TOBACCO CONSUMPTION IN MOZAMBIQUE

REGIONAL DIFFERENCES AND THE IMPACT OF INTERNAL MIGRATIONS

Dissertação de candidatura ao grau de Mestre em Epidemiologia apresentada à Faculdade de Medicina da Universidade do Porto

Porto, 2010

Investigação realizada no Serviço de Higiene e Epidemiologia da Faculdade de Medicina da Universidade do Porto e no Instituto de Saúde Pública da Universidade do Porto (ISPUP), sob orientação do Professor Doutor Nuno Lunet e co-orientação da Professora Doutora Ana Azevedo.

Esta dissertação tem como base dois manuscritos, sendo que colaborei activamente na operacionalização das hipóteses, na análise e na interpretação dos dados, fui responsável pela redacção da versão inicial do primeiro manuscrito e colaborei na redacção da primeira versão do segundo manuscrito.

- Carla Araújo, Carla-Silva Matos, Albertino Damasceno, Lídia Gouveia, Ana Azevedo, Nuno Lunet. Manufactured and hand-rolled cigarettes and smokeless tobacco consumption in Mozambique: regional differences at the early stages of the tobacco epidemic. [*submetido*]

- Nuno Lunet, Carla Araújo, Carla Silva-Matos, Albertino Damasceno, Lídia Gouveia, Ana Azevedo. Changing patterns of tobacco consumption in Mozambique: evidence from internal migration to the country capital. [*submetido*]

AGRADECIMENTOS

Agradecer a todos os que me acompanham nesta caminhada e em particular àqueles que me permitiram atingir mais este objectivo é uma tarefa ingrata, porque é grande o reconhecimento que tenho para com muitas e muitas pessoas, colegas de trabalho, colegas de mestrado e doutoramento, amigos de infância e faculdade, família.

Uma palavra especial para o Professor Doutor Nuno Lunet, que me proporcionou esta oportunidade única, a de aprender coisas tão bonitas e a quem muito agradeço o grande empenho, compreensão, competência e disponibilidade com que me orientou neste projecto.

À Professora Doutora Ana Azevedo, que me despertou o gosto pela Epidemiologia já na Faculdade como assistente das aulas práticas, agradeço muito, o convite para o desafio da Epidemiologia, o apoio e a partilha de projectos e a competência e disponibilidade com que também me orientou.

Ao Professor Doutor Albertino Damasceno agradeço a partilha do conhecimento e a interacção que conseguiu estabelecer entre Portugal e Moçambique.

E depois há aquelas pessoas muito importantes na nossa vida…

Aos meus pais agradeço tudo.

À minha irmã agradeço o amor, a disponibilidade e o exemplo de coragem e determinação.

Ao João…a esperança no futuro.

Ao Alfredo o amor, o apoio, os desafios.

Aos meus avós agradeço os valores de simplicidade e de trabalho.

Ao meu avô Delfim o exemplo de vida.

TABLE OF CONTENTS

1. INTRODUCTION

1.1. THE EPIDEMIOLOGIC TRANSITION

A major shift in the causes of illness and death throughout the world was observed in the 19th and 20th centuries, accounting for changes in the shares of morbidity and mortality. After recognizing that this transition was the result of demographic processes, but also ecobiologic, sociologic, economic and psychologic dynamics, a theory of epidemiologic transition was conceived. Three successive stages were proposed for the process:[1]

1. *The Age of Pestilence and Famine*, with a high and fluctuating mortality, precluding a sustained population growth. The average life expectancy at birth ranges between 20 and 40 years;
2. *The Age of Receding Pandemics*, when epidemic peaks become less frequent or disappear, a sustained population growth occurs and mortality declines progressively. The average life expectancy at birth rises to about 50 years;
3. *The Age of Degenerative and Man-Made Diseases,* when mortality continues to decline and stabilizes at a relatively low level. Fertility becomes the crucial determinant of population growth and the average life expectancy at birth exceeds 50 years.

Although the determinants of the transition from infectious to degenerative disease predominance are complex, three distinct groups can be defined. Ecobiologic determinants include the balance between disease agents, the level of hostility in the environment and the resistance of the host. Socioeconomic, political and cultural determinants include standards of living, health habits, and hygiene and nutrition. Medical and public health determinants are the preventive and curative measures used to combat disease, namely improved public sanitation, immunization and the development of decisive therapies.[1]

The presence of specific variations in the pattern, pace, determinants and consequences of population change were differentiated by Omran[1] in three basic

models: the *classical or western model*, the *accelerated model* and the *contemporary or delayed model*. In the classical or western model, that describes the epidemiologic transition observed in most western countries, there was a gradual transition from high to low mortality and fertility, over two centuries, enabling demographics balance. In the accelerated model, paradigmatically represented by Japan, the same pattern of evolution occurred in a few decades. The demographic gap was balanced by national and individual behaviours, that lowered fertility in a relatively short period of time. The contemporary (or delayed) model describes the relatively recent and yet-to-be completed transition of most developing countries. The beginning of mortality decline takes place after the turn of the 19th century, with rapid declines being observed after several decades. Imported public health measures and medical treatment play an important role in decreasing mortality, while leaving fertility at substantially high levels. Infant, childhood and female in reproductive age mortality, although decreased, remain excessively high. Most countries in Latin America, Africa and Asia fit this model, with significant differences, so that submodels would be useful to better define their epidemiologic transition.

Taking into account observed trends in cause-specific mortality, a fourth stage of the epidemiologic transition was proposed, described by Olshansky and Ault as the stage of the "delayed degenerative diseases"[2] and by Rogers and Hackenberg as the "hybristic stage".[3] Olshansky and Ault consider the following general characteristics to define the fourth stage:

1) Rapidly declining death rates, concentrated mostly at advanced ages and occurring at nearly the same pace for men and women;

2) The pattern of cause-specific mortality by age remains largely the same as in the third stage but deaths for degenerative causes are shifted towards older ages.

These authors attribute this change to a combination of factors, including the shift in the age structure towards population ageing, advances in medical technology, health care programs for the elderly and reductions in risk factors at population level.

According to Rogers and Hackenberg the major source of this change is the increasing influence of individual behaviours and new lifestyles on mortality. This influence may be positive or negative, according to its impact on mortality. Individual negative behaviours include sexual and social practices, like unsafe sex and excessive drinking and smoking. These authors consider acquired immunodeficiency syndrome (AIDS) to belong to the fourth stage, despite being an infectious disease, because of its direct relation to individuals' behaviour and lifestyle. They argue that the cause of the destructive lifestyle that is present in this stage is "hybris", an excessive self confidence, a belief that one is invincible, hence the name given to this stage, "the hybristic stage".[3]

The alarming increase in overweight and obesity prevalence and a continued decrease in physical activity that emerged in the last two decades led some authors to propose a fifth stage of the epidemiologic transition, "The Age of Obesity and Inactivity",[4] while other authors proposed a different fifth stage, a regressive one, defined by social upheaval or war, breaking down existing social and health structures, leading to resurgence of conditions seen in the first two stages, with persistence of diseases of the third and fourth stages.[5] With the worldwide progressive decline in infectious diseases and concomitant increase in degenerative diseases, cardiovascular diseases (CVD) and cancers became the most common causes of death. A century ago CVD accounted for less than 10% of all deaths and today they account for approximately 30% of the death burden worldwide (nearly 40% in high-income countries and about 28% in low- and middle-income countries).[6] Worldwide, the number of new cases of cancer diagnosed in 2008 was estimated in 12.7 million (5.6 million in more developed regions and 7.1 million in less developed regions) and 7.6 million cancer deaths (2.8 million occurring in more developed countries and 4.8 in less developed countries) were estimated to have occurred in the same period. Taking into account the growth and ageing of the world population, based on various assumptions

regarding trends in cancer risk, 20 to 25 million incident cases of cancer and 13 to 16 million cancer deaths annually can be expected by 2030.[7]

There are, however, several limitations of available measures of global health status to map health trends. A minority of countries, especially among the developing, has no incidence data or cause-specific mortality data, with the most serious gap being for the adult populations.[8]

The increasing survival from chronic conditions made disability, a multidimensional state that is graded and changes with age, a key measure of health status. *The Global Burden of Disease (GBD)* project defined a unifying measure, disability-adjusted life years (DALYs) lost, combining time lost through premature death (before 82.5 years for women and 80 years for men) and time lived with disability.[9] Other measures were developed to assess overall population health, namely disability-adjusted life expectancy (DALE), that separates life expectancy into years lived in good health and years lived with disability.[10] Problems in accuracy of data and the varied meanings attributed to disability limit the usefulness of these measures, although conceptually they represent a step forward.[8]

To allow comparisons of national health and disease profiles between regions, the three categories of the leading causes of death and disease burden, originally proposed by the Global Burden of Disease study,[11] are useful:

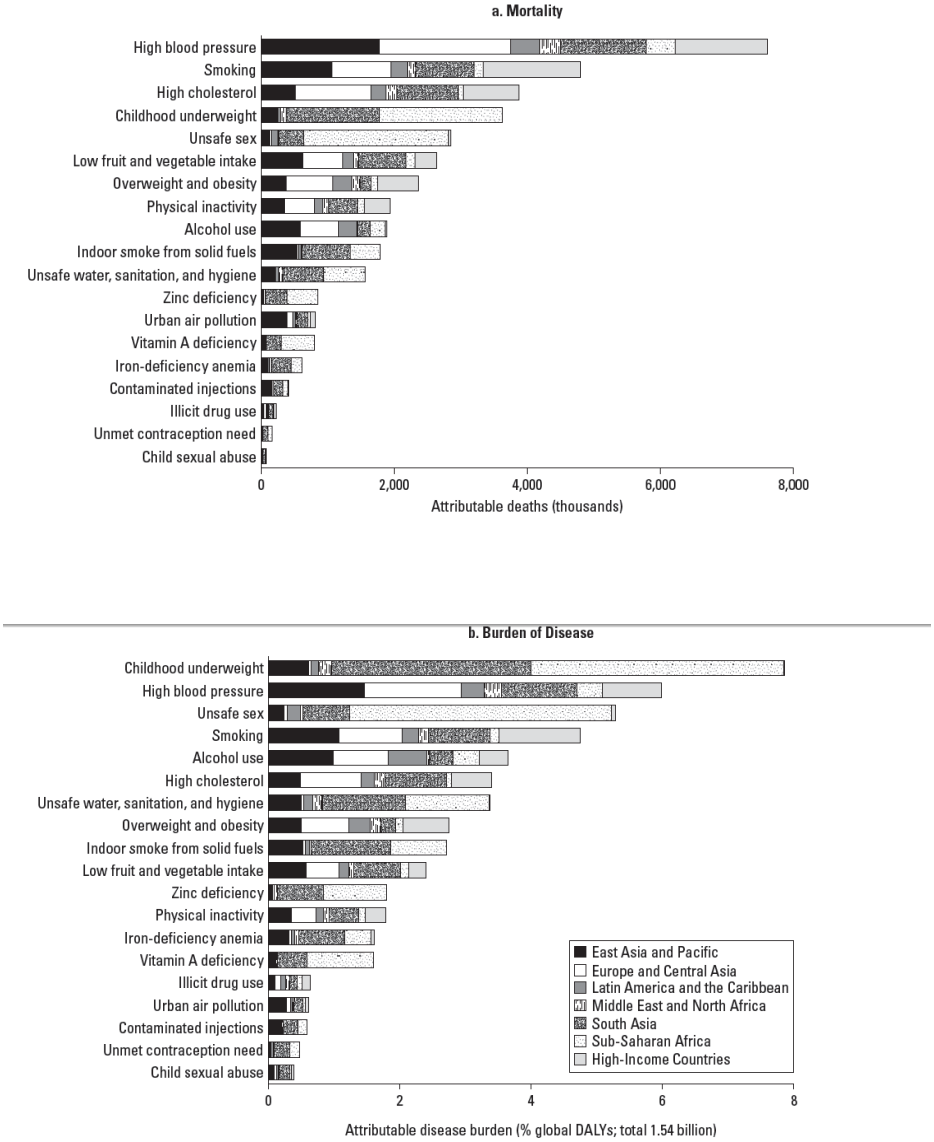
Group 1: communicable, maternal, perinatal and nutritional diseases (examples: undernutrition, unsafe water, sanitation, hygiene);

Group 2: non-communicable diseases (examples: cardiovascular diseases and cancers);

Group 3: injuries.

The quantitative contribution of the leading global risk factors to all-cause mortality and burden of disease is depicted in figures 1 to 3.

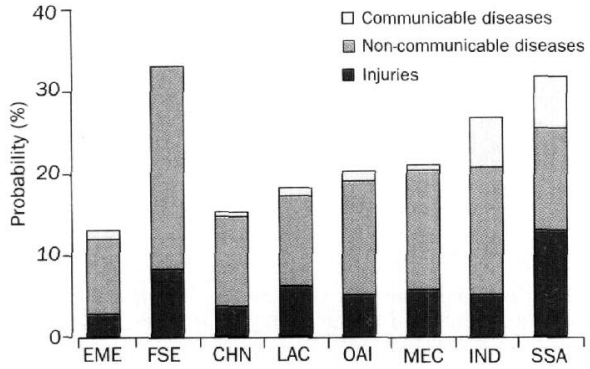
Figure 1. Mortality and burden of disease attributable to leading global risk factors, by World Bank Region.



Source: Ezzati et al, 2006[12]

The leading determinants of death and disease include risk factors for communicable, maternal, perinatal, and nutritional diseases, whose burden is primarily concentrated in low-income regions of South Asia and Sub-Saharan Africa, and unsafe sex. They also include risk factors for non-communicable diseases and injuries, such as smoking, high blood pressure and cholesterol, alcohol use, overweight and obesity, which affect most regions (Figure 1).

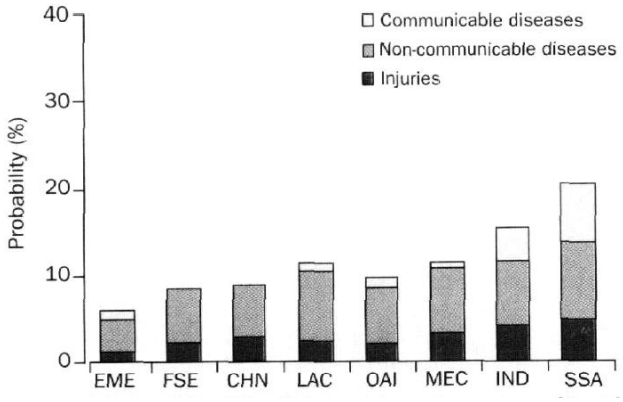
Figure 2. Probability of death for men between ages 15 and 60 years in 2010, according to disease group.



EME=Established market economies; FSE=Formerly socialist economies of Europe; IND=India; OAI=Other Asian islands; SSA=Sub-Saharan Africa; LAC=Latin America and the Caribbean; MEC=Middle Eastern Crescent.

Source: Sen and Bonita, 2000[8]

Figure 3 - Probability of death for women between ages 15 and 60 years in 2010, according to disease group.



EME=Established market economies; FSE=Formerly socialist economies of Europe; IND=India; OAI=Other Asian islands; SSA=Sub-Saharan Africa; LAC=Latin America and the Caribbean; MEC=Middle Eastern Crescent.

Source: Sen and Bonita, 2000[8]

Figures 2 and 3 show that men and women in Sub-Saharan Africa are two to three times more likely to die prematurely than in western industrialized populations (established market economies). In 2020, deaths between ages 15 and 60 years are expected to be due almost entirely to non-communicable diseases and injuries.[13]

1.1.1. Developing countries and the epidemiologic transition

Developing countries still face a high burden of communicable diseases, while the burden from non-communicable diseases is also high and increasing. In 2002 it was estimated that 29% of deaths worldwide were due to cardiovascular disease and that 43% of global morbidity and mortality, measured in disability-adjusted life years (DALYs), was caused by cardiovascular disease. Furthermore, 78% of the global number of deaths and 86% of mortality and morbidity burden from cardiovascular diseases occur in developing countries.[13-15]

In the latter settings, several factors contribute to the increasing burden of non-communicable diseases, including the large size of the population, the high proportion of individuals who are young or middle-aged adults, urbanization and increased exposure to risk factors such as obesity, diabetes, dyslipidemia, hypertension and smoking. The increase in number of deaths due to ischemic heart disease in developing countries is expected to be much larger than among the developed (between 1990 and 2020: 120% in women and 137% in men versus 29% in women and 48% in men).[5-6] These projections are largely based on the expected demographic changes, not accounting for expected increases in risk factor levels, suggesting that these are likely underestimates.

In the last five decades, large economic and social changes occurred in this setting, some beneficial to the population´s health, namely the improved access to health interventions, and others associated with increased exposure to risk factors leading to increased morbidity and mortality due to non-communicable diseases or new and reemerging communicable diseases, such as human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS), tuberculosis or cholera, among others.[16] The net result of the changes described above is a dramatic decline in mortality and an increase in life expectancy at birth.[17]

Sub-Saharan Africa has the highest burden of disease in the world.[18] The source of data to monitor this burden is still underdeveloped in many of its countries and estimates of morbidity and mortality are obtained using indirect demographic techniques based on survey and census data.[19] Despite the uncertainty in estimates of adult mortality, as these vary according to the data source and the methodology used, adult mortality rates are generally high, although wide differences are observed across countries and regions.[19] The available data show high levels of childhood mortality, namely due to malaria, diarrheal diseases, measles, lower respiratory tract infections, and conditions originating in the perinatal period, and premature deaths due to HIV/AIDS. Among individuals age 60 years and older there is a high absolute number of deaths, 1.92 million, corresponding, however, to only a fifth of the overall mortality burden.[16,19]

Cardiovascular diseases, chronic obstructive pulmonary disease, cancers and, notably, infectious diseases are major causes of death and are responsible for the double burden that this region is facing,[19] stretching already limited resources. In these developing countries, with a high proportion of citizens younger than 65 years, cardiovascular diseases are proportionally more frequent among young people, further compromising economic and social development, since death and disability in the labor force tend to be much greater than in western countries.[20]

Cancer is also an emerging health concern in Sub-Saharan Africa. Increases in the prevalence of tobacco consumption and the proportion of subjects with immunosuppression induced by the human immunodeficiency virus, coupled with frequent exposure to other risk factors for cancer such as alcohol consumption, the high prevalence of cancer-associated infectious agents, like human papillomavirus, hepatitis B viruses and human herpesvirus-8, and environmental exposure to toxins, such as aflotoxins, all contribute to the cancer´s increasingly high frequency.[21]

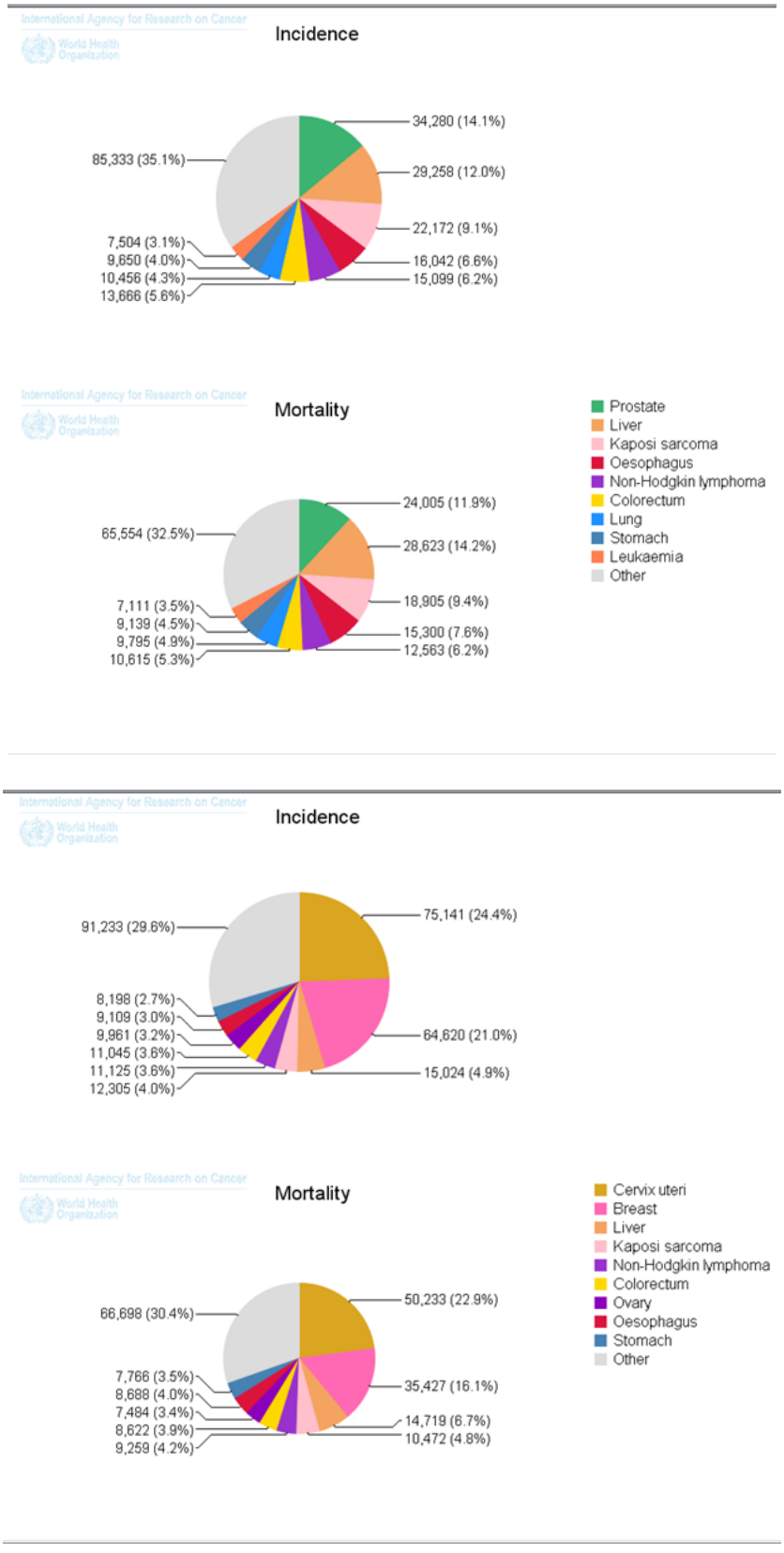
Cancer registration is essential to quantify the burden of disease associated with cancer, but it is particularly difficult to undertake in these countries,[22] as the

proportion of cases with access to health services is very low, and death registration has several limitations, namely underreporting, poor classification of some causes of death and lack of exhaustive coverage. Nevertheless, since the 1990s there has been a resurgence of interest in cancer incidence in Africa[21] and data from cancer registries from Sub-Saharan Africa have been published.[23-29]

In 2008, age-standardised cancer incidence rates (world reference population) were estimated to be 124.7 per 100000 females and 115.9 per 100000 males, while age-standardised mortality rates were 92.8 per 100000 females and 98.1 per 100000 males. In the more developed regions, in the same year, the estimated standardised incidence and mortality rates were 222.5 and 87.3 per 100000 women, respectively, and 300.1 and 143.9 per 100000 men, respectively.

Figure 4 depicts estimates for 2008 of incidence and mortality from major type of cancers in Sub-Saharan Africa.

Figure 4. Incidence and mortality from major types of cancers in Sub-Saharan Africa, for men (top) and women (bottom) (2008 estimates).



Source: Ferlay et al, 2010[7]

In 2008, the four leading cancers among men were prostate cancer, liver cancer, Kaposi sarcoma and oesophagus cancer (proportional incidences: 14.1, 12.0, 9.1 and 6.6%, respectively); while among women the four leading cancers were cervix, breast and liver cancers and Kaposi sarcoma (proportional incidences: 24.4, 21.0, 4.9 and 4.0%, respectively). These cancers are also responsible for the highest mortality burden, accounting together for 43.1% of deaths due to cancer among men and for 50.5% among women. This pattern is explained by the high prevalence of cancer-associated infectious agents, like human papillomavirus, HIV or hepatitis B virus; but also by the frequent exposure to other risk factors for cancer, namely alcohol and environmental toxins.[21] Lung was the seventh most common cancer among men, accounting for 4.9% of all deaths from cancer, with the relatively low frequency in this setting corresponding to the expected in a region at an early stage of the tobacco epidemic.[30]

1.1.2. The epidemiologic transition in Mozambique

Mozambique, a southeast African nation, has a total area of 801590 Km^2, distributed by 11 provinces, and a population density of 25.3 inhabitants/Km^2. This former Portuguese colony has a population of 20632434 inhabitants, which has increased 27.8% between 1997 and 2007. The urban dwellers represent 30.4% of the population. The female:male ratio is 1.08, and only 4.6% of the population is aged 60 or more years.[31-32]

Maputo, the capital of the country, hosts 21% of the total urban population. The southern provinces (Inhambane, Gaza, Maputo province and Maputo City), occupying the smallest land area (170680 Km^2), present the highest demographic density (27.7 inhabitants/Km^2), while the Northern provinces of Niassa, Cabo Delgado and Nampula

present the lowest (20.5 inhabitants/Km^2).[33] Distinctions in socioeconomic status, access to education and gender relationships divide the northern, central and southern parts of Mozambique.[33] Illiteracy rates are very high, especially among women (63.1% versus 33.2% for women and men respectively),[32] with rural northern regions having higher female illiteracy rates and predominance of matrilineal systems, while southern provinces, where patrilineal descent is common, have lower rates of illiteracy.[34]

Mozambique is one of the poorest countries in the world, with scarce human resources and deficient sanitary network coverage.[33] Industrial and governmental infrastructures, including health clinics and schools, were devastated by the arm struggle for independence from Portugal (1964-1974) and the externally financed civil war (1977-1992).[35]

Mozambique is still at an early stage of the epidemiologic transition, with an average life expectancy at birth of 52 years and a mortality rate among children under five years old of about 95.5 per 1000 live births.[32] Malaria is the leading cause of death (29%), followed by HIV/AIDS (27%), perinatal causes (7%), diarrheal diseases (4%), pneumonia (4%), accidents and external causes (4%), tuberculosis (3%), circulatory system diseases (3%) and cancers (1%).[36] About a third of all deaths attributed to HIV/AIDS involved tuberculosis as the direct cause of death.[36] Mozambique suffers one of the world´s highest burdens of HIV/AIDS; with the Joint United Nations Programme on HIV/AIDS (UNAIDS) prevalence estimates ranking Mozambique as the 8th most HIV-afflicted nation globally.[37]

Death registers and autopsy records were used to classify the causes of death in Maputo City in 1994,[38] following the methods of the Global Burden of Disease study.[18] Death registration data were available for approximately 86% of the population, and 68% percent of the registered deaths occurred in hospitals and were therefore medically certified. Communicable diseases accounted for 65.6% of deaths by defined causes, non-communicable diseases for 22.6% and injuries for 11.8%. The rankings of the different causes of death changed with age, with the proportion of deaths due to

non-communicable diseases increasing with age. In the 15-59 years age group, tuberculosis was the leading cause of death (10.6% of all registered deaths in this age group), cerebrovascular disease ranked sixth (3.8%) and hypertension seventh (3.4%), while in the older age group (60 years or older) cerebrovascular disease became the leading cause of death (14.5%) and hypertension became the fifth (6.9%). Many tuberculosis, diarrhoeal diseases and malaria deaths had AIDS as the underlying cause.[38]

Despite underreporting and poor classification of some causes of death, these data illustrate the burden of malaria and tuberculosis, the emergence of the HIV/AIDS epidemic, and trends toward increasing of non-communicable diseases, namely cerebrovascular diseases, among the adult population of Maputo City in 1994.[39]

Since then, further evidence has been gathered to support that cardiovascular risk is increasing among the Mozambicans. One third of adults aged 25 to 64 years are hypertensive, with only 15% being aware of their condition and half of these receiving pharmacological treatment.[40] Prevalences of obesity and overweight were 6.8% and 11.8%, respectively, among women and 2.3% and 9.4%, respectively, among men.[41] National estimates of tobacco consumption, taking into account different forms of tobacco use and a detailed description of the patterns of consumption, are lacking.

1.2. TOBACCO CONSUMPTION CONTRIBUTION TO THE EPIDEMIOLOGIC TRANSITION

Tobacco consumption was framed as an individual-level disorder, requiring medical treatment. Both the *American Psychiatric Association* and the *United States Surgeon General* officially established this disease approach by considering tobacco dependence as a psychiatric diagnosis and as an addiction, respectively.[42-43]

The *Diagnostic and Statistical Manual of Mental Disorders, 4th Edition, Text Revision* (DSM-IV-TR) classification defines nicotine dependence and nicotine withdrawal, considering tobacco a substance use disorder.[44] According to this definition nicotine dependence and withdrawal can develop with use of all forms of tobacco (the dried leaf of the plant *nicotiana tabacum* is used for smoking, chewing or snuff) and with medications (nicotine gum and patch).[44]

Based on the work of Geoffrey Rose,[45-46] and considering that the risk exposure distribution in a population depends on contextual conditions,[45] a population approach to deal with tobacco consumption was developed. The *Rose´s model* was important to understand that the individual determinants of smoking are different from the population determinants, so that the understanding of differences in the causes of smoking between populations would help to implement adjusted smoking prevention and cessation approaches.

1.2.1. Tobacco-related diseases

Smoking is the single greatest cause of avoidable morbidity and mortality worldwide.[47] Estimates of the magnitude of association between tobacco consumption and several diseases are heterogeneous, which can be explained by several factors, namely the definition of tobacco consumption (that varies according to type of tobacco, amount of tobacco smoked, years of smoking, inclusion of current, former or ever tobacco consumers), the degree of adjustment for potential confounders, and the populations' disease risk profiles.

a) Tobacco consumption and cancer

The relation between tobacco smoking and lung cancer was established since 1950 with the pioneer case-control studies by Doll et al, Wynder et al, Levin et al e Schrek et al.[48-51] The evidence of the association between tobacco smoking and other cancers has also accumulated and the *International Agency for Research on Cancer (IARC)* progressively recognized the causal relationship between tobacco smoking and an increasing number of cancers.[52] Taking into account the vast information available on smoking-related cancers, summary measures of these associations are described in Table 1, with pooled relative risks among current smokers ranging from a 50% increase in the risk of kidney cancer to a nearly 10-fold higher risk of lung cancer.[53]

Table 1. Summary measures of the association between manufactured cigarettes consumption and cancer, by anatomic site.

	Tobacco smoking	
	RR (95% CI)*	
Cancer	**Current smoker**	**Former smoker**
Lung	9.0 (6.7, 12.1)	3.8 (2.8, 5.3)
Larynx	7.0 (3.1, 15.5)	4.6 (3.4, 6.4)
Pharynx	6.8 (2.9, 16.0)	2.3 (1.0, 5.5)
Upper digestive tract	3.6 (2.6, 4.8)	1.2 (0.7, 1.9)
Oral cavity	3.4 (2.4, 4.9)	1.4 (1.0, 2.0)
Lower Urinary Tract	2.8 (2.2, 3.5)	1.7 (1.5, 2.0)
Oesophagus	2.5 (2.0, 3.1)	2.0 (1.8, 2.3)
Nasal-sinuses, Nasopharynx	2.0 (1.3, 2.9)	1.4 (1.1, 1.8)
Cervix	1.8 (1.5, 2.2)	1.3 (1.1, 1.4)
Pancreas	1.7 (1.5, 1.9)	1.2 (1.0, 1.8)
Liver	1.6 (1.3, 1.9)	1.5 (1.1, 2.1)
Stomach	1.6 (1.4, 2.0)	1.3 (1.2, 1.5)
Kidney	1.5 (1.3, 1.7)	1.2 (1.1, 1.4)

* Relative risk with 95% confidence interval

Source: Gandini et al, 2008[53]

The association between the consumption of oral and nasal forms of tobacco products (smokeless tobacco) and cancer has also been studied, although less extensively, and with less consistent results, so that controversy about putative health consequences of this kind of tobacco product still exists.[54] Some studies suggest an increased risk of oropharyngeal, oesophagus, pancreas, larynx, kidney and prostate cancers among smokeless tobacco users, consistent only for oropharyngeal cancer (summary OR=1.36, 95% CI: 1.04-1.37).[54] Despite the clearly weaker association between smokeless tobacco and cancer, compared with tobacco smoking, more data are needed, namely from investigations conducted in non-western populations where the exposure to these forms of tobacco use is frequent.

b) Tobacco consumption and cardiovascular diseases

Tobacco smoking is a well established cardiovascular risk factor, associated with several cardiovascular diseases (Table 2).

Table 2. Association between tobacco smoking and cardiovascular diseases/risk factors.

	Tobacco smoking	
	OR/RR (95% CI)*	
Cardiovascular diseases/risk factors	**Current smoker**	**Former smoker**
Cerebral infarction† (55)	3.6 (2.5, 5.9)	2.0 (1.3, 3.2)
Myocardial infarction (56)		
Males	3.0 (2.8, 3.3)	1.6 (1.5, 1.7)
Females	2.9 (2.5, 3.3)	1.0 (0.9, 1.2)
Peripheral arterial disease (57)	3.0 (2.3, 3.8)	1.5 (1.0, 2.1)
Abdominal aortic aneurysm (58)	2.4 (1.9, 3.0)	
Type 2 *Diabetes mellitus* (59)	1.4 (1.3, 1.6)	1.2 (1.1, 1.3)

* Odds ratio/relative risk with 95% confidence interval
† cerebral infarction includes cerebral thrombosis and cerebral embolism

Despite the existence of data relating smoking consumption with several cardiovascular diseases, there is a lack of consensus among studies on the magnitude of association. The relative risk estimates presented in Table 2 are the result of meta-analyses or other carefully designed and conducted studies. The associations between tobacco exposure and diseases were assumed to be causal, by each study's authors, satisfying several of the Hill criteria for causation.[60]

Given the high incidence and mortality from cardiovascular diseases, and the trend toward a higher prevalence of smokeless tobacco consumption observed in the last decades[61] it is important to understand the role of this kind of tobacco consumption in the etiology of cardiovascular diseases. Studies on the association between smokeless tobacco consumption and cardiovascular diseases generated contradictory results.[62] In one meta-analysis, only an increased risk of death (and not of incidence of the disease) from myocardial infarction and stroke was observed.[62] Whether a similar effect is present for non-fatal myocardial infarction or stroke is still not clarified, as the available studies, conducted in western populations, have several limitations, namely small samples and possible bias due to misclassification of smoking exposure.[62]

c) Other tobacco-related diseases

Several other diseases are causally associated with tobacco consumption, namely respiratory diseases (chronic obstructive pulmonary disease, pneumonia, adverse respiratory effects from *in utero* to adulthood), adverse reproductive effects and other highly prevalent conditions such as cataracts, hip fractures, low bone density or peptic ulcer.[63] Tobacco smoking was shown to increase the risk of tuberculosis infection (summary RR=1.73, 95% CI: 1.46-2.04) and tuberculosis disease (summary RR ranging from 2.33, 95% CI: 1.97-2.75 to 2.66, 95% CI: 2.15-3.28).[64] This is particularly important in developing countries, due to the high burden of tuberculosis

and because the acknowledgement of this relation can have a greater resonance in the general population than the association with other risks perceived as less likely to affect most subjects.

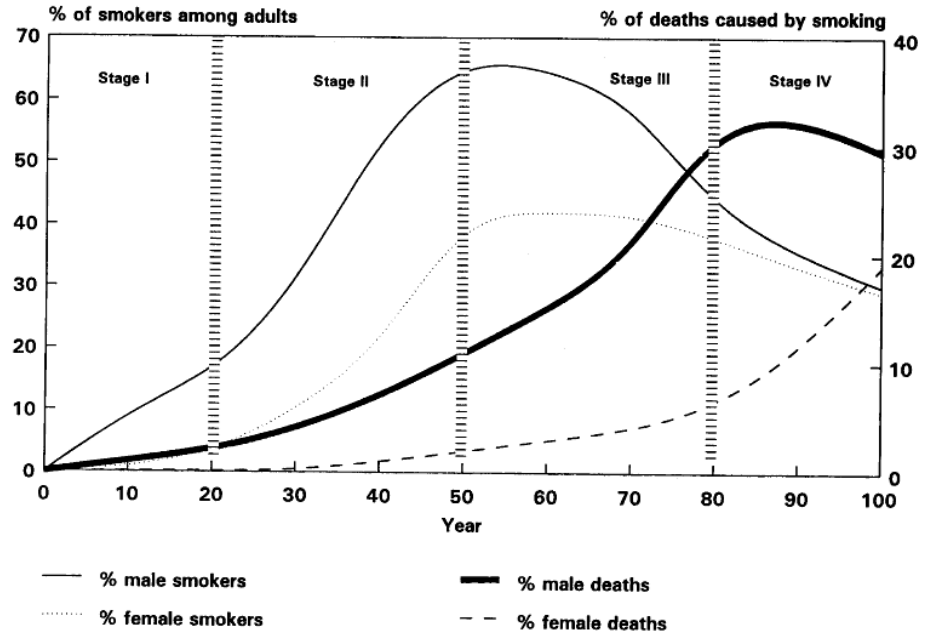
1.2.2. The tobacco epidemic

Based on available data on the prevalences of cigarette consumption and smoking-related mortality in several countries, covering a period of almost 100 years, Lopez et al proposed a four-stage model of the tobacco epidemic, and in an attempt to predict tobacco consumption and health-related disorders dynamics.[30] The three variables chosen to define the four stages were:

- prevalence of smoking (regular smoking in the adult population);
- consumption of cigarettes (the amount of cigarettes smoked per adult in a given period);
- mortality due to smoking (number of deaths attributed to smoking, by age, sex, and classified cause of death).

Prevalence of smoking and consumption of cigarettes, despite clearly related, are complementary and useful as indicators of population exposure to tobacco, so both were included to define the various stages. Lung cancer death rates were used as an index of total smoking-attributable mortality. As lung cancer maximum death rates have a lag of 30 to 40 years from the peak in smoking prevalences, this model probably underestimates smoking-attributable deaths earlier in the epidemic, as there are other lethal tobacco effects, namely related to major vascular diseases, which may occur earlier than lung cancer. Figure 5 summarizes the four stages of the tobacco epidemic.

Figure 5. A model of the cigarette epidemic.



Source: Lopez et al, 1994[30]

Stage I is characterized by a very low smoking prevalence, both among men (<15%) and women (<10% or even <5%), with an also very low per capita consumption (<500 cigarettes per adult), mostly smoked by men. Smoking is an exception behaviour of the most educated families. Tobacco-related deaths are not evident until the end of the first stage, in men. This stage lasts one or two decades.

Stage II depicts a rapid increase of smoking prevalence among men, peaking at 50-80%, with a lag of one or two decades in women, also with an increase in tobacco load (between 1000 and 4000 cigarettes per year), mainly among men. Smoking extends to all socioeconomic groups. Deaths related to tobacco increase at this stage, mainly among men (male lung cancer rates rise 10-fold). This phase takes two to three decades.

In stage III the prevalence of smoking among women reaches its peak (35-45%), with an evident age gradient (higher prevalences observed among young women). Male smoking prevalence begins to decline and, at the end of this stage, the levels of consumption approach the lower end of the range described in the model (varying between 3000 and 4000 cigarettes per year among men and between 1000 and 2000 among women). The greater declines in prevalence are observed among the more educated. At this stage there is a rapid rise in smoking attributable mortality, for both genders, and smoking becomes a less acceptable social behaviour. This phase may last for three decades.

In stage IV: smoking prevalence continues to decline, although slowly, with a rise in mortality attributable to smoking for both genders, followed by a slow decline that begins first in men.

The length of each stage is related with tobacco control policies and presence and quality of information about the hazards of smoking. Another factor determining tobacco consumption is affordability (defined as cost of cigarettes relative to per capita income),[65] explaining, in part, the level of consumption at each stage.

This very general categorization was crucial, as it clearly showed the three- to four-decade lag between the rise in smoking prevalence and the rise in smoking-attributable mortality, strengthening the importance of an early stage prevention/cessation strategy.

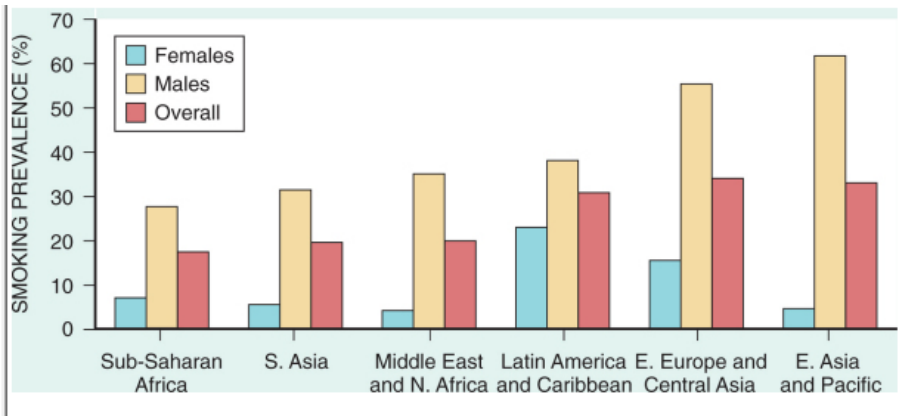
1.2.2.1. Countries at different stages of the tobacco epidemic

Tobacco is cultivated in many regions around the world and can be legally purchased in all countries.

Worldwide, 1 billion men and 250 million women smoke tobacco,[66] a number that is projected to increase to 1.6 billion by 2030.[67] Slightly over 80% of current smokers live in low- and middle-income countries. Tobacco currently causes an estimated 5 million deaths annually (9% of all deaths). This represents 1 million excess tobacco-related deaths in relation to 1990, with the increase being more pronounced in developing settings.[68] If current smoking patterns continue, by 2030 the global burden of disease attributable to tobacco will reach 10 million deaths annually, with the majority in low-income countries.[69]

Figure 6 depicts smoking prevalence by gender in low- and middle-income countries.

Figure 6. Smoking prevalence among subjects aged 15 or older, by gender and region (2000 estimates).



Source: Jha et al, 2006[69]

In high-income economies, smoking prevalences are declining. In the United States, for example, the current prevalence of smoking among adults is half the

observed in 1965, with little difference between genders.[70] Among young men and women, the frequency of smoking increased through the 1990s but now appears to be declining.[71] From 1970 to 2000, the per capita cigarette consumption fell by 14% in developed countries and rose by 46% in the developing.[72]

United States and countries from the North of Europe have already reached Stage IV of the epidemic curve. Southern Europe countries are at Stage III, some in transition to Stage IV. Developing countries, namely Asiatic and Latino-American countries are at Stage II.[72]

1.2.2.2. Sub-Saharan Africa and the tobacco epidemic

Africa was first introduced to tobacco in 1560, by Portuguese and Spanish merchants, and tobacco was already grown by the 1650´s in South Africa, but the use of tobacco has been relatively uncommon in the continent until recently.[73] Cigarette consumption is on an alarming increase in most Sub-Saharan African countries,[73] but accurate information on the prevalence and patterns of use remains scarce.[74] Data on cigarette use cover 68.3% of the African population[72] and the comparison of data from different sources is particularly difficult due to the use of heterogeneous definitions of tobacco consumption and formats of data presentation.[74] Studies on the prevalence of tobacco consumption in Sub-Saharan Africa often rely on non-representative samples, not covering both urban and rural populations, and sample sizes range from as few as 33 social service students in Senegal[75] to as many as 30000 in a survey in South Africa.[76] National samples are available for few Sub-Saharan countries, namely South Africa,[76-79] Tanzania,[80-81] Zambia.[81] Smoking patterns in Sub-Saharan Africa are heterogenous, both between and within countries.[82] With one exception, among Luo Kenyans,[83] the prevalence of tobacco use is higher among males compared to females

across all countries, irrespective of age and ethnicity.[82] Males also smoke higher quantities of tobacco per day than females.[82] Despite this fact, cigarette smoking among women, particularly in developing countries, is increasing.[84] There is evidence that to the tobacco industry, sales of tobacco products to women in developing countries represent one of the largest product marketing opportunities in the world.[85]

Tobacco consumption prevalences vary greatly according to ethnicity. Among Sub-Saharan males, the highest and lowest prevalences of tobacco consumption were found among Coloured males in South Africa (79%)[86] and Nigerian undergraduate students (9%).[87] Among females the highest prevalences were recorded among Luo Kenyans (67%)[83] and the lowest among Nigerian general medical patients (0.3%).[88] Data from Demographic Health Surveys from 14 Sub-Saharan African nations[74] revealed different scenarios, with cigarette smoking prevalence among men ranging from 8.0% to 27.3% in Nigeria and Madagascar, respectively, and among women from 0.1% to 5.9% in Ghana and Namibia, respectively.[74]

Cross-country analyses showed that males aged between 30 and 49 years used tobacco more frequently than those younger than 30 years or older than 49 years, while among females there was a trend toward a steadily increase with age.[82] The onset of tobacco use in Sub-Saharan countries occurred mostly in late adolescence or early adulthood.[82, 89]

A clear and consistent relation between socioeconomic status and tobacco use in Sub-Saharan Africa was not found,[82] although people with higher socioeconomic status tend to smoke more manufactured cigarettes, and the less educated are exposed to traditional forms of tobacco use more frequently.[74, 82]

According to the social diffusion theory,[90] cigarette smoking would first be experimented by highly educated and affluent people and subsequently it would difuse to members of the less privileged classes. This was the experience of most developed countries.[30] Nevertheless, in Sub-Saharan Africa, traditional forms of tobacco were used centuries before the arrival of western tobacco products, which might partly

explain why the historical pattern of tobacco diffusion in high-income nations at advanced stages of the tobacco epidemic does not provide a model to understand the current consumption patterns in Sub-Saharan countries.[81]

Findings from studies that made a valuable distinction between urban/rural location indicated that urban/rural differences were country or tobacco product-specific.[82] For example, in The Gambia, Walraven et al reported that people living in rural locations smoked more than those living in urban areas,[91] while in Malawi and Zambia most smokers lived in urban rather than rural areas.[81] According to results from national surveys, male and female cigarette smokers were more likely to live in cities, while those living in rural settings were more likely to consume other forms of tobacco.[74]

Across the developing world, rural-to-urban migration is probably one of the most important demographic phenomena at this time. In Sub-Saharan Africa it is estimated that 35% of the population lived in urban areas in 2005 and that by 2050 this proportion will have risen to 61%.[92] This phenomenon will bring about changes in patterns of tobacco consumption, as it will interfere with affordability, one of the main determinants of tobacco consumption,[65] and sociocultural factors. This rural-urban shift will make smoking more accessible during the early stages of the epidemiological transition, so that the peak prevalences reached in the third or fourth stages of the tobacco epidemic, in men and women, respectively, in the high-income countries, will probably be observed much earlier in the developing settings, in the first or second stages of the epidemic, and are expected to continue rising.

These findings do indicate that stratification of adult Sub-Saharan African populations by gender, age, ethnic group, socioeconomic group, urban/rural location and place of birth/place of residence would be useful to clarify the position of this poor region of the world in the tobacco epidemic and to identify particularly vulnerable subgroups within populations, an important task in countries with so scarce health resources.

1.3. AIMS

Widespread cigarette smoking will exacerbate worldwide health disparities between nations, leading to an increasing burden of non-communicable diseases in countries still facing a high burden due to communicable diseases. The understanding of the extent, as well as the social, cultural and economical distribution of the problem in developing countries is essential to develop and monitor control strategies. Given the concern that tobacco companies are targeting developing countries and females to compensate for their declining markets in developed nations, and the expected impact of growing urbanization in the access to different types of tobacco products, namely manufactured cigarettes, and in the exposure to cultural influences able to shape consumption patterns, setting-specific data covering all these dimensions are necessary to develop locally grounded actions on tobacco control in low-income settings.

The aim of this dissertation was to characterize tobacco consumption in Mozambique, defining prevalences of different types of tobacco consumption, according to gender and region and considering the influence of internal migrations. This objective was accomplished through two manuscripts with the following specific aims:

1) to describe the use of different types of tobacco (manufactured and hand-rolled and smokeless tobacco) in the adult Mozambican population, across regions at different stages of the epidemiologic transition;

2) to assess differences in the patterns of different types of tobacco consumption according to the place of birth, among dwellers in the capital Maputo City that were

also born in the capital with those born in other southern or northern regions of Mozambique, and with inhabitants of the same southern and northern regions.

1.4. REFERENCES

1. Omran AR. The epidemiologic transition. A theory of the epidemiology of population change. *Milbank Mem Fund Q.* 1971;49(4):509-538.

2. Olshansky SJ, Ault AB. The fourth stage of the epidemiologic transition: the age of delayed degenerative diseases. *Milbank Q.* 1986;64(3):355-391.

3. Rogers RG, Hackenberg R. Extending epidemiologic transition theory: A new stage. *Biodemography Soc Biol.* 1987;34(3):234-243.

4. Gaziano JM. Fifth Phase of the Epidemiologic Transition: The Age of Obesity and Inactivity. *JAMA.* 2010;303(3):275-276.

5. Yusuf S, Reddy S, Ounpuu S, Anand S. Global Burden of Cardiovascular Diseases: Part I: General Considerations, the Epidemiologic Transition, Risk Factors, and Impact of Urbanization. *Circulation.* 2001;104(22):2746-2753.

6. Lopez A, Mathers C, Ezzati M, Jamison D, Murray C, Oluwafemi A. Global Burden of Disease and Risk Factors. Washington DC: Oxford University Press and The World Bank; 2006.

7. Ferlay J, Shin HR, Bray F, Forman D, Mathers C, Parkin DM. GLOBOCAN 2008, Cancer Incidence and Mortality Worldwide: IARC CancerBase No. 10 [Internet]. International Agency for Research on Cancer. Available at: http://globocan.iarc.fr Accessed September 2010.

8. Sen K, Bonita R. Global health status: two steps forward, one step back. *Lancet.* 2000;356(9229):577-582.

9. Murray CJL. Quantifying the burden of disease: the technical basis for disability adjusted life years. In: Murray CJL, Lopez AD, eds. *Global comparative assessments in the health sector*. Geneva: WHO; 1994:3-16.

10. World Health Organization. *World Health Report 2000: health systems - improving performance.* Geneva: WHO; 2000.

11. Murray CJL, Lopez AD. The Global Burden of Disease: A Comprehensive Assessment of Mortality and Disability from Diseases, Injuries, and Risk Factors in 1990 and Projected to 2020.Vol. 1 of Global Burden of Disease and Injury Series. Cambridge, MA: Harvard University Press; 1996.

12. Ezzati M, Stephen Vander Hoorn SV, Alan D. Lopez AD, et al. Comparative Quantification of Mortality and Burden of Disease Attributable to Selected Risk Factors. In: Lopez A, Mathers C, Ezzati M, Jamison D, Murray C, Oluwafemi A, eds. *Global Burden of Disease and Risk Factors*. Washington DC: Oxford University Press and The World Bank; 2006:241-396.

13. Murray CJL, Lopez AD. The Global Burden of Disease. Cambridge, Mass: Harvard University Press; 1996.

14. World Health Organization. *World Health Report 2003: Shaping the Future*. Geneva: 2003.

15. Yusuf S, Reddy S, Ounpuu S, Anand S. Global Burden of Cardiovascular Diseases: Part II: Variations in Cardiovascular Disease by Specific Ethnic Groups and Geographic Regions and Prevention Strategies. *Circulation.* 2001;104(23):2855-2864.

16. Adetunji J, Bos E. Levels and Trends in Mortality in Sub-Saharan Africa: An Overview. In: Jamison D, Feachem R, Makgoba M, Bos E, Baingana F, Hofman K, et al., eds. *Disease and Mortality in Sub-Saharan Africa*. 2nd ed ed. Washington, DC: The World Bank; 2006.

17. World Bank. *World Development Indicators*. Washington, DC: Bank W; 2005.

18. Murray CJL, Lopez AD. Global mortality, disability, and the contribution of risk factors: Global Burden of Disease Study. *The Lancet.* 1997;349(9063):1436-1442.

19. Jamison D, Feachem R, Makgoba M, et al. Disease and Mortality in Sub-Saharan Africa. Washington, DC: The World Bank; 2006.

20. Gaziano TA, Gaziano JM. Historical perspective on heart disease and worldwide trends. In: Gaziano JM, ed. *Atlas of Cardiovascular Risk Factors*. Philadelphia: Current Medicine; 2006.

21. Sitas F, Parkin M, Chirenje Z, Stein L, Mqoqi N, Wabinga H. Cancers. In: Jamison D, Feachem R, Makgoba M, Bos E, Baingana F, Hofman K, et al., eds. *Disease and Mortality in Sub-Saharan Africa*. 2nd ed. Washington, DC: The World Bank; 2006.

22. Parkin D, Ferlay J, Hamdi-Cherif M, et al. Cancer in Africa - Epidemiology and Prevention. Lyons: IARC Press; 2003.

23. Bah E, Parkin DM, Hall AJ, Jack AD, Whittle H. Cancer in the Gambia: 1988-97. *Br J Cancer.* 2001;84(9):1207-1214.

24. Bayo S, Parkin DM, Koumare AK, et al. Cancer in Mali, 1987-1988. *Int J Cancer.* 1990;45(4):679-684.

25. Koulibaly M, Kabba IS, Cissé A, et al. Cancer incidence in Conakry, Guinea: first results from the cancer registry 1992–1995. *Int J Cancer.* 1997;70(1):39-45.

26. Echimane AK, Ahnoux AA, Adoubi I, et al. Cancer incidence in Abidjan, Ivory Coast. *Cancer.* 2000;89(3):653-663.

27. Wabinga HR, Parkin DM, Wabwire-Mangen F, Nambooze S. Trends in cancer incidence in Kyadondo County, Uganda, 1960-1997. *Br J Cancer.* 2000;82(9):1585-1592.

28. Chokunonga E, Levy LM, Bassett MT, Mauchaza BG, Thomas DB, Parkin DM. Cancer incidence in the African population of Harare, Zimbabwe: second results from the cancer registry 1993-1995. *Int J Cancer.* 2000;85(1):54-59.

29. Banda LT, Parkin DM, Dzamalala CP, Liomba NG. Cancer incidence in Blantyre, Malawi 1994-1998. *Trop Med Int Health.* 2001;6(4):296-304.

30. Lopez AD, Collishaw NE, Piha T. A descriptive model of the cigarette epidemic in developed countries. *Tob Control.* 1994;3(3):242-247.

31. Instituto Nacional de Estatística. Recenseamento Geral da População 1997. Available at: http://www.ine.gov.mz/censos_dir/recenseamento_geral/. Accessed September 2010.

32. Instituto Nacional de Estatística. Recenseamento Geral da População 2007. Available at: http://www.ine.gov.mz/home_page/censo2007. Accessed September 2010.

33. Instituto Nacional de Estatística e Ministério da Saúde. *Inquérito Demográfico e de Saúde 2003*. Maputo: 2005.

34. Arnaldo C. Ethnicity and Marriage Patterns in Mozambique. *Etude Popul Afr.* 2004;19(1):143-164.

35. Finnegan W. A complicated war: the harrowing of Mozambique. Berkeley: University of California Press; 1992.

36. Instituto Nacional de Estatística. *Mortalidade em Moçambique. Inquérito Nacional sobre causas de mortalidade 2007/8. Relatório preliminar*. 2009.

37. Joint United Nations Programme on HIV/AIDS (UNAIDS). Report on the global HIV/AIDS epidemic 2008. Available at: http://www.unaids.org/en/KnowledgeCentre/HIVData/GlobalReport/2008/2008_Global_report.asp. Accessed September 2010.

38. Dgedge M, Novoa A, Macassa G, et al. The burden of disease in Maputo City, Mozambique: registered and autopsied deaths in 1994. *Bull World Health Organ.* 2001;79(6):546-552.

39. Damasceno A, Gomes J, Azevedo A, Carrilho C, Lobo V, Lopes H ea. An Epidemiological Study of Stroke Hospitalizations in Maputo, Mozambique - A High Burden of Disease in a Resource-Poor Country. *Stroke.* 2010: DOI 10.1161/STROKEAHA.110.594275.

40. Damasceno A, Azevedo A, Silva-Matos C, Prista A, Diogo D, Lunet N. Hypertension Prevalence, Awareness, Treatment, and Control in Mozambique: Urban/Rural Gap During Epidemiological Transition. *Hypertension.* 2009;54(1):77-83.

41. Gomes A, Damasceno A, Azevedo A, et al. Body mass index and waist circumference in Mozambique: urban/rural gap during epidemiological transition. *Obes Rev.* 2010 Apr 7. [Epub ahead of print].

42. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders, Third Edition (DSM-IIII). Arlington, VA: American Psychiatric Publishing; 1977.

43. US Department of Health and Human Services. The Health Consequences of Smoking: Nicotine Addiction: A Report of the Surgeon General Available at: http://profiles.nlm.nih.gov/NN/B/B/Z/D/. Accessed September 2010.

44. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR). 4th ed ed. Arlington, VA American Psychiatric Publishing; 2000.

45. Rose G. Sick individuals and sick populations. *Int J Epidemiol.* 2001;30(3):427-432.

46. Rose G. The strategy of preventive medicine. Oxford (UK): Oxford University Press; 1992.

47. Smoking-Attributable Mortality, Years of Potential Life Lost, and Productivity Losses--United States, 2000-2004. *JAMA.* 2009;301(6):593-594.

48. Doll R, Hill AB. Smoking and carcinoma of the lung; preliminary report. *Br Med J.* 1950;2(4682):739-748.

49. Wynder EL, Graham EA. Tobacco smoking as a possible etiologic factor in bronchiogenic carcinoma; a study of 684 proved cases. *J Am Med Assoc.* 1950;143(4):329-336.

50. Levin ML, Goldstein H, Gerhardt PR. Cancer and Tobacco Smoking: a Preliminary Report. *J Am Med Assoc.* 1950;143(4):336-338.

51. Schrek R, Baker LA, et al. Tobacco smoking as an etiologic factor in disease; cancer. *Cancer Res.* 1950;10(1):49-58.

52. International Agency for Research on Cancer. *IARC Monograph on the Evaluation of Carcinogenic Risks to Humans. Tobacco Smoke and Involuntary Smoking*. 2004.

53. Gandini S, Botteri E, Iodice S, et al. Tobacco smoking and cancer: a meta-analysis. *Int J Cancer.* 2008;122(1):155-164.

54. Lee PN, Hamling J. Systematic review of the relation between smokeless tobacco and cancer in Europe and North America. *BMC Med.* 2009;7:36.

55. Paul SL, Thrift AG, Donnan GA. Smoking as a crucial independent determinant of stroke. *Tob Induc Dis.* 2004;2(2):67-80.

56. Anand SS, Islam S, Rosengren A, et al. Risk factors for myocardial infarction in women and men: insights from the INTERHEART study. *Eur Heart J.* 2008;29(7):932-940.

57. Agarwal S. The Association of Active and Passive Smoking With Peripheral Arterial Disease: Results From NHANES 1999-2004. *Angiology.* 2009;60(3):335-345.

58. Cornuz J, Sidoti Pinto C, Tevaearai H, Egger M. Risk factors for asymptomatic abdominal aortic aneurysm. *Eur J Public Health.* 2004;14(4):343-349.

59. Willi C, Bodenmann P, Ghali WA, Faris PD, Cornuz J. Active Smoking and the Risk of Type 2 Diabetes: A Systematic Review and Meta-analysis. *JAMA.* 2007;298(22):2654-2664.

60. Hill AB. The environment and disease: association or causation? *Proc R Soc Med.* 1965;58:295-300.

61. International Agency for Research on Cancer. *IARC Monograph on the Evaluation of Carcinogenic Risks to Humans. Smokeless tobacco products*. 2008.

62. Boffetta P, Straif K. Use of smokeless tobacco and risk of myocardial infarction and stroke: systematic review with meta-analysis. *BMJ.* 2009;339:b3060.(doi):10.1136/bmj.b3060.

63. U.S. Department of Health & Human Services. Office of the Surgeon General. The Health Consequences of Smoking: A Report of the Surgeon General. Available at: http://www.surgeongeneral.gov/library/smokingconsequences/index.html. Accessed August 2010.

64. Bates MN, Khalakdina A, Pai M, Chang L, Lessa F, Smith KR. Risk of Tuberculosis From Exposure to Tobacco Smoke: A Systematic Review and Meta-analysis. *Arch Intern Med.* 2007;167(4):335-342.

65. Blecher EH, van Walbeek CP. An international analysis of cigarette affordability. *Tob Control.* 2004;13(4):339-346.

66. Action on Smoking and Health. Factsheet no. 21. Tobacco in the Developing World. Available at: http://www.ash.org.uk?html/factsheets/html/fact21.html. Accessed September, 2010.

67. World Health Organization. *Tobacco Free Initiative: Building Blocks for Tobacco Control: a handbook*. WHO; 2004.

68. World Health Organization. *World Health Report 2002: Reducing risks, promoting healthy life*. Geneva: WHO; 2002.

69. Jha P, Chaloupka JM, Gajalakshmi V et al. Tobacco Addiction. Disease Control Priorities in Developing Countries. 2nd ed. New York: Oxford University Press; 2006.

70. Centers for Disease Control and Prevention. *Smoking prevalence among U.S. adults*. Washington, DC: Office on Smoking and Health; 2005.

71. Global Youth Tobacco Survey Collaborative Group. Tobacco use among youth: a cross country comparison. *Tob Control.* 2002;11(3):252-270.

72. Guindon GE, Boisclair D. Past, Current and Future Trends in Tobacco Use. Center for Tobacco Control Research and Education. Available at: http://escholarship.org/uc/item/4q57d5vp. Accessed August 2010.

73. Shafey O, Dolwick S, Guindon GE (eds). *Tobacco Control Country Profiles*. Atlanta, GA: American Cancer Society; 2003.

74. Pampel F. Tobacco use in sub-Sahara Africa: Estimates from the demographic health surveys. *Soc Sci Med.* 2008;66(8):1772-1783.

75. Baylet R, Diop S, Belinga NDO, de Medeiros D. Enquête sur la consommation du tabac chez les élèves Assistants-Sociaux à Dakar. *Bull Soc Méd Afr Noire Lang Franç.* 1974(19):84-87.

76. van Walbeek C. Recent trends in smoking prevalence in South Africa--some evidence from AMPS data. *S Afr Med J.* 2002;92(6):468-472.

77. Martin G, Steyn K, Yach D. Beliefs about smoking and health and attitudes toward tobacco control measures. *S Afr Med J.* 1992;82(4):241-245.

78. Reddy P, Meyer-Weitz A, Yach D. Smoking status, knowledge of health effects and attitudes towards tobacco control in South Africa. *S Afr Med J.* 1996;86(11):1389-1393.

79. Steyn K, Bradshaw D, Norman R, Laubscher R, Saloojee Y. Tobacco use in South Africans during 1998: the first demographic and health survey. *J Cardiovasc Risk.* 2002;9(3):161-170.

80. Jagoe K, Edwards R, Mugusi F, Whiting D, Unwin N. Tobacco smoking in Tanzania, East Africa: population based smoking prevalence using expired alveolar carbon monoxide as a validation tool. *Tob Control.* 2002;11(3):210-214.

81. Pampel FC. Patterns of tobacco use in the early epidemic stages: Malawi and Zambia, 2000-2002. *Am J Public Health.* 2005;95(6):1009-1015.

82. Townsend L, Flisher AJ, Gilreath T, King G. A systematic literature review of tobacco use among adults 15 years and older in sub-Saharan Africa. *Drug Alcohol Depend.* 2006;84(1):14-27.

83. Kaplan M, Carriker L, Waldron I. Gender differences in tobacco use in Kenya. *Soc Sci Med.* 1990;30(3):305-310.

84. Samet JM, Yoon S. Women and the Tobacco Epidemic: Challenges for the 21st Century Available at: http://www.who.int/tobacco/media/en/WomenMonograph.pdf. Accessed September 2010.

85. Kaufman NJ, Nichter M. The Marketing of Tobacco To Women: Global Perspectives. Available at: http://www.who.int/tobacco/media/en/WomenMonograph.pdf. Accessed September 2010.

86. van der Burgh C. Smoking behaviour of White, Black, Coloured and Indian South Africans. Some statistical data on a major public health hazard. *S Afr Med J.* 1979;55(24):975-978.

87. Ndom RJ, Adelekan ML. Psychosocial correlates of substance use among undergraduates in Ilorin University, Nigeria. *East Afr Med J.* 1996;73(8):541-547.

88. Harries AD, Chugh KS, Neumann T. Smoking habits and disease patterns amongst hospital patients in north-east Nigeria. *J Trop Med Hyg.* 1986;89(1):37-41.

89. World Health Organization. Global Youth Tobacco Survey - country reports. Available at: http://www.who.int/tobacco/surveillance/country_reports_afro/en/index.html. Accessed September 2010.

90. Rogers E, Shoemaker F. Communication of Innovations: A Cross-Cultural Approach. London: Collier Mcmilan; 1971.

91. Walraven GEL, Nyan OA, Van Der Sande MAB, et al. Asthma, smoking and chronic cough in rural and urban adult communities in The Gambia. *Clin Exp Allergy.* 2001;31(11):1679-1685.

92. Population Division of the Department of Economic and Social Affairs. 2009 Revision of World Urbanization Prospects Available at: http://esa.un.org/unpd/wup/index.htm. Accessed September 2010.

2. MANUSCRIPTS

2.1. Manufactured and hand-rolled cigarettes and smokeless tobacco consumption in Mozambique: regional differences at the early stages of the tobacco epidemic

Manufactured and hand-rolled cigarettes and smokeless tobacco consumption in Mozambique: regional differences at the early stages of the tobacco epidemic

Carla Araújo[1,2,3], Carla Silva-Matos[4], Albertino Damasceno[5], Maria Lídia Gouveia[6], Ana Azevedo[1,2], Nuno Lunet[1,2]

[1] Department of Hygiene and Epidemiology, University of Porto Medical School, Porto, Portugal;

[2] Institute of Public Health – University of Porto (ISPUP), Porto, Portugal;

[3] Department of Cardiology, Centro Hospitalar de Entre Douro e Vouga, EPE, Hospital de São Sebastião, Santa Maria da Feira, Portugal;

[4] Department of Non-Communicable Diseases, Mozambique Ministry of Health, Maputo, Mozambique;

[5] Faculty of Medicine, Eduardo Mondlane University, Maputo, Mozambique;

[6] Department of Mental Health, Mozambique Ministry of Health, Maputo, Mozambique.

ABSTRACT

Objectives: To describe the use of different types of tobacco (manufactured and hand-rolled cigarettes, and smokeless tobacco) in the adult Mozambican population, across regions at different stages of the epidemiologic transition.

Methods: A representative sample of 12902 Mozambicans aged 25-64 years was evaluated in a national household survey conducted in 2003 using a structured questionnaire.

Results: The prevalence of current tobacco consumption was 39.9% in men and 18.0% in women. Women consumed predominantly smokeless tobacco (prevalence: 10.1%), especially in the north. Hand-rolled and manufactured cigarettes were the most frequently consumed among men (prevalences: 18.7% and 17.2%, respectively), the latter predominantly in the south and urban areas and the former in the north and rural settings.

Conclusions: The overall tobacco consumption was higher than expected for an African country at the earlier stages of the tobacco epidemic, mostly due to traditional forms of consumption. The gender and regional specific patterns of consumption identified in Mozambique may contribute to the development of culturally adapted and locally grounded actions for tobacco control, and stress the need of locale-specific surveillance data and public health action in this field.

INTRODUCTION

In Sub-Saharan African countries, the increase in incidence and mortality by smoking-related diseases, mainly cardiovascular disease, cancer and chronic respiratory disease, currently superimposed on HIV/AIDS, malaria and diarrhoeal diseases which are still the leading causes of death,[1] contributes to a "double burden" of disease in these low income countries[2] at the early stage of the epidemiologic transition.[3]

Tobacco consumption is influenced by factors at the individual and population level, including demographic, economic, and cultural determinants[4] but also macro-level factors such as pressure by the tobacco industry and policies for tobacco control.[5-8] In the African setting, oppositely to most high income societies, the consumption of hand-rolled cigarettes and smokeless tobacco is common and likely to have specific determinants.[9] With urbanization the traditional forms of tobacco use are shifting to manufactured cigarettes smoking,[10-11] which is also expected in Mozambique where effective anti-tobacco policies still lack.[10, 12-13] On the other hand, transnational tobacco manufacturing and tobacco leaf companies make numerous efforts to resist global tobacco control, namely by stressing the economic importance of tobacco to the developing countries that grow it.[5, 14-15]

In Mozambique, tobacco production increased from 1500 tons, involving about 6000 producers, in 1997, to 60000 tons, involving about 150000 producers, in 2006, mostly in the northern provinces.[16] From 2008 to 2009 national tobacco production increased 10.8%, from 62500 to 69300 tons,[17] depicting the need for surveillance of tobacco consumption in this setting, namely taking into account the regional epidemiological,[18-20] sociodemographic and cultural heterogeneity.[21-23]

We aimed to describe the use of different types of tobacco (manufactured and hand-rolled and smokeless tobacco) in the adult Mozambican population, across regions at different stages of the epidemiologic transition.

METHODS

Sample and design

Between September and December 2003, 12902 subjects aged 25 to 64 years were evaluated in a community-based cross-sectional study, using the sampling frame of the 1997 census, which was designed to be representative at national and province levels and by place of residence (urban or rural). Six hundred and four geographical clusters were selected, among which all the households were listed and 24 randomly selected and visited. Homeless and people living in collective residential institutions (*e.g.* hotels, hospitals, military facilities) were not eligible. All the eligible subjects in the same household were invited to the study.

Trained interviewers conducted face-to-face interviews in each household. Given the ethnic and linguistic diversity in Mozambique, all interviewers were able to correctly speak the predominant languages in the regions where they collected data. Subjects were evaluated following standardized procedures and using a structured questionnaire for assessment of sociodemographic and behavioral factors.

The study protocol was approved by the National Mozambican Ethics Committee and written informed consent was obtained from all participants.

Variables assessed

Regarding tobacco consumption, participants were asked about the use of any tobacco product, including manufactured cigarettes, hand-rolled cigarettes and smokeless tobacco, and were classified according to ever and current tobacco consumption. Current consumers were asked about the age of their regular consumption uptake, and further grouped using the age cut-off of 13 (<13 and ≥13 years) and 18 (<18 and ≥18 years). Current consumers were also asked about the type

of tobacco most often consumed, and classified as consumers of manufactured cigarettes, hand-rolled cigarettes or smokeless tobacco. Only 20 subjects reported cigar or pipe smoking as the predominant type of tobacco consumed and these categories were not considered in the analysis by type of tobacco. Manufactured cigarette smokers were asked about the number of cigarettes smoked in the previous 24 hours and were further grouped according to the frequency of consumption (<5 and ≥5 cigarettes/day).

For analysis, the 11 provinces from Mozambique were grouped in south (including the Maputo City, which corresponds to the capital Maputo, Maputo province, which is the province adjacent to the capital, and Inhambane and Gaza) and north provinces (Sofala, Manica, Zambézia, Tete, Nampula, Niassa and Cabo Delgado). The former correspond to less than one quarter of the country area and approximately one quarter of the population and 6 of the latter were responsible for nearly 100% of the Mozambican tobacco production in 2008/2009.[17, 21]

The classification of the place of residence as urban (in any of the 23 cities and 68 towns) or rural (outside cities or towns) was done in accordance with the 1997 census.[24]

Education was registered as the highest education level attained and participants grouped in four categories (<1 year, 1-5 years, 6-7 years, ≥8 years).

Data analysis

All the analyses were conducted considering the sampling weights and adjusting for strata and clustering at the primary sampling unit level using Stata, version 9.2, including 12891 subjects for whom data were available on the consumption of tobacco and socio-demographic variables (complete data were not available for only 11 subjects).

Prevalence estimates with 95% confidence intervals (95%CI) were computed for different measures of tobacco consumption according to sociodemographic characteristics. The prevalences of tobacco consumption were georeferenced by province, using gender-specific quintiles as cut-offs to define the categories for each variable.

The association between residence at different provinces and tobacco consumption was quantified through prevalence ratios, crude and adjusted for age, education and place of residence (urban/rural setting and south/north provinces), using Poisson regression models.

RESULTS

Characteristics of the study sample

The population under study was predominantly rural (nearly three quarters). Most subjects were aged under 45 years (two thirds); about half of women and one quarter of men had no formal education and less than 5% of women and less than 10% of men had secondary or higher education (Table 1).

Overall tobacco consumption

The overall prevalence of ever and current tobacco consumption was 20.5% and 18.0%, respectively, in women, and 46.4% and 39.9%, respectively, in men.

The proportion of current tobacco consumers increased with age among women (from 6.7% in the age-group 25-34 years to 36.4% in those aged 55 to 64), with no meaningful variation in men (from 38.4% at ages 25-34 to 42.5% in the age-group 45-54 years), and decreased with education both in women (from 25.0% in the less educated to 3.5% in those with ≥ 8 schooling years) and men (from 45.0% to 23.0%, respectively). These trends were only slightly attenuated after adjustment for the potential confounding effect of age, education and place of residence (Table 2).

The highest prevalences of current tobacco consumption were observed in the northern provinces of Nampula (31.7% for women and 46.4% for men) and Cabo Delgado (23.2% for women and 60.6% for men), and the lowest in the southern provinces of Maputo City (4.4% for women and 29.0% for men) and Inhambane (7.4% for women and 24.5% for men) (Figure 1). The association between residence in the north and tobacco consumption was independent from age, education and dwelling in an urban or rural setting, stronger in women (prevalence ratio=3.57, 95%CI: 2.70-4.71) than in men (prevalence ratio=1.39, 95%CI: 1.23-1.57). Independent urban/rural

differences were also observed in both genders, corresponding to adjusted prevalence ratios of 1.34 in women and 1.20 in men (Table 2).

Age at regular tobacco consumption uptake

The mean age at regular tobacco consumption uptake was 21.9, 22.2, 24.0 and 24.4 in the age groups 25-34, 35-44, 45-54 and 55-64, respectively. The prevalence of regular consumption uptake before the ages of 13 and 18 was 4.8% and 27.2%, respectively, in women, and 4.2% and 22.0%, respectively, in men. There was no significant variation across sociodemographic characteristics except for higher prevalences of early uptake in women aged above 34 and lower prevalences of uptake before 18 years of age in rural women (Table 2).

Consumption of different types of tobacco

Among women, the prevalence of use of the main type of tobacco consumed ranged from 2.7% for manufactured cigarettes to 10.1% for smokeless tobacco. Both hand-rolled and manufactured cigarettes were the predominant type consumed by men (18.7% and 17.2%, respectively) while the prevalence corresponding to smokeless tobacco was 3.7%. Most manufactured cigarette consumers smoked less than 5 cigarettes per day (Table 3).

Despite the gender differences in the prevalence of consumption, the relation with sociodemographic variables was similar for hand-rolled and smokeless tobacco, with differences unlikely to be due to confounding. For smokeless tobacco the prevalence was approximately 6-fold higher in the older subjects compared to the younger, regardless of gender, while for hand-rolled cigarettes the association was weaker among men (prevalence ratio: 1.62 vs. 6.57). A strong independent negative association with schooling was observed both for smokeless and hand-rolled tobacco,

and consumption was higher in northern provinces and in rural settings. A south to north gradient of hand-rolled and smokeless tobacco use is depicted in Figure 1, corresponding to adjusted prevalence ratios 2- to 3-fold higher in the north, except for hand-rolled cigarette smoking that was not observed among women from the south. The predominance of smokeless tobacco use in rural areas was less pronounced among women (prevalence ratio=1.31, 95%CI: 0.97-1.78) than in men (prevalence ratio=2.21, 95%CI: 1.10-4.41), while hand-rolled cigarette smoking was approximately 4-fold more frequent in rural areas regardless of gender (Table 3).

Manufactured cigarette smoking as the main type of tobacco consumption was more frequent in men (17.2% vs. 2.7%), with much larger differences when smoking of ≥ 5 cigarettes per day was considered (6.0% vs. 0.3%). The mean number of manufactured cigarettes smoked per day was 3.0 (95%CI: 2.4-3.7) among women and 5.0 (95%CI: 4.6-5.5) among men. Consumption increased with age among women, up to 2- to 3-fold higher prevalences in those aged 45-54 years compared with the younger, while among men it steadily decreased with age, reaching 63% to 66% lower adjusted prevalences in the older subjects than in the younger. Among women there was no consistent variation in smoking of manufactured cigarettes with education, but the daily consumption of ≥ 5 cigarettes was nearly 4-fold more frequent in the more educated than in those with less than one year of schooling. Among men, manufactured cigarette smoking increased with education, up to an approximately 70% higher prevalence in those with 6-7 schooling years compared with the less educated (Table 3).

As shown in Figure 1, northern women tended to be more often consumers of manufactured cigarettes, corresponding to an adjusted prevalence ratio of 3.26, but there were no significant north/south differences in daily smoking of ≥ 5 cigarettes. On the other hand, among men the prevalences were lower in the northern provinces, especially for smoking of ≥ 5 cigarettes per day (prevalence ratio=0.41, 95%CI: 0.31-

0.54). Manufactured cigarette smoking was approximately 50% less frequent in rural areas, regardless of gender and independently from age, education and province.

DISCUSSION

In Mozambique the overall prevalence of tobacco consumption was higher than expected for an African country at the early stages of the tobacco epidemic. However hand-rolled and smokeless tobacco accounted for a larger proportion of consumption than manufactured cigarette smoking. Gender differences were observed in the overall consumption, but also in the geographical distribution of the main types of tobacco used. Women consumed predominantly smokeless tobacco especially in the north while southern and urban men consumed mostly manufactured cigarettes and those from the north and living in rural areas opted more frequently for hand-rolled cigarettes.

For many sub-Saharan African countries, including Mozambique, epidemiological data on the prevalence of tobacco consumption are available, showing that, in African populations, tobacco consumption is higher in men, in rural settings and in older and less educated people.[12, 25-27] The present study, however, evaluated subjects aged 25 or more years, had rural populations properly represented, and assessed the exposure to traditional forms of tobacco consumption, all contributing to the high prevalences observed when compared with some previous studies from other African countries, and previous estimates from Mozambique.[10, 12]

The mean age at regular tobacco consumption uptake was the first half of the third decade in all the age groups, similarly to what was found in Tanzania.[26] In Mozambique regular tobacco consumption uptake before the age of 18 was in accordance to previous observations in sub-Saharian countries, with prevalences ranging from 1.5% in Zimbabwe and Nigeria to 34.4% in Cape Town, South Africa.[28-30]

Differences in socioeconomic status, access to education, language, and gender relationships distinguish the northern and southern parts of the country[31] and are probably responsible for the heterogeneous tobacco consumption prevalences observed across regions and by gender. In Mozambique, women are less financially secure than men, earning 18% of the typical salary among the male population. This

financial dependence on men is exacerbated by low rates of secondary school completion among females, low incomes for women in rural areas, and limited employment choices for uneducated individuals other than subsistence agriculture and trading.[21] In the rural Northern provinces of Mozambique matrilineal systems, with high female illiteracy rates (85-88%) predominate; while in the southern provinces, where patrilineal descent is common, women had lower rates of illiteracy (48%-77%) and a greater access to radio, television, newspapers and health information.[23] Differences in religion are also observed across Mozambican regions; the majority of people in the south are Christian while the north is populated by a large percentage of Muslims.[32]

The north/south heterogeneity in tobacco consumption patterns is also clear when considering the main type of tobacco consumed. Both hand-rolled and smokeless tobacco consumption were predominant in the north, probably due to the proximity to the production as nearly 100% of the tobacco production in Mozambique is concentrated in 5 of the 6 northern provinces.[17] Some authors suggested that living in a growing tobacco region makes smoking an acceptable practice and probably women from the north are exposed to an environment that facilitates tobacco uptake, making them vulnerable to shift the consumption from traditional types, mainly smokeless tobacco, to manufactured tobacco.[33] On the other hand, the northern province of Cabo Delgado has virtually no industrialized tobacco production and ranks among the regions with the highest prevalences of consumption, mainly of manufactured cigarettes, for which cultural and sociodemographic factors such as a lower prevalence of illiteracy and a smaller proportion of people below the first quintile of wealth[21] may account. The lower consumption of manufactured cigarettes in the north and its predominance in the south and urban regions may reflect an easier access to manufactured cigarettes in these regions, probably driven by the higher earnings in this region and a trend towards western lifestyle habits.

A limitation of the present study is that consumption of different types of tobacco could only be assessed as the most frequently consumed type of tobacco. Therefore,

the prevalences of consumption of each type of tobacco are underestimated to an extent that is difficult to predict, and no conclusions can be drawn regarding the consumption of more than one type of tobacco simultaneously. However, our results provide valid estimates of the patterns of exposure to different types of tobacco as the form of tobacco use reported is the most frequent. Furthermore, the overall consumption estimates are not biased. Given the interpretation of the gender- and region-specific patterns of consumption based on affordability and access to the different types of tobacco as well as on cultural factors, we do not expect a meaningful overlap between different forms of tobacco use that could render the observed associations null.

Considering all the data provided by our study, namely the prevalence of consumption of different types of tobacco, and the amount of manufactured cigarettes consumed, Mozambique fits the tobacco epidemic stage II,[8] with a prevalence of tobacco consumption of 39.9% in men and 18.0% in women. Among manufactured cigarette smokers the great majority are light consumers, as was observed in previous studies in Sub-Saharan countries.[12, 26] Smokers typically increase consumption with increasing disposable income and therefore this low consumption is probably the result of low affordability.[34] The small difference between ever and current tobacco consumption prevalences, representing a low proportion of ex-smokers, is again consonant with stage 2 of the tobacco epidemic curve.[8] The historical pattern of tobacco diffusion in high-income nations at advanced stages of the tobacco epidemic does not provide a model to understand the current consumption patterns in Mozambique,[27] where, as in other Sub-Saharian countries, there are two main types of tobacco consumption: manufactured and traditional forms. Considering the manufactured cigarette smoking pattern alone, Mozambique fits stage 1 of the tobacco epidemic, with a prevalence of 17.2% in men, and a clear association with younger ages and higher education, replicating the experience of most developed nations,[8] while among women the prevalence of manufactured cigarettes smoking is very low

(2.7%), with no meaningful variation across education groups. The higher use of tobacco by low educational groups in Mozambique, mainly due to the predominance of the traditional forms of tobacco consumption, contrasts with the experience of most developed countries, where tobacco use emerged earliest among the more educated population.[8, 35]

Cultural and social patterns of tobacco use in Mozambique do not clearly mirror past patterns in more-developed countries,[27] but these results raise concern namely because Mozambique signed but did not yet ratify the Framework Convention on Tobacco Control, in effect since February 2006.[13] The lack of a clear policy for tobacco control, the weak government restrictions on tobacco use or sales and the economic increasing interest of tobacco international companies makes Mozambique a vulnerable country to the expansion of this market.[10] The very low prevalence of manufactured cigarettes smoking in women should not encourage complacency as there is evidence that the tobacco companies are increasing their targeting of women in developing countries.[26] On the other hand, tobacco consumption in women, mainly those living in the North, is locally acceptable, making them potential new consumers of manufactured cigarettes.

In conclusion, our results show that the positioning of Mozambique in the frame of the tobacco epidemic needs to take into account both manufactured cigarette smoking and traditional forms of tobacco consumption, which contribute largely to tobacco exposure in this setting. The gender and regional specific patterns of consumption may contribute to the development of culturally adapted and locally grounded actions for tobacco control in Mozambique, and stress the need of locale-specific surveillance data and public health action in this field.

Acknowledgments

The authors gratefully acknowledge the contribution of Fátima Pina in drawing the maps in Figure 1.

References

1. Yusuf S, Reddy S, Ounpuu S, Anand S. Global Burden of Cardiovascular Diseases: Part I: General Considerations, the Epidemiologic Transition, Risk Factors, and Impact of Urbanization. *Circulation.* 2001;104(22):2746-2753.

2. World Health Organization. *Preventing chronic diseases: a vital investment: WHO global report*. Geneva, Switzerland: World Health Organization; 2005.

3. World Health Organization. Country Health System Fact Sheet 2006 Mozambique. Available at: http://www.unpei.org/PDF/Mozambique-country-sheet.pdf. Accessed March 2010.

4. Ezzati M, Lopez AD. Estimates of global mortality attributable to smoking in 2000. *Lancet.* 2003;362(9387):847-852.

5. Lunet N, Williams L, Govind M, et al. Tobacco advertising in Maputo, Mozambique: how will they keep pressing? *Gac Sanit.* 2006;20(3):251-252.

6. Eriksen MP, Cerak RL. The diffusion and impact of clean indoor air laws. *Annu Rev Public Health.* 2008;29:171-185.

7. Gallus S, Schiaffino A, La Vecchia C, Townsend J, Fernandez E. Price and cigarette consumption in Europe. *Tob Control.* 2006;15(2):114-119.

8. Lopez AD, Collishaw NE, Piha T. A descriptive model of the cigarette epidemic in developed countries. *Tob Control.* 1994;3(3):242-247.

9. Saloojeea Y. Tobacco control in South Africa. In: Steyn K, Fourie J, Temple N, eds. *Chronic Diseases of Lifestyle in South Africa since 1995 - 2005*. Athabasca: South African Medical Research Council; 2006.

10. Shafey O, Dolwick S, Guindon GE (eds). *Tobacco Control Country Profiles*. Atlanta, GA: American Cancer Society; 2003.

11. Townsend L, Flisher AJ, Gilreath T, King G. A systematic literature review of tobacco use among adults 15 years and older in sub-Saharan Africa. *Drug Alcohol Depend.* 2006;84(1):14-27.

12. Pampel F. Tobacco use in sub-Sahara Africa: Estimates from the demographic health surveys. *Soc Sci Med.* 2008;66(8):1772-1783.

13. World Health Organization. Updated status of the WHO Framework Convention on Tobacco Control. Available at: http://fctc.org/dmdocuments/ratification_latest_Bahamas.pdf. Accessed September 2010.

14. Otañez MG, Mamudu H, Glantz SA. Global leaf companies control the tobacco market in Malawi. *Tob Control.* 2007;16(4):261-269.

15. Otanez MG, Mamudu HM, Glantz SA. Tobacco Companies' Use of Developing Countries' Economic Reliance on Tobacco to Lobby Against Global Tobacco Control: The Case of Malawi. *Am J Public Health.* 2009;99(10):1759-1771.

16. IAM (Instituto do Algodão de Moçambique). *Agricultural Diversification and Crop Alternative to Tobacco: Perspective and Experience of the Tobacco Sub-Sector in Mozambique*. Maputo: 2007.

17. MINAG-CEPAGRI (Centro de Promoção da Agricultura Comercial). *Relatório de Balanço de 2009*. Maputo: 2010.

18. Pereira M, Lunet N, Azevedo A, Barros H. Differences in prevalence, awareness, treatment and control of hypertension between developing and developed countries. *J Hypertens.* 2009;27(5):963-975.

19. Gomes A, Damasceno A, Azevedo A, et al. Body mass index and waist circumference in Mozambique: urban/rural gap during epidemiological transition. *Obes Rev.* 2010 Apr 7. [Epub ahead of print].

20. Padrão P, Silva-Matos C, Damasceno A, Lunet N. Association between tobacco consumption and alcohol, vegetable and fruit intake across urban and rural areas in Mozambique. *J Epidemiol Community Health.* 2010 Jun 7. [Epub ahead of print].

21. Instituto Nacional de Estatística e Ministério da Saúde. *Inquérito Demográfico e de Saúde 2003*. Maputo: 2005.

22. Ndege G. Culture and customs of Mozambique. Westport, CT: Greenwood Press; 2007.

23. Arnaldo C. Ethnicity and Marriage Patterns in Mozambique. *Etude Popul Afr.* 2004;19(1):143-164.

24. Instituto Nacional de Estatística. Recenseamento Geral da População 1997. Available at: http://www.ine.gov.mz/censos_dir/recenseamento_geral/. Accessed September 2010.

25. Steyn K, Bradshaw D, Norman R, Laubscher R, Saloojee Y. Tobacco use in South Africans during 1998: the first demographic and health survey. *J Cardiovasc Risk.* 2002;9(3):161-170.

26. Jagoe K, Edwards R, Mugusi F, Whiting D, Unwin N. Tobacco smoking in Tanzania, East Africa: population based smoking prevalence using expired alveolar carbon monoxide as a validation tool. *Tob Control.* 2002;11(3):210-214.

27. Pampel FC. Patterns of tobacco use in the early epidemic stages: Malawi and Zambia, 2000-2002. *Am J Public Health.* 2005;95(6):1009-1015.

28. Global Youth Tobacco Survey Collaborative Group. Tobacco use among youth: a cross country comparison. *Tob Control.* 2002;11(3):252-270.

29. Townsend L, Flisher AJ, Gilreath T, King G. A systematic review of tobacco use among sub-Saharan African youth. *Journal of Substance Use.* 2006;11(4):245 - 269.

30. World Health Organization. Global Youth Tobacco Survey - country reports. Available at: http://www.who.int/tobacco/surveillance/country_reports_afro/en/index.html. Accessed September 2010.

31. Audet C, Burlison J, Moon T, Sidat M, Vergara A, Vermund S. Sociocultural and epidemiological aspects of HIV/AIDS in Mozambique. *BMC Int Health Hum Rights.* 2010;10(1):15.

32. Gengenbach H. Boundaries of Beauty: Tattooed Secrets of Women's History in Magude District, Southern Mozambique. *J Womens Hist.* 2003;14(4):106-141.

33. Mpabulungi L, Muula AS. Tobacco use among high school students in a remote district of Arua, Uganda. *Rural Remote Health.* 2006;6(4):609.

34. Blecher EH, van Walbeek CP. An international analysis of cigarette affordability. *Tob Control.* 2004;13(4):339-346.

35. Barbeau EM, Krieger N, Soobader MJ. Working class matters: socioeconomic disadvantage, race/ethnicity, gender, and smoking in NHIS 2000. *Am J Public Health.* 2004;94(2):269-278.

Table 1. Socio-demographic characteristics of the participants.

	Women (n=7848)			Men (n=5043)		
	n	Unweighted % *	Weighted % *	n	Unweighted % *	Weighted % *
Province						
Maputo city †	724	9.2	6.0	393	7.8	4.7
Maputo province †	624	8.0	6.8	308	6.1	4.6
Gaza †	897	11.4	6.3	358	7.1	3.5
Inhambane †	847	10.8	10.5	387	7.7	6.8
Sofala ‡	657	8.4	5.9	480	9.5	6.5
Manica ‡	628	8.0	5.6	422	8.4	5.6
Tete ‡	668	8.5	8.3	448	8.9	8.1
Zambézia ‡	689	8.8	14.5	613	12.2	20.0
Nampula ‡	885	11.3	21.6	685	13.6	23.7
Cabo Delgado ‡	665	8.5	9.7	558	11.1	12.1
Niassa ‡	564	7.2	4.7	391	7.8	4.5
Urban/rural region						
Urban	2871	36.6	29.2	1696	33.6	26.0
Rural	4977	63.4	70.8	3347	66.4	74.0
Age (years)						
25-34	3151	40.2	40.9	1800	35.7	36.3
35-44	2116	27.0	26.1	1397	27.7	27.5
45-54	1607	20.5	20.6	1088	21.6	21.1
55-64	974	12.4	12.3	758	15.0	15.1
Education (years) §						
<1	3940	50.3	54.5	1132	22.5	26.1
1-5	3124	39.9	37.7	2802	55.6	55.2
6-7	501	6.4	5.0	656	13.0	11.7
≥8	269	3.4	2.7	448	8.9	7.0

* within each variable the sum of the proportions may not be 100% due to rounding;

† southern provinces;

‡ northern provinces;

§ the sum of the number of participants in each category is lower than 7848 for women and 5043 for men due to missing data.

Table 2. Prevalence of current tobacco consumption and regular tobacco consumption uptake below the ages of 13 and 18, according to socio-demographic variables, by gender.

	Current tobacco consumption		Regular tobacco consumption uptake below the age of 13		Regular tobacco consumption uptake below the age of 18	
	Prevalence (95%CI) †	Prevalence Ratio * (95%CI) †	Prevalence (95%CI) †	Prevalence Ratio * (95%CI) †	Prevalence (95%CI) †	Prevalence Ratio * (95%CI) †
Women						
All participants	18.0 (16.4-19.6)	---	4.8 (3.2-6.4)	---	27.2 (24.2-30.4)	---
Age (years)						
25-34	6.7 (5.3-8.1)	1 [reference]	1.7 (0.2-3.3)	1 [reference]	25.1 (16.8-33.4)	1 [reference]
35-44	16.5 (14.4-18.6)	2.52 (2.06-3.08)	4.6 (1.9-7.2)	2.64 (1.09-6.39)	26.6 (20.2-33.0)	1.05 (0.70-1.56)
45-54	31.3 (28.0-34.7)	4.27 (3.45-5.28)	5.2 (2.6-7.9)	3.00 (1.12-8.02)	28.4 (22.7-34.2)	1.03 (0.69-1.64)
55-64	36.4 (32.1-40.6)	4.94 (3.91-6.24)	6.3 (2.2-10.4)	3.57 (1.28-9.99)	27.7 (20.6-34.7)	0.99 (0.66-1.47)
Education (years)						
<1	25.0 (22.6-27.3)	1 [reference]	5.1 (3.2-7.0)	1 [reference] ‡	29.5 (25.6-33.3)	1 [reference]
1-5	11.0 (9.4-12.6)	0.73 (0.62-0.85)	3.9 (1.1-6.7)	0.92 (0.42-2.05)	20.9 (14.8-27.0)	0.68 (0.48-0.96)
6-7	3.4 (1.8-5.0)	0.48 (0.29-0.80)	4.9 (0.0-14.4)	1.30 (0.13-12.56)	18.1 (1.3-34.8)	0.47 (0.18-1.26)
≥8	3.5 (0.8-6.3)	0.42 (0.19-0.95)	---	---	22.5 (0.0-45.9)	0.55 (0.18-1.69)
South/north province						
South	5.9 (4.3-7.5)	1 [reference]	5.2 (0.6-9.8)	1 [reference]	27.3 (17.3-37.2)	1 [reference]
North	23.1 (20.9-25.2)	3.57 (2.70-4.71)	4.7 (3.0-6.4)	0.97 (0.35-2.66)	27.2 (24.0-30.5)	0.96 (0.63-1.44)
Urban/rural setting						
Urban	10.6 (7.9-13.4)	1 [reference]	3.4 (1.2-5.7)	1 [reference]	34.0 (25.7-42.3)	1 [reference]
Rural	21.0 (19.0-23.0)	1.34 (1.07-1.69)	5.1 (3.2-7.0)	1.45 (0.67-3.18)	25.8 (22.6-28.9)	0.70 (0.53-0.94)
Men						
All participants	39.9 (38.0-41.8)	---	4.2 (2.9-5.5)	---	22.0 (19.8-24.1)	---
Age (years)						
25-34	38.4 (35.2-41.6)	1 [reference]	4.6 (2.5-6.8)	1 [reference]	20.9 (17.3-24.5)	1 [reference]
35-44	39.1 (36.0-42.2)	1.03 (0.92-1.14)	3.5 (1.6-5.4)	0.80 (0.43-1.47)	23.8 (19.5-28.2)	1.14 (0.88-1.47)
45-54	42.5 (38.9-46.2)	1.08 (0.96-1.22)	2.9 (3.8-5.4)	0.60 (0.22-1.58)	20.3 (15.6-25.0)	0.94 (0.70-1.28)
55-64	41.3 (36.8-45.9)	1.04 (0.90-1.21)	6.6 (2.5-10.6)	1.29 (0.61-2.74)	23.7 (17.8-30.0)	1.08 (0.80-1.46)
Education (years)						
<1	45.0 (41.7-48.3)	1 [reference]	5.8 (3.0-8.7)	1 [reference]	22.9 (18.0-27.8)	1 [reference]
1-5	41.1 (38.7-43.5)	0.95 (0.88-1.04)	3.5 (2.2-4.8)	0.65 (0.35-1.23)	22.4 (19.3-25.5)	0.96 (0.72-1.28)
6-7	33.6 (29.6-37.5)	0.84 (0.73-0.98)	5.0 (0.0-10.1)	1.00 (0.27-3.68)	18.4 (11.7-25.2)	0.77 (0.47-1.26)
≥8	23.0 (18.1-28.0)	0.61 (0.48-0.77)	0.7 (0.0-2.1)	0.15 (0.02-1.20)	19.1 (8.2-30.0)	0.78 (0.41-1.51)
South/north province						
South	28.3 (25.3-31.3)	1 [reference]	3.7 (1.8-5.6)	1 [reference]	20.9 (16.2-25.6)	1 [reference]
North	42.7 (40.5-45.0)	1.39 (1.23-1.57)	4.3 (2.8-5.7)	0.98 (0.50-1.94)	22.2 (19.8-24.6)	1.06 (0.82-1.39)
Urban/rural setting						
Urban	30.8 (27.7-33.9)	1 [reference]	3.0 (0.8-5.2)	1 [reference]	22.9 (17.8-27.9)	1 [reference]
Rural	43.1 (40.8-45.4)	1.20 (1.07-1.34)	4.5 (3.0-6.0)	1.44 (0.54-3.82)	21.7 (19.4-24.1)	0.89 (0.68-1.16)

* adjusted for age (categorical: 25-34, 35-44, 45-54, 55-64 years), education (categorical: <1, 1-5, 6-7, ≥8 years); south/north province and urban/rural setting;
† 95% confidence interval;
‡ adjusted for age (categorical: 25-34, 35-44, 45-54, 55-64 years), education (categorical: <1, 1-5, ≥6 years); south/north province and urban/rural setting.

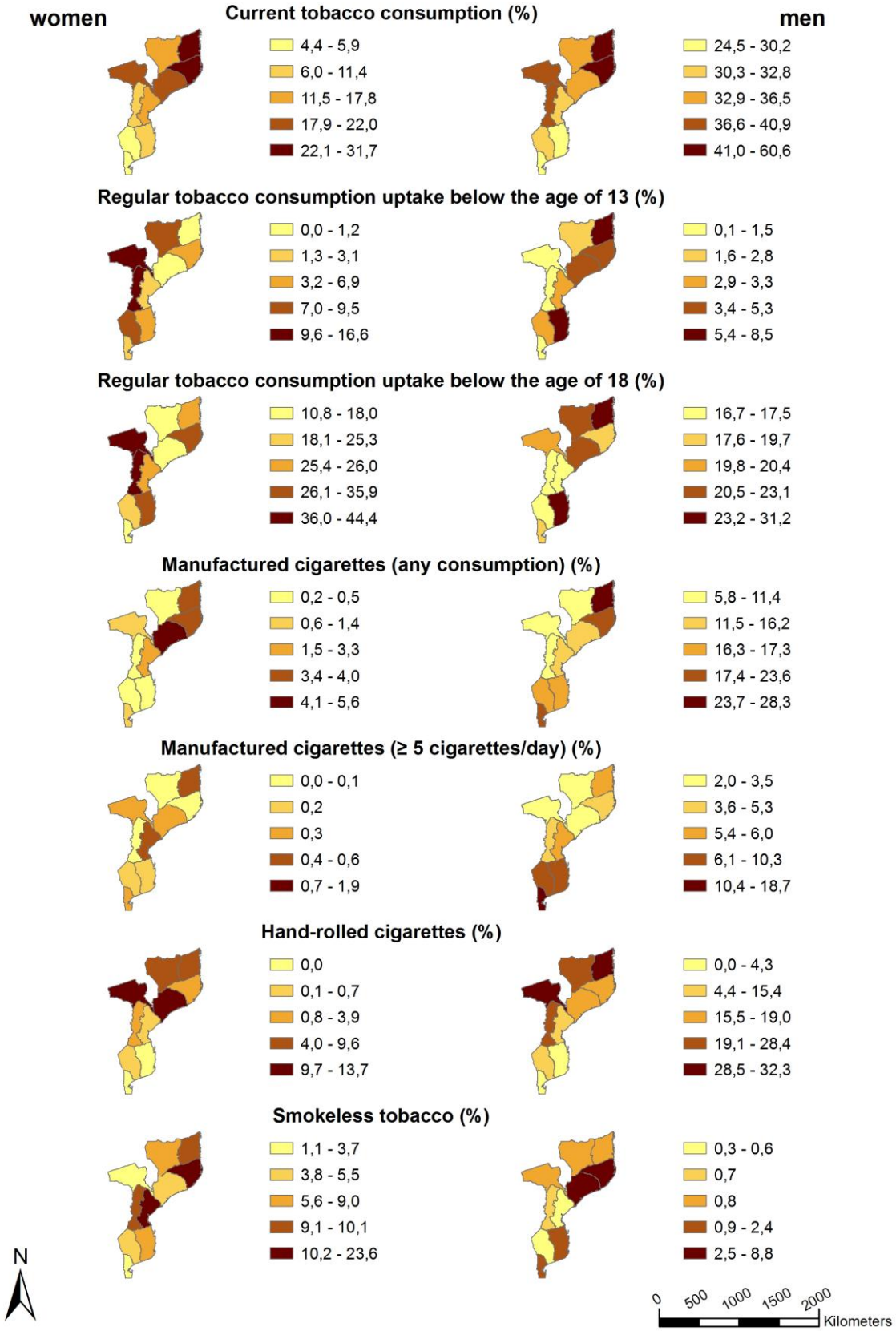
Table 3. Prevalence of current consumption of different types of tobacco* according to socio-demographic variables, by gender.

	Manufactured cigarettes							
	Any consumption		≥ 5 cigarettes/day		Hand-rolled cigarettes		Smokeless tobacco	
	Prevalence (95%CI) ‡	Prevalence Ratio † (95%CI) ‡	Prevalence (95%CI) ‡	Prevalence Ratio † (95%CI) ‡	Prevalence (95%CI) ‡	Prevalence Ratio † (95%CI) ‡	Prevalence (95%CI) ‡	Prevalence Ratio † (95%CI) ‡
Women								
All participants	2.7 (1.9-3.4)	---	0.3 (0.2-0.5)	---	5.0 (4.2-5.9)	---	10.1 (8.8-11.4)	---
Age (years)								
25-34	1.7 (1.1-2.3)	1 [reference]	0.2 (0.1-0.4)	1 [reference]	1.5 (0.8-2.2)	1 [reference]	3.4 (2.4-4.4)	1 [reference]
35-44	3.4 (2.3-4.5)	2.02 (1.31-3.13)	0.4 (0.1-0.7)	2.00 (0.75-5.34)	4.4 (3.3-5.5)	3.05 (1.94-4.78)	8.7 (7.0-10.4)	2.55 (1.95-3.34)
45-54	4.0 (2.2-5.8)	2.35 (1.48-3.75)	0.5 (0.0-1.0)	3.08 (0.75-12.67)	9.1 (7.2-10.9)	5.34 (3.30-8.63)	17.9 (15.0-20.8)	4.61 (3.41-6.23)
55-64	2.2 (0.7-3.6)	1.35 (0.64-2.83)	0.3 (0.0-0.7)	2.18 (0.40-11.90)	11.3 (8.4-14.1)	6.57 (3.97-10.86)	22.5 (18.7-26.3)	5.73 (4.10-8.01)
Education (years)								
<1	3.0 (1.9-4.2)	1 [reference]	0.2 (0.0-0.4)	1 [reference]	7.5 (6.1-8.9)	1 [reference] §	14.1 (12.2-16.0)	1 [reference] §
1-5	2.1 (1.3-2.8)	0.76 (0.48-1.21)	0.3 (0.1-0.6)	1.33 (0.51-3.47)	2.4 (1.7-3.1)	0.65 (0.47-0.90)	6.5 (5.2-7.7)	0.75 (0.61-0.93)
6-7	2.4 (1.1-3.6)	1.03 (0.50-2.11)	1.2 (0.3-2.1)	3.88 (1.26-11.93)	0.5 (0.3-1.2)	0.37 (0.08-1.73)	0.5 (0.1-1.1)	0.07 (0.02-0.24)
≥8	3.5 (0.8-6.3)	1.22 (0.48-3.12)	1.5 (0.0-3.7)	3.76 (0.77-18.23)	---	---	---	---
South/north province								
South	1.2 (0.6-1.8)	1 [reference]	0.5 (0.1-1.0)	1 [reference]	0.0 (0.0-0.00)	1 [reference]	4.6 (3.1-6.2)	1 [reference]
North	3.3 (2.2-4.3)	3.26 (1.90-5.56)	0.3 (0.1-0.4)	0.92 (0.41-2.07)	7.2 (5.9-8.4)	230.46 (32.05-1657.26)	12.4 (10.7-14.2)	2.40 (1.69-3.42)
Urban/rural region								
Urban	3.6 (2.0-5.2)	1 [reference]	0.8 (0.3-1.3)	1 [reference]	1.0 (0.4-1.6)	1 [reference]	6.1 (4.3-7.8)	1 [reference]
Rural	2.3 (1.4-3.1)	0.51 (0.27-0.95)	0.1 (0.0-0.2)	0.23 (0.10-0.54)	6.7 (5.5-7.9)	4.08 (2.11-7.88)	11.8 (10.1-13.5)	1.31 (0.97-1.78)

	Manufactured cigarettes							
	Any consumption		≥ 5 cigarettes/day		Hand-rolled cigarettes		Smokeless tobacco	
	Prevalence (95%CI) ‡	Prevalence Ratio † (95%CI) ‡	Prevalence (95%CI) ‡	Prevalence Ratio † (95%CI) ‡	Prevalence (95%CI) ‡	Prevalence Ratio † (95%CI) ‡	Prevalence (95%CI) ‡	Prevalence Ratio † (95%CI) ‡
Men								
All participants	17.2 (15.6-18.8)	---	6.0 (5.2-6.9)	---	18.7 (16.7-20.7)	---	3.7 (2.9-4.6)	---
Age (years)								
25-34	22.9 (20.1-25.8)	1 [reference]	6.6 (5.2-8.0)	1 [reference]	14.1 (11.6-16.7)	1 [reference]	1.2 (0.4-1.9)	1 [reference]
35-44	17.8 (15.2-20.3)	0.76 (0.63-0.91)	7.4 (5.8-9.0)	1.06 (0.79-1.43)	19.0 (15.9-22.1)	1.38 (1.13-1.68)	1.9 (0.9-3.0)	1.70 (0.76-3.80)
45-54	13.7 (11.3-16.1)	0.61 (0.49-0.75)	5.7 (4.1-7.4)	0.84 (0.58-1.20)	21.3 (18.2-24.5)	1.43 (1.18-1.73)	7.1 (4.9-9.3)	5.54 (3.05-10.07)
55-64	7.2 (4.4-10.0)	0.34 (0.23-0.50)	2.5 (1.4-3.5)	0.37 (0.24-0.57)	25.5 (21.4-29.6)	1.62 (1.31-2.01)	8.4 (5.6-11.2)	6.09 (2.96-12.50)
Education (years)								
<1	10.3 (7.7-12.8)	1 [reference]	2.6 (1.5-3.8)	1 [reference]	27.9 (24.3-31.6)	1 [reference]	6.2 (4.4-8.0)	1 [reference] §
1-5	18.1 (16.1-20.0)	1.55 (1.22-1.96)	6.5 (5.4-7.6)	1.79 (1.16-2.76)	19.1 (16.8-21.4)	0.80 (0.69-0.92)	3.7 (2.6-4.9)	0.78 (0.51-1.20)
6-7	26.5 (22.5 (30.5)	1.71 (1.30-2.25)	9.6 (7.1-12.1)	1.75 (1.04-2.95)	6.8 (4.1-9.4)	0.41 (0.28-0.60)	0.3 (0.1-0.7)	0.08 (0.02-0.35)
≥8	20.9 (15.9-25.9)	1.26 (0.86-1.83)	9.1 (5.8-12.4)	1.38 (0.70-2.73)	2.0 (0.1-3.8)	0.16 (0.06-0.39)	---	---
South/north province								
South	21.4 (18.8-23.8)	1 [reference]	13.4 (11.2-15.6)	1 [reference]	5.0 (3.4-6.5)	1 [reference]	1.5 (0.3-2.8)	1 [reference]
North	16.2 (14.2-18.1)	0.87 (0.74-1.03)	4.2 (3.3-5.2)	0.41 (0.31-0.54)	22.1 (19.6-24.5)	3.25 (2.42-4.37)	4.2 (3.2-5.2)	2.41 (1.03-5.61)
Urban/rural region								
Urban	25.3 (22.4-28.2)	1 [reference]	12.0 (9.9-14.0)	1 [reference]	4.2 (2.9-5.4)	1 [reference]	1.3 (0.5-2.1)	1 [reference]
Rural	14.3 (12.5-16.2)	0.64 (0.51-0.79)	3.9 (3.1-4.8)	0.46 (0.32-0.66)	23.8 (21.4-26.3)	3.64 (2.66-4.99)	4.6 (3.5-5.7)	2.21 (1.10-4.41)

* main type of tobacco consumed;
† adjusted for age (categorical: 25-34, 35-44, 45-54, 55-64 years), education (categorical: <1, 1-5, 6-7, ≥8 years), south/north province and urban/rural setting;
‡ 95% confidence interval;
§ adjusted for age (categorical: 25-34, 35-44, 45-54, 55-64 years), education (categorical: <1, 1-5, ≥6 years), south/north province and urban/rural setting.

Figure 1. Prevalence of current tobacco consumption in different provinces of Mozambique, by gender.



2.2. Changing patterns of tobacco consumption in Mozambique: evidence from internal migration to the country capital

Changing patterns of tobacco consumption in Mozambique: evidence from internal migration to the country capital

Nuno Lunet[1,2], Carla Araújo[1,2,3], Carla Silva-Matos[4], Albertino Damasceno[5], Maria Lídia Gouveia[6], Ana Azevedo[1,2]

[1] Department of Hygiene and Epidemiology, University of Porto Medical School, Porto, Portugal;

[2] Institute of Public Health – University of Porto (ISPUP), Porto, Portugal;

[3] Department of Cardiology, Centro Hospitalar de Entre Douro e Vouga, EPE, Hospital de São Sebastião, Santa Maria da Feira, Portugal;

[4] Department of Non-Communicable Diseases, Mozambique Ministry of Health, Maputo, Mozambique;

[5] Faculty of Medicine, Eduardo Mondlane University, Maputo, Mozambique;

[6] Department of Mental Health, Mozambique Ministry of Health, Maputo, Mozambique.

ABSTRACT

Background: The capital of Mozambique, Maputo, hosts a high proportion of internal migrants and contrasts with the rest of the country regarding sociodemographic characteristics of the population and patterns of tobacco exposure. We conducted a migrants study to compare the prevalence of manufactured cigarettes smoking and traditional forms of tobacco use between the capital city dwellers that were also born in Maputo City (MC/MC) with those born in southern (SP/MC) or northern (NP/MC) provinces, and with inhabitants in the same southern (SP) and northern regions (NP).

Methods: A representative sample of 12902 Mozambicans aged 25-64 years was evaluated in a national household survey conducted in 2003. We computed age- and education-adjusted prevalence ratios (PR) with 95% confidence intervals (95%CI) using Poisson regression.

Results: The prevalence of any type of tobacco consumption among Maputo City inhabitants born in other southern or northern provinces contrasted with those observed in the locally born (SP/MC vs. MC/MC – men: PR=0.61, 95%CI: 0.44-0.85; women: PR=0.38, 95%CI: 0.18-0.79; NP/MC vs. MC/MC – men: PR=0.66, 95%CI: 0.34-1.29; women: PR=4.56, 95%CI: 1.78-11.69) and resembled those of the inhabitants of their provinces of origin. More dramatic changes were observed for traditional forms of tobacco use among men, which were seldom consumed in Maputo City, in stark contrast with other provinces.

Conclusions: Setting-specific factors related to cultural background, affordability and availability of different types of tobacco are strong determinants of tobacco consumption patterns in urban Mozambique and need to be considered when developing strategies to tackle the progression of the tobacco epidemic.

INTRODUCTION

The patterns of tobacco consumption are shaped by demographic, economic, and cultural determinants[1] as well as by the tobacco industry pressure and the enforcement of measures for controlling tobacco exposure[2-5] which operate to different extents in specific settings and phases of the tobacco epidemic.

Transnational tobacco manufacturing and tobacco leaf companies make numerous efforts to resist global tobacco control, namely by stressing the economic importance of tobacco to the developing countries that grow it,[2, 6-7] and effective anti-tobacco policies still lack in many developing countries. Specifically in Mozambique, a country that signed but did not yet ratify the Framework Convention on Tobacco Control,[8] tobacco production increased recently, from 1500 tons, involving about 6000 producers, in 1997, to 60000 tons, involving about 150000 producers, in 2006, mostly in the northern provinces.[9]

In the African setting, oppositely to most high income societies, the consumption of hand-rolled cigarettes and smokeless tobacco is common,[10] but urbanization is driving a shift from the consumption of traditional forms of tobacco to manufactured cigarettes smoking.[11-12] This is also expected in Mozambique where we recently showed that the overall tobacco consumption was higher than expected for an African country at the early stages of the tobacco epidemic, with hand-rolled and smokeless tobacco consumption being more frequent than manufactured cigarettes smoking. A gender-specific geographical distribution of the patterns of tobacco use was also observed, with women consuming predominantly smokeless tobacco, especially in the north, while southern and urban men consumed mostly manufactured cigarettes and those from the north and living in rural areas opted more frequently for hand-rolled cigarettes.[13]

Therefore, we hypothesized that among the dwellers in each Mozambican region there will be differences in the patterns of consumption according to the place of

birth, and tested this hypothesis with a migrants study design. We aimed to compare the prevalence of manufactured cigarettes smoking and traditional forms of tobacco use between dwellers in the capital Maputo City that were also born in the capital with those born in other southern or northern regions of Mozambique, and with inhabitants of the same southern and northern regions.

METHODS

Study design

Between September and December 2003, 12902 subjects aged 25 to 64 years were evaluated in a community-based cross-sectional study, using the sampling frame of the 1997 census, which was designed to be representative at national and province levels and by place of residence (urban or rural). Six hundred and four geographical clusters were selected, and among each of them all the households were listed and 24 randomly selected and visited. Homeless and people living in collective residential institutions (*e.g.* hotels, hospitals, military facilities) were not eligible. All the eligible subjects in the same household were invited to the study.

Trained interviewers conducted face-to-face interviews in each household. Given the ethnic and linguistic diversity in Mozambique, all interviewers were able to correctly speak the predominant languages in the regions where they collected data. Subjects were evaluated following standardized procedures and using a structured questionnaire for assessment of sociodemographic and behavioral factors.

Data collection and analysis

Regarding tobacco consumption, participants were asked about the use of any tobacco product, including manufactured cigarettes, hand-rolled cigarettes and smokeless tobacco. Current tobacco consumers were asked about the type of tobacco most often consumed, and classified as consumers of manufactured cigarettes or traditional forms of tobacco consumption (hand-rolled cigarettes or smokeless tobacco). Only 20 subjects reported cigar or pipe smoking as the predominant type of tobacco consumed and these categories were not considered in the analysis by type of tobacco.

The classification of the place of residence as urban (in any of the 23 cities and 68 towns) or rural (outside cities or towns) was done in accordance with the 1997 census.[14]

Education was registered as the highest education level attained and participants grouped in four categories (<1 year, 1-5 years, 6-7 years, ≥8 years).

In Mozambique there is a clear north/south gradient in the patterns of exposure to tobacco.[13] Maputo City, which corresponds to the capital Maputo, is the only of the 11 provinces hosting a high proportion of internal migrants (Table 1) and depicting the strongest contrasts with the rest of the country in terms of sociodemographic characteristics (Table 1) and smoking habits of the population.[13] Therefore, for analysis we grouped participants according to the place of residence as shown in Figure 1: Maputo City (1162000 inhabitants in 633 km^2); other southern provinces (3561000 inhabitants in 170283 km^2); northern provinces (13789000 inhabitants in 629276 km^2).[15] The dwellers in the country capital were further classified according to their place of birth: Maputo City, other southern provinces; northern provinces.

We computed age- and education-adjusted prevalences and prevalence ratios with 95% confidence intervals (95%CI) using logistic and Poisson regression models, respectively, for overall tobacco consumption and for the types of tobacco consumed more often (manufactured cigarettes and traditional forms of tobacco use). All the analyses were conducted considering the sampling weights and adjusting for strata and clustering at the primary sampling unit level using Stata, version 9.2, including 12891 subjects for whom data were available on the consumption of tobacco and sociodemographic variables (complete data were not available for only 11 subjects).

The study protocol was approved by the National Mozambican Ethics Committee and written informed consent was obtained from all participants.

RESULTS

Characteristics of the study sample

Among the dwellers in Maputo City, nearly three quarters were born in other provinces, predominantly from the south, but more than 90% were already living in Maputo five years before the present survey. On the other hand, less than 10% of the inhabitants of southern provinces and less than 5% of those living in the north were born in other regions. Maputo City is an exclusively urban area, and the proportion of subjects living in rural settings was higher in the northern provinces (approximately three quarters) than in the southern ones (approximately three fifths) (Table 1).

Most subjects were aged less than 45 years (two thirds) with no meaningful differences by region, except for a higher proportion of older subjects among those living outside Maputo City. Overall, about half the women and one quarter of men had no formal education and less than 5% of the women and less than 10% of men had secondary or higher education. The proportion of subjects with the lowest education levels gradually increased from Maputo City (15.2% among women versus 3.0% among men) to the north (59.4% among women versus 25.1% among men) (Table 1).

Tobacco consumption according to internal migration to the country capital

The prevalence estimates for overall tobacco consumption and types of tobacco consumed more frequently for Maputo City dwellers, according to place of birth [Maputo City dwellers born in Maputo City (MC/MC), other southern provinces (SP/MC) or northern provinces (NP/MC)], and for the inhabitants in the other southern (SP/SP) and northern provinces (NP/NP) are presented in Table 2, and Figure 2 depicts the corresponding prevalence ratios using MC/MC as reference.

Among women, Maputo City dwellers born in other southern provinces had a lower prevalence of tobacco consumption than those born in Maputo City (SP/MC versus MC/MC, adjusted prevalence ratio=0.38, 95%CI: 0.18-0.79), which was lower but not significantly different from the observed in the inhabitants of the other southern regions (SP/MC versus SP/SP: adjusted prevalence ratio=0.53, 95%CI: 0.25-1.13). These differences are due mainly to a similar pattern of manufactured cigarettes smoking between Maputo City dwellers born in other southern provinces and inhabitants of those provinces (SP/MC versus SP/SP, adjusted prevalence ratio=1.63, 95%CI: 0.50-5.26), since the latter present much lower prevalences than the Maputo City dwellers born in the capital (SP/SP versus MC/MC, adjusted prevalence ratio=0.16, 95%CI: 0.07-0.38). Regarding traditional forms of tobacco use, the prevalences were not significantly different between Maputo City dwellers born in Maputo City or in the other southern provinces (SP/MC versus MC/MC, adjusted prevalence ratio=1.66, 95%CI: 0.31-8.93), as among the latter the prevalence was three-fold lower than in southern provinces dwellers (SP/MC versus SP/SP, adjusted prevalence ratio=0.33, 95%CI: 0.12-0.88). The prevalence of tobacco consumption was higher in women living in Maputo City that were born in the north than in those born in Maputo City (NP/MC versus MC/MC, adjusted prevalence ratio=4.56, 95%CI: 1.78-11.69), and the same was observed for the traditional forms of tobacco use (NP/MC versus MC/MC, adjusted prevalence ratio=12.21, 95%CI: 1.05-141.79). Although overall tobacco consumption in Maputo City dwellers born in the north was not significantly different from the observed in the northern provinces (NP/MC versus NP/NP, adjusted prevalence ratio=2.07, 95%CI: 0.84-5.10), manufactured cigarettes smoking was more frequent (NP/MC versus NP/NP, adjusted prevalence ratio=6.14, 95%CI: 1.84-20.50) and the traditional forms were used less often (NP/MC versus NP/NP, adjusted prevalence ratio=0.87, 95%CI: 0.83-0.92).

Among men, the prevalence of tobacco consumption (all types) in Maputo City dwellers born in other southern provinces was lower than in those born and living in

Maputo City (SP/MC versus MC/MC, adjusted prevalence ratio=0.61, 95%CI: 0.44-0.85), but similar to the observed in inhabitants of the remaining southern regions (SP/MC versus SP/SP, adjusted prevalence ratio=0.93, 95%CI: 0.72-1.20). No significant differences between these groups were observed for manufactured cigarettes smoking (SP/MC versus MC/MC, adjusted prevalence ratio=0.85, 95%CI: 0.61-1.18; SP/MC versus SP/SP, adjusted prevalence ratio=1.20, 95%CI: 0.90-1.58), but no traditional forms of tobacco use were observed among men born and living in Maputo City while those born in the southern provinces and then moving to Maputo City were less likely to report the use of hand-rolled or smokeless tobacco as the type of tobacco more frequently consumed (SP/MC versus SP/SP, adjusted prevalence ratio=0.14, 95%CI: 0.02-0.97). The prevalence of use of any type of tobacco in Maputo City dwellers born in the northern provinces was not significantly different from the observed in subjects born and living in Maputo City (NP/MC versus MC/MC, adjusted prevalence ratio=0.66, 95%CI: 0.34-1.29) or in the northern provinces inhabitants (NP/MC versus NP/NP, adjusted prevalence ratio=0.66, 95%CI: 0.36-1.20), and the same was observed for manufactured cigarettes smoking (NP/MC versus MC/MC, adjusted prevalence ratio=0.80, 95%CI: 0.39-1.63; NP/MC versus NP/NP, adjusted prevalence ratio=1.30, 95%CI: 0.66-2.53). However, the prevalence of traditional forms of tobacco use in Maputo City dwellers born in the northern provinces and in those born in Maputo City was 0%, in stark contrast with the high consumptions in the northern provinces (adjusted prevalence=25.6%).

DISCUSSION

Among Maputo City inhabitants there were important differences in the patterns of tobacco consumption according to the place of birth. Prevalences of manufactured cigarettes smoking in subjects born in other southern provinces or in the north of the country tended to depart from the observed in the locally born and resembled more closely the observed in inhabitants of their provinces of origin. More dramatic changes in the patterns of consumption with migration were observed regarding the exposure to traditional forms of tobacco use among men, which were virtually not referred as the main type of tobacco consumed, in stark contrast with the observed in the inhabitants of other provinces.

Migrant studies have generally supported the role of environmental exposures as determinants of chronic conditions, namely oncologic and cardiovascular, or infectious diseases,[16-20] by showing changes in their frequency among migrant populations towards the observed in the host settings. The evidence provided by studies focusing on the patterns of disease according to migration status is based on the assumption that changes in the rates of the diseases within one or two generations are predominantly explained by variation in the individual exposure to disease determinants,[21] which is supported by migrant studies specifically addressing the changes in behaviours, such as diet or tobacco consumption.[22-26]

Place of birth and place of residence are predictors of both health exposures and outcomes,[25] and the characterization of the patterns of change in exposure to risk factors for chronic diseases according to internal migrations, namely from rural to urban areas (in Sub-Saharan Africa it is estimated that 35% of the population lived in urban areas in 2005 and that by 2050 this proportion will have risen to 61%[27]), may support locally grounded public health interventions. Luo tribe members moving from rural land in western Kenya to urban Nairobi, displayed an increase in mean systolic blood pressure after migration, and exhibited a greater prevalence of hypertension, than tribe

members who did not migrate.[28] Similarly, migrants moving from southwestern rural China to the urban area of Xichang City showed an increase in serum total cholesterol.[29] In Tanzania, 12 months after migration from the Morogoro rural region to urban Dar es Salaam, migrants decreased physical activity, increased weight and increased the intake of red meat, but also of fresh fruit and vegetables, with mixed changes in lipid profile and a decrease in blood pressure.

Studies of differences in smoking prevalence between migrants and the host population showed trends of convergence in smoking prevalence that differed according to ethnic group, gender, socioeconomic group and length of residence.[26, 30-33] Trends of converging risk factors were found for smoking among Turkish men migrating to Netherlands; while Turkish women of second generation smoked significantly more than ethnic Dutch women. This trend was not observed for smoking among Moroccan migrants to the Netherlands.[26] Prevalences of tobacco consumption partly converged to those of the German reference population or were even higher, but only in the second generation of Turkish migrants.[33]

To our knowledge the present investigation is the first addressing this topic in a Sub-Saharan African country at the early stages of the epidemiological transition, adding to previous research original and methodologically sound evidence on the dynamics of tobacco exposure in these settings, that may inform local tobacco control policies. It is, however, limited by the small number of internal migrants to Maputo born in the northern provinces, and because the exposure to each form of tobacco use was not specifically quantified, although valid estimates were obtained regarding the patterns of exposure to different types of tobacco reported as the more frequently consumed. Furthermore, although age- and education-adjusted estimates were computed in a gender-stratified analysis, these variables are unlikely to fully capture the potential confounding effect of socioeconomic and cultural differences between migrants and the remaining population. However, it seems unlikely that the observed patterns, characterized by consistent relations that are in accordance with the

heterogeneity in sociodemographic and cultural characteristics, and tobacco consumption patterns across regions in Mozambique, would disappear if a finer adjustment for potential confounders could have been accomplished.

The interpretation of our findings needs to take into account that, for most subjects, migration to Maputo represents more than a change from a less urbanized to a more urbanized setting. The regional differences in tobacco production, with a substantially higher production and a much easier access to raw tobacco products in the north, contribute to explain why migrants to Maputo City tended to smoke manufactured cigarettes more often and to use traditional forms of tobacco consumption less often than inhabitants of their provinces of origin. This change of the main type of tobacco consumed was very pronounced among women from the north, probably reflecting the fact that matrilineal systems, with high female illiteracy, predominate in the northern provinces, while southern women tend to receive more formal education and to have an easier access to information.[34] This strengthens the fact that women from settings where tobacco consumption is locally acceptable are potential new consumers of manufactured cigarettes[13] and is in accordance with the evidence that the tobacco companies are increasing their targeting of women in developing countries.[35]

In conclusion, setting-specific factors related to cultural background, affordability and availability of different types of tobacco are strong determinants of the tobacco consumption patterns in urban Mozambique and need to be considered when developing strategies to tackle the progression of the tobacco epidemic. Of particular concern are the trends in smoking behaviour among women.

Table 1. Sociodemographic characteristics of the participants.

	Place of residence in 2003								
	Maputo City			Southern provinces *			Northern provinces †		
	n	Unweighted % ‡	Weighted % ‡	n	Unweighted % ‡	Weighted % ‡	n	Unweighted % ‡	Weighted % ‡
Women	724			2368			4756		
Place of birth									
Maputo City	282	39.0	38.3	70	3.0	3.0	7	0.2	0.0
Southern provinces †	408	56.4	57.0	2256	95.3	95.2	57	1.2	0.9
Northern provinces ‡	23	3.2	3.7	36	1.5	15.5	4581	96.4	96.9
Out of the country	11	1.5	1.0	6	0.2	0.2	105	2.2	2.2
Place of residence in 1998 §									
Maputo City	667	93.3	93.1	54	2.3	2.2	2	0.0	0.0
Southern provinces †	43	6.0	6.1	2284	97.2	97.1	3	0.1	0.1
Northern provinces ‡	5	0.7	0.8	13	0.6	0.7	4722	99.8	99.8
Other country	II	II	II	II	II	II	5	0.1	0.1
Place of residence in 2003									
Urban	724	100.0	100.0	873	36.9	33.0	1274	26.8	21.9
Rural	0	0.0	0.0	1495	63.1	67.0	3482	73.2	78.1
Age (years)									
25-34	291	40.2	40.3	864	36.5	37.0	1996	42.0	42.2
35-44	215	29.7	29.5	646	27.3	27.6	1255	26.4	25.4
45-54	150	20.7	20.2	507	21.4	20.8	950	20.0	20.6
55-64	68	9.4	9.9	351	14.8	14.6	555	11.7	11.8
Education (years)									
<1	110	15.2	14.4	1011	42.7	43.7	2819	59.4	61.6
1-5	402	55.5	54.6	1085	45.8	45.1	1637	34.5	33.7
6-7	124	17.1	17.7	191	8.1	8.0	186	3.9	3.0
≥8	88	12.2	13.2	80	3.4	3.2	101	2.1	1.7
Men	393			1053			3597		
Place of birth									
Maputo City	143	36.4	37.5	34	3.2	3.2	1	0.0	0.0
Southern provinces †	205	52.2	52.1	955	90.7	91.8	30	0.8	0.6
Northern provinces ‡	40	10.2	9.3	58	5.5	4.7	3500	97.4	98.0
Out of the country	5	1.3	1.1	6	0.6	0.2	61	1.7	1.4
Place of residence in 1998 §									
Maputo City	345	93.0	92.8	35	3.4	3.0	4	0.1	0.0
Southern provinces †	15	4.0	4.1	967	95.4	95.0	5	0.1	0.2
Northern provinces ‡	11	3.0	3.1	12	1.2	1.1	3539	99.6	99.6
Other country	II	II	II	II	II	II	5	0.1	0.1
Place of residence in 2003									
Urban	393	100.0	100.0	401	38.1	34.1	902	25.1	20.1
Rural	0	0.0	0.0	652	61.9	65.9	2695	74.9	79.8
Age (years)									
25-34	153	38.9	39.3	324	30.8	28.9	1323	36.8	37.5
35-44	99	25.2	25.5	278	26.4	27.2	1020	28.4	27.7
45-54	83	20.7	19.2	249	23.6	24.1	756	21.0	20.7
55-64	58	9.4	16.0	202	19.2	19.8	498	13.8	14.2
Education (years)									
<1	12	3.0	2.3	217	20.6	20.4	903	25.1	28.6
1-5	211	53.7	52.6	569	54.0	55.9	2022	56.3	55.2
6-7	90	22.9	23.5	153	14.5	14.6	413	11.5	10.5
≥8	80	20.4	21.5	114	10.8	9.1	254	7.1	5.7

* Maputo Province, Gaza and Inhambane; † Manica, Sofala, Tete, Zambézia, Nampula, Niassa and Cabo Delgado; ‡ Within each variable the sum of the proportions may not be 100% due to rounding; § The sum of the number of participants in each category is lower than the total in each group due to missing data; II No observations.

Table 2. Prevalence of different forms of tobacco consumption for participants living in Maputo city, according to their place of birth, and for participants living in other Mozambican provinces.

	Tobacco consumption					
	Any type of tobacco		Manufactured cigarettes *		Traditional forms of tobacco consumption*	
	Crude prevalence % (95%CI)	Adjusted† prevalence % (95%CI)	Crude prevalence % (95%CI)	Adjusted† prevalence % (95%CI)	Crude prevalence % (95%CI)	Adjusted† prevalence % (95%CI)
Women						
Place of birth/place of residence						
Maputo City/Maputo City	4.4 (1.8-6.9)	6.4 (3.7-11.0)	4.0 (1.5-6.5)	4.4 (2.3-8.0)	0.4 (0.0-1.0)	0.6 (0.1-2.4)
Southern provinces‡/Maputo City	3.1 (0.8-5.4)	2.0 (0.9-4.3)	1.6 (0.0-3.6)	1.5 (0.4-4.7)	1.4 (0.1-2.8)	0.9 (0.3-2.2)
Southern provinces‡II/Southern provinces‡	6.3 (4.4-8.2)	3.9 (2.8-5.3)	0.7 (0.3-1.1)	0.6 (0.3-1.2)	5.6 (3.7-7.4)	3.2 (2.2-4.5)
Northern provinces§/Maputo City	19.6 (16.3-37.6)	32.0 (13.1-59.4)	16.2 (0.0-33.7)	16.8 (5.2-42.6)	3.4 (0.0-10.1)	6.4 (0.9-33.4)
Northern provinces§II/Northern provinces§	23.1 (20.9-25.2)	18.1 (15.9-20.5)	3.3 (2.2-4.3)	3.2 (2.4-4.3)	19.6 (17.6-21.6)	13.8 (11.9-16.1)
Men						
Place of birth/place of residence						
Maputo City/Maputo City	35.2 (26.2-44.2)	42.2 (32.7-52.4)	35.2 (26.2-44.2)	26.0 (18.7-35.0)	¶	¶
Southern provinces‡/Maputo City	24.4 (19.3-29.4)	26.6 (21.4-32.4)	23.0 (17.8-28.2)	22.2 (17.1-28.3)	0.8 (0.0-2.5)	0.9 (0.1-5.9)
Southern provinces‡II/Southern provinces‡	28.1 (24.5-31.8)	29.1 (25.5-33.0)	19.1 (16.3-21.9)	18.4 (15.7-21.5)	8.4 (5.8-11.0)	7.7 (5.7-10.4)
Northern provinces§/Maputo City	24.2 (9.5-38.9)	28.5 (15.2-47.0)	24.2 (9.5-38.9)	20.3 (9.6-38.0)	¶	¶
Northern provinces§II/Northern provinces§	42.7 (40.5-45.0)	43.4 (41.2-45.7)	16.2 (14.2-18.1)	15.2 (13.3-17.2)	26.3 (23.7-28.9)	25.6 (23.0-28.4)

95%CI – 95% confidence interval.

* Form of tobacco consumption reported as the most frequent by current smokers; † Age- and education-adjusted; ‡ Maputo Province, Gaza and Inhambane; § Manica, Sofala, Tete, Zambézia, Nampula, Niassa and Cabo Delgado; II These groups include a small proportion of subjects born elsewhere; ¶ No observations.

Figure 1. Distribution of the Mozambican provinces and respective grouping for data analysis.

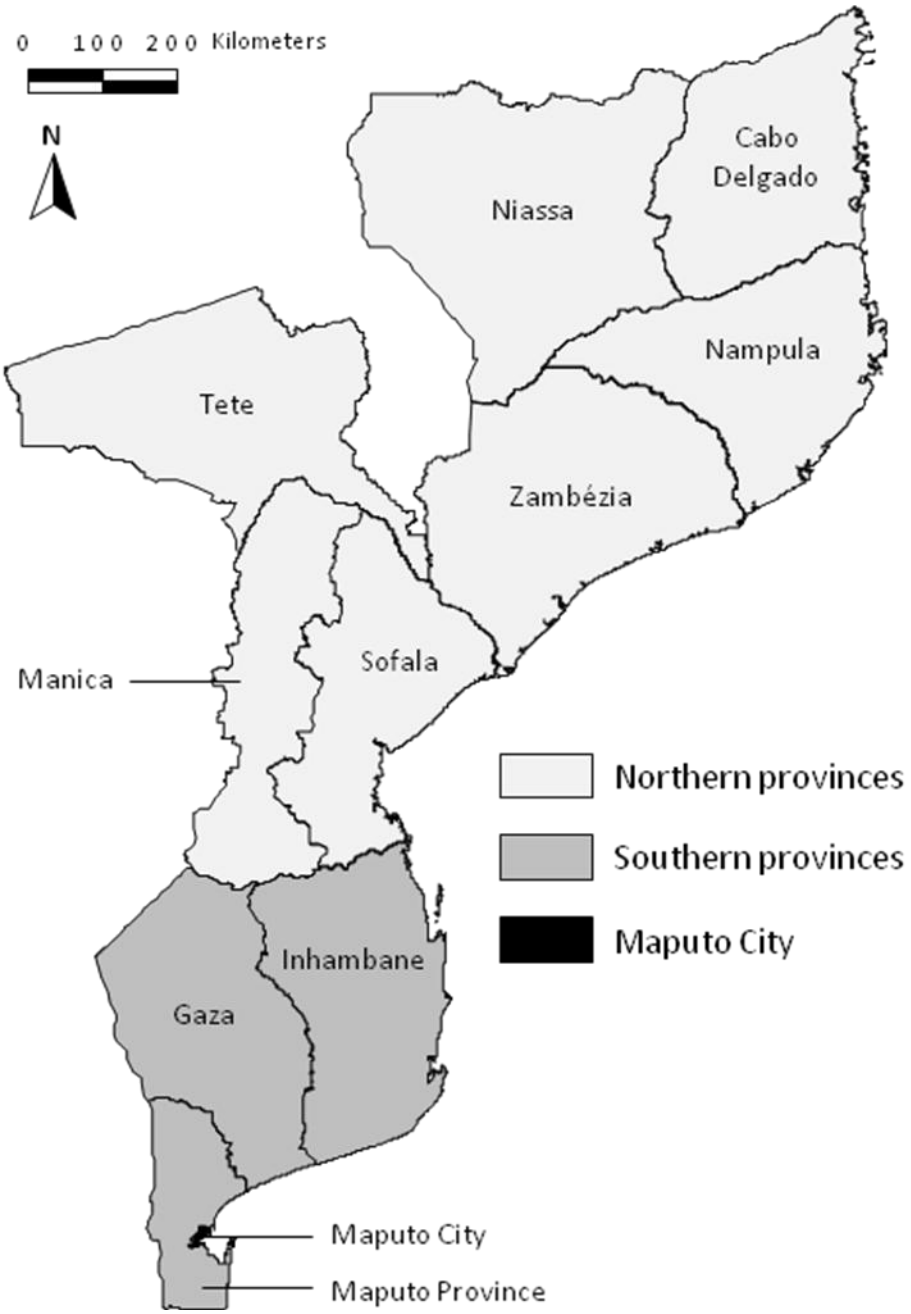
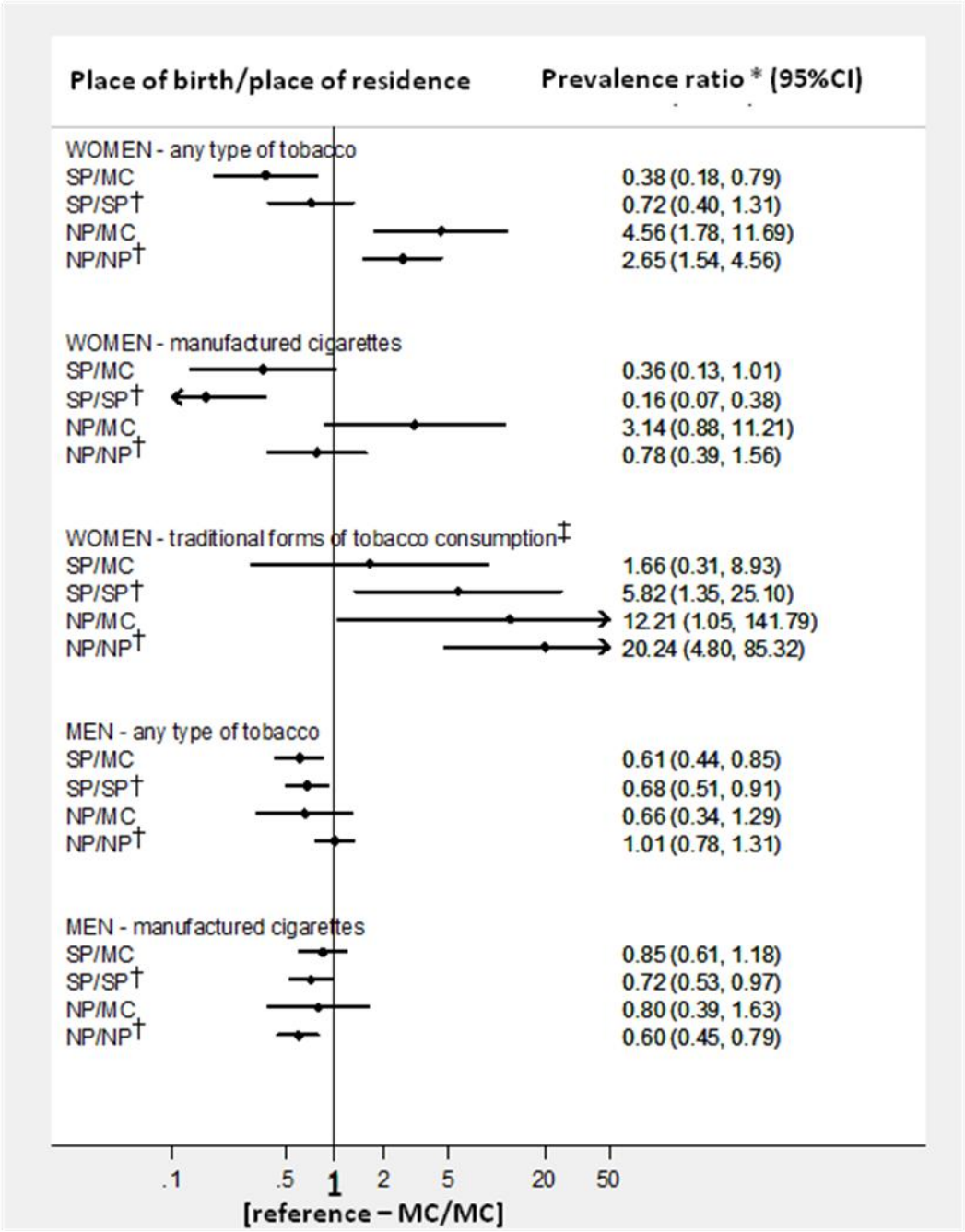


Figure 2. Prevalence ratios for tobacco consumption for different combinations of place of birth/place of residence (in 2003) in comparison with participants born and living in Maputo City.



95%CI – 95% confidence interval; MC – Maputo City; NP – Northern provinces (Manica, Sofala, Tete, Zambézia, Nampula, Niassa and Cabo Delgado); SP – Southern provinces (Maputo Province, Gaza and Inhambane).

* Age- and education-adjusted prevalence ratios for tobacco consumption, having the subjects born and living in Maputo City as the reference; † These groups include a small proportion of subjects born elsewhere; ‡ Traditional forms of tobacco consumption include hand-rolled cigarettes and smokeless tobacco.

References

1. Ezzati M, Lopez AD. Estimates of global mortality attributable to smoking in 2000. *Lancet.* 2003;362(9387):847-852.

2. Lunet N, Williams L, Govind M, et al. Tobacco advertising in Maputo, Mozambique: how will they keep pressing? *Gac Sanit.* 2006;20(3):251-252.

3. Eriksen MP, Cerak RL. The diffusion and impact of clean indoor air laws. *Annu Rev Public Health.* 2008;29:171-185.

4. Gallus S, Schiaffino A, La Vecchia C, Townsend J, Fernandez E. Price and cigarette consumption in Europe. *Tob Control.* 2006;15(2):114-119.

5. Lopez AD, Collishaw NE, Piha T. A descriptive model of the cigarette epidemic in developed countries. *Tob Control.* 1994;3(3):242-247.

6. Otañez MG, Mamudu H, Glantz SA. Global leaf companies control the tobacco market in Malawi. *Tob Control.* 2007;16(4):261-269.

7. Otanez MG, Mamudu HM, Glantz SA. Tobacco Companies' Use of Developing Countries' Economic Reliance on Tobacco to Lobby Against Global Tobacco Control: The Case of Malawi. *Am J Public Health.* 2009;99(10):1759-1771.

8. World Health Organization. Updated status of the WHO Framework Convention on Tobacco Control. Available at: http://fctc.org/dmdocuments/ratification_latest_Bahamas.pdf. Accessed September 2010.

9. IAM (Instituto do Algodão de Moçambique). *Agricultural Diversification and Crop Alternative to Tobacco: Perspective and Experience of the Tobacco Sub-Sector in Mozambique*. Maputo: 2007.

10. Saloojeea Y. Tobacco control in South Africa. In: Steyn K, Fourie J, Temple N, eds. *Chronic Diseases of Lifestyle in South Africa since 1995 - 2005*. Athabasca: South African Medical Research Council; 2006.

11. Shafey O, Dolwick S, Guindon GE (eds). *Tobacco Control Country Profiles*. Atlanta, GA: American Cancer Society; 2003.

12. Townsend L, Flisher AJ, Gilreath T, King G. A systematic literature review of tobacco use among adults 15 years and older in sub-Saharan Africa. *Drug Alcohol Depend.* 2006;84(1):14-27.

13. Araújo C, Silva-Matos C, Damasceno A, Gouveia L, Azevedo A, Lunet N. Manufactured and hand-rolled cigarettes and smokeless tobacco consumption in Mozambique: regional differences at the early stages of the tobacco epidemic. *[submitted]* 2010.

14. Instituto Nacional de Estatística. Recenseamento Geral da População 1997. Available at: http://www.ine.gov.mz/censos_dir/recenseamento_geral/. Accessed September 2010.

15. Instituto Nacional de Estatística e Ministério da Saúde. *Inquérito Demográfico e de Saúde 2003*. Maputo: 2005.

16. Maskarinec G, Noh J. The effect of migration on cancer incidence among Japonese in Hawaii. *Ethnic Dis.* 2004;14:431-439.

17. Jeemon P, Neogi S, Deepak Bhatnagar D, Cruickshank K, Prabhakaran D. The impact of migration on cardiovascular disease and its risk factors among people of Indian origin: Current Science; 2009.

18. Voeten HA, Vissers DC, Gregson S, et al. Strong Association Between In-Migration and HIV Prevalence in Urban Sub-Saharan Africa. *Sex Transm Dis.* 2009;2:2.

19. Feldacker C, Emch M, Ennett S. The who and where of HIV in rural Malawi: Exploring the effects of person and place on individual HIV status. *Health Place.* 2010;16(5):996-1006.

20. Marmot M, Syme S, Kagan A, Kato H, Cohen J, Belsky J. Epidemiologic studies of coronary heart disease and stroke in Japanese men living in Japan, Hawaii and

California: Prevalence of coronary and hypertensive heart disease and associated risk factors. *Am J Epidemiol.* 1975;102(6):514-525.

21. Collinson MA. Striving against adversity: the dynamics of migration, health and poverty in rural South Africa. *Global Health Action.* 2010:3:5080.

22. Tsugane S, Hamada G, de Souza J, et al. Lifestyle and health related factors among randomly selected Japanese residents in the city of São Paulo, Brazil, and their comparisons with Japanese in Japan. *J Epidemiol.* 1994(4):37–46.

23. Schwingel A, Nakata Y, Ito LS, et al. A comparison of the prevalence of the metabolic syndrome and its components among native Japanese and Japanese Brazilians residing in Japan and Brazil. *Eur J Cardiov Prev R.* 2007;14(4):508-514.

24. Torun B, Stein AD, Schroeder D, et al. Rural-to-urban migration and cardiovascular disease risk factors in young Guatemalan adults. *Int J Epidemiol.* 2002;31(1):218-226.

25. McKay L, Macintyre S, Ellaway A. *Migration and Health: A Review of the International Literature* Glasgow: Unit MSPHS; 2003.

26. Hosper K, Nierkens V, Nicolaou M, Stronks K. Behavioural risk factors in two generations of non-Western migrants: do trends converge towards the host population? *Eur J Epidemiol.* 2007;22(3):163-172.

27. Population Division of the Department of Economic and Social Affairs. 2009 Revision of World Urbanization Prospects Available at: http://esa.un.org/unpd/wup/index.htm. Accessed September 2010.

28. Poulter NR, Khaw KT, Hopwood BE, et al. The Kenyan Luo migration study: observations on the initiation of a rise in blood pressure. *BMJ.* 1990;300(6730):967-972.

29. He J, Klag MJ, Wu Z, et al. Effect of Migration and Related Environmental Changes on Serum Lipid Levels in Southwestern Chinese Men. *Am J Epidemiol.* 1996;144(9):839-848.

30. Acevedo-Garcia D, Pan J, Jun H-J, Osypuk TL, Emmons KM. The effect of immigrant generation on smoking. *Soc Sci Med.* 2005;61(6):1223-1242.

31. Nierkens V, de Vries H, Stronks K. Smoking in immigrants: do socioeconomic gradients follow the pattern expected from the tobacco epidemic? *Tob Control.* 2006;15(5):385-391.

32. Hyman I, Fenta H, Noh S. Gender and the smoking behaviour of Ethiopian immigrants in Toronto. *Chronic Dis Can.* 2008;28(4):121-127.

33. Reeske A, Spallek J, Razum O. Changes in smoking prevalence among first- and second-generation Turkish migrants in Germany - an analysis of the 2005 Microcensus. *Int J Equity Health.* 2009;8:26.

34. Arnaldo C. Ethnicity and Marriage Patterns in Mozambique. *Etude Popul Afr.* 2004;19(1):143-164.

35. Townsend L, Flisher AJ, Gilreath T, King G. A systematic review of tobacco use among sub-Saharan African youth. *Journal of Substance Use.* 2006;11(4):245-269.

3. DISCUSSION AND CONCLUSIONS

The two reports included in this dissertation, based on analyses of the same survey of the Mozambican adult population, provide findings that are complementary in their ability to capture different dimensions of the patterns of tobacco consumption in this particular setting.

The collection of specific information on the exposure to different forms of tobacco from a large nationally representative sample allowed the presentation of gender-, age- and region-stratified estimates for both manufactured cigarettes and traditional forms of tobacco consumption that depict high overall prevalences and important heterogeneity in the patterns of exposure across population strata. Despite the cross-sectional nature of the present investigation, comparing the patterns of exposure in different age-groups in tobacco and non-tobacco producer regions and in urban and rural settings, both in men and in women, allows insights on the gender-specific trends towards novel patterns of consumption observed in the younger generations and in the urban areas, as well as the potential impact of tobacco production on the exposure, from quantitative and qualitative standpoints. This interpretation is complemented and strengthened by the comparison of urban populations with different migration status.

Overall, the results illustrate a deviation from the pattern of tobacco consumption expected, under the tobacco epidemic model, for a low-resource Sub-Saharan country such as Mozambique. Although the proportion of smokers of more than 5 manufactured cigarettes per day is relatively low, the high prevalence of consumption raises concern regarding the impact of an easier access to these tobacco products. The high prevalence of exposure to traditional forms of tobacco use among women is also noteworthy, as it suggests that tobacco consumption is an acceptable social behaviour among this population subgroup, predicting changes in patterns of consumption as urbanization and increasing earnings make manufactured cigarettes more easily affordable.

In conclusion:

• In Mozambique the overall prevalence of tobacco consumption was higher than expected for an African country at the early stages of the tobacco epidemic, with hand-rolled and smokeless tobacco accounting for a larger proportion of consumption than manufactured cigarettes.

• Gender differences were observed in the overall consumption, but also in the geographical distribution of the main types of tobacco used. Women consumed predominantly smokeless tobacco especially in the north while southern and urban men consumed mostly manufactured cigarettes and those from the north and living in rural areas opted more frequently for hand-rolled cigarettes.

• Among Maputo City inhabitants there were important differences in the patterns of tobacco consumption according to the place of birth. Prevalences of manufactured cigarettes smoking in subjects born in other southern provinces or in the north of the country tended to depart from the observed in the locally born and resembled more closely the observed in inhabitants of their provinces of origin. More dramatic changes in the patterns of consumption with migration were observed regarding the exposure to traditional forms of tobacco use among men, which were virtually not referred as the main type of tobacco consumed, in stark contrast with the observed in the inhabitants of other provinces.

Overall, our results show that setting-specific factors related to cultural background, affordability and availability of different types of tobacco are strong determinants of the tobacco consumption patterns in Mozambique. The gender and regional specific patterns of consumption may contribute to the development of

culturally adapted and locally grounded actions for tobacco control, and stress the need of locale-specific surveillance data and public health action in this field.

4. ABSTRACT

Tobacco consumption in Mozambique: regional differences and the impact of internal migrations

Widespread cigarette smoking will exacerbate worldwide health disparities between nations, leading to an increasing burden of non-communicable diseases in countries still facing a high burden due to communicable diseases. The understanding of the extent, as well as the social, cultural and economical distribution of the problem in developing countries is essential to develop and monitor control strategies. Given the concern that tobacco companies are targeting developing countries and females to compensate for their declining markets in developed nations, and the expected impact of growing urbanization in the access to different types of tobacco products, namely manufactured cigarettes, and in the exposure to cultural influences able to shape consumption patterns, locale-specific data covering all these dimensions are necessary to develop locally grounded actions on tobacco control in low-income settings.

The present dissertation aimed to characterize tobacco consumption in Mozambique, defining prevalences of different types of tobacco consumption, according to region and considering the influence of internal migration. It comprises two manuscripts with the following specific aims:

Manuscript 1:

To describe the use of different types of tobacco (manufactured and hand-rolled and smokeless tobacco) in the adult Mozambican population, across regions at different stages of the epidemiologic transition.

Manuscript 2:

To compare the prevalence of manufactured cigarettes smoking and traditional forms of tobacco use (including hand-rolled cigarettes and smokeless tobacco) between dwellers in the capital Maputo City that were also born in the capital with those born in other southern or northern regions of Mozambique, and with inhabitants of the same southern and northern regions.

Both studies were based on the same national survey conducted in 2003 that evaluated a representative sample (nationally, by province and by place of residence, urban or rural) of 12902 Mozambicans, aged 25-64 years. Regarding tobacco consumption, participants were asked about the use of any tobacco product, including manufactured cigarettes, hand-rolled cigarettes and smokeless tobacco, and were classified as ever or current tobacco consumers. Current consumers were asked about the type of tobacco most often consumed, and classified as consumers of manufactured cigarettes, hand-rolled cigarettes or smokeless tobacco. Manufactured cigarette smokers were asked about the number of cigarettes smoked in the previous 24 hours and were further grouped according to the frequency of consumption (<5 and ≥5 cigarettes/day).

For analysis, the 11 provinces from Mozambique were grouped in southern (Maputo City, Maputo province, Inhambane and Gaza) and northern provinces (Sofala, Manica, Zambézia, Tete, Nampula, Niassa and Cabo Delgado). The dwellers in the country capital (Maputo corresponds to the province Maputo City) were further classified according to their place of birth: Maputo City (MC/MC), other southern provinces (SP/MC), northern provinces (NP/MC).

The main findings of these studies were the following:

Manuscript 1:

The prevalence of current tobacco consumption was 39.9% in men and 18.0% in women. Women consumed predominantly smokeless tobacco (prevalence: 10.1%), especially in the north. Hand-rolled and manufactured cigarettes were the most frequently consumed among men (prevalences: 18.7% and 17.2%, respectively), the latter predominantly in the south and urban areas and the former in the north and rural settings. The proportion of current tobacco consumers increased with age among women with no meaningful variation in men, and decreased with education in both genders. We observed an association between residence in the north and tobacco consumption, which was independent of age, education and dwelling in an urban or rural setting, and stronger in women than in men.

Manuscript 2:

The prevalence of any type of tobacco consumption among Maputo City inhabitants born in other southern or northern provinces contrasted with those observed in the locally born [SP/MC vs. MC/MC – men: age- and education-adjusted prevalence ratio (PR)=0.61, 95% confidence interval (95%CI): 0.44-0.85; women: adjusted PR=0.38, 95%CI: 0.18-0.79; NP/MC vs. MC/MC – men: adjusted PR=0.66, 95%CI: 0.34-1.29; women: adjusted PR=4.56, 95%CI: 1.78-11.69] and resembled those of the inhabitants of their provinces of origin. More dramatic changes were observed for traditional forms of tobacco use among men, which were seldom consumed in Maputo City, in stark contrast with other provinces.

In conclusion:

• In Mozambique, the overall prevalence of tobacco consumption was higher than expected for an African country at the early stages of the tobacco epidemic, with hand-rolled and smokeless tobacco accounting for a larger proportion of consumption than manufactured cigarettes.

• Gender differences were observed in the overall consumption, but also in the geographical distribution of the main types of tobacco used. Women consumed predominantly smokeless tobacco especially in the north while southern and urban men consumed mostly manufactured cigarettes and those from the north and living in rural areas opted more frequently for hand-rolled cigarettes.

• Among Maputo City inhabitants there were important differences in the patterns of tobacco consumption according to the place of birth. Prevalences of manufactured cigarettes smoking in subjects born in other southern provinces or in the north of the country tended to depart from the observed in the locally born and resembled more closely the observed in inhabitants of their provinces of origin. More dramatic changes in the patterns of consumption with migration were observed regarding the exposure to traditional forms of tobacco use among men, which were virtually not referred as the main type of tobacco consumed, in stark contrast with the observed in the inhabitants of other provinces.

Overall, our results show that setting-specific factors related to cultural background, affordability and availability of different types of tobacco are strong determinants of the tobacco consumption patterns in Mozambique. Understanding the gender and regional specific patterns of consumption may contribute to the development of culturally adapted and locally grounded actions for tobacco control, and

stress the need of locale-specific surveillance data and public health actions in this field.

5. RESUMO

Consumo de tabaco em Moçambique: diferenças regionais e o impacto das migrações internas

A expansão do consumo de tabaco nos países em desenvolvimento irá contribuir para o aumento da frequência das doenças não transmissíveis, sobrepondo este ónus à já elevada carga de doença e ao consumo de recursos associados às doenças transmissíveis. O conhecimento da frequência e dos determinantes do consumo de tabaco nestes contextos é essencial para desenvolver e monitorizar estratégias de controlo da exposição ao tabaco. As empresas produtoras de tabaco visam actualmente as populações dos países em desenvolvimento e o sexo feminino, como forma de compensar o declínio do mercado nos países desenvolvidos. A urbanização crescente influenciará previsivelmente o acesso a diferentes formas de tabaco, nomeadamente a cigarros manufacturados, e a exposição a factores culturais capazes de modular os padrões de consumo. A caracterização da exposição tendo em conta todas estas dimensões permite fundamentar o desenvolvimento de medidas locais de controlo.

A presente dissertação teve como objectivo caracterizar o consumo de diferentes tipos de tabaco em Moçambique, por região e considerando a influência de migrações internas. Inclui dois manuscritos com os seguintes objectivos específicos:

Manuscrito 1:

Descrever o uso de diferentes tipos de tabaco (cigarros manufacturados, cigarros enrolados manualmente e rapé) na população adulta de Moçambique, em regiões em diferentes fases da transição epidemiológica.

Manuscrito 2:

Comparar a prevalência de consumo de cigarros manufacturados e de formas tradicionais de consumo de tabaco (incluindo cigarros enrolados manualmente e rapé) entre os habitantes de Maputo Cidade, tendo em conta o seu local de nascimento (Maputo Cidade, outras províncias do sul e outras províncias do norte), e com habitantes dessas mesmas regiões.

Os dois estudos basearam-se no mesmo estudo transversal de âmbito nacional, conduzido em 2003, em que foi avaliada uma amostra representativa (a nível nacional, por província e local de residência, urbano ou rural) de 12902 Moçambicanos, com idades compreendidas entre os 25 e os 64 anos. Os participantes foram questionados sobre o consumo de qualquer produto derivado do tabaco, incluindo cigarros manufacturados, cigarros enrolados manualmente e rapé e foram classificados como consumidores de tabaco (no momento da avaliação ou em qualquer momento da vida). Os participantes que no momento da avaliação eram consumidores foram questionados sobre o tipo de tabaco que utilizavam mais frequentemente, e classificados como consumidores de cigarros manufacturados, de cigarros enrolados manualmente ou de rapé. Os fumadores de cigarros manufacturados foram avaliados quanto ao número de cigarros consumidos nas 24 horas prévias e agrupados de acordo com a frequência de consumo (<5 e ≥5 cigarros/dia).

Para a análise, agruparam-se as 11 províncias de Moçambique em províncias do sul (Maputo Cidade, Maputo província, Inhambane e Gaza) e do norte (Sofala, Manica, Zambézia, Tete, Nampula, Niassa e Cabo Delgado). Os habitantes da capital do país (Maputo corresponde à província Maputo Cidade) foram seguidamente classificados de acordo com o seu local de nascimento: Maputo Cidade (MC/MC), outras províncias do sul (PS/MC), províncias do norte (PN/MC).

Os principais resultados destes estudos foram os seguintes:

Manuscrito 1:

A prevalência de consumo actual de tabaco foi 39,9% nos homens e 18,0% nas mulheres. As mulheres consumiam predominantemente rapé (prevalência: 10,1%), sobretudo no norte. Os homens consumiam predominantemente cigarros enrolados manualmente e manufacturados (prevalências: 18,7% e 17,2%, respectivamente), os cigarros manufacturados eram consumidos predominantemente no sul e em áreas urbanas e os enrolados manualmente no norte e em áreas rurais. A proporção de consumidores de tabaco aumentava com a idade nas mulheres, sem variação significativa nos homens, e diminuía com a escolaridade em ambos os sexos. Foi observada uma associação, mais forte nas mulheres do que nos homens, entre a residência no norte e o consumo de tabaco, independente da idade, escolaridade e residência numa área urbana ou rural.

Manuscrito 2:

A prevalência de consumo de qualquer tipo de tabaco pelos habitantes de Maputo Cidade que nasceram noutras províncias do sul ou do norte contrastava com a observada nos que nasceram em Maputo Cidade [PS/MC vs. MC/MC – homens: razão de prevalências ajustada para idade e educação (RP ajustada)=0,61, intervalo de confiança a 95% (IC 95%): 0,44-0,85; mulheres: RP ajustada=0,38, IC 95%: 0,18-0,79); PN/MC vs. MC/MC – homens: RP ajustada=0,66, IC 95%: 0,34-1,29; mulheres: RP ajustada=4,56, IC 95%: 1,78-11,69] e era mais próxima da observada nos habitantes das respectivas províncias de origem. Foram registadas alterações mais acentuadas no consumo de formas tradicionais de tabaco pelos homens, raramente utilizadas em Maputo Cidade, em franco contraste com o observado nas restantes províncias.

Em conclusão:

• Em Moçambique, a prevalência global de consumo de tabaco foi superior à esperada para um país Africano nas fases iniciais da epidemia do tabaco, com uma proporção superior de consumo de cigarros enrolados manualmente e rapé do que de cigarros manufacturados.

• Observaram-se diferenças por género no consumo de tabaco e na distribuição geográfica dos principais tipos de tabaco utilizados. As mulheres consumiam predominantemente rapé, sobretudo no norte, enquanto os homens do sul e de áreas urbanas consumiam mais frequentemente cigarros manufacturados e os do norte e de áreas rurais mais frequentemente cigarros enrolados manualmente.

• Nos habitantes de Maputo Cidade os padrões de consumo de tabaco variavam em função do local de nascimento. Os indivíduos que nasceram noutras províncias do sul ou do norte do país apresentaram prevalências de consumo de cigarros manufacturados diferentes das dos indivíduos que tinham nascido na capital, e com tendência a aproximarem-se das prevalências observadas nos habitantes das respectivas províncias de origem. O padrão de consumo de formas tradicionais de tabaco pelos homens sofreu uma alteração mais acentuada com a migração, já que, os habitantes de Maputo Cidade, independentemente do local de nascimento, não referiram o tabaco enrolado manualmente ou o rapé como principal forma de tabaco consumido, em franco contraste com o padrão observado nos habitantes das outras províncias.

Os nossos resultados demonstram que factores contextuais, nomeadamente o perfil cultural, e a acessibilidade e disponibilidade dos diferentes tipos de tabaco são fortes determinantes dos padrões de consumo de tabaco em Moçambique. Conhecer os padrões de consumo específicos por região e género poderá contribuir para

fundamentar o desenvolvimento de acções de controlo locais adaptadas às especificidades culturais, enfatizando a necessidade de promover a vigilância epidemiológica e intervenções de saúde pública específicas por região.