, was made in furtherance of the long-term interest of the Department of Community Health of Addis Ababa University, to undertake a longitudinal research on Non-communicable diseases (NCDs) among three of the largest factories in the country, including Akaki. It is intended that the outcome of this study and others that may follow, would contribute to the much needed data source on NCDs in the country.

The method applied for the research was a cross-sectional, descriptive approach, using the convenience sampling technique. This technique was used to enable the researcher achieve a reasonable sample size, given the total population of the factory. Moreover, the study applied a three-step approach, consistent with the WHO procedure, namely, the use of structured questionnaire to assess risk factor prevalence, anthropometric measurements and lastly, biochemical testing for blood glucose levels.

Out of the 533 eligible subjects in the factory, 475 were studied, with a non-response rate of 11%. Overall, the prevalence of impaired glucose homeostasis in the population was 6.9 ±0.3%. Diabetes was present in 3.4 ±0.2%, while impaired fasting glucose was found in 3.6 ±0.4% of the studied population. The overall prevalence of hypertension in the studied population was 22.1 ±0.4% while 25.9% are overweight: these figures were higher than those reported from previous studies in the country. Moreover, among the

diabetics, 38% had hypertension, and 47% of those with impaired fasting glucose also had hypertension ($p<0.05$). 56% of subjects with diabetes were found to be overweight, while only 19% of them had obesity ($p <0.05$).

The overall results of the study are significant. They indicate, among other things, that the prevalence of diabetes in this mostly young adult, urban population is high, as is hypertension. Advancing age and a positive parental history of diabetes proved to be two of the most important determinants of diabetes prevalence in this population. Unlike in most other studies, obesity was found not to be an independent risk factor for impaired glucose homeostasis among the Akaki workers.

Finally, the study recommends that Non-communicable diseases awareness programmes should be established in the country, together with periodic screening of high-risk urban and suburban populations (if resources are available) so as to detect early cases before the onset of complications. Longitudinal studies should also be set up to monitor trends in risk factor prevalence as well as evaluate intervention programmes.

1. INTRODUCTION

Diabetes Mellitus has become, in recent times, a cause of growing public health concern in developing countries, as it has been for a long time in the most developed ones. How this trend has evolved, its implications for pubic health and policy, and what strategies might be pursued to redress the situation, have therefore also become issues of legitimate scientific research interests.

For the developed countries, the trend emerges somewhat in the character of a paradox: remarkable successes achieved in undernutrition and infectious disease control within the last century have produced a sharp decline in infant mortality, as a result of which life expectancies have increased considerably. However, Noncommunicable diseases (NCDs) such as cardiovascular diseases (including hypertension), and diabetes, have replaced infectious diseases as the major causes of morbidity and mortality (1). Great Britain, the United States of America (USA) and Sweden are prominent examples of developed countries where NCDs presently rank among the top five causes of mortality. Some of the main reasons underlying this trend include increasingly ageing populations and profound lifestyles changes, resulting from socio-economic developments in the concerned countries. Such changes have been associated with behavioural and environmental factors that put more people at risk of developing chronic health conditions later on in their lives (2).

At present, the prevalence of diabetes in adults globally is estimated to be 150 million. Projections are that this figure will reach 300 million by the year 2025, with the largest

increases occurring in the developing countries, where the rates could approach almost 200% compared to 45% for the developed countries. By 2025, 75% of all persons with diabetes would be living in the developing countries. Furthermore, at the global level, NCDs are responsible for almost half of the approximately 52 million deaths that occur annually. Millions of people die prematurely from these diseases each year, and many more face years of chronic disability and suffering resulting from these diseases (2, 3).

For the newly industrialized and middle-income countries such as Malaysia, China, Singapore and the former Soviet Union countries, the trend has also been marked by increases in the prevalence of these diseases, in particular diabetes and hypertension. Indeed, the Global Burden of Diabetes Report by King, Aubert and Herman, published in 1998, reveal that China and India presently account for two of the top three countries in the world with the greatest number of diabetic cases, the third being the USA. In fact, projections are that this trend will also remain unchanged in the next 20 years. (4).

With respect to most developing countries, especially those of Sub-Saharan Africa (SSA), where infectious diseases have been, and continue to pose a serious public health challenge, the emergence of NCDs as a major health burden, has worsened an already bad situation. Within the sub-region, countries such as Tanzania, South Africa and Nigeria where some epidemiological surveys on diabetes, hypertension and related chronic diseases have been undertaken, reports reveal a moderately high prevalence among their populations (5). For example, from the national survey on NCDs carried out in Nigeria in 1997, diabetes was found to affect 1-7% of the population (6).

Against this background, Ethiopia, the focus of this research, presents an interesting case study. Despite an assumption of a low prevalence of diabetes and related NCDs in the country, there is a paucity of actual epidemiological data as is typical of most of SSA. Consequently, little is known about the real extent of the burden of diabetes in the country. In addition, mortality statistics available generally tend to underestimate the contribution of diabetes to overall mortality rates for most countries including Ethiopia. Even in countries with more sophisticated vital registration systems, this holds true also, since coding the immediate cause of death alone using the ICD classification criteria might actually exclude the majority of the deaths of individuals resulting from diabetes (7).

This situation notwithstanding, it is clear that Ethiopia, if not the case already, will develop along the demographic trends of other countries, developing or developed, with regards to NCDs. Presently, the country's population pyramid typifies that of most developing countries with very low proportion of aged persons: about 46% of the population is below 15 years of age. Furthermore, less than 14% of its 53.5 million population (1994 census estimates) live in urban areas (8).

Given current urbanization and industrialization efforts in the country however, together with improvements in health services, a demographic transition in which the proportion of adults and aged population will increase significantly vis-a-vis the younger age group,

seems inevitable. Expectedly, this would lead to a rise in the prevalence of chronic diseases that are generally more common among older age populations (9).

This study aims to provide institution-based data on the prevalence and possible determinants of diabetes mellitus, among a population of factory workers in Akaki, a suburb of Addis Ababa, in Ethiopia. The choice of Akaki was made taking into consideration, the long-term interest of the Community Health Department of Addis Ababa University, in the establishment of a longitudinal cohort study on NCDs in the country, using Akaki factories as a case study. It is pertinent to note that the only community-based, cross-sectional study on diabetes prevalence in the country was conducted over 20 years ago near Gonder, in northeastern Ethiopia (10). Given the aforementioned facts of increased urbanization and associated lifestyle changes in the country since then, a more recent survey that could provide important up-to-date data on the situation of diabetes in the country was deemed necessary.

At a global level, this research finds added relevance within the context of the resolution passed at the 53rd World Health Assembly of the World Health Organization in 2000, with a goal to support Member States in their efforts to reduce the toll of morbidity, disability and premature mortality related to NCDs. Specific strategies adapted at the meeting focus on assisting Member States in mapping the emerging epidemics of NCDs in their respective countries and analyzing the socio-economic, behavioural and political determinants of observed trends . This will provide guidance for policy, legislation and the financial commitment of nations towards NCDs.

Furthermore, WHO urges countries to develop measures to reduce the level of exposure of individuals and populations to the common risk factors for NCDs as well as strengthen health care services for people with NCDs (7,11). An appropriate first step towards initiating NCDs risk factor surveillance system therefore, is for countries to conduct a 'baseline' nationwide survey, where this has not been done. The aim is to provide useful data on the status of the diseases and their local determinants, as well as identify modifiable risk factors associated with the more common NCDs, which should provide an effective source of evidence to support and guide the development and implementation of specific prevention and control programmes. However, where resources are a constraint as in most developing countries including Ethiopia, ad hoc surveys and registry data can be used as initial data source for the establishment of NCDs surveillance (12).

In the light of the foregoing, this research hopes to make an important contribution to the establishment of a much needed surveillance system for NCDs in Ethiopia. By offering up to date information on the status of diabetes and hypertension, it hopes to shed light on the prevalence and risk factors of the diseases and thus facilitate a future assessment of their burden and impact. In turn, this should enable relevant health administrators to develop comprehensive and appropriate community-based health promotion strategies to encourage healthy lifestyles among its populations, detect cases early enough, and choose efficient clinical interventions to control these diseases.

2. LITERATURE REVIEW

2.1. Definition and Classification

In most existing literature on the subject, diabetes mellitus is defined as a chronic metabolic disorder, characterized by deficiencies in the secretion and/or action of the insulin, a hormone secreted by the pancreatic beta cells. Manifesting in high levels of blood glucose, the disease is associated with increased risk of premature death due to immediate complications such as hyper and/or hypo-glycaemic comas and overwhelming infections (13).

Diabetes mellitus is also an important risk factor for arterial disease of the coronary, cerebral and peripheral arterial trees, and for microvascular disease that can lead to renal failure, blindness and limb amputations. Its management represents a major clinical challenge, compounded by the fact the disease, particularly the Type 2, can have a long pre-symptomatic phase, during which internal organ damage can still occur (14,15).

Standard classification of diabetes by scholars has undergone several changes over the years. One of the earliest classifications proposed by the WHO Experts Committee in 1980, categorized the disease into two major classes, namely, Insulin-dependent Diabetes Mellitus (IDDM) or Type 1 Diabetes, and Non Insulin-dependent Diabetes Mellitus (NIDDM) or Type 2 Diabetes. This classification was based mainly on the major clinical types of diabetes. The 1985 WHO Study Group Report, however, recommended that the terms ‘Type 1’ and ‘Type 2’ be omitted from the earlier classifications, but retained the terminologies ‘IDDM’ and ‘NIDDM’. This modified classification also introduced the

term Malnutrition-related Diabetes Mellitus and related categories of glucose intolerance (14,15).

The latest classification, however, is the one proposed by Kuzuya and Matsuda, cited in the WHO Consultation Report on Diabetes, which was published in 1999. The publication recommends a new classification that encompasses both clinical and aetiological types of diabetes mellitus and other categories of hyperglycemia, such as Impaired Glucose Regulation (IGR) and Gestational Diabetes. This report also recommends the reintroduction of the terms ‘Type 1’ and ‘Type 2’ to replace ‘IDDM’ and ‘NIDDM’ respectively, as the later has been found to be both confusing and misleading in regard to their categorization of patients with diabetes. Impaired Glucose Regulation is the broad terminology now used to describe the intermediate metabolic state between normal glucose homeostasis and frank diabetes. It includes the clinical states of Impaired Fasting Glycaemia (IFG), which is diagnosed in the fasting state, and Impaired Glucose Tolerance (IGT), a condition diagnosed only after an oral glucose challenge test. These are not categories of diabetes per se, but are recognized as associated with increased risks for future diabetes (15).

In epidemiological settings, diabetes can be determined with sufficient validity on the basis of a single fasting blood glucose analysis. This helps to define prevalence as well as provide estimate of population changes in diabetes and related impaired glucose regulation. In clinical settings however, at least one additional fasting blood glucose and/or an oral glucose tolerance test (OGTT) is usually needed to confirm the diagnosis

especially in asymptomatic subjects or when the fasting glucose value lies in the uncertain range.

Currently, two separate standard criteria are used internationally to define the diabetes diagnostic groups. These are the 1998 World Health Organization (WHO) criteria and the 1997 criteria of the American Diabetes Association (ADA). Both classification criteria are unanimous in adopting the new diagnostic levels that represents a lowering of the fasting plasma glucose to ≥7.0 mmol l^{-1} (or ≥6.1 mmol l^{-1} for whole blood) from the former level of ≥7.8mml l^{-1} (≥6.7mmol $^{l-}$1 for whole blood), a level that has been shown to accord more closely with the 2-hour post-glucose level, which has remained unchanged. The major difference between the two types of classification criteria is that while the ADA strongly recommends the fasting blood glucose level alone as sufficient for diagnostic classification of diabetes in epidemiological studies, the 1998 WHO group advocates using the 2-hour post glucose load test to identify persons with non-diabetic fasting glucose levels that may turn out either as IGT or frank diabetes when the OGTT is performed. These include the elderly and those with less obesity, such as are found in many Asian populations. The ADA recommendation however allows for easier population screening especially in resource-poor settings, where it might otherwise not be feasible using the OGTT. Interestingly enough, the WHO group agrees with the ADA perspective (15,16).

Type 2 diabetes occurs primarily in adults and is by far the most common, accounting for 85-95% of all diabetics in most populations. Although the pathogenesis of Type 2

diabetes is not fully understood, it is clear that at least three factors are important: individual or ethnic genetic predisposition to the disease; decreased action of insulin in insulin-sensitive tissues (insulin resistance); and a defect in pancreatic beta-cell function. How this cluster of aetiological factors interacts to represent a single disease process remains uncertain (17,18).

On the other hand, Type 1 diabetes is mostly diagnosed in childhood and adolescence and makes up less than 10% of diabetes cases. The prevalence of Type 1 diabetes among persons of Caucasian origin is generally higher than in African, Latin American and Asian populations, and the highest incidence have been reported to occur in persons of Northern European decent, especially Finland, Sweden and the other Nordic countries (14). Its aetiology is primarily the result of an autoimmune-related, pancreatic beta cell destruction, probably triggered by certain childhood viral infections or early exposure to cow's milk protein in genetically predisposed individuals.

2.2. Global Overview

Globally, diabetes (especially Type 2) has emerged as a public health problem of pandemic proportions within the last century. Between 1976 and 1991, WHO undertook a survey by collecting standardized information on the prevalence of diabetes and IGT in adult communities from about 32 countries worldwide. Among the significant findings from this study, was the fact that in European populations, age-standardized prevalence rates for diabetes and IGT ranged from 3-10% and 3-15% respectively, whereas, some Arabs, migrant Asian Indians, Chinese and Hispanic American

populations showed much higher prevalence rates of diabetes, ranging from 14-20%. In addition, moderate (3-10%) or high (11-20%) prevalences of IGT were observed in many populations worldwide (19).

Utilizing data from a five-year longitudinal study of various countries in 1995, King H. *et al* estimated the global prevalence of diabetes in adults 20 years of age and above, and found a prevalence rate of 4.0% globally. The projection was that by 2025, this figure would rise to 5.4%. The study also reported that the overall prevalence of diabetes was still higher in the developed countries; ≈ 6% (compared to 3.3% for the developing countries), and would reach 7.6% by 2025. However, the rate of increase of diabetes prevalence in the developing countries was projected to reach 170% by 2025, compared to only about 42% increase for developed countries (4).

Estimates from the 3rd National Health and Nutrition Survey (NHANES III), conducted between 1988-1994, put the overall prevalence of diabetes mellitus and IFG in United States adult population ≥20 years of age, at 7.8% (about 15.6 million persons) and 6.9% (13.4 million) respectively (20). Among persons who were 40-74 years of age, the prevalence rate was 12.3% for diabetes, and 9.7% for IFG, using the ADA diagnostic criteria. However, a significant difference in the prevalence of diabetes was also observed when the WHO criteria were used: 14.3% compared with 12.3% with the ADA criteria. A similar survey conducted about ten years earlier (NHANES II), had reported a diabetes prevalence rate of 8.9% in those ≥40 years; indicating an increase of about 30% in the 1994 survey (20).

The reason given for the disparity in the results using the two criteria was that using the WHO criteria, undiagnosed diabetes constituted 44% of total diabetes in that age group, whereas by the ADA criteria, undiagnosed diabetes represented only 35% of total diabetic cases. Other significant findings from that survey were that type 2 diabetes was twice as common in African Americans and Hispanics, compared to non-Hispanic whites, and that obesity and sedentary lifestyles were significant risk factors for diabetes in the US populations (20).

A similar study on the Americas, published in the Pan-America Health Organization (PAHO) Epidemiological Bulletin of 2001, estimates the number of people affected by Type 2 diabetes in the region at the end of the year 2000, at 35 million. This figure represents over 25% of the total number of people throughout the world affected by the disease. Out of the American estimates, 19 million were from Latin America and the Caribbean, while 15 million were from the USA and Canada (21).

Within the American region, however, significant variations are reported on the prevalence of diabetes among the different population/ethnic groups. For example, among the Mapuche Indians of Chile, South America, a low (less than 1%) prevalence was detected, whereas, among adult Jamaicans, the prevalence was about 17.9%. The Pima Indians of Arizona had the highest rate of over 50% among its adult population (3, 21).

Furthermore, WHO Reports on prevalences of diabetes and IGT, reveal that the prevalence of Type 2 diabetes is increasing not only in affluent societies as previously thought, but also among people of the newly industrialized and less developed regions of the world. For example, within Asia-Pacific Region, age-standardized prevalence rates of 40-50% have been reported from parts of Papua New Guinea and the Republic of Nauru, while Singapore and Hong Kong have about 15% (22). However, the reports show that these high percentage prevalences are not absolute. Thus, among traditional Chinese populations, a prevalence rate of 2% is still observed, and Malaysia has been reported to have a 5% annual incidence rate for diabetes (22).

2.3. Distribution in Africa

Although only a few epidemiological studies on diabetes and other major NCDs have been undertaken with respect to the Sub-Saharan African region, indications are that there is increasing prevalence and incidence of NCDs, especially diabetes and hypertension, among urban populations in recent times. In addition, the incidence of Type 2 diabetes among young adults in the region has also increased (2,5).

McLarty *et al*, in 1997, conducted a survey on diabetes prevalence in Tanzania, and established an adult prevalence rate at 4-10% among the economically privileged population of Dar es Salaam. Consistent with most studies on diabetes, McLarty found no significant gender variation in the prevalence of diabetes in the population, although being female was a significant risk factor for IGT (23). Similarly, Levitt NS *et al*, on their study on urban South African Zulus, found that the prevalence of Type 2 diabetes and

IGT were 8.0% and 7.0% respectively. They also found that urban residency, increasing age and obesity were significant, independent risk factors for diabetes in that population (24).

Mauritius, a multi-ethnic island in Africa, has been reported to have a high prevalence rate of diabetes and IGT, and one of the highest diabetes mortality rates in the world. Researchers like Dowse GK et al who have conducted population-based studies in the country's adult population 25-74 years of age, have reported crude prevalence rates of 12% for diabetes and 20% for IGT, for all the ethnic groups combined, using the oral Glucose Tolerance Test (OGTT), and the WHO diagnostic criteria (25). A similar study among the Danagla Community of Southern Sudan, by Elbager MN and Eltom MA, revealed a prevalence rate of 8.3% and 7.9% for diabetes and IGT respectively. That study however reported no urban or rural difference in the prevalence (26).

2.4. Situation in Ethiopia

Very few studies on diabetes epidemiology have been undertaken in Ethiopian populations in general or within the country as a whole. Furthermore, no such study has been conducted within the last ten to fifteen years. The only community-based study conducted over 20 years ago near Gonder by Peters WH et al, reported an overall prevalence rate of 0.5% for diabetes and IGT. However, that study used glycosuria for screening and hyperglycemia for confirmatory purposes only. Furthermore, the findings were limited by the fact that 86% of those screened were less than 20 years of age (10).

The other study in Ethiopians was the institution-based study by Teklu in 1979, on chronic diseases prevalence among bank employees that used data from clinic registry only. In that study, the researcher found that, among the chronic diseases reported in the clinic statistics, diabetes had a prevalence rate of 1.7% (27). However, this may not have been representative of the prevalence among the entire bank employees, since hospital-based statistics are difficult to relate to actual population prevalences. The study on 158 Ethiopian immigrants to Israel, by Cohen MP *et al* in 1987, found prevalence rates of 8.9% for diabetes and 8.9% for IGT in the mostly young adult population, aged 30 years and below (28).

2.5. Implications of Policy Neglect and Action

In spite of the apparent increase in the burden of NCDs across the various regions of the world, including SSA, many countries in the region, appear not to be sufficiently addressing the challenges of NCDs within the framework of their existing health policies, as specific strategies or guidelines to tackle these issues, have not been put in place. This may be due to the fact that being relatively poor countries, with limited resources and competing demands, their energies are mostly directed towards dealing with infectious diseases and under-nutrition – issues of top priority especially for these countries (29).

However, it should be stated that unless countries begin to tackle both chronic and infectious diseases simultaneously, the burden of NCDs is likely to increase hugely over the coming decades as projected in the Global Burden of Diseases Study. When this occurs, it could overwhelm the already over-stretched health care resources. Indeed,

projections are that by the year 2020, the proportion of the overall disease burden in SSA due to NCDs will increase to between 26% and 34%; among adults aged 15-59 years, the increase could be 37% to 42%. Therefore, failure to take action on NCDs could also jeopardize the development of effective measures for the prevention and control of these diseases (29,30).

2.5. Risk Factors for Diabetes

Presently, diabetes, particularly Type 2, has no known single cause; indeed some factors are known to influence the risk of its development. Among the known factors, advancing age, obesity and sedentary lifestyle probably play the most important part in the development of Type 2 diabetes in most populations.

Age: In many populations worldwide, the incidence of Type 2 diabetes is generally low before age 30 years, but gradually increases during adult life and is highest in old age populations. In the 3rd NHANES Survey of 1988-94, researchers in the USA found that the prevalence of diabetes increased from 1-2% among persons in the age group 20-39 years, to 18-20% in the age group 60-74 years; the prevalence peaked at ages 75 years and above. However, studies on high-risk populations, such as the Pima Indians of the USA, have found that a significant proportion (up to 13%) of adults with diabetes were between the ages of 25-29 years, which was similar to the prevalence in a US non-Hispanic white population, 60-64 years of age. (3,20,21).

Researchers, on the general norm observed in most hospital and community-based studies in developing countries, have also shown that the age factor is critical in determining the incidence and prevalence of Type 2 diabetes. However, while the prevalence is highest among persons aged 65 years and above in developed countries, this is true for the ages 45-60 years in most developing countries. This trend, as projected by King Hubert *et al*, in the Global Burden of Diabetes Study, is likely to continue for the next 25 years or so (2,4).

Gender: Although some studies have reported degrees of gender variation in the prevalence of diabetes, a review of global estimates indicate no discernible trend in the observed variations. This may be related to differences of risk factor prevalence among the different populations (19,31). It is worth mentioning for example, that women who have a history of delivery of large-for-gestational age babies (generally taken as a birth weight of >9 pounds or 4kg), or a previous history of glucose intolerance, may be at risk of developing Type 2 diabetes than those without such a history. A finding of impaired fasting glucose in such women therefore, is a strong indication for an OGTT (15).

Obesity: Obesity is strongly related to dietary habits and sedentary lifestyles, and is a widely recognized risk factor for Type 2 diabetes. Its prevalence varies greatly from region to region and among different communities within the regions. In recent years, the disease has been on the increase worldwide, at an alarming rate (32). Studies in both developing and developed countries have documented rates that range from 3.1% to 12% in males and 1.5% to 32% in females (33). In the United States of America, the 3rd

NHANES survey reported that the prevalence of obesity in American populations aged 40-74 years, increased from 11.4% in 1980 to 14.3% in 1994, corresponding with an increase in the national prevalence of diabetes from 8.9% to 12.3% within the same period (20).

Once regarded as a condition of affluent societies, obesity is now said to co-exist with undernutrition in many poor and developing countries. In addition, among urban and sub-urban populations of some of the newly industrialized countries and those currently undergoing economic transition, prevalence rates are nearly as high as those observed in the industrialized countries. For example, in Nigeria, obesity rates of 8.3% for men and 35% for women were documented in a study, as reported in the WHO Statistics Quarterly Publication of 1993 (33). Although prosperity and abundance of food do not necessarily cause obesity, they could increase the incidence through overindulgence in food intake (32).

Some studies have identified certain characteristics of obese individuals, which further increase their risk for developing Type 2 diabetes. These include obesity during childhood and adolescence, progressive weight gain after 18 years of age, and excessive intra-abdominal fat accumulation (central obesity). Indeed, central or upper-body obesity has been particularly implicated as a stronger predictor of Type 2 diabetes than overall fatness, and has been shown in several studies as an independent risk factor in several studies (15,32).

Insulin resistance in target tissues and /or hyperinsulinemia, have been suggested as the underlying mechanism(s) linking central obesity with impaired glucose tolerance and related disease conditions such as hypertension, hyperlipidaemia and microalbuminuria. In fact, some authors have referred to this as the "Insulin Resistance Syndrome", or the " Metabolic Syndrome" (15,32). In many ethnic groups with high prevalence rates of obesity, epidemiological studies have also confirmed the prevalence of the Metabolic Syndrome. It is also well documented that the features of this syndrome can be present for several years before the detection of a hyperglycemic state in the individual. Therefore, early identification through screening, together with vigorous management of persons with the metabolic syndrome who are at higher risks for diabetes and cardiovascular diseases, can significantly reduce the risk of complications in the future (15).

Sedentary lifestyle: Lack of physical activity and unhealthy dietary habits are important modifiable risk factors for diabetes. In the United States Hispanic Health and Nutrition Examination Survey (HANES) of 1982-84, lack of physical exercise was suggested as being significantly related to the prevalence of obesity and Type 2 diabetes among the Hispanic-white American population. Some studies within and outside Africa have also reported that the prevalence of Type 2 diabetes and hypertension is consistently lower in populations with higher levels of habitual physical activity than in urban populations with more sedentary lifestyles. It has been postulated that, regular physical exercise serves in decreasing the risk of development of diabetes by preventing insulin resistance in target tissues and is therefore a protective factor for Type 2 diabetes (5, 34).

Alcohol Consumption: Alcohol consumption, especially heavy 'binge' drinking (which implies occasional, over-consumption of alcohol), has also been suggested as an important risk factor for Type 2 diabetes. Excessive alcohol consumption can adversely affect the liver and pancreas, and increase excess abdominal adiposity through increased caloric intake. However, recent studies such as that conducted on Japanese middle-aged men between 1994 and 2001, suggests that moderate alcohol consumption (about 2-3 glasses of wine or less than 40gm of ethanol per day for men) in healthy persons, may in fact have some protective effect by decreasing the risk of developing Type 2 diabetes and coronary heart disease (14,35).

Hereditary/Genetic factors: In an attempt to explain the differences observed among different racial/ethnic groups in the prevalence of diabetes worldwide, researchers have focused on the role of demographic and behavioral risk factors. However, these efforts have failed to fully explain the differences in prevalence observed between racial groups/ thus underscoring the importance of genetic or non-genetic hereditary factors in determining diabetes prevalence. In the NHANES II Survey of 1976-80, the preponderance of Type 2 diabetes among blacks compared to Caucasian whites (about two times higher) could not be fully explained by differences in age, gender, obesity, family history of diabetes and socio-economic background: the missing risk factor is likely to be hereditary/genetic (31). Similar studies in other populations have shown that some ethnic groups such as the Asian Indians, indigenous North Americans, Australian Aborigines and the Pacific Islanders, have a greater predisposition to Type 2 diabetes

than Caucasians. Genetic factors have been suggested as being the most likely explanation for the very high prevalence of diabetes in Mauritians, who are mostly of Indian decent (14,21).

Irrespective of racial or ethnic background however, a family history of Type 2 diabetes is an established risk factor for the disease. Several researches involving twins have served to support the role of genetic factors in the etiology of Type 2 diabetes, but the estimates of concordance have presented rates of much less than 100% even for monozygotic twins, a fact that further supports the role of some non-genetic factors as well. Indeed, familial aggregation of hyper-insulinaemia and/or insulin resistance has been demonstrated in several population-based and clinical studies in the U.S. (31).

Lastly, earlier notions on diabetes epidemiology were that populations with greater affluence, education and social status (and usually greater access to food) had higher diabetes prevalence. Comparative studies on diabetes prevalence in developing countries (including Africa) had shown that urban residents generally had higher rates of Type 2 diabetes than rural dwellers due to higher prevalence of sedentary lifestyles; obesity; stress and unhealthy dietary habits (23,25). However, more recent studies from developed countries are now reporting a higher incidence of diabetes among the less educated and socio-economically disadvantaged, urban communities in these countries, while the prevalence among the affluent appear to be on the decline (20, 34,36).

2.6. Testing for Diabetes

Epidemiological surveillance of Type 2 diabetes is hampered by several factors. The fact that a large percentage of persons with the disease (up to 50% in most populations) are unaware of their conditions, hinders early detection. In addition, diagnosis of diabetes involves complex biochemical tests that are particularly difficult to perform on a large population. Furthermore, comparisons among studies are difficult because of differences in the study protocol and diagnostic criteria used to define diabetes (15, 21).

In spite of these limitations, population-based surveys are useful data sources for understanding the situation of diabetes in a country. When satisfactorily conducted, they enable planners establish effective prevention and control programmes and monitor prevailing trends. Countries like the USA and Canada use periodic questionnaire-based national health surveys to assess the prevalence of diabetes and other chronic diseases among their populations. Such a method usually provides quick and efficient data on the status of chronic diseases in countries with advanced telecommunications system.

For many developing countries without efficient telecommunications facilities, other survey methods have to be relied upon to obtain similar information. These include ad hoc surveys on selected populations, such as in institutions and factories; census data; health registries and hospital statistics (7,12). These can provide the needed data within a reasonable timeframe, utilizing available limited resources.

In conclusion, given the existing literature surveyed in the foregoing paragraphs, it appears justified to undertake a study on the present situation of diabetes and related conditions in Ethiopia, utilizing a cross-sectional survey method in the Akaki factory population, so as to determine prevalence of diabetes and its determinants. The literature survey indicates that there is merit in using the fasting blood glucose levels for estimating hyperglycaemia in this population, without discounting the OGTT. The outcome of this study, it is hoped, would contribute to filling the existing gaps in current literature on diabetes prevalence and risk factors in Ethiopia.

2.8 Conceptual Framework of the Research: The conceptual framework of this research is best illustrated below as:

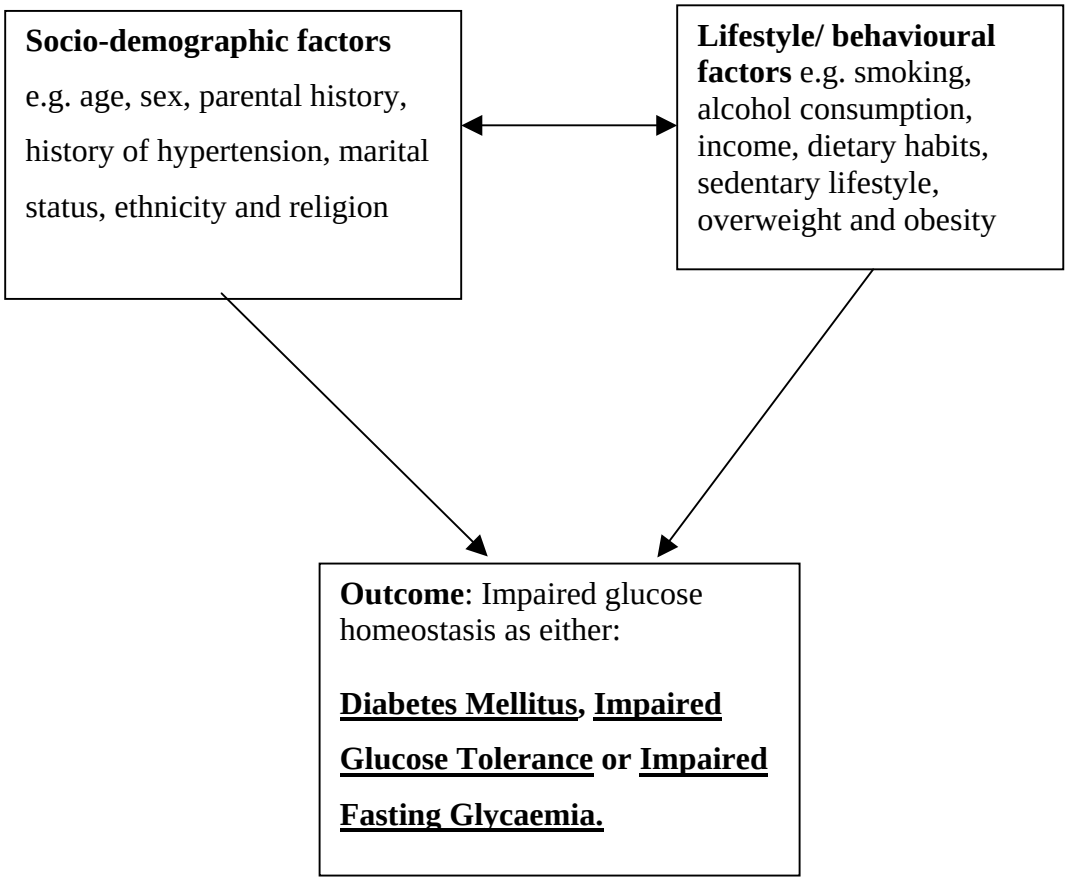


Figure1. Conceptual framework of the Research

3. OBJECTIVES

3.1. General Objective:

The general objective of this study is to assess the magnitude of diabetes and impaired fasting glucose, and their determinant factors, among adult workers of the Akaki Spare Parts Share Factory, Ethiopia.

3.2. Specific Objectives:

I. To estimate the proportion of diabetes mellitus and impaired fasting glucose in the study population.

II. To identify socio-demographic characteristics, which are associated with increased risk of diabetes and impaired fasting glucose among the study population.

III. To examine the behavioural and environmental factors that impact on the prevalence of diabetes in the population, which would also serve as baseline data for future surveillance studies on diabetes and related non-communicable diseases in the country.

3. RESEARCH METHODS AND MATERIALS

4.1. Study design

The study is a descriptive, cross-sectional survey to assess the proportion and determinants of diabetes mellitus and impaired fasting glucose among adult workers of the Spare Parts Share Company, which was conducted between November and December 2002 in Akaki, Ethiopia.

4.2. Geographic location of the study area

The study was undertaken in Akaki, a suburban industrial town, about 20 kilometres south of the Addis Ababa Metropolis. Administratively, it is located in weredas 27 of the Addis Ababa Administrative Region of Ethiopia (see map in Annex 1). Akaki town about 35 small and large industrial plants, of which the Spare Parts Share Company established about 15 years ago, is one of the largest in the area. The factory produces industrial and household hardware products, and is Government-owned and Government operated.

4.3. Study Population

The factory has a total of 600 full workers, out of which 533 are permanent. It was selected for this study because it represents a homogenous population with similar characteristics, which can be studied over time, as is envisaged in the cohort study to be established in the area. Furthermore, the proximity of the factory to Addis Ababa, the capital of Ethiopia, makes it suitable for assessing the sociodemographic and lifestyle characteristics of urban/suburban populations, in relation to diabetes and associated diseases, of interest in this study.

The following criteria were applied in the selection of study subjects:

- Eligible subjects were all workers in the factory, aged 16 years and above, who are under full-term contracts at the factory.
- Workers who were less than 16 years of age, and temporary or part-time workers were excluded.

4.4. Sampling Method and Sample Size Estimation

The study used a convenience sampling technique to select the subject population. Since it involved a population of a known sample size of 533, all eligible workers were invited to participate in order to achieve a reasonable sample size, which would not have been possible were a probability sampling method, such as the simple random sampling, employed. However, the degree of precision to which the proportion of the subjects with the diabetes was obtained, was estimated, using the standard error of proportion (37).

For a single population sample as in this study, the standard error of proportion,

$$s.e. = \sqrt{[p\,(1-p)]\,/n}$$

Where p = proportion of individuals with disease (diabetes) in a given population, assuming 5% prevalence rate (i.e. p = 0.05).

n = sample size

If the actual observed individuals with disease = r, then the estimated proportion will be r/n, and so, p = r/n. The 95% Confidence Interval (C.I.) for the prevalence of disease is therefore = $p \pm 1.96 \times$ s.e. (p).

The standard error in this case = $\sqrt{\frac{[0.05(1.0-0.05)]}{533}}$

$$\text{s.e.} = \sqrt{\frac{[0.05(0.95)]}{533}} = 0.0094 \text{ or } 0.94\%$$

And the 95% C.I. = 1.96 x 0.0094 = 1.84 (or ≈2.0)%

The degree of precision around the expected prevalence of diabetes in the study population = 5.0 (± 2.0)%. This is adequate for making international comparisons.

A 5.0% expected prevalence of diabetes in the population was assumed, based on data from studies on similar populations in sub-Sahara Africa, as no current data was available on the prevalence of diabetes in a similar population in Ethiopia**.**

4.5. Measuring Instruments

As recommended in the WHO STEPwise Approach guidelines on NCD risk factor surveillance, the survey comprised:

1) Use of interviewer-administered structured questionnaires, to assess the socio-economic, demographic and behavioural characteristics of the study subjects, which might put them at risk of diabetes and related disorders.
2) Physical measurements such as pulse rate, blood pressure, height, weight, waist and hip circumference of all study subjects, using standard calibrated instruments.
3) Rapid fasting blood glucose estimations of capillary whole blood samples of study subjects, using the glucometer analyzer and tests strips.

4.6. Procedure for data Collection

Participants' eligibility were first determined by verifying the time of their last meal to ascertain that they had undergone an overnight fast of at least 8 hours. A written consent as well as the subject's identification was obtained after careful explanation of the purpose and procedure of the study. Socio-demographic data and relevant behavioural and lifestyles characteristics were recorded in a pre-tested structured questionnaire. Anthropometric measurements and biochemical tests were then taken and recorded for each participant.

Prior to data collection, permission was sought and obtained from the factory management, to carry out the survey at the factory. Workers were then sensitized about the proposed study through the clinic staff and the workers union, to ensure maximum participation. Those who accepted to participate were requested to register at the clinic and were later informed of when to undergo an overnight fast before the day of their test.

A two-day training on interviewing techniques, questionnaire administration and physical measurement techniques, was given to the data collectors a week before the actual survey by the principal investigator, assisted by the research advisor. Five data collectors, comprising two registered nurses, two health assistants and a laboratory technician were recruited for the study. The questionnaire used was a modified form of the WHO Global Risk Factor Surveillance Questionnaire, which had been test-piloted at the Butajira Health Project site by researchers from the Department of Community Health, Addis Ababa University (38). Pre-testing was also carried out to ensure suitability

of the questions for the survey and corrections reflected in the final questionnaire used. An Amharic translated version of the questionnaire was used in the survey for ease of administration and comprehension by data collectors and participants.

Following WHO recommendation, blood pressure was measured with the subject in a seating position after waiting in a quiet room for at least five minutes with legs uncrossed. Depending on the size of the subject's right upper arm, one of two mercury sphygmomanometers with different size cuffs were used to take three readings for blood pressure, measured to the nearest 2mmHg, at intervals of one minute each. An average of three readings was later used for the analysis, in compliance with WHO recommendation of taking a minimum of two recordings of both the systolic and diastolic pressures, to minimize measurement errors. The pulse rate was also similarly recorded from the radial pulse, taking three readings of one minute each (12).

Heights of subjects were measured to the nearest 0.1centimetres, using a standard stadiometer with subjects standing in the upright position and without shoes on their feet. To ensure that an upright position was maintained, each subject was told to stand tall, looking straight forward, while the data collector positioned the head, so that the temporo-mandibular joint was at level with the eye and both heels on the ground, before taking the height measurement.

To measure the weight, subjects first had to take off heavy outer jackets, overalls, scarves or heavy items in their pockets, and stand with both feet close together on a bathroom

scale. Weight was recorded to the nearest kilogram. Next the waist and hip girth were measured with the use of a flexible, inelastic tape, calibrated in centimeters. Waist girth was measured at the mid-way circumference between the lowermost rib margin and the iliac crest at the end of normal expiration, while the hip girth was measured at the level of widest circumference of the hip over the greater trochanter. Both measurements were taken three times and the average of the three readings were also taken for the calculation of the body mass index, and further analysis. Body mass index calculated for each subject, as the value of the weight (kg), divided by the square of the height (m^2) or wt/ht^2 (12).

4.7. Variables for the study

Dependent Variables (outcome):

- Proportion of subjects with Diabetes Mellitus.
- Proportion of subjects with Impaired Fasting Glucose.

Independent Variables

i. Socio-demographic variables:

Age, gender, ethnicity, religion, marital status, family history of diabetes and/or hypertension, history of delivery of large for-gestational-age babies, height, weight, body mass index (as an index of obesity), waist and hip ratio (as an index of central obesity), systolic and diastolic pressures and sedentary lifestyle (physical inactivity).

ii. Socio-economic variables:

Occupation, monthly income, highest education attained, history of smoking, alcohol consumption and dietary consumption of fruits and vegetables.

4.8. Operational definitions of Terms

I. **Diabetes Mellitus** - For the purpose of this study, a capillary whole blood fasting glucose value, equal to or greater than 6.1mmol l^{-1} (≥110mg dl^{-1}), was used to classify subjects as having diabetes using the WHO diagnostic criteria (15,16).

II. **Impaired Fasting Glycaemia (Impaired fasting Glucose -IFG) -**A fasting blood glucose value ≥ 5.6mmol l^{-1} (≥100mg dl^{-1}) and <6.1mmol l^{-1} (<110mg dl^{-1}) for capillary whole blood (15,16).

III. **Impaired Glucose Homeostasis** (IGH) - The totality of subjects with diabetes and impaired fasting glucose.

IV. **Risk Factor -** Any attribute, characteristic or exposure of an individual, which increases the likelihood of developing the disease of interest.

V. **Fasting Blood Glucose -** Blood glucose estimation obtained from a subject who has undergone an overnight fast from any food or drink (excluding water or clear, plain tea) for at least 8 hours.

VI. **Obesity -** a body mass index (BMI) ≥30.0 kg m^{-1}.

VII. **Overweight -** a BMI ≥25.0 but less than 30.0 kg m^{-1}.

VIII. **Central Obesity** - A waist-to-hip ratio (WHR) greater than 1.0 in men or greater than 0.85 in women (12).

IX. **Normal Fasting Glucose** - A capillary whole blood fasting glucose level <5.6 mmol l^{-1} (100mg dl^{-1}).

X. **Hypertension -** the average of casual systolic blood pressure readings ≥140 mmHg and/or diastolic pressure readings ≥ 90mmHg (17,39).

XI. **Sedentary lifestyle** (Physical inactivity) – In this study is measured as a response of being always or usually engaged in light/leisure activities for most days of the week, or a response of sometimes/never engagement in moderate to intense physical activity outside work for most days of the week, that would add up to at least three hours per week of moderate to intense (vigorous) physical activity (12).

XII. **Positive Family History of Diabetes and Hypertension** - is a reported history of diabetes and/or hypertension in the father, mother, full brother or sister, or the respondent.

XIII. **Heavy Alcohol Consumption** - Refers to the average consumption of more than 3 standard alcoholic drinks per day for men (≈30gm of alcohol) or >2 alcoholic drinks (or 20gm alcohol) for women. A standard alcoholic drink is the equivalent of one

glass/can/bottle (330ml) of regular beer (with 3% ethanol), one glass (100ml) of wine (10% ethanol) or one glass or measure (40ml) of distilled spirit, each of which adds up to about 10g of ethanol per drink (12).

XIV. **Low consumption of fruits/vegetables** – Is the consumption of less than one serving per day of fruits and vegetables, other than those added to foods such as soups, stews and sauces. A serving is the equivalent of one whole orange, one apple or banana, a slice of pineapple or papaya, half to one cup of diced vegetables or fruits, etc.

4.9. Data Quality

Quality of data was assured through the following methods:

- Use of structured questionnaire, which was translated into Amharic language and pre-tested before the actual survey.
- Intensive training of data collectors a week prior to commencement of actual survey.
- Active participation of the principal investigator in the data collection process as well as regular supervision of other data collectors.
- Checking of questionnaires at the end of each day of data collection, for consistency, completeness, clarity and accuracy.
- Taking physical measurements twice, and in some cases three times, to minimize observer error in measurements and recording as well as rotation of data collectors undertaking physical measurements to compare values. Duplicate checks in measurements were also randomly made by the

principal investigator and the advisor to check accuracy of measurements recorded by the data collectors.

- Checking the weight scale daily against a standard calibrated weight for accuracy each day before start of measurements.
- Comparing blood pressure readings from the field sphygmomanometers with that normally used in the clinic.
- Checking the glucometer machine and test strips periodically for accuracy using the manufacturer's recommended quality control instruments.

4.10. Data entry and analysis

Data coding was done at the end of each day of data collection and recoded later where necessary. Data were entered into the computer using EPI info version 6.04 statistical package, which was also used to clean the data. Frequencies and random independent checks were used to check for accuracy of data entry. Frequency distributions, percentages, tables and charts were used to show results of univariate analysis. Cross-tabulations, chi-square tests, p-values, odds-ratios and 95% confidence intervals were used to present results of bivariate analysis. Multivariate analysis was done on SPSS, version 10.0 statistical package, using the logistic regression models to control for potential confounders in the analysis. For the purpose of this study, statistical significance was defined at a probability level of 0.05 ($p<0.05$).

4.11. Ethical issues

Clearance for the study was obtained from the research and publication committee of the Medical Faculty of Addis Ababa University through the Community Health Department. A written permission was obtained from the factory management to undertake the study in the factory and the timing of the data collection process was coordinated with the various sectional heads so as to minimize disruption of the factory's usual activities.

The study was done with an informed written consent obtained from each participant and data collection was conducted confidentially. The different steps in the data collection process were carefully explained to the study subjects, who were also assured that they could withdraw from the study at any time if they so desired.

International standard safety measures were employed during biochemical testing to minimize potential harms to the study subjects. Subjects found to have grades 2 or 3 hypertension, that is, arterial blood pressure ≥160/100mmHg, and/or abnormally high fasting blood glucose were immediately informed of their results and referred to the factory's clinic or other health institution of their choice for immediate management and follow-up. Those with less extreme values were informed and counseled at the feedback visit to the factory on completion of data collection. In addition, health education on avoiding risk factors for diabetes and hypertension was made available to the generality of the factory workers.

5. RESULTS

A total of 475 subjects of ages 16-67 years, participated in the study out of the 533 eligible workers at the factory, with a non-response rate of 11%. The 58 non-responders were made up of mostly the junior-level staffs and about 10 senior/managerial grade staffs, of which only two are females. No specific reasons were reported for their refusal to participate in the survey despite intense sensitization efforts made by the researcher and the factory's clinic staff.

Of the total 475 subjects who were tested, 16 (3.4%) had diabetes, while 17 (3.6%) had impaired fasting glucose. Overall, impaired glucose homeostasis (IGH) was present in 33 (6.9 %) of the respondents. Nine (56.3%) out of the 16 subjects with diabetes were already known diabetics, and the rest 7 (43.7%) did not know of their condition, and the ratio of diagnosed to undiagnosed diabetes in the surveyed population was 1.3:1.0.

5.1. Univariate Analysis of Results:

5.1.1. Socio-demographic characteristics

Table 1 shows the results of analysis of the socio-demographic characteristics of the study population. Of the total respondents, 403 (84.8%) were males and the rest, 72 (15.2%) were females, with a male to female ratio of 6:1.

The age of the study subjects ranged from 16 to 67 years, with a mean age of 33.5 ±7.9 years. The age group of 25-34 years, with a total of 187 study subjects (39.4%), constituted the majority of respondents. The highest proportions of male and female

subjects (38.1% and 43.1% respectively) were also in that age group. Respondents in the age group 35-44 years constituted the second largest group with 175 subjects (36.8%), while those aged 16-24 years were about 70 subjects (14.7%). Persons aged 45 years and above made up the lowest proportion of subjects in the population, with only 43 (9.1%) subjects (Table 2).

The dominant ethnic group was Amhara, accounting for 56.8% of the study population, followed by Oromo (30.7%). Persons of other ethnic groups combined, made up only 12.4% of the total study population (Figure 3).

Three hundred and ninety-nine (84.0%) of the study subjects belonged to the Orthodox Christian religion. Fifty (10.5%) were Protestants and the rest twenty-six (5.5%), were made up of Muslims and people of other religions (Table 1).

The majority, 258 (54.3%) of study subjects were married. However, there were also a high proportion of single subjects (42.3%) among the study population, and the rest (3.4%), were either divorced or widowed.

An overwhelming majority of respondents, 469 (98.7%) had some formal education, and those with no formal education constituted only 1.3% of the study population. Of those with formal education, 221 subjects (46.5%) had post-secondary or higher education, 208 (43.8%) secondary, and the rest 40 (8.4%), only primary education. The median highest grade attained by the factory workers was twelfth grade (Table 1).

The description of the job categories of the workers was closely linked to their income level, according to information obtained from the factory (Figure 4). Of the three occupational levels described by the respondents, junior level workers (with monthly income of below 900 Birr) made up the majority (379 subjects or 79.8%). Middle level workers, earning between 900 and 1334 Birr per month, constituted 13.9% of the workers (66 in all), while the senior and management staff with monthly income above 1335 Birr, were only 30 (6.3%). The median monthly income of the respondents was calculated to be 478 Birr.

A total 115 (24.2%) study subjects had a family history of diabetes and hypertension, but the majority, 360 (75.8%) had no such history (Table 1). About 30.6% of the female and 23.1% of the male respondents had a positive family history. Parental history of diabetes and hypertension was present in 76.2% of those who reported a positive family history, while the rest 23.8% had positive history in full siblings. Diabetes was reported as being present in the family by 20.9% of the respondents, hypertension in 70.4% and both conditions in the remaining 8.4% of those with positive family history (not shown in table).

Among the female respondents, 7 (9.7%) reported having delivered a large-for-gestational age baby, while 65 (90.3%) had not. However, this was highly subjective since many of the women did not know the exact birth weight of their babies.

Table 1. Socio-demographic characteristics of the study subjects at the SPSC Akaki, Ethiopia Nov-Dec 2002 (n=475).

Characteristic		No of subjects	% of study Population
Gender	Male	403	84.8
	Female	72	15.2
Age group (yrs)	16-24	70	14.7
	25-34	187	39.4
	35-44	175	36.8
	45-54	39	8.2
	55-67	4	0.8
Mean ± SD	33.5 ± 7.9		
Ethnicity	Amhara	270	56.8
	Oromo	146	30.7
	Others	59	12.4
Religion	Christians	399	84.0
	Protestants	50	10.5
	Others	26	5.5
Marital Status	Single	201	42.3
	Married	258	54.3
	Others	16	3.4
Educational status	No Formal Education	6	1.3
	Primary	40	8.4
	Secondary	208	43.8
	Higher	221	46.5
Occupation	Junior staff	379	79.8
	Mid-level staff	66	13.9
	Senior staff	30	6.3
Income (ETB)	<900	339	71.4
	900-1334	65	13.7
	≥1335	30	6.3
	Declined	41	8.6
Median income	478 Birr		
Family history of Diabetes/hypertension	Yes	115	24.2
	No	318	66.9
History of 'big' baby* (n = 72)	Yes	7	9.7
	No	65	90.3

* Refers to delivery of large-for-gestational age babies (female subjects only)

Table 2. Distribution of study subjects by age group and gender, at the SPSC, Akaki, Ethiopia. Nov-Dec 2002 (n=475)

	Gender		
Age-group (Years)	**Men n(%)**	**Women n(%)**	**Total n(%)**
16-24	64 (15.9)	6 (8.3)	70 (14.7)
25-34	156 (38.7)	31 (43.1)	187 (39.4)
35-44	147 (36.5)	28 (38.9)	175 (36.8)
≥45	36 (8.9)	7 (9.7)	43 (9.1)
Total	403 (84.8)	72 (15.2)	475 (100.0)

Figure 2. Proportion of males and females, by age group of respondents, at SPSC Akaki, Ethiopia Nov-Dec 2002 (n = 475)

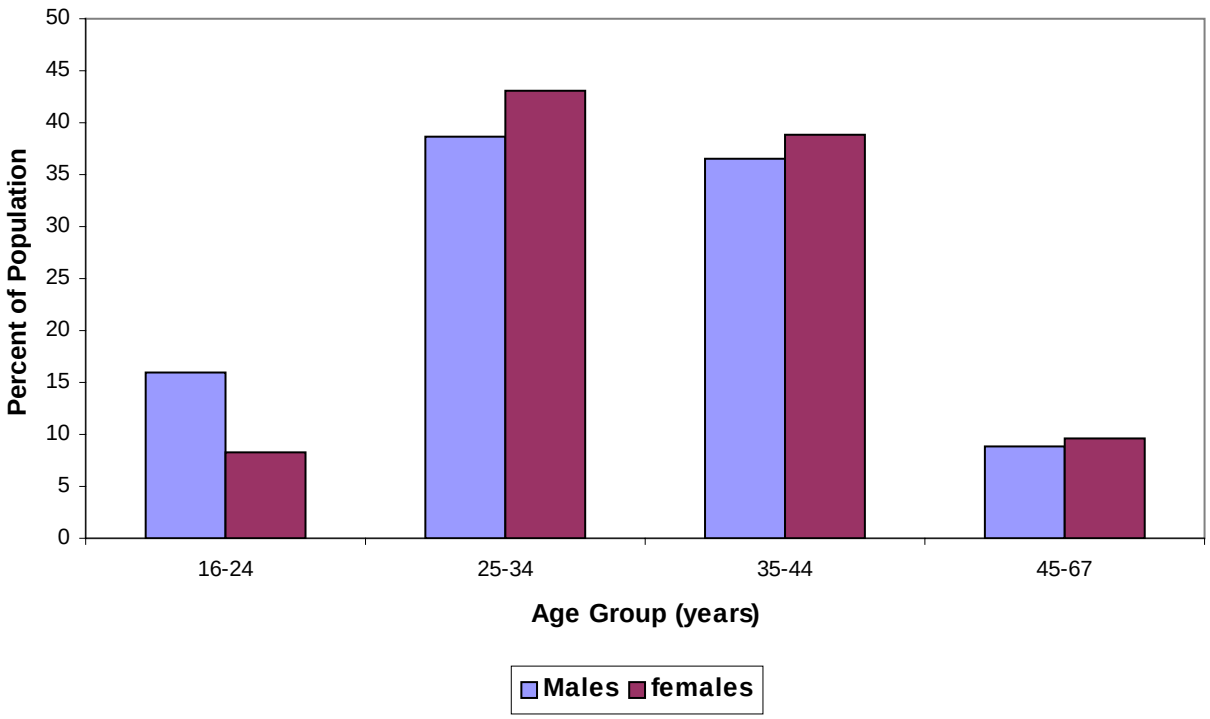


Figure 3. Ethnic Composition of the Study Population at SPSC, Akaki Nov-Dec 2002

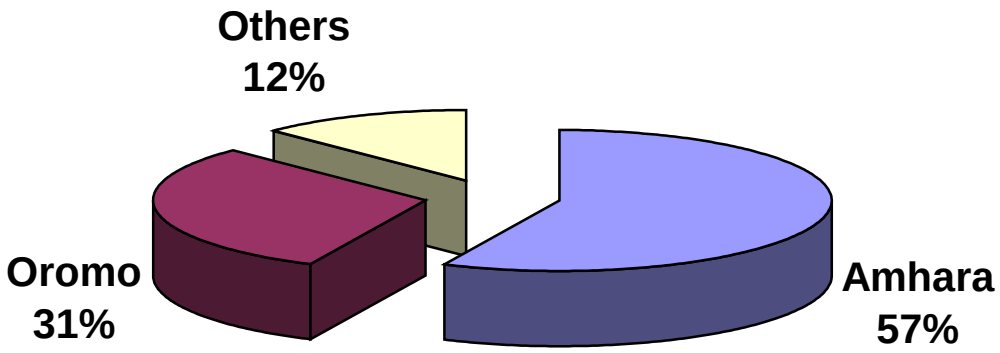
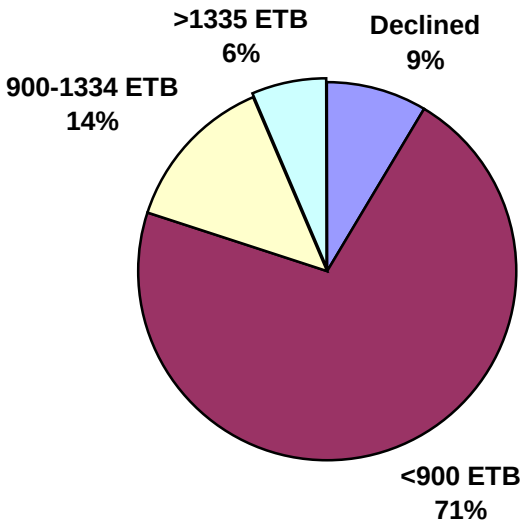


Figure 4. Distribution of monthly income among the study subjects at the SPSC, Akaki Nov-Dec 2002



5.1.2. Behavioural characteristics

Table 3 depicts a description of selected behavioural characteristics of the study population. Overall, 50 (10.5%) of the respondents reported ever having smoked cigarettes in their lifetime, but only 34 (7.2 ±2%), are current smokers. All the smokers in this study are interestingly males. A slightly higher proportion of the current smokers (55.9%) have been smoking for up to 10 years and the remaining 44.1% for over 10 years. The median duration of smoking was however 9.0 ± 3 years. The number of cigarettes smoked ranged from <1.0 to 20 sticks per day, with a mean of 5 cigarettes/day.

The overall number of subjects, who have ever used 'khat', is 85 (17.9%). The proportion of male subjects that admitted to using 'Khat' was about 20.8%, and only 1.4% of females claimed to have ever taken 'khat.

Among the study population, 326 (68.6%) regularly consume one or more alcoholic drinks per day. Heavy alcohol consumption was however found in 42.3% of regular drinkers or 29.1% of the total population. Only 4.2% of females, in contrast to 33.5% of males, were found to engage in heavy alcohol consumption (Table 3).

A surprising majority of respondents, 448 (94.3%), do not eat at least one serving of fruits and vegetables everyday. The rest 5.7% of the subjects reported that they consume one or more servings of fruits and vegetables each day.

Out of the total survey respondents, 167 (35.2%) reported that they regularly engage in moderate to intense physical activities adding up to at least three hours per week, and 308 (64.8%) do not. A higher proportion of females compared to males (88.9% versus 60.5%) did not engage in regular physical activity.

The body mass index (BMI) of the respondents ranged from 14.2 to 34.8 kg m^{-2}, with a mean of 22.4 ±3.5 kg m^{-2}. The mean BMI of the male respondents was found to be 22.1 ±3.3 kg m^{-2}, whereas that of the female respondents was 23.5 ±4.4 kg m^{-2}. Overall, 352 (74.1%) of subjects had BMI <25.0 kg m^{-2}, and 25.9% of respondents had BMI ≥25.0 kg m^{-2}. Of these, 109 (23.0%) subjects were overweight, and 14 (2.9%) were obese (Table 3). In addition, higher proportions of female respondents than males were overweight (37.5% versus 23.8%), and a similarly higher proportion, were obese (8.3% of females versus 2.0% of males) (Figure 5).

The mean waist-hip-ratio (WHR) of the respondents was 0.87 ±0.7 for men, and 0.79 ±1.4 for women. Overall, 8 men (2.0%) and 10 women (13.9%) had central obesity (as defined by the WHR) or 3.9% of the total study subjects (Table 3).

The mean systolic blood pressure of the study population was 120 ± 16mmHg, while the diastolic mean was 82 ±10mmHg. Analysis of the blood pressure by age, showed that the mean blood pressure (both systolic and diastolic), was highest in age group ≥45 years. Among the survey subjects, a total of 105 (22.1 ±0.4% %) had hypertension. The prevalence of hypertension in the survey subjects was also found to increase with age (X^2

for linear trend = 19.44; p <0.001). The proportion of males with hypertension was 23.8%, whereas 12.5% of the female subjects had hypertension. In addition, the highest proportion of subjects with hypertension (39.5%) was in the age group ≥45 (Table 4). There was some variation in the prevalence of systolic and diastolic hypertension in the study population. Whereas 43 subjects (9.1%) had systolic hypertension, 105 (22.1%) had diastolic hypertension (Table 3).

Table 3. Distribution of selected behavioural characteristics among study subjects at the SPSC factory, Akaki, Ethiopia Nov-Dec 2002 (n = 475)

Characteristic		No of subjects	Percentage of study population (%)
Ever smokers	Yes	50	10.5
	No	425	89.5
Current smokers	Yes	34	7.2
	No	441	92.8
Duration of smoking (years)	Up to 10	19	55.9
	>10	15	44.1
Number of cigarettes smoked per day*	1-10	31	91.2
	>10	3	8.8
Ever users of 'Khat'	Yes	85	17.9
	No	390	82.1
Regular alcohol drinkers	Yes	326	68.6
	No	149	31.4
Heavy alcohol consumption**	Yes	138	42.3
	No	188	57.7
Low consumption of fruits and vegetables	Yes	448	94.3
	No	27	5.7
Sedentary lifestyle	Yes	308	64.8
	No	167	35.2
Categories of BMI	Normal (<25.0)	352	74.1
	Overweight (25.0-29.9)	109	23.0
	Obesity (≥30.0)	14	2.9
Central obesity	Yes	18	3.9
	No	457	96.2
Systolic hypertension	Yes	43	9.1
	No	432	90.9
Diastolic hypertension	Yes	105	22.1
	No	370	77.9

* Denominator is no. of current smokers

** Denominator is no. of regular drinkers

Figure 5. BMI by gender distribution among study subjects at SPSC Akaki, Nov-Dec 2002

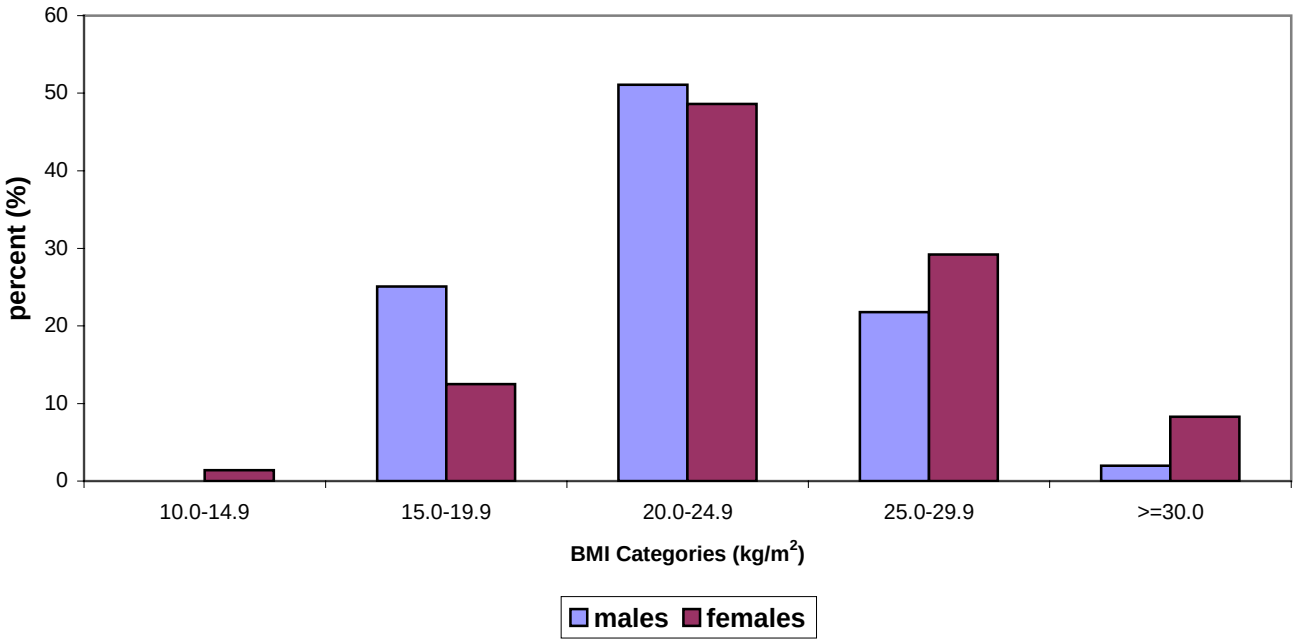


Table 4. Age and gender distribution of study subjects with hypertension, at the SPSC Akaki Nov-Dec 2002 (n=475)

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Age (years)	Presence of Hypertension					
	Men		Women		Both	
	Yes #(%)	No # (%)	Yes # (%)	No #(%)	Yes # (%)	No #(%)
16-24	4 (6.3)	60 (93.7)	1 (16.7)	5 (83.3)	5 (7.1)	65 (92.9)
24-34	33 (21.2)	123 (78.8)	3 (9.7)	28 (90.3)	36 (19.3)	151 (80.7)
35-44	43 (29.3)	104 (70.7)	4 (14.3)	24 (85.7)	47 (26.9)	128 (73.1)
≥45	16 (44.4)	20 (55.6)	1 (14.3)	6 (85.7)	17 (39.5)	26 (60.5)
Total	96 (23.8)	307 (76.2)	9 (12.5)	63 (87.5)	105 (22.1)	370 (77.9)

X^2 for linear trend = 19.44; p <0.001

5.1.3. Study Outcomes

The proportion of subjects with diabetes and impaired fasting glucose (IGH) in the surveyed population were 3.4 ±0.2% and 3.6 ±0.4% respectively. Overall, impaired glucose homeostasis was present in 6.9 ±0.3% of respondents.

Twenty-nine men (7.2%), and 4 women (5.6%) were found to have IGH. A breakdown of the subjects with IGH by age groups showed that, age group ≥45 years had the highest proportion of subjects with IGH (18.6%), followed by the age group 35-44 with 8.6%, and the age group 16-34 years, had the lowest proportion of subjects (3.9%), with IGH. There was a significant increase in the prevalence of IGH with age (X^2 = 12.55; p <0.001) (Table 5).

Diabetes mellitus was found to affect 16 (3.4%) of the studied subjects. The proportion of subjects with diagnosed to undiagnosed diabetes was 56.3% to 43.7%, with a ratio of 1.3 to 1.0. Among the males, 3.2% were found to have diabetes, while the proportion of females with diabetes was 4.2% (Table 6). The age group ≥45 years also had the highest proportion of males and females with diabetes (13.9% and 14.3%, respectively). In addition, the prevalence of diabetes mellitus was found to increase significantly with age (X^2 = 18.92; p <0.001) (Table 6).

Overall, 17 subjects (3.6%) had impaired fasting glucose. These were made up of 16 males (4.0%) and only 1 female (1.4%) among the surveyed population (not shown in table).

Table 5. Age and gender distribution of study subjects with Impaired Glucose Homeostasis (IGH) at SPSC, Akaki Nov-Dec 2002 (n = 475)

	Presence of IGH					
Age	**Men**		**Women**		**Both**	
(years)	**Yes # (%)**	**No #(%)**	**Yes # (%)**	**No # (%)**	**Yes #(%)**	**No #(%)**
16-34	9 (4.1)	211 (95.9)	1 (2.7)	36 (97.3)	10 (3.9)	247 (96.1)
35-44	13 (8.8)	134 (91.2)	2 (7.1)	26 (92.8)	15 (8.6)	160 (91.4)
≥45	7 (19.4)	29 (80.6)	1 (14.3)	6 (85.7)	8 (18.6)	35 (81.4)
Total	29 (7.2)	374 (92.8)	4 (5.6)	68 (94.4)	33 (6.9)	442 (93.1)

X^2 for linear trend = 12.55, p <0.001

Table 6. Age and gender distribution of study subjects with diabetes mellitus, at the SPSC Akaki Nov-Dec 2002 (n = 475)

	Presence of Diabetes Mellitus					
Age (years)	**Men**		**Women**		**Both**	
	Yes # (%)	**No # (%)**	**Yes# (%)**	**No # (%)**	**Yes # (%)**	**No # (%)**
16-34	2 (0.9)	218 (99.1)	0 (0)	37 (100.0)	2 (0.8)	255 (99.2)
35-44	6 (4.1)	141 (95.9)	2 (7.1)	26 (92.9)	8 (4.6)	167 (95.4)
≥45	5 (13.9)	31 (86.1)	1 (14.3)	6 (85.7)	6 (13.9)	37 (86.1)
Total	13 (3.2)	390 (96.8)	3 (4.2)	69 (95.8)	16 (3.4)	459 (96.6)

X^2 for linear trend =18.92, p <0.001

5.2. Bivariate Analysis of Results:

In bivariate analysis of the socio-demographic variables with impaired glucose homeostasis (IGH), age was found to have statistically significant association with the prevalence of IGH in this population (x^2 =15.72, p <0.05). Family history of diabetes and hypertension was also positively associated with IGH (OR =2.49, 95%CI (1.13,5.42) (Table 7). Family history was also found to be also positively associated with the prevalence of diabetes and hypertension: OR =7.45, 95%CI (2.05,27.17), and OR =1.84, 95% CI (1.09,3.07), respectively.

There was no significant difference found in the prevalence of diabetes or hypertension amongst the different ethnic groups of the studied population. Similarly, religion, marital status and educational status did not show any statistically significant association with the prevalence of overall impaired glucose, diabetes mellitus or hypertension in the surveyed population.

An increase in the prevalence of impaired glucose with increasing income level was noted in the bivariate analysis, but it was not statistically significant. Although gender did not show any significant association with the prevalence of IGH, diabetes or IFG in this population, there was however, a positive association between gender and the prevalence of hypertension, with males more likely than females to have hypertension (OR 2.19, 95%CI (1.01,4.91) (Table 12).

Among the behavioural characteristics, being overweight was found to be positively associated with the prevalence of IGH (OR = 2.22, 95% CI (1.03,4.90). A similar positive association was found for obesity and IGH (0R= 5.95, 95% CI (1.47,22.47). In addition, gender was found to be significantly associated with overweight and obesity, with females more likely than males to be overweight (OR= 1.92, 95% CI (1.09,3.36), as well as obese (OR= 4.49, 95% CI (1.33,14.84). Females were similarly found to be more likely to engage in sedentary lifestyles than males (OR=5.21, 95%CI (2.34,12.09).

Presence of systolic and diastolic hypertension had statistically significant associations with the prevalence of IGH among the surveyed subjects, with OR = 3.72, 95%CI (1.42,9.48) for systolic hypertension, and OR=2.84, 95%CI (1.29,6.22) for diastolic hypertension (Table 7).

Males were found to be more likely than females to be heavy alcohol drinkers (OR =11.40, 95%CI (3.28,47.42), although this was not associated with the prevalence of impaired glucose.

Other behavioural variables such as smoking, heavy alcohol consumption, low dietary consumption of fruits and vegetables, and sedentary lifestyles, did not show any significant associations with the prevalence of IGH or diabetes in the study population, although such associations have been observed in other studies.

Table 7. Distribution of impaired glucose homeostasis among respondents by selected risk factors at SPSC Akaki, Ethiopia Nov-Dec 2002 (n = 475)

Characteristic		Presence of IGH Yes # (%)	No # (%)	X^2	p-value	OR (95% CI.)
Age	16-34	10 (3.9)	247 (96.1)	13.47	0.001*	
	35-44	15 (8.6)	160 (91.4)			
	≥45	8 (18.6)	35 (81.4)			
Sex	Male	29 (7.2)	374 (92.8)			1.00
	Female	4 (5.6)	68 (94.4)			0.97 (0.30-3.08)
Educ. status	Primary	3 (6.5)	43 (93.5)	0.88	0.643	
	Secondary	17 (8.2)	191 (91.8)			
	Higher	13 (5.9)	208 (94.1)			
Income	<900	22 (6.5)	317 (93.5)	3.82	0.282	
	900-1334	6 (9.2)	59 (90.8)			
	≥1335	4 (13.3)	26 (86.7)			
	Declined	1 (2.4)	40 (97.6)			
Ethnicity	Amhara	16 (5.9)	254 (94.1)	1.01	0.602	
	Oromo	12 (8.2)	134 (91.8)			
	Others	5 (8.5)	54 (91.5)			
Family History of DM/Hpt	Y	14 (12.2)	101 (87.8)			2.49 (1.13, 5.42)*
	N	19 (5.3)	341 (94.7)			
Ever-smokers	Y	4 (8.0)	46 (92.0)			1.19 (0.34, 3.76)
	N	29 (6.8)	396 (93.2)			
Current smokers	Y	1 (3.0)	33 (97.0)			2.58 (0.36, 52.36)
	N	32 (7.3)	409 (92.7)			
Heavy alcoholism (n = 326)**	Y	9 (6.5)	129 (93.5)			0.88 (0.35, 2.23)
	N	14 (7.4)	174 (92.6)			
Low dietary fruits/vegetables	Y	29 (6.5)	419 (93.5)			1.95 (0.39, 9.82)
	N	4 (14.8)	23 (85.2)			
Sedentary lifestyle	Y	22 (7.1)	286 (92.9)			0.79 (0.32, 2.00)
	N	11 (6.6)	156 (93.4)			
History of big baby (n = 72)***	Y	2 (28.6)	5 (71.4)			12.8 (0.99, 177.5)
	N	2 (3.1)	64 (96.9)			
Overweight	Y	14 (11.4)	109 (88.6)			2.25 (1.03, 4.90)*
	N	19 (5.4)	333 (94.6)			
Obesity	Y	4 (28.6)	10 (71.4)			5.96 (1.47, 22.47)*
	N	29 (6.3)	432 (93.7)			
Hypertension	Y	14 (13.3)	91 (86.7)			2.84 (1.29, 6.22)*
	N	19 (5.1)	351 (94.9)			

* Denotes statistical significance ** denominator is regular drinkers

*** Female respondents only Y= yes N= no

5.3. Multivariate Analysis:

5.3.1. Impaired glucose homeostasis

Using binary logistic regression analysis, only the age group ≥45 years, proved to have an independently significant association with the prevalence of impaired glucose homeostasis among the surveyed population. Persons in the age group ≥45 years were found to be 7 times at more risk of having impaired glucose homeostasis than the other age groups, AOR = 7.09, 95%CI (1.98,25.43) (Table 8).

A family history of diabetes and hypertension also showed an independent association with the prevalence of IGH. Respondents with a positive family history were found to be almost three times at more risk of having impaired glucose homeostasis, than those without such a history, AOR = 2.74, 95%CI (1.22,6.14). Other socio-demographic variables did not show independent significant associations with the prevalence of IGH, when binary logistic regression analysis was applied (Table 8).

Among the behavioural/lifestyle characteristics of the study subjects, only the presence of hypertension was found to have an independent association with IGH, AOR 2.48, 95% CI (1.0,6.12). History of smoking, heavy alcohol consumption, sedentary lifestyle, low dietary fruits and vegetables and being overweight were not independently associated with IGH in this population, using logistic regression (Table 9).

Table 8. Distribution of Impaired Glucose Homeostasis among respondents by selected sociodemographic characteristics. Akaki, Ethiopia Nov-Dec 2002 (n=475)

Characteristic		Presence of IGH			
		Yes n (%)	No n (%)	COR (95%CI)	AOR (95%CI)
Gender	Male	29 (7.2)	374 (92.8)	1.00	1.00
	Female	4 (5.6)	68 (94.4)	0.76 (0.22,2.36)	0.97 (0.30,3.08)
Age	16-34	10 (3.9)	247 (96.1)	1.00	1.00
	35-44	15 (8.6)	160 (91.4)	2.32 (0.95,5.70)	1.74 (0.67,4.47)
	≥45	8 (18.6)	35 (81.4)	5.65 (1.88,16.87)*	7.09 (1.98,25.43)*
Educ Status	Primary	3 (6.5)	43 (93.5)	1.00	1.00
	Secondary	17 (8.2)	191 (91.8)	1.28 (0.33,5.74)	2.57 (0.62,10.64)
	Higher	13 (5.9)	208 (94.1)	0.90 (0.20-4.15)	1.43 (0.29,7.11)
Income	<900	22 (6.5)	317 (93.5)	1.00	1.00
	900-1334	6 (9.2)	59 (90.8)	1.47 (0.51,4.03)	1.48 (0.44,4.92)
	≥1335	4 (13.3)	26 (86.7)	2.22 (0.60,7.51	1.05 (0.23,4.83)
	Declined	1 (2.4)	40 (97.6)	0.36 (0.02,2.63)	0.42 (0.05,3.55)
Marital Status	Single	8 (4.0)	193 (96.0)	1.00	1.00
	Married	25 (9.7)	233 (90.3)	2.59 (1.08,6.35)*	1.59 (0.60,4.19)
	Others	1 (5.9)	16 (94.1)	1.51 (0.0)	0.00 (0.0)
Family History	Yes	14 (12.2)	101 (87.8)	2.49 (1.13,5.42)*	2.74 (1.22,6.14)*
	No	19 (5.3)	341 (94.7)	1.00	1.00
History of Big baby	Yes	2 (28.6)	5 (71.4)	12.80 (0.9,177.5)	8.86 (0.92,85.24)
	No	2 (3.1)	64 (96.9)	1.00	1.00

* Denotes statistical significance

Table 9. Association of Impaired Glucose Homeostasis among respondents with selected behavioural characteristics Akaki, Ethiopia Nov-Dec 2002 (n = 475)

Characteristic		Presence of IGH			
		Yes n (%)	No n (%)	COR (95%CI)	AOR (95%CI)
Current smoker	**Yes**	1 (3.0)	33 (97.0)	0.39 (0.02,2.78)	0.50 (0.06,4.4)
	No	32 (7.3)	409 (92.7)	1.00	1.00
Heavy alcohol use (n = 326)	**Yes**	9 (6.5)	129 (93.5)	1.06 (0.42,2.63)	1.11 (0.45,2.76)
	No	14 (7.4)	174 (92.6)	1.00	1.00
Khat chewing	**Yes**	4 (4.7)	81 (95.3)	0.61 (0.18,1.90)	0.50 (0.13,1.92)
	No	29 (7.4)	361 (92.6)	1.00	1.00
Sedentary Lifestyle	**Yes**	22 (7.1)	286 (92.9)	1.09 (0.49,2.47)	1.28 (0.51,3.21)
	No	11 (6.6)	156 (93.4)	1.00	1.00
Low consumption of fruits/vegetables	**Yes**	29 (6.5)	419 (93.5)	0.40 (0.12,1.46)	0.49 (0.09,2.52)
	No	4 (14.8)	23 (85.2)	1.00	1.00
Overweight**	**Yes**	14 (11.4)	109 (88.6)	2.25(1.03,4.90)*	1.88 (0.89,3.96)
	No	19 (5.4)	333 (94.6)	1.00	1.00
Hypertension	**Yes**	14 (13.3)	91 (86.7)	2.84(1.29,6.22)*	2.51(1.19,5.30)*
	No	19 (5.1)	351 (94.9)	1.00	1.00

* Denotes statistical significance

** Denotes BMI ≥25.0 kg m^2

5.3.2. Diabetes Mellitus

Using the binary logistic regression model to explain the relationship between diabetes and selected socio-demographic variables, only age group ≥45 years and a positive family history, proved to have independent significant associations with the prevalence of diabetes among the studied population. Being 45 years and older meant having about 41 times the risk of having diabetes than being in the other younger age groups. AOR = 41.13, 95%CI (4.70,359.64). In addition, respondents with a family history of diabetes and hypertension were 7 times more likely to have diabetes than those without such history. AOR =7.45, 95%CI (2.05,27.10) (Table 10). None of the selected behavioural variables such as smoking, khat chewing, obesity, sedentary life style and low consumption of vegetables, showed a significant independent association with the prevalence of diabetes in the studied population (Table 11).

5.3.3. Hypertension

In binary logistic regression, the age group ≥45 years, gender and positive family history proved to have independently significant associations with the prevalence of hypertension in this population. Being 45 years of age and above had 3 times more risk of having hypertension than being in the other age groups. AOR =3.61, 95%CI (1.52,8.58). Similarly, males were about two and half times more likely to be hypertensive than females. AOR = 2.50, 95%CI (1.14,5.47). Respondents with a positive family history were about 2 times more likely to have hypertension than those without such a history. AOR =1.84, 95%CI (1.09,3.07) (Table 12).

Lastly, having a history of smoking, heavy alcohol consumption, khat chewing, sedentary lifestyle, low dietary fruits and vegetables, obesity and diabetes, had no independent associations with the prevalence of hypertension in the studied subjects (Table 13).

Table 10. Distribution of Diabetes Mellitus among respondents by selected sociodemographic characteristics. Akaki, Ethiopia Nov-Dec 2002 (n = 475)

Characteristic		Presence of Diabetes Yes n (%)	No n (%)	COR (95%CI)	AOR (95%CI)
Gender	Male	13 (3.2)	390 (96.8)	1.00	1.00
	Female	3 (4.2)	69 (95.8)	1.30 (0.29,5.07)	2..55 (0.55, 11.87)
Age	16-34	2 (0.8)	255 (99.2)	1.00	1.00
	35-44	8 (4.6)	167 (95.4)	6.11 (1.19,42.15)*	4.19 (0.75, 23.38)
	≥45	6 (14.0)	37 (86.0)	20.68 (3.58,154.52)*	41.13 (4.70, 359.64)*
Educ. Status	Primary	2 (4.3)	44 (95.7)	1.00	1.00
	Secondary	5 (2.4)	203 (97.6)	0.54 (0.09,4.18)	1.49 (0.22, 10.29)
	Higher	9 (4.1)	212 (95.9)	0.93 (0.18,6.49)	1.56 (0.19, 12.56)
Income	<900	8 (2.4)	331 (97.6)	1.00	1.00
	900-1334	5 (7.7)	60 (92.3)	3.45 (0.94,12.14)	2.29 (0.47, 11.24)
	>1335	3 (10.0)	27 (90.0)	4.60 (0.91,20.70)	0.82 (0.10, 6.64)
	Declined	1 (2.40)	41 (97.6)	1.01 (0.0)	0.00
Marital Status	Single	3 (1.5)	198 (98.5)	1.00	1.00
	Married	13 (5.0)	245 (95.0)	3.50 (0.92,15.69)	1.47 (0.34, 6.55)
	Others	1 (5.9)	17 (94.1)	4.13 (0.0)	0.00
Family History	Yes	10 (8.7)	105 (91.3)	5.62 (1.83,17.85)*	7.45 (2.05, 27.10)*
	No	6 (1.7)	354 (98.3)	1.00	1.00
History of big baby	Yes	2 (28.6)	5 (71.4)	25.60 (1.41,881.2)*	22.0 (1.68,287.2)*
	No	1 (1.5)	64 (98.5)	1.00	1.00

* Denotes statistical significance

Table 11. Association of Diabetes Mellitus among study subjects, with selected behavioural characteristics. Akaki, Ethiopia Nov-Dec 2002 (n= 475)

Characteristic		Presence of Diabetes		OR (95% Confidence Limits)	
		Yes n (%)	No n (%)	Crude	Adjusted
Current smokers	Yes	1 (2.5)	34 (97.1)	0.78 (0.0)	0.00
	No	16 (3.6)	425 (96.4)	1.00	1.00
Heavy alcohol use (n=326)	Yes	5 (3.6)	133 (96.4)	1.73 (0.39,7.83)	1.89 (0.44,8.15)
	No	4 (2.1)	184 (97.9)	1.00	1.00
Khat chewing	Yes	2 (2.4)	83 (97.6)	0.65 (0.10,3.06)	0.47 (0.06,4.03)
	No	14 (3.6)	376 (96.4)	1.00	1.00
Sedentary Lifestyle	Yes	11 (3.6)	297 (96.4)	1.20 (0.38,4.04)	1.32 (0.45, 3.93)
	No	5 (3.0)	162 (97.0)	1.00	1.00
Overweight	Yes	9 (7.3)	114 (92.7)	3.89 (1.29,11.90)*	1.96 (0.81, 9.72)
	No	7 (2.0)	345 (98.0)	1.00	1.00
Low dietary Fruits/vegetables	Yes	14 (3.1)	434 (96.9)	0.40 (0.08,2.72)	0.49 (1.10, 2.34)
	No	2 (7.4)	25 (92.6)	1.00	1.00
Hypertension	Yes	6 (5.7)	99 (94.3)	2.18 (0.69,6.72)	1.67 (0.58, 4.86)
	No	10 (2.7)	360 (97.3)	1.00	1.00

*Denotes statistical significance

Table 12. Distribution of Hypertension among respondents by selected sociodemographic characteristics. Akaki, Ethiopia Nov-Dec 2002 (n = 475)

Characteristic		Presence of Hypertension Yes # (%)	No # (%)	OR (95% Confidence Limits) Crude	Adjusted
Gender	Male	96 (23.8)	307 (76.2)	2.19 (1.01,4.91)	2.50 (1.14,5.47)*
	Female	9 (12.5)	63 (87.5)	1.0	1.00
Age	16-34	41 (16.0)	216 (84.0)	1.00	1.00
	35-44	47 (26.9)	128 (73.1)	1.93 (1.19,3.19)*	1.69 (0.96,2.99)
	≥45	17 (39.5)	26 (60.5)	3.44 (1.62,7.30)*	3.61 (1.52,8.58)*
Educ. Status	Primary	9 (19.6)	37 (80.4)	1.00	1.00
	Secondary	47 (22.6)	161 (77.4)	1.20 (0.51,2.89)	1.85 (0.75,4.56)
	Higher	49 (22.2)	172 (77.8)	1.17 (0.50,2.81)	1.68 (0.63,4.48)
Income	<900	71 (20.9)	268 (79.1)	1.00	1.00
	900-1334	17 (26.2)	48 (73.8)	1.34 (0.69,2.56)	0.98 (0.47,2.04)
	>1335	10 (33.3)	20 (66.7)	1.89 (0.78,4.48)	1.23 (0.45,3.33)
	Declined	7 (17.1)	34 (82.9)	0.78 (0.30,1.93)	0.92 (0.37,2.27)
Marital Status	Single	36 (17.9)	165 (82.1)	1.00	1.00
	Married	66 (25.6)	192 (74.4)	1.58 (0.97,2.55)	1.19 (0.67,2.11)
	Others	3 (18.8)	13 (81.2)	1.06 (0.23,4.27)	0.89 (0.21,3.88)
Family History	Yes	35 (30.4)	80 (69.6)	1.81 (1.10,2.99)*	1.84 (1.09,3.07)*
	No	70 (19.4)	290 (80.6)	1.00	1.00

* Denotes statistical significance

Table 13. Hypertension among respondents in relation to selected behavioural characteristics. Akaki, Ethiopia Nov-Dec 2002 (n = 475)

Characteristic		Presence of Hypertension			
		Yes n (%)	No n (%)	COR (95%CI)	AOR (95%CI)
Current smokers	Yes	10 (29.4)	24 (70.6)	1.52 (0.65,3.46)	1.23 (0.48,3.11)
	No	95 (21.5)	346 (78.5)	1.00	1.00
Heavy alcohol use (n=326)	Yes	36 (26.1)	102 (73.9)	1.19 (0.69,2.04)	0.92 (0.54,1.58)
	No	43 (22.9)	145 (77.1)	1.00	1.00
Khat chewing	Yes	24 (28.2)	61 (71.8)	1.50 (0.85,2.63)	1.31 (0.67,2.58)
	No	81 (20.8)	309 (79.2)	1.00	1.00
Sedentary Lifestyle	Yes	64 (20.8)	244 (79.2)	0.81 (0.50,1.29)	0.86 (0.50,1.45)
	No	41 (24.6)	126 (75.4)	1.00	1.00
Obesity**	Yes	42 (34.1)	81 (65.9)	2.38 (1.46,3.87)*	0.59 (0.34,1.04)
	No	63 (17.9)	289 (82.1)	1.00	1.00
Low dietary fruits/vegetables	Yes	97 (21.7)	351 (78.3)	0.66 (0.26,1.69)	0.61 (0.19,1.97)
	No	8 (29.6)	19 (70.4)	1.00	1.00
Impaired Glucose Homeostasis	Yes	14 (42.4)	19 (57.6)	2.84 (1.29,6.22)*	0.41 (0.17,0.99)
	No	91 (20.6)	351 (79.4)	1.00	1.00

*Denotes statistical significance

** Denotes BMI ≥25.0 kg m^{-2}

6.1. DISCUSSIONS

The study was designed in compliance with the WHO Stepwise Approach to Noncommunicable disease risk factors surveillance, namely, the initial establishment of a baseline population-based data indicating the prevalence and local determinants of NCDs, were this is lacking, as it currently the case in Ethiopia (9).

The crude prevalences of diabetes and IFG in the surveyed population, were 3.4 ±0.2% and IFG 3.6 ±0.4% respectively. These results are almost six times higher than those reported from the population-based study over 10 years ago, in Ethiopia, in which the overall prevalence of diabetes and IFG was only 0.5% in adults above15 years of age, and 2.4% in those over 40 (10). Hospital-based studies of adult medical in-patients in different parts of the country had also reported diabetes prevalence rates of between 1.9 and 4.3% (27). The results of our study are comparable to that, reported from a similar study on a factory population in South Africa, which found a prevalence of 2.5% for diabetes and 2.7% for IGT. The prevalence is however lower than those reported from community-based studies in other developing countries such as Egypt and Lebanon (36,40).

A summary of the socio-demographic characteristics is depicted in tables 1-2 and figures 2-4, while the distribution of possible risk factors and their association with IGH and diabetes, are shown in tables 4, 7-11.

The majority of respondents (90.9%), were below 45 years of age, making it a relatively young adult population. The mean age of respondents was 33.5 ±7.9 years, with the

highest proportion of males (38.7%) and females (43.1%), belonging to the age group 25-34 years. The study found no respondent below the age of 25 years with diabetes or IGH. It appears therefore, that the diabetics in this study are probably of Type 2.

The proportion of subjects with Type 2 diabetes in this mostly young adult population appears high, compared to those reported from other studies in developing countries. Notably, many of such studies, report very low prevalence of Type 2 diabetes in populations below 40 years of age, in contrast to the findings in this study (36,40). For example, in the Transkei factory population in South Africa, no one below 40 years of age was found to have diabetes (40). In contrast, Lester, F.T. had reported in 1984, that most Ethiopian diabetics were diagnosed between the ages of 30 and 50 years, with 20% or less diagnosed after 40 years of age (41).

This study found a significant increase in the prevalence of diabetes and hypertension with age, for both male and female respondents. Age group ≥45 years was found to have a significant positive association with IGH, diabetes and hypertension, even after adjusting for confounders. This is consistent with the view that the prevalence of diabetes and hypertension tend to increase with advancing age, and which has been confirmed in previous studies, both within and outside Ethiopia (2, 4,10,42).

There was no significant gender variation in the prevalence of diabetes in the study population. This is consistent with reports from many studies on diabetes in different parts of the world, like the Transkei, South African study and the 3rd NHANES, in the

USA (20,40). In general, although gender differences have been noted in diabetes prevalence in some communities, there are no consistent patterns seen from the various studies across the globe. The consensus, therefore, is that the differences sometimes observed, may in fact represent the effects of the prevalence of different risk factors in different populations (31).

The ethnic composition of the population is comparable to that of most populations in the Administrative Region of Addis Ababa, where the predominant ethnic group is Amhara, followed by Oromo, according to the census statistics of 1991. Similarly, the Orthodox Religion constitutes the major religious inclination of the study population as seen from the last population and housing census in Ethiopia (42). This suggests that extrapolation to the wider Addis Ababa population is legitimate.

About half of the surveyed population (52.2%) has attained a secondary (up to twelfth grade) education, and another 46.5%, post-secondary educational qualifications. This may be attributable to the fairly technical nature of their jobs at the factory as well as to its nearness to Addis Ababa, which has many secondary and post-secondary educational institutions.

Parental history of diabetes and hypertension was reported by about 76.2% of the 115 (24.2%) of workers who had a positive family history. Family history proved statistically significant, even after adjusting for potential confounders in the study. This is consistent with other studies and publications that have established the role that genetic/hereditary

factors play, especially in the aetiology of Type 2 diabetes and hypertension (13, 14,31). For example, Mensegha *et al* in 1990, reported that, among 147 Type 2 diabetes patients studied, 27% of them knew of a close relative with the disease as against 1.65% of controls who knew of a close relative with the disease (43).

Although cigarette-smoking and excessive alcohol consumption, have been implicated in many studies as being significantly associated with the prevalence of diabetes, no such association was found in this study (2,11). In addition, socio-economic status, religion, sedentary lifestyle, low dietary fruits and vegetables did not have significant associations with the prevalence of diabetes in this study. However, among Americans and other populations of developed countries, sedentary lifestyle, high energy-dense diet with low fruits and vegetables, have been found to be significantly associated with diabetes (20,34).

The mean BMI of the surveyed subjects, 22.4 kg m^{-2}, is comparable to the general observation in studies on Ethiopian populations. For instance, in the study on hypertension prevalence and determinants in Wonji by Hiwot G, the mean BMI was reported to be 18 kg m^{-2} (42).

Hospital-based studies in Ethiopia, have reported that the proportion of diabetics with normal BMI, is generally greater than those with higher-than-normal BMI. Of the 849 consecutive Ethiopian diabetic patients in one study, 54.4% were non-obese NIDDM, whereas only 24.7% were obese NIDDM, and the rest 20.1%, IDDM (44). Neither over-weight nor obesity was found to be an independent risk factor for diabetes or IFG in this

population, once adjustment for hypertension was made. In contrast, most studies outside the country have consistently found obesity an independent risk factor for diabetes, IGT and other cardiovascular diseases, including hypertension (7, 20, 24, 36). This study may suggest that among Ethiopians, only a sub-group of obese people (those who develop hypertension), are susceptible to diabetes. Central obesity was significantly higher in female respondents than males ($p<0.05$), which is consistent with the view that obesity is more prominent in females and confirmed by several studies (31, 32, 34).

The prevalence of hypertension in this study population is high (22.1%) compared to an urban prevalence of 11.8%, reported by Hiwot, G, in the Wonji study (42). Cohen *et al* had also reported a hypertension prevalence rate of 11.6% among Ethiopian immigrants to Israel (28). The higher prevalence of hypertension found in our study, might be explained in part by the criteria for diagnosis, in which the current WHO cut-off level of 140/90 mmHg was used, as against the former level of ≥160/90 mmHg, used in those studies (39).

In this study, hypertension was present in 38% of those with diabetes and 47% of those with IGH ($p <0.05$). Hypertension was found to be an independent risk factor for IGH, but not for diabetes alone, when logistic regression analysis was applied. This may have been due to the fact that other risk factors like obesity and family history, which were significantly associated with the prevalence of hypertension on their own, may have acted as confounders in the association with diabetes. Different studies have shown that the prevalence of hypertension in diabetics varies worldwide. In Africa, hypertension

prevalence rates of between 37% and 45% have been recorded among diabetic clinic patients. Osuntokun et al in 1972 reported a prevalence rate of 25% in Ibadan, Nigeria, which rose to 42% by 1990. Another report from Jos, Nigeria indicated that hypertension was present in 35% of the 302 diabetics that where studied (45,46). Our study findings are consistent with those reported in these studies.

This study also found a significant association in the prevalence of hypertension with gender, with males more likely than females to have hypertension. AOR=2.50 (1.14, 5.47). This is consistent with previous studies that have suggested that, in general, men (especially young adults) are at a higher risk for hypertension and its complications than women. (30,39).

Lastly, our study found no association between heavy alcohol consumption and khat chewing, with the prevalence of diabetes and IFG. Although the prevalence of diabetes seemed to increase, with increasing income level in this population, it was not statistically significant. Studies in other developing countries, such as Tanzania, Sudan and Bangladesh, have reported, however, that the prevalence of diabetes was higher in urban, affluent communities compared with rural (23, 24, 47). However, in economically advanced countries, recent studies are reporting the higher prevalence among the economically disadvantaged urban population than in the affluent. This has been explained in part, by the higher prevalence of sedentary life style, obesity, and excess dietary fat consumption, among the lower socio-economic class.

6.2. STRENGTHS OF THE STUDY

Among the strengths of this study are:

- ✓ The survey involved the whole study population, which allowed for greater precision as compared to taking a sample of the population of interest.
- ✓ It followed the WHO Stepwise approach to NCDs risk factor surveillance studies in a given population. The survey used a modified version of the standard WHO risk factor questionnaire that had been pre-tested in the Butajira health project, for its suitability in the Ethiopian population.
- ✓ The fasting glucose (and not glycosuria) was used in determining impaired glucose states as currently recommended by the American Diabetes Association Committee Report on the Diagnosis and Classification of diabetes mellitus, as against using glycosuria.
- ✓ It utilized several data quality control measures such as careful training of data collectors recruited as qualified health professionals (nurses and health assistants) who were already familiar with the process.

6.3. LIMITATIONS OF THE STUDY

Some of the limitations of this research include the following:

- It was a restricted population survey with a relatively small sample size, which has inherent sampling bias that makes it difficult to generalize the findings to the

Ethiopian population as a whole. However, it can be applicable to similar factory or urban working populations in the country.

- The comparatively smaller proportion of female workers at the factory (although not unexpected, given the type of products manufactured in the factory), made it difficult to adequately assess the actual prevalence of diabetes and IFG in a female factory population.

- The OGGT, which might capture more subjects with impaired glucose tolerance than the fasting glucose testing alone, could not be used in this survey due to limited resources.

7. CONCLUSION

This study has found a prevalence of diabetes and impaired fasting glucose that are higher than previously reported in urban populations in the country, but comparable to similar populations in other parts of Africa. Strong family history, advancing age, overweight and hypertension were observed as significant risk factors for the prevalence of diabetes and IFG in the studied population. The proportion of subjects with diagnosed diabetes was similar to undiagnosed.

Compared to the prevalence in similar populations within SSA and other developing countries, this mostly young adult Ethiopian population has a high prevalence of diabetes and IFG. Hypertension was observed to be similarly high. The high proportion of subjects who consumed high energy-dense food, but engaged in lower level of physical activity, could in part have been responsible for the high prevalence of over-weight, hypertension, and diabetes among them.

8. RECOMMENDATIONS

From the findings of the study, the following recommendations are suggested:

I. Chronic disease prevention and control programmes, such as health education and promotion of regular physical exercise should established through the factory clinic to help decrease the high prevalence of some of the modifiable risk factors like hypertension, overweight and sedentary lifestyle observed in this study.

II. Non-communicable diseases (in particular, diabetes and hypertension) awareness and prevention activities should be established in the country as a whole, through the collaborative efforts of the government, non-governmental organizations, the international community and the private sector.

III. Where resources are available, screening of high-risk urban and suburban working populations can be undertaken as a means of early intervention. However, opportunistic screening of individuals presenting with two or more risk factors in health institutions, has been shown to be more cost-effective and has a higher pick-up rate of new cases than population-wide screening, and should be advocated among health practitioners. Early detection, combined with early treatment and lifestyle modifications can significantly reduce the risk of complications and the burden of disease management on both the individual and the nation as a whole.

IV. Some mechanisms for diabetes and other chronic disease management and rehabilitation should be established in the country to compliment other existing structures for treatment and care, including the wider availability of drugs and supplies such as insulin, syringes and oral hypoglycemic medications.

V. A broader population-based survey is needed to adequately assess the national prevalence and burden of diabetes as well as explore the interactions of the various risk factors observed in this study.

VI. A longitudinal study to follow-up on the direction and magnitude of trends in diabetes and risk factor prevalence and incidence, as well as to plan or evaluate health promotion or preventive strategies, should be set up. This cohort study can also serve as data source for predicting likely future demands for health services in the country.

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Annex I: Map of Addis Ababa Regional Administration, Ethiopia, showing the study area, Akaki (as Woreda 27).

Annex II. Sample of English Questionnaire used in survey.

Name: ---------- **Respondent's code number ----------**

Father' name: ----------

QUESTIONNAIRE ON

The prevalence and Risk Factors for Type 2 Diabetes and Impaired Glucose Tolerance (IGT), among Factory Workers at Akaki.

I am a member of the research team of Addis Ababa University, Community Hlth Dept. I would like to request your participation in this study that will involve asking you some questions and conducting some tests. Before we proceed, I will request you to listen carefully to what I am going to read to you about the purpose of this study and what it involves and tell me whether you are willing to participate in this research or not.

CONSENT FORM

The purpose of this study is to find out how many workers in this factory have diabetes. Diabetes is a potentially serious long-term condition, which can result in severe disability or even death if not properly managed. However, early detection and control of the blood sugar have been found to markedly reduce the risk of complications and this is what we hope to do here. This survey will form the beginning of a long-term follow up study that we shall undertake to see how many workers may develop the condition in the future.

The survey will be made up of three parts as follows:

- Ask you some questions that have been found to be associated with the disease.
- Take some body measurements such as weight, height and blood pressure.
- Do a simple blood test to check your blood sugar level, and so determine if you are at risk of developing the disease now or in future.

The whole test will take about one and half hours and you will be asked to have nothing to eat or drink except plain water from midnight before the test.

We would like to assure you that the information obtained will be strictly for our research use and you and not your employer will be informed of the test result. Your name will not be used in our report and the information obtained will not be used in any way that will identify you.

The interview is voluntary. Your participation/ non-participation, or refusal to answer questions will have no effect now or in the future on services that you or any member of your family may receive from health service providers.

Are you willing to participate in this study?

[ ] Yes.

[ ] No

Date of interview: -----day-----month----year *Name/signature of data collector*: ----------

Step 1 A. Sociodemographic Information of Respondent				
No	**Questions**	**Alternative Choices for Response**		**Code**
1	Sex	1. Male 2. Female		------
2	Age (enter number)	----------Years		
3	Date of birth	-------/-------/------- Day/Mth/Yr (Ethiopian Calendar)		------
4	Religion	1. Orthodox Christian 2. Protestant 3. Catholic 4. Moslem 88. Other, specify ----------		------
5	To which ethnic group do you belong?	1. Amhara 2. Oromo 3. Tigre 4. Gurage 88. Other, specify ----------		------
6	Marital status	1.Never Married (single) 2.Currently Married 3 Separated 4.Divorced 5.Widowed		------
7⇒	Education status	1. Literate (can read and write) 2. Illiterate (cannot read and write) **Skip to Qn. 9**		------
8	If literate, highest level of completed education	----------(Grade)		------
9	What is your job description at this factory?	----------		------
10	What is your family's total monthly income	1. ---------- Birr 2. Don't know		-------
11 ⇒	**About your family's medical history**. Do you or any first-degree relative∗ of yours suffer from any chronic disease such as hypertension or diabetes?	1. Yes 2. No ⇒**Skip to Qn. 13** 3. Don't know		
12	If yes to Qn 11, specify which relative(s) and nature of disease(s) from the following list.	Relative	Nature of Disease	-------
	1. Diabetes 2. Hypertension or Heart disease 3. Don't know nature of disease 88.Others, (specify)			-------
13	**For females only.** Have you ever given birth to a very big baby?	1. Yes 2. No		-------

∗**A first-degree relative refers to: your actual father/mother (not step-), full brother/sister and full child.**

Comments-

			Code
	B**. Concerning Smoking or Tobacco Use**		
14	Have you ever smoked on a regular basis?	1.Yes, daily 2.Yes, but not daily 3.No, never daily	-------
15	Do you <u>currently</u> smoke any tobacco product such as cigarettes, cigars, or pipes?	1. Yes 2. No ⇒Skip **to Qn 18**	------
16	When did you <u>start</u> smoking daily? **(Select <u>one answer</u> only)**	1. Since the last---------years 2. Since the last--------months 3. Since the last--------weeks 4.On ------/------/-------Date (Day/mth/yr**)** 5. At ----------years of age	------
17	On the average, how many of the following listed items do you smoke each day?	1. --------no of factory-produced cigarettes per day 2. --------no of hand-rolled (local) cigarettes per day 3. --------no of local pipes (‘gaya’) full of tobacco per day 4. ----------no of cigars per day 88.Other ---------- (specify type ,and no per day) e.g.’sisha’	------
18	Do you <u>currently</u> use smokeless tobacco product such as snuff, chewing tobacco, etc?	1. Yes, daily 2. Yes, sometimes 3. No, not at all	------
19	Do you chew Khat?	1. Yes, daily 2. Yes, sometimes 3. No, not at all	------
	C. **Concerning Alcohol Consumption**		
20	Have you <u>ever taken any type</u> of alcoholic drink? (Beer, wine, spirit, ‘ tella’, ‘ tej’ etc)	1. Yes 2. Yes, but not in the past 12 months 3. No, I have never ⇒ **Skip to Qn.23**	------

21	In the <u>past one month,</u> how frequently have you taken at least one alcoholic **drink?∗** ∗This refers to one 'standard drink' **(see below**)	1. 5 or more days a week 2. 1-4 days a week 3. Less than three days this month 4. Less than every month	-------
22	When you drink alcohol, what is your average consumption at a sitting?	--------- (number of drinks)	-------
	D *Concerning Feeding*		**Code**
23	How many times per day do you usually take fruits? (Select one response)	1. Don't eat fruits at all 2. Don't eat fruit everyday 3. I take fruits once a day 4. I take fruits2-4 times per day 5. I take fruits 5 or more times per day	-------
24	How many times per day do you usually eat vegetables? (Select one response)	1. Don't eat vegetables at all 2. Don't eat vegetables everyday 3. I eat vegetables once a day 4. I eat vegetables 2-4 times per day 5. I eat vegetables 5 or more times per day	------
Note; [∗One ' standard drink' is the equivalent of * one glass, can or bottle (330ml) of regular beer (which contains about 5% alcohol), * one measure (40ml) of spirit, or one glass of wine] [One helping of fruit includes one banana, one orange, one apple or one slice of pineapple etc]**.**			
E **Concerning Physical Activity** **Code**			
25	**Work-related physical activity:** Firstly, how many hours do you typically spend at work each day?	---------no of hours	-----
26	During these hours, how frequently do you practice the following? (**Fill 1-4 from the response choices in the space provided**)		------

	A. Mostly Sitting or Standing with only a short walking distance --------- (mild exercise) **B**. Activities that require the same physical effort as walking long distance or backyard gardening ------- (moderate exercise) **C**. Activities that require the same effort as lifting heavy weights or heavy construction work -------- (heavy exercise)	1. Always 2. Usually/Often 3. Sometimes 4. Never	
27	**How often do you use the following transportation methods on a typical day?)** **A**. Private car or taxi ------- **B**. Public transport such as city bus, factory bus, minibus or train ------- **C.** Motorbike or bicycle ------- **D.** Walking (on foot) ------- E. 'Geri' (horse-drawn carriage) --------	1. Always 2. Usually/Often 3. Sometimes 4. Never	------
28	**Outside the working hours or transportation time, how often do you practice the following activities?** (Fill 1-4 from the choices in the space provided) A. Mostly Sitting or Standing with only a little walking ---- B. Activities that require the same effort as walking long distance, or backyard gardening, or climbing upstairs ------ **C.** Activities that require the same effort as lifting heavy weight or strenuous exercise ------	1. Always 2. Usually/Often 3. Sometimes 4. Never If answer to Qn 28 is always (1) or often (2), specify the time spent on these activities. --------hours OR --------mins	-------
	Step 2. Physical Measurements		**Code**
29	Pulse Rate (measured 3 times)	1st ----------beats per min (bpm) 2nd ----------beats per min	-------

		3rd ---------- beats per min	
30	Blood Pressure (measured 3 times)	1st ----------mmHg (systolic/diastolic) 2nd ----------mmHg (systolic/diastolic) 3rd ----------mmHg (systolic/diastolic)	-------
31	Height (measured 2 times)	1st ----------cm 2nd ----------cm	-------
32	Weight (kg)	----------Kg	------
33	Waist circumference or abdominal girth (measured 3 times)	G1 ---------cm G2 --------cm G3 --------cm	-------
34	Hip circumference (measured 3 times)	1st -------cm 2nd -------cm 3rd --------cm	-------
Step 3. Biochemical Tests			**Code**
35	**Checking Fasting status**. When did you last take any food of fluids? (Excluding plain water)	_____hrs _____ mins	-------

36	**Blood glucose analysis:** **Fasting blood sugar**	 Result: _____mmol/l	--------

Comments: -

ANNEX III. CURRICULUM VITAE

NAME: PERPETUA EGONMWAN UHOMOIBHI (MD.)

DATE OF BIRTH: MARCH 6, 1964

NATIONALITY: NIGERIAN

MARITAL STATUS: MARRIED WITH CHILDREN

PROFESSIONAL QUALIFICATIONS:

1. Bachelor of Medicine, Bachelor of Surgery (M.B.B.S) Degree, from the College of Medical Sciences, University of Benin, Nigeria (1988).
2. Masters in Public Health (MPH) Degree, from the Faculty of Medicine, Addis Ababa University, Ethiopia (2003) (in view)

PROFESSIONAL EXPERIENCE

1. House Officer- University of Benin Teaching Hospital, Benin City, Nigeria (1988-89)

2. Medical Officer- (National Youth Service Corps), Ojo Military Cantonment Medical Centre, Lagos, Nigeria (1989-90)

3. General Practitioner-Wuse Hospital and Nyanya Hospital, both under the Federal Capital Development Authority, Abuja, Nigeria (1991 - 97)

4. General Practitioner. - State House Annex Clinic, Abuja, Nigeria (1998 - 99)

RESEARCH EXPERIENCE

- Prevalence of Sexually Transmitted Diseases among High School Students in Benin City. University of Benin, Department of Community Health Project, Nigeria 1987

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Declaration

I, the undersigned, declare that, this thesis is my original work, has never been presented in this or any other university, and that all resources and materials used herein, have been duly acknowledged.

Name: PERPETUA EGONMWAN UHOMOIBHI, MD

Signature: ———————————

Place: Addis Ababa University, Ethiopia

Date of Submission: June16th April 2003

This thesis has been submitted for examination with my approval as a university advisor

Name: Dr. GAIL DAVEY (MBBChir, MSc, MD.) Signature: ———————————