



**The « Together in Health » Project for the prevention
of chronic noncommunicable diseases in Sousse, Tunisia
Description, results and perspectives**

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1. Preface

According to the World Health Organization (WHO), chronic diseases are responsible for 36 million deaths in 2008. Chronic diseases known as non-communicable diseases (NCDs) include mainly cardiovascular diseases, cancers, diabetes and chronic respiratory diseases. The global epidemic of NCDs were responsible for 63% of all deaths, including at least one quarter before the age of 60. The NCD deaths are projected to increase by 15% overall between 2010 and 2020 (to reach 44 million deaths). Only 20% of these deaths occurred in high-income countries, while 80% occurred in the low-income and middle-income countries.

Tunisia is currently undergoing an epidemiological transition characterized by a decrease in mortality and birth rates, increase in life expectancy and a decline in infectious diseases compared to chronic noncommunicable diseases that are constantly increasing. This change also affects the lifestyle of Tunisians who are adopting the new so-called "Western habits" (physical inactivity, changes in dietary habits and leisure means...). Thus, Tunisia is now facing the pronounced emergence of NCDs, hence the need to prepare an integrated prevention strategy to address common risk factors and major determinants shared by NCDs.

Most of what we know about the prevention of NCDs comes from the experience of developed countries where many of these diseases have been the object of successful interventions. Four preventable risk factors: tobacco use, unhealthy diet, physical inactivity and harmful use

of alcohol play a dominant and often synergistic role in the development of these NCDs. This means that integrated actions against these risk factors implemented in the social context can lead to the reduction of major chronic diseases. The available evidence supports the feasibility and effectiveness of large-scale prevention in the population intended to increase the proportion of people at low risk for these diseases. The concept of integrated NCD prevention as an essential component of existing health system with a focus on health promotion at the population level could be the way that our country must take to significantly reduce the future epidemic of these diseases.

The project "Together in Health" is an example of an integrated chronic disease prevention programme in an intersectoral approach that goes beyond the health care system. This manuscript aims to describe the epidemiology of NCDs in Tunisia and around the world and to present the project "Together in Health" and its results in the region of Sousse in Tunisia.

2. Epidemiology of chronic noncommunicable diseases

2.1. Definition, rational of reflection

Having a comprehensive and integrated national policy for the prevention and control of noncommunicable diseases (NCDs) is required to address common risk factors and major determinants shared by NCDs (which are cardiovascular disease, diabetes , cancers and chronic respiratory diseases). Having a comprehensive policy is more appropriate than to have separate policies for each NCD or even worse for each individual risk factor or determinant of NCDs, particularly for developing countries facing a shortage of resources (1).

Develop and implement policy for NCD prevention in a country like ours, where the transition is compressed in time compared to what happened in developed countries where the health system has taken the time needed for adaptation, is a major challenge in itself (2). Most developing countries have limited capacity to fight against NCDs (3), therefore in these countries, there is very little experience and expertise in the development of integrated community response to NCD prevention programs but the challenge must be met in our country.

Moreover, most of what we know about the prevention of NCDs comes from the experience of developed countries. For example, the prediction of absolute cardiovascular risk, which is based on the calculation of the Framingham risk score was developed in the United States. It can not be directly applicable to all people in developing

countries; therefore, it must be calibrated and validated using new data from these countries (4).

Fortunately, we have long known that in developed countries, many of these diseases have benefited from successful interventions (5, 6). In fact, there is evidence that a small number of risk factors are common to NCDs. Four preventable risk factors: tobacco use, unhealthy diet, physical inactivity and harmful use of alcohol play a dominant and often synergistic role in the development of these chronic problems. This means that integrated actions against these risk factors implemented in the social context can lead to the reduction of major NCDs (7, 8). The available evidence supports the feasibility and effectiveness of large-scale prevention in the population intended to increase the proportion of people at low risk of NCDs (9, 10). The concept of integrated NCD prevention as an essential component of the existing health system with a focus on health promotion at the population level could be the way that our country must take to significantly reduce the future epidemic of these diseases.

So we will emphasize in this monograph on the justification and the need to launch community based programs to the control of NCDs in the population.

The model to follow is based on concrete evidence and consists of an integrated approach to NCD prevention essentially inspired from the project in North Karelia (11) in Finland. This approach aims to assess the best way to reduce major risk factors of NCDs through interventions in

schools, workplaces, communities and health centers through multisectoral and integrated approach. This document will also highlight the merits and limitations of this approach and attempts to identify the challenges that may be encountered in the implementation of these programs through the example of our project "Together in Health" undertaken in the region of Sousse.

2.2. Brief overview of the problem's burden

36 million people died in 2008 from NCDs mainly from cardiovascular diseases, stroke, cancer and diabetes mellitus (12). The global epidemic of NCDs was responsible for 63% of all deaths, including at least one quarter before the age of 60. The NCD deaths are projected to increase by 15% overall between 2010 and 2020 (to reach 44 million deaths). Only 20% of these deaths occurred in high-income countries, while 80% occurred in the low-income and middle-income countries. The expected number of deaths from NCDs will increase from 35 million in 2005 to 41 million in 2015, at the same time, years of life lost adjusted for disability (DALYs) will increase from 725 to 808 million (13) as shown in the following table:

Table I : Projected global deaths and DALYs (Adjusted Life Years lost to disability) of chronic conditions by age 2005-2015

	Deaths (million)		DALY (million)	
	2005	2015	2005	2015
0-29 years	1,7	1,5	220	219
30-59 years	7	8	305	349
60-69 years	7	8	101	125
≥ 70 years	20	24	99	116
all ages	35	41	725	808

It is also estimated that in 2030 the number of deaths related to cardiovascular disease in the world is expected to reach 23 million, with approximately 85% occurring in countries with low and middle income (14). According to projections by the World Health Organization, over a period of ten years (2006-2015), the largest increases in NCD deaths occur in regions of Africa and the Middle East (12) . The total number of people with diabetes is expected to increase in the Middle East from 20 million in 2000 to nearly 52.8 million in 2030 and this is the largest relative increase (163%) of the number of people with diabetes worldwide (15). Moreover, and according to the International Diabetes

Federation (16), in 2007, six of the ten countries with the highest prevalence of diabetes in the world come from the Middle East mainly from the Gulf countries.

Tunisia is currently undergoing an epidemiological transition characterized by a decrease in mortality and birth rates, increase in life expectancy and a decline in infectious diseases compared to chronic noncommunicable diseases that are constantly increasing. This change also affects the lifestyle of Tunisians who are adopting the new so-called "Western habits" (physical inactivity, changes in dietary habits and leisure means...). Thus, Tunisia is now facing the pronounced emergence of NCDs and because of their multiple determinants, they add to the burden of disease that will be described in detail later on in the chapter dedicated to the burden of NCDs in Tunisia. This burden results in an increase in the economic and social health costs for both the state and households.

This epidemiological transition raises fundamental questions about either the selection of health policy, medical practice, dietary behaviors, the necessary coordination with other sectors such as education, agri-food and the environment, or the place and role granted to the individual in order to empower the grip of his own health and diet while acting on the environment to make easier the choices that protect health.

A purely curative approach, even the most rational, can not therefore solve the problem. Hence the importance of a strategy to integrate the

fight against non-communicable diseases in a coherent system giving importance as well to treatment as prevention and health promotion. This is what the WHO strategy for the fight against NCDs called to by all member states in the framework of its 2008-2013 action plan advocating the need for a multisectoral approach (17). One of the major objectives of the WHO strategy for NCD prevention is to promote interventions to reduce the main shared modifiable risk factors for noncommunicable diseases: tobacco use, unhealthy diet, physical inactivity and harmful use of alcohol. This population-based prevention strategy is to:

A- Fight against tobacco

Consider implementing the following set of six cost-effective interventions (MPOWER) inspired measures to reduce demand in the WHO Convention Framework on Tobacco Control:

- Monitor tobacco use and prevention policies;
- Protect people against tobacco smoke;
- Offer help to those who want to stop smoking;
- Warn against the dangers of smoking;
- Enforce the ban on advertising tobacco, promotion and sponsorship;
- Raise taxes on tobacco.

B- Promote a healthy diet

Apply, without limitation, the measures recommended in the Global Strategy on Diet, Physical Activity and Health to:

- To promote and support exclusive breastfeeding for the first six months of life and promote programs to ensure optimal feeding for all infants and young children;
- Develop a national policy and action plan on food and nutrition with a focus on national priorities on nutrition, including the fight against non-communicable diseases related to the nutrition;
- To develop and implement guidelines for food and advocate more healthy foods:
 - by reducing the salt content;
 - eliminating industrially produced trans fatty acids;
 - reducing saturated fatty acids;
 - limiting free sugars;
- Providing consumers with accurate and balanced information to enable them to make positive health choices;
- Prepare and implement, as appropriate, and with all stakeholders, a framework and / or devices to promote responsible marketing of food and non-alcoholic beverages to children, in order to reduce impact of foods high in saturated fats, trans-fatty acids, free sugars, or salt.

C- Promoting physical activity

Apply, without limitation, the measures recommended in the Global Strategy on Diet, Physical Activity and Health to:

- to develop and implement national guidelines on physical activity in favor for health;
- implement programs in schools in accordance with the WHO initiative for health promotion in schools;
- ensure that the physical environment promotes active and safe travel and create spaces for recreational activities in the following ways:
 - ensuring that walking, cycling and other forms of physical activity are accessible and safe;
 - introducing transport policies that promote active and safe methods of travel to get to school or work, such as walking or cycling;
 - improving sports and recreational facilities;
 - increasing the number of safe places available for active games.

2.3. Epidemiology of cardiovascular diseases

Cardiovascular diseases (CVD) are responsible alone of over 17 million deaths in 2008 (18), 3 million occurring prematurely before the age of 60 years. They are the leading cause of death in developed countries (19, 20) despite the decline observed over the last 30 years (21, 22). Their risk factors are well known in most industrialized countries (23, 24) where effective prevention programs have been established (25, 26).

Very few studies have investigated the extension of the risk factors of CVD in developing countries (27, 28) which are increasingly affected by this new flaw.

While communicable diseases are not completely controlled in these countries, health systems are likely to face a new pathology, that is chronic and increasingly expensive.

With socio-economic development and health infrastructure, Tunisia is in the midst of epidemiological transition (29). This transition is characterized by a decrease in mortality rates, increased life expectancy, changes in causes of death in favor of chronic non-communicable diseases, especially cardiovascular disease.

In Tunisia, chronic diseases are responsible of 80% of deaths in 2002 according to the WHO report about the impact of these diseases in the country (30).

CVD are considered in our country as a national priority both in research and in terms of intervention programs. In this context, the need for scientifically valid and relevant information for decision-making at the population level and sensitive enough to measure the impact of interventions is acute.

2.3.1. Mortality

Statistics on causes of death in Tunisia in 2009, revealed that MCV ranks first with 28.9% of all registered deaths (31). In a study of trends in mortality from ischemic heart disease in Tunisia between 1997 and 2009 (32), the mortality rate due to coronary disease increased by 11.8% for men and 23.8% for women, resulting in 680 additional coronary deaths in 2009 compared to the baseline in 1997 and after adjustment for concurrent changes in population. These increases were explained by a 98% deterioration of the cardiovascular risk profile (hypertension and hypercholesterolemia).

2.3.2. Morbidity

In a study that looked at the reasons for hospitalization, in six cardiology departments at the District of Tunis during two periods ten years apart 1992-2002 (33), of 9499 hospitalized patients, the percentage of ischemic heart disease rose from 39.2% of men and 15.5% of women in 1992, to 58.9% and 38.2% respectively in 2002, while rheumatic heart disease passed from 11.8% in men and 25.3% in women to 4.4% and 11.7% respectively.

2.3.3. Risk factors

CVD are not just diseases caused by impairment of an organ and the malfunction of a system; they also reflect individual behavior which in turn is highly influenced by social class.

The world health report 2002 (8) found that risk factors for the major cardiovascular diseases and responsible for much of the morbidity and mortality were hypertension, smoking, hypercholesterolemia, low consumption of fruits and vegetables, overweight and obesity and physical inactivity.

2.3.3.1. Hypertension

Hypertension is currently recognized as a public health problem worldwide due to its frequency and risk of cardiovascular disease attached to it. It would be responsible for approximately 7.5 million deaths annually or about 12.8% of all deaths worldwide according to statistics from 2009/2010 (34, 35).

The problem of high blood pressure is a public health priority in Tunisia by its high frequency, severity of complications and the excessive cost of its management (monitoring, exploration and drugs). A summary of the various epidemiological data on population studies is presented in Table II.

The first survey in this area was that of Gharbi et al (36) in 1988 - 1990. It focused on a representative sample of urban and rural population of the Good Cape region (692 men and women aged 35-50 years).

Hypertension was defined at that time by a systolic blood pressure (SBP) ≥ 160 mm Hg and / or diastolic blood pressure (DBP) ≥ 95 mm Hg or already known and treated. In urban areas, the prevalence of hypertension was 12, 8% with 11.6% for men and 13.8% among women. In rural areas, the figures were 8.8%, 4% and 13.3%.

The first survey in the central region of Tunisia was that of Ghannem et al (37) conducted in 1990 among 555 adults aged 20 and older (60% women and 40% men), living in the town of Kalaa Kebira (semi-urban Tunisian Sahel region). Hypertension was defined as a SBP ≥ 140 mmHg and / or DBP ≥ 90 mm Hg. The prevalence of hypertension was 24.5% and was slightly higher among women (25.5%) than men (23%) with no statistically significant difference.

The same team undertook in 1997 an epidemiological survey of a representative sample of adults aged 20 and older, living in urban areas in the city of Sousse (n = 957) (38). Hypertension was defined as a SBP ≥ 140 mmHg and / or DBP ≥ 90 mm Hg. Prevalence of hypertension was 28.9%. This prevalence increased with age. There was no significant difference between men (30%) and women (28.4%).

The team of Ben Romdhane (39) conducted two surveys in five years intervals, 1996 - 1997 and 2000 - 2001, with two representative samples of the population of Ariana as part of the monitoring system of CVD. In total 7608 adults aged 35-70 years were observed: 5771 adults aged 35-64 years have been studied in 1997; the second survey, meanwhile, took place in 2001 and involved a sample of 1837 adults aged 40-70 years.

Was considered hypertensive, anyone with an SBP ≥ 140 mmHg and / or DBP > 90 mm Hg or those claiming to be treated for hypertension and having a balanced blood pressure. In 1997, 39.6% of men and 49.7% of women aged 40-64 years of age were hypertensive. In the second survey, the percentages were 35.9% for men and 46.2% among women, but the difference was not statistically significant between the two populations. However, for the two surveys, the prevalence was consistently higher in women for all age groups and the difference was statistically significant ($p < 10^{-3}$). For both sexes, the prevalence was relatively low before the age of 50 years and increased significantly after this age of 50.

Ben Romdhane et al (40) also conducted a national study published in 2011 on a sample of 8007 adults aged 35-70 years. The overall prevalence of hypertension was 30.6% (33.5% among women and 27.3% men). Only 38.8% of hypertensive patients knew their diagnosis. Of these, 84.8% were treated and 24.1% were balanced.

Other studies have been performed in older populations. Laouani et al (41) found a prevalence of 69.3% among adults aged 60 and over, Hammami et al (42) showed a prevalence of 52% in a population of adults aged 65 and over.

Table II: The various studies of hypertension in adults in Tunisia

Author	Study	Population	Date	Global Prevalence %	Males %	Females %
Gharbi (36)	CVD risk factors FRCV in urban and rural population of Good cape	692 males and females aged 35-50 years HBP >160/95 mmHg	1988	12,8 (Urban)	11,6 (Urban)	13,8 (Urban)
			- 1990	8,8 (Rural)	4 (Rural)	13,3 (Rural)
Ghannem (37)	CVD risk factors in the commune of Kalaa Kebira	555 adults aged 20 years and over	1990	24,4	23	25,5
Ghannem (38)	CVD risk factors in urban city of Sousse	957 adults aged 20 years and over	1997	28,8	30	28,4
Ben Romdhane (39)	CVD surveillance: prevalence of risk factors	5771 adults aged 35- 64 years	1996 - 1997	—	39,6	49,7
Ben Romdhane (39)	CVD surveillance: ischemic heart disease and risk factors	1837 adults aged 40- 70 years	2000 - 2001	—	35,9	46,2
Ben Romdhane (40)	TAHINA projet : Hypertension among adults in Tunisia, national study	8007 adults qged 35- 70 years	2011	30,6	27,3	33,5
Laouani (41)	CVD risk factors in primary care centres of the district of Sousse	600 adults aged 60 years and over	2000	69,3	37	63
Hammami (42)	Prevalence of hypertension among old persons	598 adults aged 65 years and over	2011	52	45	55,5

2.3.3.2. Smoking

A real public health problem worldwide, the tobacco epidemic killed in the 20th century, almost 100 million people worldwide, with an increase of that number to about one billion for the current century (43, 44). If current trends continue, by 2030 tobacco will become the leading cause of preventable morbidity and mortality worldwide, responsible for more than 8 million deaths per year (43). The epidemiological data on smoking among adults in Tunisia are shown in Table III

Among the older surveys on smoking in the general population, a cross-sectional study was conducted by Ghannem et al (37) in 1990 in a semi-urban community of Tunisia's Sahel among 555 persons aged 20 years and over. The proportion of smokers was 66.5% in men and 0.6% among women.

Another cross-sectional study was conducted in 1996 of a nationally representative sample of 5696 subjects aged 25 and over (45). Tobacco use was reported by 30.4% of the respondents. Smoking was reported by 55.6% of men and 5.2% of women. Among men, the proportion of tobacco users diminished with age, in parallel with an increase in dropout rates. Among women, the proportion of smoking peaked in the age group 35-54 years. In contrast, the proportion of consuming traditional tobacco increased with age in both sexes, from 2.4% in men 25-34 years to 20.4% among those over 55 years and 0,1% to 14.3% in women for the same age groups. Smoking was more prevalent in rural

areas in men with the lowest levels of education and belonging to the lower social classes.

In urban areas, Ghannem et al (38) noted in the 1997 survey in Sousse, that smoking was found in 21% of cases. At all ages, men were significantly more often smokers (61%) than women (4%) ($p < 0.001$). Among men, the proportion of heavy smokers (more than 20 cigarettes per day) was 23% of all smokers, and that of light smokers (fewer than 10 cigarettes per day) was 31%.

Ben Romdhane H. et al (39) reported that, in men, the percentage of smokers passed from 51.2% to 46.9%; the non - smokers from 37.3% to 25.1% and the ex - smokers from 11.5% to 28% ($p < 0.001$). Among women, the percentage remained stable at respectively 5.2% and 5.9% for those who smoke, 94.1% and 92.9% for those who do not smoke and 0.7% and 1.2% of those who stopped smoking. In both surveys, the differences between men and women were statistically significant ($p < 0.001$).

The National Family and Population office conducted a study in 2001 in 7000 households for people aged over 12 years (46). The overall prevalence of smoking was 24% with 45.4% for men and 3.8% among women.

Table III : The various studies of smoking among adults in Tunisia

Author	Study	Population	Date	Global Prevalence %	Males %	Females %
Ghannem (37)	CVD risk factors in the commune of Kalaa Kebira	555 adults aged 20 years and over	1990	26,8	66,5	0,6
Fakhfakh (45)	Smoking in Tunisia : Behaviours and knowledges	5696 adults aged 25 years and over	1996	30,4	55,6	5,2
Ghannem (38)	CVD risk factors in urban city of Sousse	957 adults aged 20 years and over	1997	21	61	4
Ben Romdhane (39)	CVD surveillance: prevalence of risk factors	5771 adults aged 35- 64 years	1996 - 1997	—	51,2	5,2
Ben Romdhane (39)	CVD surveillance: ischemic heart disease and risk factors	1837 adults aged 40- 70 years	2000 - 2001	—	46,9	5,9
Laouani (41)	CVD risk factors in primary care centres of the district of Sousse	600 adults aged 60 years and over	2000	—	13,3 (tabagisme actif)	24,5 (neffa)
The National Family and Population office (46)	Tunisian study of family health	7000 households; persons aged over 12 years	2001	24	45,4	3,8

2.3.3.3. Dyslipidemia

Hypercholesterolemia is a major risk factor for cardiovascular disease and is responsible for about a third of deaths from ischemic heart disease (34). Globally, high cholesterol would be responsible for approximately 2.3 million deaths annually (18, 34). In 2008, the overall

prevalence of high cholesterol in adults - defined as a total cholesterol level ≥ 6.2 mmol / l (≥ 240 mg / dl) - was 9.7% (8.5% for men and 10.7% for women) (35).

In Tunisia, in the study of cardiovascular risk factors in semi-urban areas in Sousse in 1990 (37), hypercholesterolemia was relatively low in the general population with about 12%. In the city of Ariana (38) during the first survey (1997), 12% of men and 17.4% of women had cholesterol levels ≥ 6.2 mmol/l; 20.9% and 22.2% respectively had borderline cholesterol levels, between 5.2 and 6.2 mmol/l. In the second survey (2001), the percentage of those with high cholesterol was 8.7% in men and 18.2% among women, but the difference was not statistically significant between the two surveys. During the first survey, 16.6% of men and 12.3% of women had triglycerides ≥ 2.3 mmol/l. These percentages were 18.9% and 13.8% for the second survey, but the differences were not statistically significant between the two surveys. A 2009 study on the prevalence of dyslipidemia in Tunisia has found a prevalence of hypercholesterolemia of 8.4% in the adult population (47) with 21% of hypertriglyceridemia.

2.3.3.4. Diabetes

Diabetes mellitus is a common cosmopolitan health problem with a rapid growth representing a real pandemic according to the International Diabetes Federation IDF (48). The number of diabetics in the world is estimated at 366 million in 2011 and is expected to reach 552 million in 2030 according to IDF prediction. Among the countries in

the top 10 of the highest diabetes prevalence, there is 6 countries of the Arab Middle East region affected (48) (Kuwait, Lebanon, Qatar, Saudi Arabia, Bahrain and the United Arab Emirates).

In Tunisia, the oldest diabetes study ever conducted was realized in 1977 and concerned a representative sample of the governorate of Tunis (49). The total number of people investigated during that survey was 9712 subjects composed of 45% men and 55% women. The average age was respectively 24.8 and 26 years. The overall prevalence of diabetes was 2.3%, half of which was old known diabetic.

In 1990, the prevalence of diabetes (fasting glucose ≥ 7.8 mmol / l) in the commune of Kalaa Kebira (37) was 6.4%. It was virtually the same in both sexes.

In the 1997 survey (38) at the city of Sousse, the prevalence of diabetes increased with age and was present in 10% of the study population. Regardless of age, women were significantly more often affected than men with 11% and 7% respectively ($p = 0.04$).

In both surveys in the region of Ariana (39), the prevalence of diabetes (fasting glucose ≥ 7.8 mmol / l) was 14.5% for the general population, 13% of men and 15% of women. The difference between men and women was not statistically significant except for the age group 40-49 years for which the prevalence was higher among women. The prevalence increased significantly starting from 50 years but had not changed statistically significantly between the two periods.

Gharbi et al (50) conducted a study in the governorate of Nabeul in 692 adults aged 35-50 years. They found an overall prevalence of 7.2%, two-

thirds were aware of their diabetes diagnosis. This prevalence was different in urban and rural areas. Indeed, it was respectively 9.3% and 10.4% for men and women in urban areas and 2% and 4.5% in rural areas respectively. In 2007, Bouguerra et al (51) published a study of 3729 adults with whom they have found a prevalence of diabetes of 9.9% (9.5% in men and 10.1% women). The age adjusted prevalence was 8.5% (7.3% for men and 9.6% among women). Among those aged 60 years and over, the prevalence was 23% (41). In a recent study (52) on a national sample of 7,700 aged 35-70 years in 2005 people, the prevalence of diabetes was 15.1% (14.1% among women and 16.1% among men) with differences between urban and rural areas and between regions of Tunisia. The epidemiological data on diabetes among adults in Tunisia are shown in Table IV

Table IV : The various studies of diabetes among adults in Tunisia

Author	Study	Population	Date	Global Prevalence %	Males %	Females %
Ben Khalifa (49)	Prevalence of diabetes in the gouvernorate of Tunis	9712 adults	1977	2,3	—	—
Ghannem (37)	CVD risk factors in the commune of Kalaa Kebira	555 adults aged 20 years and over	1990	6,4	6,4	6,4
Ghannem (38)	CVD risk factors in urban city of Sousse	957 adults aged 20 years and over	1997	10	7	11
Ben Romdhane (39)	CVD surveillance: prevalence of risk factors	5771 adults aged 35- 64 years	1996 - 1997	14,5	13	15
Ben Romdhane (39)	CVD surveillance: ischemic heart disease and risk factors	1837 adults aged 40- 70 years	2000 - 2001	15,2	15,7	14,9
Gharbi (50)	Prevalence of diabetes among adults in Nabeul	692 adults aged 35- 50 years	2002	7,2	9,3 urbain	10,4 urbain
					2 rural	4,5 rural
Bouguerra (51)	Diabetes study in Tunisia	3729 adults	2007	9,9	9,5	10,1
Laouani (41)	CVD risk factors in primary care centres of the district of Sousse	600 adults aged 60 years and over	2000	23	20,4	25
Ben Romdhane (52)	Prevalence of diabetes in Tunisia	7700 adults aged 35- 70 years	2005	15,1%	16,1%	14,1%

2.3.3.5. Other risk factors

2.3.3.5.1. Obesity

Obesity is a growing public health problem in both developed and developing countries (35). It is a cardiovascular risk factor predisposing to glucose intolerance and diabetes and responsible for an increase of blood pressure and dyslipidemia (35).

Worldwide, at least 2.8 million people die each year from conditions related to overweight or obesity (35). In 2008, 34% of adults aged over 20 were overweight with a Body Mass Index BMI (equal or greater than 25 kg/m^2 : 33.6% of men and 35% of women. For the same year 2008, 9,8% of men and 13.8% of women were obese (BMI equal or greater than 30 kg/m^2 I), compared with 4.8% for men and 7.9% for women in 1980 (35).

In Tunisia, several epidemiological studies have been devoted to overweight and obesity. Epidemiological data on adult obesity in Tunisia are shown in Table V

In the study of the semi urban area of Kalaa Kebira (37), the prevalence of obesity ($\text{BMI} \geq 30$) was 20.7%. The prevalence of overweight ($27 \leq \text{BMI} < 30$) was 18.4%. Moreover, the prevalence of obesity was twice as high in women than in men for all ages. This difference was statistically significant.

In the survey conducted in 1997 in the city of Sousse (38), obesity ($\text{BMI} \geq 30$) was found in 28% of cases. It was significantly more common among

women (34%) than men (12%) ($p < 10^{-3}$). Android or abdominal obesity was found in 36% of cases. Its prevalence increased with age and was significantly higher, regardless of age except for those over 70 years, for men (50%) than women (30%) ($p < 10^{-3}$).

Abdominal obesity was estimated in adults aged 35 to 70 years in the city of Tunis to 69% among women and 21% among men with a significant difference (53). The prevalence of metabolic syndrome in this population was 31.2% (37.3% among women and 23.9% men). Another study involving 2927 adults aged over 20 years found 9% of men with a waist circumference greater than 102 cm and 33% of women with a waist circumference greater than 88 cm (54). Another study in Tunisia on a sample of 8576 people aged over 15 years (55) reported an overall prevalence of obesity of 12.2% with a prevalence of 18.3% among women. In a study of obesity among women aged 20-59 years (56), we found a prevalence of obesity of 22.6%.

Huge inequalities in the prevalence of obesity according to gender were found in a Tunisian study in 2005 on a random cluster sample of 2379 men and 2964 women aged between 35 and 70 years. The prevalence of obesity was higher among women (37%) than men (13.3%) and in urban areas, but it was lower in subjects with a higher grade level of education (57).

Tableau V: The various studies of diabetes among adults in Tunisia

Author	Study	Population	Date	Global Prevalence %	Males %	Females %
Ghannem (37)	CVD risk factors in the commune of Kalaa Kebira	555 adults aged 20 years and over	1990	18,4 ($27 \leq \text{BMI} < 30$)	—	—
				20,7 ($\text{BMI} \geq 30$)	12	26
Gharbi (36)	CVD risk factors FRCV in urban and rural population of Good cape	692 males and females aged 35-50 years	1996		16 (obesity in urban area)	35,2 (obesity in urban area)
					5,4 (obesity in rural area)	26,3 (obesity in rural area)
Ghannem (38)	CVD risk factors in urban city of Sousse	957 adults aged 20 years and over	1997	28 ($\text{BMI} \geq 30$)	12 ($\text{BMI} \geq 30$)	34 ($\text{BMI} \geq 30$)
Laouani (41)	CVD risk factors in primary care centres of the district of Sousse	600 adults aged 60 years and over	2000	37,5 ($27 \leq \text{BMI} < 30$)	—	—
				24,2 ($\text{BMI} \geq 30$)	13,1 ($27 \leq \text{BMI} < 30$)	32,6 ($27 \leq \text{BMI} < 30$)
Kamoun (55)	Prevalence of obesity and overweight	8576 persons aged 15 years and over	2001	Obesity 12,2	6,1	18,3
Beltaifa (56)	Prevalence of obesity among women	1849 women aged 20-59 years	2009	-	-	22,6 $\text{BMI} \geq 30$
				-	-	29,2 waist size > 88cm
El Ati (57)	Obesity and gendre	2379 men and 2964 women aged 35-70 years	2005	25,4%	13,3%	33%

2.3.3.5.2. Physical inactivity

Insufficient physical activity can be defined as making less than 5 times 30 minutes of moderate activity per week, or less than 3 times 20 minutes of vigorous activity per week, or equivalent. Insufficient physical activity is the fourth leading risk factor for mortality, responsible globally of about 3.2 million deaths (18, 34). Very few epidemiological studies have focused on the study of sedentary or physical activity in Tunisia because of the difficulty of quantifying these concepts validly. In a study in 2002-2003 (58) describing the variability of the data on the prevalence of physical inactivity in 51 countries from different WHO regions and for different age groups, it was reported for Tunisia a prevalence of physical inactivity of 11.5% in men and 18.9% among women in a sample of 4332 people aged 18-69 years. Physical activity was assessed using the short form of the International Physical Activity Questionnaire (IPAQ), in which people were asked to indicate the number of days and duration of severe or moderate activities and walking activities that they have taken during the last week.

2.3.3.5.3. Unhealthy diet

There are a considerable number of evidence regarding the involvement and role of nutrition in the development of atherosclerosis in general and in particular cardiovascular disease (34, 35). High dietary intake of saturated fats, cholesterol, trans fats, salt and low dietary intake of fruit, vegetables and fish are associated with cardiovascular risk (34, 35). Obesity appears when there is an imbalance between energy intake in the diet and energy expenditure. Regular physical activity can help

prevent obesity by increasing energy expenditure. Approximately 16 million of deaths worldwide (1.0%) and 1.7 million of disability adjusted life years DALYs (2.8%) are attributable to low fruit and vegetable consumption (34).

2.3.3.5.4. Excessive alcohol consumption

Harmful use of alcohol is a risk factor for numerous adverse health and social outcomes, including hypertension, acute myocardial infarction, cardiomyopathy, cardiac arrhythmia, liver cirrhosis and other consequences. Excessive and harmful alcohol consumption was responsible for 2.5 million deaths (3.8%) in the world in 2004 (18,34). Very little data are available on excessive alcohol consumption in Tunisia.

2.3.3.5.5. Social determinants and cardiovascular diseases

Social determinants such as social class, income distribution and the level of education indirectly affect cardiovascular health and overall health. These determinants play a role in the hierarchy of power and access to resources and health system. They have a cardiovascular and metabolic impact because of behavioral risk factors that they condition (59).

In 2005, WHO convened the Commission on Social Determinants of Health (60) to provide advice on how to reduce inequalities in health by fighting against the unequal distribution of power and resources.

3. Description of the project « Together in Health »

3.1. Introduction, justification of the project « Together in Health »

Tunisia is currently undergoing an epidemiological transition characterized by a decrease in mortality and birth rates, increased life expectancy and a decline in infectious diseases in relation to chronic diseases that are increasing constantly. This change also affects the lifestyle of Tunisian who are adopting new Western habits (physical inactivity, dietary changes and means of leisure ...).

The cardiovascular risk profile is extremely worrying in Tunisia both in adults and in adolescents. The cardiovascular risk factors increasingly appear early in life and tend to persist and to be stable over the time. A cohort study among schoolchildren in the city of Sousse between 1999 and 2003 confirmed the stability of cardiovascular risk factors. Indeed, the percentage of the stability of blood pressure was 25%, that of obesity was 48.9% and cholesterol was 59%. These results attest to the stability of lipids and different vascular risk parameters and impose to undertake prevention policies targeted at a young age in order to reduce the burden of morbidity and mortality of cardiovascular disease in adulthood.

A double burden of disease, with the persistence of perinatal disease results in greater economic and social cost of health care for both the state and households. This double burden of disease raises fundamental questions about either the selection of health policy, medical practice, dietary behaviors, the necessary coordination with

other sectors, including education, the agro-food and environment, or the place and role granted to individuals and their responsibility in the handling of their own health and diet while acting on the environment to make it easier the choices that protect health.

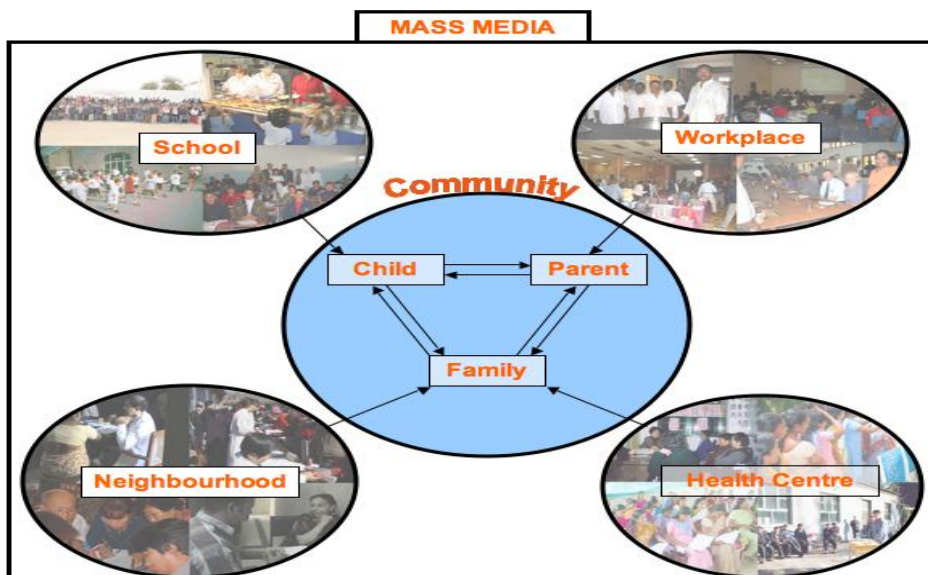
It is in this context that the Research Centre for Chronic Disease Prevention in Sousse attempts to establish an intervention at the community level to assess its feasibility and effectiveness in the prevention of major risk factors for chronic disease.

The project, implemented in the city of Sousse aimed to reduce major risk factors for chronic diseases at the community level: smoking, unhealth diet and physical inactivity.

The intervention programme intereted the following settings:

- School settings
- Workplace settings
- Health centre settings
- Community settings

It is based not only on education through various niches, including mass media, but also and hopefully on structural changes in the environment (fitness trails, bike paths, sports field, smoke free environment...).



**Health education & structural changes through
community coalition building**

The center worked in collaboration with different project partners to implement the program. This monograph proposes, for information, to describe some of the intervention actions in the different settings.

These actions were discussed with the partners according to their feasibility in the context of the city of Sousse. Participants who work in the field could of course propose further actions that they deem beneficial.

A multidisciplinary team of teachers, doctors, psychologists, nutritionists and graphic designers have been working for the center to

produce guides and intervention tools (such as pamphlets, posters, films ...) adapted to each stakeholder and each sector to serve for the intervention activities.

3.2. Intervention guide in school settings

Coordinated programs that involve the school, community and families can be effective in promoting healthy behaviors, such as eating more healthy and be more active.

Schools provide a key setting in which children observe and adopt healthy lifestyles that will last a lifetime. Children spend many hours in school during their growing years, and it is necessary to give them daily opportunities to be physically active, eat healthy and develop their self-esteem to maximize their growth and learning.

Schools can play a key role in promoting healthy lifestyles by following tracks:

- Provide schoolchildren with training in nutrition, physical activity, smoking and body image and self-esteem to help them acquire the knowledge and skills appropriate to their age as part of a health training program offered from kindergarten to age 12.
- Train teachers to focus on the principles and benefits of healthy eating, physical activity and consequences of smoking and the social skills that enable schoolchildren to avoid smoking. Enable teachers to use active learning methods to invest and interest young students in the school intervention program.

- Involve parents in learning activities at home, provide training on the three factors in the context of parental and school activities and encourage parents to call for policies and services.
- Working with public health agencies and voluntary organizations to the introduction of large school and community programs.
- Develop peer leadership and stimulate leadership for schoolchildren.

Schools can play an important role in health promotion for the following reasons:

- All children and young people can be reached.
- Diet, physical activity and smoking are social behaviors influenced by education, social support and educational services.
- Training in schools can improve the lifestyles of young people.
- Role models, such as teachers, instructors and group leaders can profoundly influence children by example.
- Preventive services and other health services that may be offered in schools allow for early detection of problems, refer youth to appropriate resources and offer efficient services.
- All parents can be reached through schools.

The authors of experimental studies have found a number of effects of education programs for health. It is common to see an increase of knowledge, less common to see changes in attitudes and uncommon to

see behavior change. When program effects are observed, we find that they disappear with time.

Hence the importance of sustaining our actions, begin step by step: Knowledge then attitudes and behavior. It also requires that actions are any community-wide and not just in schools.

The chronic disease prevention research centre of Sousse with its partners, particularly the Regional Direction of Education and the Regional Commissioner for Youth, Sports and Physical Education have worked to build a program intervention to promote healthy lifestyles in schools. The intervention began in the early school year 2010/2011 and lasted 3 years.

The objective of this intervention is to promote healthy eating, physical activity and tobacco control. To work on these three factors, the project team organized training seminars for school doctors, teachers and administrative staff to make them aware of the importance of the intervention, how to approach children and information to be sent to schoolchildren.

We started by developing leaders in each category such as teachers, administrators, school physicians, schoolchildren and parents that will have to pass the message through (Figure 1). We made these trainings for each separate category because each has a special message to deliver and a particular way of doing it.

Education of leaders about healthy lifestyles, communication and social skills to allow the message to pass through to different social categories

namely schoolchildren, teachers, parents and administrative and medical personnel.

All these categories fell into a cycle of behavior change to move from the contemplation stage to the action stage and maintenance of a new behavior. (Figure 2)

Leaders

- Teachers
- Administrative personnel
- School health team
- Schoolchildren
- Parents

Increase awareness for the need for change, provide information on the possible benefits of change

Motivate and encourage the individual to a specific plan or a personal approach

Assist the individual in the development of concrete and possible actions

Assist in providing feedback, problem solving, social support, reward and reinforcement elements

Assist in the search for alternatives, avoid relapses and misconduct

The others

- Teachers
- Administrative personnel
- School health team
- Schoolchildren
- Parents

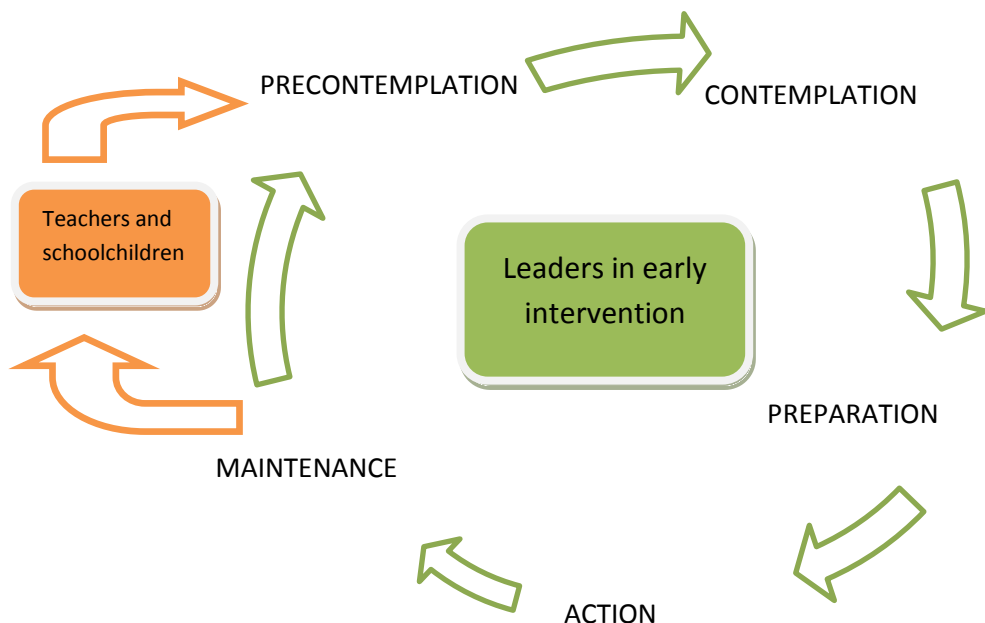


Figure 2 : stages of behavior change from leaders to other teachers and students

Follow-up meetings were scheduled at month 3, month 6 each year with different groups to document the process and monitor progress and difficulties encountered.

The project team proposed to support, train and assist different school stakeholders in the following actions:

3.2.1. Actions for school principals:

- Examine the school environment (eg. Cafeterias, opportunities for physical activity), develop plans and policies to create and maintain a healthy school environment and monitor progress.
- Participate in programs of nutrition, physical activity and anti tobacco set up at school at the beginning by the project team. Thereafter, once leaders are trained, they can maintain these programs and develop others.
- Encourage schoolchildren to participate in events on healthy lifestyles: taking part in days of tobacco control, sporting events ...
- Encourage parents to engage in physical activity with their children (meeting at mid semester and end of the year)
- Animation of awareness days and workshops for schoolchildren and their parents.
- Ensure a healthy environment even outside of the school (small merchants around the school, we can involve them in the program).
- Ask teachers to talk about physical activity and active living, healthy eating and anti tobacco actions in class.
- Provide time for teachers and give them the opportunity to participate in training sessions that focus on healthy lifestyles.

3.2.2. Actions for teachers:

- Build a trust relationship with their schoolchildren, taking into account their emotional world.

- Ensure that schoolchildren hear and see the same messages on nutrition, physical activity and tobacco control.
- Incorporate healthy nutrition, physical activity and tobacco control to other materials, such as using community trails for a field trip science, write essays in literary materials on different ways to do a physical activity .
- Encourage physical activity during physical education sessions, leave the choice to the schoolchildren of the discipline they prefer to practice.
- Rewarding academic and social efforts of schoolchildren by providing opportunities for physical activity.
- Encourage and congratulate the schoolchildren who are members of a sports club.
- Organize fitness class that combines discipline, but mostly fun and unwinding after class or during peak hours for schoolchildren and teachers.
- Lead by example in their feeding behavior, vis-à-vis physical activity and smoking. Get involved and participate in the school program.
- The staff room should be 100% non smoking, as throughout the whole school, promote physical exercises during breaks and a healthy diet.
- Ask The local media to cooperate to deal with school events and promote healthy eating.

- Provide opportunities for schoolchildren to explore nutrition, physical activity, smoking, positive body image and positive self-esteem with their families, giving them activities to take home.
- Assist schoolchildren set goals to improve their behavior, rewarding new behaviors and celebrate successes.

3.2.3. Actions for schoolchildren :

- Encourage students to participate as leaders in the project.
- Involve students in the program by adopting their ideas.
- Encourage students to enroll in a fitness class offered by the school after class and invite their friends to follow their examples.
- Develop socially appropriate behavior by leaders: Do not smoke, eat dairy products or fruit as a snack, do physical activity at breaks.
- Develop students' skills in terms of decision making and the selection and preparation of food.
- Encourage students to demonstrate leadership and to handle health problems.
- Set an example of healthy eating, active living and tobacco control and encourage others to do the same.

3.2.4. Actions for parents:

- Ensure that their child's school offers a program to promote healthy lifestyles, otherwise make the suggestion to do it for teachers and administration.

- Involve parents in learning activities at home, provide training on nutrition in the context of parental and school activities and encourage parents to call for policies and services.
- Organize meetings and mailings of information for parents

3.2.5. Actions school health team:

- Developing the idea and train managers of health promotion in schools
- Teaching teachers to teach nutrition, use of active learning methods and recognize eating disorders and neglect.
- Ensuring that nutritionists offer on-site services to teachers.
- Treating eating disorders in the context of peer support programs

All these actions aim to promote healthy lifestyles in schools with the collaboration of different stakeholders. These ideas could be developed by the participants themselves with details to suit the conditions of each establishment. The project team provides necessary guides for each category and for each factor mentioned: diet, physical activity and tobacco control.

3.3. Intervention guide in work places

The objectives of intervention in work places were :

- Develop a compelling communication to motivate executives and other stakeholders to be involved in creating an environment that promotes and encourages healthy lifestyles.
- Encourage community labor to value healthy lifestyles and develop work environments conducive to healthy eating, physical activity and tobacco control.
- Improve knowledge of workers on healthy lifestyles and risk factors for cardiovascular disease.

The conditions of success for the development of a program of healthy lifestyles in the workplace are:

- Obtain a formal and clear commitment from the management of the company for the promotion of healthy lifestyles
- Work as a team;
- Get the support of all;
- Promote activities by various means and in a sustained manner

The three important components of a healthy work environment elements are: the physical environment, safety and health at work; hygien and lifestyles; culture of the workplace and a positive environment.

It is not surprising that leading companies addressed the three elements of well-being at work on a variety of fronts, ranging from ergonomics to the feeling of employee control over their work. Most companies surveyed have implemented detailed security plans, health and welfare at work to make informed decisions about programs, implementation,

participant observation, monitoring and evaluation. The main conclusion was: health in the workplace, it pays.

Occupational health is primordial. The more a person is healthy, the less he is absent from work and the more he expresses a sense of belonging towards the organization. He also is more likely to be happy and to enjoy a good quality of life, both in his professional and personal life. Each investment in a program of healthy lifestyle generates productivity gains in firms within 5 years after launch.

Thus, the promotion of healthy lifestyles in the workplace is profitable:

	For employees	For the enterprise
To improve	• Quality of life • Stress management	• Quality of life at work • Image of entreprise • Relations at work
To increase	• Psychological well beeing	• Sens of belonging
To reduce	• Premature mortality risk • Risk of suffering from certain diseases (mainly cardiovascular disease, diabetes, hypertension and hypercholesterolemia)	• Absenteeism • Staff turnover

It is for these reasons that the proposed project of prevention of chronic diseases has included the workplace in education actions on healthy lifestyles. It is for the interest of employees as well as business leaders.

The chronic disease prevention research centre of Sousse with its partners, particularly the Department of occupational health at the University Hospital Farhat Hached of Sousse and the grouping of Occupational Medicine of Sousse have introduced an intervention program to promote of healthy lifestyles in the workplace. The intervention began in September 2010 and lasted three years.

The objective of this intervention was to promote healthy eating, physical activity and anti tobacco fight in the workplace. To work on these three factors, the project team in collaboration with the grouping of Occupational Medicine of Sousse has organized training seminars for physicians, business managers and employees to make them aware of importance of intervention for employees but also for business productivity. The team developed a proposal for a program of training and intervention that was discussed and approved by the partners and stakeholders.

The project team proposed to support, train and assist the various stakeholders in the workplace in the following actions:

3.3.1. Actions for occupational health teams:

- Develop a compelling communication to motivate executives and other stakeholders to be involved in creating an environment that promotes and encourages healthy lifestyles. The workplace offers several ways to get the attention of employees. It is the responsibility of the enterprise to determine the best means of communication, innovate and diversify messages. It is important to disseminate these messages regularly to arouse and sustain the interest of most employees.
- Provide a training program for doctors working on the implementation of a healthy lifestyles program in workplace and health education in the hiring and supervision visits.
- Offer entrepreneurs an intervention program on healthy lifestyles in the workplace.
- Negotiate changes in the work environment that are realistic and operational
- Develop a newsletter for health officials in the workplace. This newsletter will be sent regularly to companies in the program. One can find credible and documented articles on lifestyles such as stress reduction, smoking cessation and maintaining a healthy weight, nutrition information from registered dietitians to prevent heart disease, recommendations for physical activity to protect the heart health.

- Involve supervisors, managers and union leaders in the program promotion "Advertising". Use of multiple communication and repeated promotions for program "advertising".

3.3.2. Actions for employers:

- Helping employers encourage their employees to use a non-motorized mode of transport for round trip between home and work, such as walking or cycling if distances permit.
- Implement an intervention-based reward if the employee joins the program and shows an improvement (stops smoking, becomes less sedentary, loses weight ...), the administration is committed to reward him according to the means and interests of the company.
- Prohibit smoking in the company while ensuring proper smoking rooms for smokers.
- Providing healthy food in canteens and cafeterias of companies, identifying the needs of the kitchen staff and the consumption profile of the clientele.
- Provide signage at point of purchase and make available posters, leaflets available in cafeterias and projection of educational videos.
- Ensure individual actions (advocacy, self - assessment of dietary habits, skill development to change behavior, taste panel ...).
- Undertake environmental actions (setting up a committee of employees, improving the availability and accessibility of healthy food, posters, table signage at point of service, mascot, etc ...).

- Stimulate the spirit of mutual support and respect.
- Show the organizational commitment to the well-being of its members or employees.
- Provide training, conferences, demonstrations and special events that promote the exchange of experiences and inform the participants on various aspects of healthy lifestyles.
- Organize a special event like a sneaker day, a bike ride, a hike, an open house in a sports center, etc. This type of event also provides an opportunity for discussion between management and staff.

3.3.3. Actions for occupational physicians:

- Conduct seminars and workshops for employees on healthy lifestyles.
- Provide smoking cessation consultation in the enterprise.
- Conduct regular screening for chronic diseases and risk factors among all employees while relying on screening algorithms and treatment.
- Identify barriers in the enterprise that could harm a good diet, the practice of physical activity, anti tobacco fight and the achievement of program objectives. Discuss barriers with the administration project leaders and among employees and try to find practical and feasible solutions.
- Distribution of information materials and disseminating messages.

3.3.4. Actions for employees (leaders):

- Give environmental activities to an employee committee who should conduct an analysis of their environment, find solutions and implement them.
- Improve the knowledge of colleagues on healthy lifestyles.
- Promote alternative modes of transport to the car (on foot, by bicycle)
- Implement a walking club in the company.
- Adopt healthy behaviors during breaks and encourage colleagues to participate.
- Organize sports tournaments between different departments of the company or different companies.
- Promote good behavior during breaks and meetings.
- Encourage colleagues to adhere to healthy lifestyles programs promotions introduced by the administration.
- Form groups to make physical activity (sports, walking faster ...)
- Encourage colleagues to bring healthy meals for lunch.
- Encourage colleagues to quit smoking and consult for medical help.
- Carry out a survey to better understand the interests and needs of employees for physical activity, providing healthy food and having a separate space for smokers.

3.4. Intervention guide in community settings

Given the limited success of previous attempts to improve health through education on lifestyles, the focus of the intervention has shifted from individual to more holistic approaches that consider health as a social or community issue, to approaches that address the social processes that change individual behavior. We now know it is not enough to put the full responsibility to the person change. Such an approach blames the victim instead of addressing the social conditions that cause the harmful behavior. In fact, social or community interventions can add resources to the set of strategies a person could have to do the change and improve his health.

It is usual to recognize the limit of the current individual intervention models for health problem prevention, considering communities as complex systems, dynamic and adaptive that we can change in order to influence the healthy lifestyle.

Community initiatives to change the relationship between the individual and the environment are very promising. It is multidisciplinary approaches comprising a solid component focused on citizen participation.

Citizens must interact in their community while addressing certain special problems and helping their colleagues. As the studied problem becomes more complex, the level of action becomes more complex

because people will need more resources, as it is the case of chronic diseases. In the community we can target the following actions:

3.4.1. Actions for officers and regional directors:

- Increase the availability, accessibility and the safe use of sports facilities and services offered in the community.
- Develop facilities to support regular physical activity outside of school hours and working practice.
- Identify unsafe areas (accidents, injuries) for young people (parks, recreation centers, etc.) and make the necessary corrections.
- Develop green spaces and playgrounds.
- Encourage active transport (walking, cycling) creating security arrangements (safe routes, road signs, walking trails, bike paths, police surveillance).
- Establish and ensure compliance with policies, regulations and procedures for the promotion of healthy lifestyles:
 - Development of fitness trails, bike paths.
 - Programming and competitive rates for group activities and sport leisure.
 - Development of neighborhood where services are within walking or cycling.
 - Design of urbanization based walking and cycling (identified intersections, pedestrian streets, etc.).

- Measures of traffic calming (limit of the speed limit, stop lights, reducing the width of some streets, etc.).
- Access to bike track

3.4.2. Actions for Non governmental organisations NGOs:

- Strengthen stakeholder knowledge about the risks of smoking and the importance of adopting and maintaining healthy lifestyles in the physical, psychological, intellectual and social development of young people and the prevention of chronic diseases;
 - information on activities, resources, tools available in the community.
 - incentives (adjusted prices) for the participation of low-income citizens in sports activities.
- Continue the citizens mobilization and all community organizations around the optimal development of young people.
- Develop a common vision of promoting healthy lifestyle approach.
- Consolidate and develop local and regional collaborative action plans (community, school, family, youth) to promote the adoption and maintenance of healthy lifestyles and safe

behavior (healthy eating, physically active life , tobacco abstinence)

- Continue the pooling of resources, services, programs, activities already in place in the territory (geographical and sociological).
- Integrate advocacy and information for a healthy lifestyle in activities for youth and their families.
- Provide citizens with a diverse range of physical activities and sport (individual or group) to help them reach the target of at least 30 minutes of moderate intensity physical activity of (brisk walking, swimming, etc.) to high intensity (running, sporting event, etc.) daily.
- Encourage the development of skills to identify and resist social influences favorable to smoking.
- Support the engagement of individuals in the fight against smoking by promoting the relationship with non-governmental organizations fighting against smoking.

Among the participatory evaluation methods we can include the seasonal calendar of events that these NGOs can use to educate the community about the importance of chronic disease prevention:

- February 4: World fight against cancer day
- March 14: World hypertension day
- April 6: World physical activity day.
- May 31: World no tobacco day
- November 14: World diabetes Day

3.4.3. Actions for leaders:

- Give environmental activities to a committee of citizens who should do an analysis of their environment, find solutions and implement them.
- Improve knowledge of citizens on healthy lifestyles.
- Promote alternative modes of transport to the car (on foot, by bicycle).
- Value the social aspect of sport.
- Adopt healthy behaviors and encourage citizens to do it.
- Organize sports tournaments between different neighborhoods.
- Develop good eating habits at parties and social gatherings.
- Encourage citizens to adhere to healthy lifestyles promotion programs introduced by the municipality.
- Form groups to make physical activity (sports, fast walking ...).

3.4.4. Actions for mass media:

- Media campaigns against smoking emphasizing the risks of active and passive smoking (spot TV, radio, magazine articles, newspapers, ...)
- Frequently raising awareness about the health risks of a fatty food, sweet and rich in salt.
- Organisation of social groups and committees for the promotion of healthy lifestyle using new information technology (facebook, twitter ...).

- The use of various media operations, including television, radio, press, Internet, cinema, on billboards and in the new electronic media.
- Appropriate public relations, including media outreach to the problems associated with smoking and lack of physical activity to generate wider media coverage of these issues.
- An outreach to various community organizations, such as schools, religious institutions and civic organizations, and mobilization; and products such as t-shirts, pins, brochures and posters that can invite the audience to participate in or attend certain events, encourage discussion and having a long lasting presence. These products can play a major role in a campaign of public awareness if they are carriers of strategic messages and are widely distributed.
- The broadcast campaigns in the mass media should be ubiquitous: advertisements must be seen and heard often enough to generate a change in beliefs, attitudes and behaviors. Awareness related to a campaign, advertisements or a message is not enough.
- The campaign should include a wide variety of targeted messages and constantly renewed to motivate different groups of people trying to quit smoking, to do physical activity and eat a healthy diet.

- A campaign should reflect lessons learned internationally in identifying the most effective messages and developing creative strategies. It must be organized and implemented in full independence, away from the influence of the tobacco industry and the food and beverage industry.

3.5. Intervention guide in health centres

3.5.1. The objectives of intervention in health centres:

The objectifs are:

- Encourage leaders and health professionals and other stakeholders to be involved in creating an environment that promotes and encourages healthy lifestyles.
- Improve the knowledge of health professionals about healthy lifestyles and risk factors for cardiovascular disease.
- Encourage health centers to value healthy lifestyles and develop work environments conducive to healthy eating, physical activity and tobacco control.
- To promote the quality of care for chronic diseases (hypertension, diabetes) in primary and tertiary level of care.

The intervention to promote healthy lifestyle can not be considered without the involvement of the health sector, seen as a key area of action in parallel to community actions.

The chronic disease prevention research centre of Sousse with its partners, particularly the Departments of Cardiology, Endocrinology, Pediatrics of the University Hospital Farhat Hached of Sousse and the regional service of primary health care of Sousse have implemented an intervention program to promote healthy lifestyles in primary care. The intervention began in September 2010 and lasted three years. The objective of this intervention was to promote healthy eating, physical activity and tobacco control in primary care. To work on these three factors, the project team hold meetings with partners, as well as training seminars for primary care physicians, paramedical staff as well as inter-regional seminars to raise awareness of the importance of intervention for health professionals.

3.5.2. Training programme of primary care physicians

The Department of Epidemiology of the University Hospital Farhat Hached of Sousse was responsible for the following actions:

- Presentation of updated epidemiological data on the extent of NCDs, cardiovascular diseases and their risk factors.
- Presentation of the results of the pre assessment of chronic disease risk factors in the districts of Sousse and Msaken
- Presentation of importance of the intervention program in primary care.

The Departments of Cardiology, Endocrinology, Pediatrics and Occupational health of the University Hospital Farhat Hached of Sousse were responsible of the following actions:

- Introduction to international recommendations for the adoption of healthy lifestyles and encouraging the medical and paramedical staff to adopt good habits and be the example to follow.
- Presentation of the value of screening for cardiovascular risk factors (the importance of taking weight, height, waist circumference, blood pressure and calculate BMI)
- Management of patients with cardiovascular risk according to validated recommendations.
- Health education and compliance to treatment
- Prevention of obesity and overweight in children.

After the presentation sessions of the intervention, physicians were required to:

- discuss and propose various alternatives for intervention on promoting healthy lifestyle in primary care.
- Share their experience on the feasibility of such an initiative.
- Raise any obstacles and propose appropriate solutions to provide.

3.5.3. Actions for the regional direction of health:

- Develop a compelling communication to motivate executives and other stakeholders to be involved in creating an environment that promotes and encourages healthy lifestyles.
- Provide a training program for health professionals on the implementation of a program of healthy lifestyles in hospitals and primary care.
- Propose to Regional Directors an intervention on healthy lifestyles in primary care.
- Establish, with other organizations and other sectors, a network aimed at removing obstacles for health promotion.
- Design guides for primary care physicians and paramedics containing algorithms for management of at risk patients.

3.5.4. Actions for primary care physicians:

- Adhere to the healthy lifestyles program.
- Participate in training seminars organized by the project team.
- Know the magnitude of chronic diseases and the frequency of complications such as myocardial infarction, stroke.
- Screen adequately for chronic diseases in primary care.
- Raise awareness among at-risk patients on the importance of proper hygiene life

- Educate and inform patients about the importance of promoting healthy eating and smoking cessation and practice of regular physical activity.
- Get the lifestyle management to all patients and particularly those at risk.
- Design practical guides for hypertensive or diabetic patients on healthy eating, physical activity and smoking cessation.
- Alternate individual and group health education sessions for patients with cardiovascular risk.

3.5.5. Actions for paramedical staff:

- To raise awareness about the constantly changing factors, which determine the emergence of NCDs and cardiovascular disease.
- Attend training seminars on healthy lifestyles promotion and encourage active participation (communication, price ...)
- Communicate the concepts taught to patients and encourage their awareness on the preventive health component.

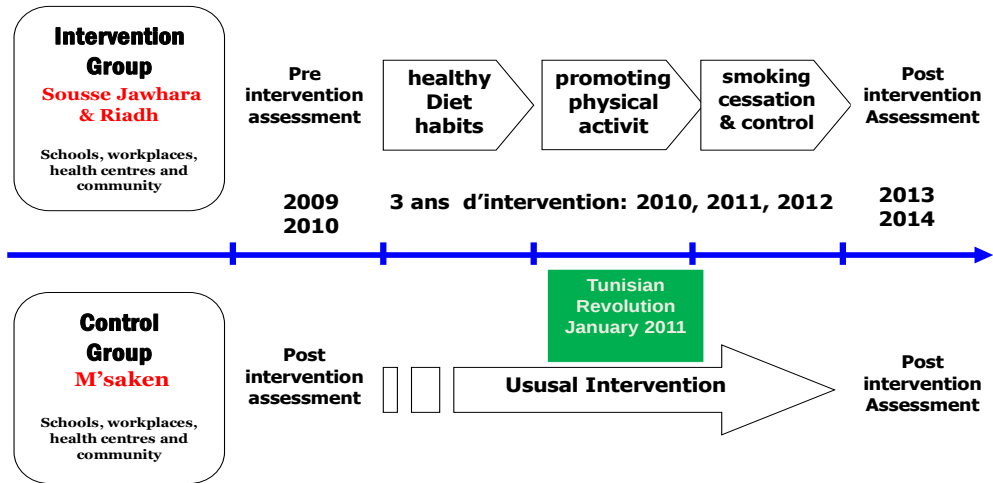
4. Methodology and Results of the project « Together in Health »

4.1. Methodology

4.1.1. Study design

To evaluate the effectiveness of an intervention program at the community level for the prevention of risk factors for noncommunicable diseases (NCDs) in the region of Sousse in Tunisia, a quasi-experimental intervention study was conducted in two districts in the governorate of Sousse. The first district community that has served for the intervention group was represented by delegations of Sousse Jawhara and Sousse Erriadh. The district community of control was located in the delegation Msaken. We have included various settings to the evaluation of risk factors for NCDs in the two groups namely the schools, the workplaces and the communities. The study design (see below) shows that we have carried out an evaluation before intervention (pre assessment) in 2009-2010. It focused on the knowledge, attitudes and behaviors of participants in relation to the various studied risk factors that were represented by diet, physical activity and smoking in the three environments and for both groups. An intervention was made during 3 years in the three settings of the project intervention area. In the control area, there's been no specific intervention program from the usual or routine interventions. The evaluation of these parameters was made at the end of the intervention (post assessment) in both groups in 2013-2014.

Study design: Quasi-experimental design (Pre - Post assessment with a control group)



4.1.2. Study population

Our study population consisted of a sample from the different settings included in the study. These samples have helped us evaluate the different NCDs risk factors but the intervention actions concerned the entire population of these setting areas.

The sample size calculation in the three settings was based on a type 1 error of $\alpha = 5\%$, a type 2 error of $\beta = 20\%$ and a change in the prevalence of various factors risk (smoking, poor diet, lack of physical activity) of 6% between the pre and post intervention. For this, we needed 4,000 college schoolchildren in intervention and control area,

2,000 adults in communities and 2,000 employees in professional settings.

For school and community settings, the assessment before and after the intervention concerned representative samples drawn, while for the workplace setting assessment, we selected a convenience sample of three enterprises in the intervention area and 3 enterprises in the control area based on their numbers of employees and sex distribution.

Thus, in the schools, all colleges from delegations of Sousse Jawhara and Sousse Erriadh ($n = 8$) formed the intervention group and all colleges from the delegation Msaken ($n = 7$) formed the control group. A stratified proportional sampling was used to select the schoolchildren who participated in the data collection.

In the community, we have drawn 500 households in the intervention area and 500 households in the control area, all adults aged 18 to 65 years found in these households were included in the data collection. In the workplace, 3 enterprises were selected by convenience to be part of the intervention group (Epi d'Or, TEXMED, UATS) and 3 enterprises relatively similar in terms of size and gender composition in the control group (STIP, AAF, FITLEC). All employees of the selected companies were included in the data collection.

4.1.3. Data collection

Three questionnaires designed for the "Community Intervention for Health" project to which we previously participated were translated into Arabic, pre-tested and used for data collection among participants in the

three settings: schools, work places and communities. They were administered before and after the intervention. In schools, the questionnaire was self-administered and distributed to schoolchildren in their classes, in the presence of pre-trained doctors to ensure the standardization of administration. The administration of the questionnaires was conducted by interview in the workplaces and neighborhoods.

The questionnaires have enabled us to collect the following information in three areas:

- Socio demographic characteristics
- Knowledge, attitudes and smoking behavior
- Knowledge, attitudes and eating behaviors
- Knowledge, attitudes and physical activity behaviors

We also collected biometric data such as height and weight. The weight was measured to the nearest 0.1 kg using a portable electronic scale. The height, in standing position was measured in participants with bare feet to the nearest 0.5 cm. Blood pressure was measured only for adult participants in the household and workplace twice at rest using an arm electronic sphygmomanometer.

4.1.4. Variables definition

Definition of overweight and obesity: Body Mass Index (BMI) in kg / m^2 was calculated by the ratio of weight to the square of the height. To define overweight and obesity among schoolchildren, we used the Cole BMI threshold values by age and sex (61).

Definition of hypertension: an average of the two measurements greater than or equal to 140 mmHg for systolic blood pressure and / or 90 mmHg for diastolic blood pressure (62).

Definition of smoking: In adults, participants were asked the question: "Do you currently smoke tobacco products such as cigarettes, cigars, or chicha?". Smokers were participants who answered yes to this question. Among adolescents were considered smokers, schoolchildren who smoked at least one cigarette a month prior to the study (63).

The recommended level of physical activity was used as defined by WHO for children and adults (64).

For healthy diet, the notion of eating at least 5 servings of fruits and vegetables per day was used to assess participants' knowledge and their eating habits.

4.1.5. statistical analysis

Data were entered and analyzed using SPSS 17.0 software. The following analysis procedures were carried out where their applications were appropriate: The Student t test and the Chi-square test were used on independent samples, respectively for comparison of means and inter-group percentages. A statistical significance was set at 5% for the different tests used.

4.1.6. Ethical considerations

The study protocol, data collection forms, the questionnaire and the manual methods of investigation were approved by the ethics committee of the University Hospital Farhat Hached of Sousse.

We asked permissions to the Ministry of Health, the Governor of Sousse, the Regional direction of education, school management and the group of Occupational Medicine of Sousse. For schoolchildren, we got the passive consent of their parents who were informed of the ongoing project and its objectives and could refuse the participation of their children and report it to the research team.

Adults in the workplaces and households participants signed a written consent form prior to participation in data collection.

4.2. Results of the project « Together in Health »

4.2.1. Results in school settings

4.2.1.1. Sociodemographic characteristics:

Before the beginning of the intervention program, 4003 schoolchildren were included in the study: 1929 in the intervention group and 2074 in the control group with a response rate of 94.6%. After the intervention, 4275 schoolchildren participated in the evaluation with respectively 2170 and 2105 in each group. The response rate at the end of the study was 92.9% (Table VI).

Table VI: Schoolchildrens' distribution and responses rates in both intervention and control groups before and after the intervention program.

		Intervention group	Control group	Total
		n (response rate %)	n (response rate %)	n (response rate %)
Pre-assesement	Colleges n=15	1929 (93.1)	2074 (96.0)	4003 (94.6)
Post-assesement	Colleges n=15	2170 (91.9)	2105 (93.9)	4275 (92.9)

Regarding the gender distribution in the two groups, there was not a significant difference between participants before and after the intervention in both intervention ($p = 0.35$) and control ($p = 0.45$) groups. (Figure 3)

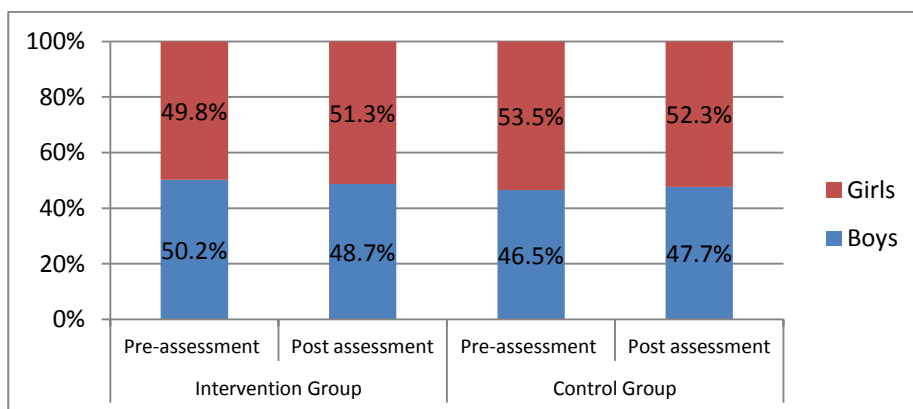


Figure 3: Schoolchildrens' distribution by gender in both intervention and control groups before and after the intervention.

In terms of age; in the intervention group; there was no significant difference between participants before and after the intervention ($p=0.52$). However in control group, the composition has changed significantly including more schoolchildren aged less than 14 years ($p<0.001$) (Figure 4).

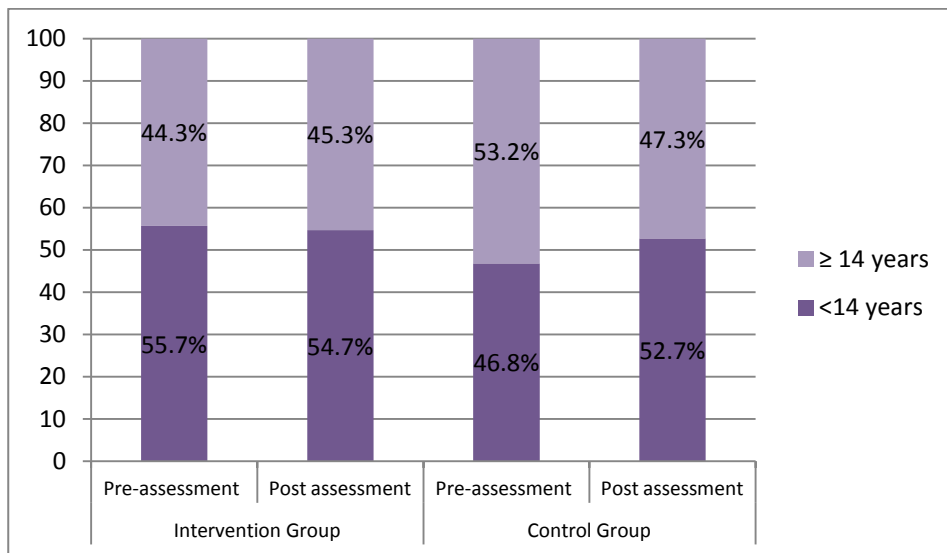


Figure 4: Schoolchildrens' distribution according to the age in both intervention and control groups before and after the intervention.

4.2.1.2. Knowledge and perceptions evolution:

4.2.1.2.1. Evolution of tobacco use perceptions:

In the intervention group, perceptions about smoking have been improved but not significantly. While in the control group, there was a

significant decline in evaluated perceptions. In fact, the proportion of schoolchildren who agreed with a legislation banning smoking in public places decreased from 98.5% to 93% ($p < 0.001$) and the proportion of those who thought that smoking did not make the boys more attractive decreased significantly (Table VII).

Table VII: Evolution of schoolchildrens' tobacco use perceptions before and after the intervention in both intervention and control groups.

	Intervention group			Control group		
	Pre assesement n(%)	Post assesement n(%)	p	Pre assesement n(%)	Post assesement n(%)	p
It is important to ban tobacco use in public places	1824 (94.9)	2023 (94.6)	0.60	2018 (98.5)	1886 (93.0)	<0.001
Tobacco use does not make boys more attractive	1644 (85.8)	1790 (87.0)	0.26	1854 (90.2)	1684 (86.3)	<0.001
Tobacco use does not make girls more attractive	1753 (91.5)	1887 (91.6)	0.98	1878 (91.8)	1822 (92.3)	0.5

4.2.1.2.2. Evolution of knowledge about physical activity:

We observed a non significant increase on knowledge about the recommended level of physical activity (60 minutes per day) in the intervention group from 45.3% to 46.4% ($p = 0.48$). However, in the

control group we observed a significant decrease from 49.6% to 44.3% ($p < 0.001$).

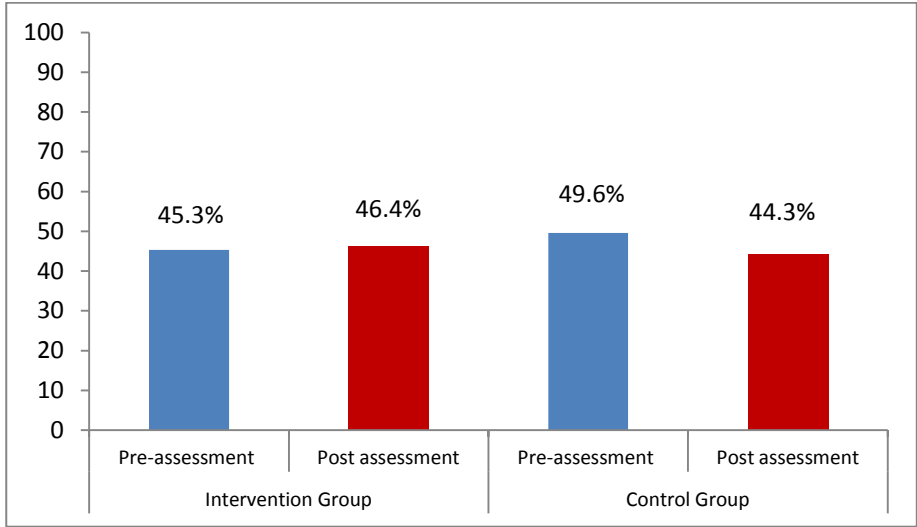


Figure 5: Evolution of schoolchildrens' knowledge about the recommended level of physical activity before and after the intervention in both intervention and control groups.

4.2.1.2.3. Evolution of knowledge on diet:

Knowledge about the unhealthy eating habits has improved in the two groups (Table VIII). Moreover, knowledge about health dietary benefits has improved significantly in the intervention group. This improvement was especially observed with the impact of sugar and fat consumption in the intervention group contrary to the control group (Table IX).

Table VIII: Evolution of schoolchildrens' knowledge on diet before and after the intervention in the two groups.

	Intervention group			Control group		
	Pre assesement n(%)	Post assesement n(%)	p	Pre assesement n(%)	Post assesement n(%)	p
It is recommended to consume 5 portions of fruits and vegetables daily	454 (23.6)	529 (24.6)	0.453	738 (35.6)	478 (23.6)	<0.001
Unhealthy eating habits can be harmful	344 (17.9)	686 (31.8)	<0.001	457 (22.1)	675 (33.1)	<0.001

Table IX: Evolution of schoolchildren's knowledge about the benefits of healthy diet before and after the intervention in the two groups.

Eating habits which can have a significant influence on health:	Intervention group			Control group		
	Pre assesement n(%)	Post assesement n(%)	p	Pre assesement n(%)	Post assesement n(%)	p
Increasing fruits and vegetables consumption	1779 (86.2)	1673 (82.6)	0.002	1608 (83.8)	1844 (85.8)	0.08
Reducing sugar consumption	1313 (68.6)	1567 (74.9)	<0.001	1597 (77.5)	1467 (72.8)	<0.001
Reducing fat consumption	1292 (67.5)	1532 (72.3)	<0.001	1628 (79.0)	1389 (69.4)	0.001
Reducing salt consumption	1206 (63.1)	1442 (68.0)	0.7	1386 (67.4)	1343 (66.9)	0.001

4.2.1.3. Evolution of lifestyle habits:

4.2.1.3.1. Tobacco use evolution:

There was a non significant decrease in tobacco use from 5.7% to 4.8% ($p= 0.2$) in the intervention group. Whereas, in control group tobacco use increased significantly from 7.5% to 9.2% ($p= 0.048$). (Figure 6)

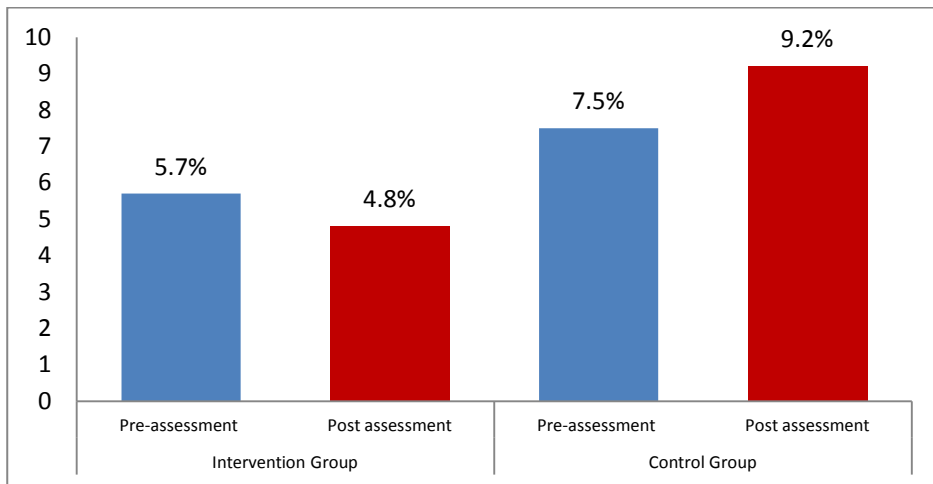


Figure 6 : Evolution of the tobacco use among schoolchildren before and after the intervention in both intervention and control groups.

After adjustement for sex, in the intervention group, there was a non-significant decline in tobacco use among both boys and girls. While, in control group we observed a significant increase of tobacco use among girls from 1.1% to 5.2% ($p < 0.001$). We observed also a significant increase in tobacco use from 3.3% to 5.9% among those under 14 years of age in the same group ($p = 0.006$). (Table X)

Table X : Evolution of tobacco use among schoolchildren according to age and sex before and after the intervention in intervention and control groups

	Intervention group			Control group		
	Pre assesement n (%)	Post assesement n (%)	p	Pre assesement n (%)	Post assesement n (%)	p
Boys	85 (8.8)	81 (7.8)	0.4	143 (14.8)	136 (13.6)	0.4
Girls	25 (2.6)	23 (2.1)	0.4	12 (1.1)	57 (5.2)	<0.001
<14 years	37 (3.4)	41 (3.5)	0.9	32 (3.3)	65 (5.9)	0.006
≥14 years	73 (8.5)	63 (6.5)	0.09	123 (11.1)	127 (12.8)	0.2

4.2.1.3.2. Practice of recommended level of physical activity evaluation:

The practice of the recommended level of physical activity (60 minutes per day) decreased significantly from 29.1% to 25.5% ($p = 0.010$) in the intervention group and remain unchanged in control group ($p = 0.887$) (Figure 7).

The decrease of the practice of the recommended level of physical activity was significant for boys and for schoolchildren aged 14 or more in the intervention group (Table XI).

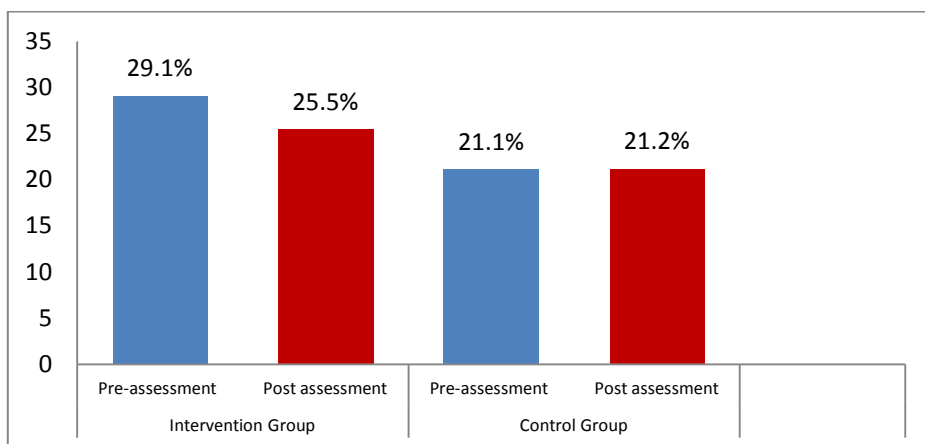


Figure 7: Evolution of practice of the recommended level of physical activity before and after the intervention in the two groups.

Table XI: Evolution of the schoolchildrens practice of the recommended level of physical activity before and after the intervention in the two groups.

	Intervention group			Control group		
	Pre assesement n(%)	Post assesement n(%)	p	Pre assesement n(%)	Post assesement n(%)	p
Boys	431 (44.9)	406 (39.8)	0.02	355 (37.1)	343 (35.8)	0.6
Girls	123 (13.0)	126 (11.9)	0.40	79 (7.2)	82 (7.9)	0.5
<14 years	320 (30.1)	326 (28.5)	0.400	203 (21.1)	229 (21.5)	0.80
≥14 years	234 (27.8)	206 (21.8)	0.003	231 (21.0)	195 (20.9)	0.96

4.2.1.3.3. Eating habits evolution:

Concerning the consumption of five fruits and vegetables per day, there was a significant improvement in the intervention group from 30% to 33.2% ($p = 0.027$) in opposition to a significant decrease from 40.2% to 35% ($p = 0.001$) in control group. (Figure 8)

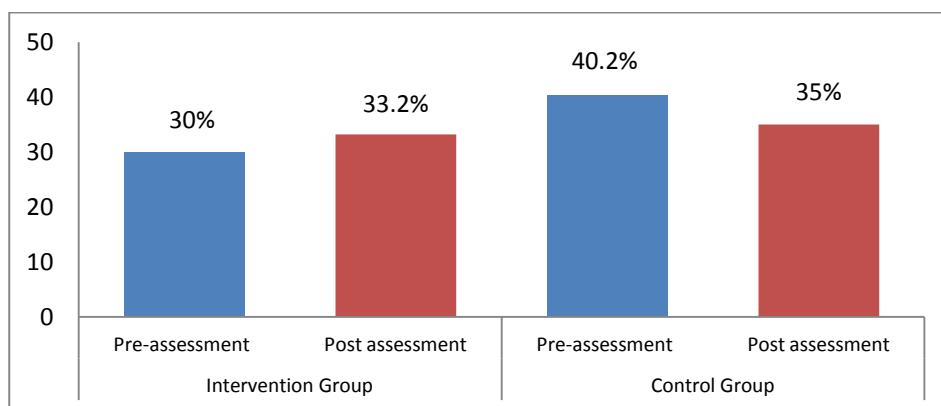


Figure 8: Evolution of 5 fruits and vegetables consumption daily before and after the intervention in the two groups.

When we adjusted by sex, improvement of the consumption of five fruits and vegetables per day in the intervention group becomes non significant contrary to a significant decrease in the control group for both sexes (Table XI). Furthermore we observed a significant improvement from 30.2% to 35.4% ($p = 0.009$) among schoolchildren aged under 14 years in the intervention group, whereas there was a significant decrease in those 14 years old or more in the control group. (Table XII)

Table XII : Evolution of the consumption of 5 portions of fruits and vegetables daily before and after the intervention in the two groups.

	Intervention group			Control group		
	Pre assesement n(%)	Post assesement n(%)	p	Pre assesement n(%)	Post assesement n(%)	p
Boys	314 (33.3)	350 (37.1)	0.070	419 (44.0)	353 (37.2)	0.002
Girls	251 (26.6)	320 (30.0)	0.100	402 (36.9)	340 (32.9)	0.050
<14 years	319 (30.2)	408 (35.4)	0.009	379 (39.5)	401 (37.9)	0.460
≥14 years	246 (29.7)	290 (30.6)	0.700	442 (40.9)	291 (31.6)	<0.001

Focusing on family eating habits, we observed in the intervention group a significant increase in parental provision of fruits and vegetables. We observed also an increase in parental encouragement to consume more fruits and vegetables in addition to an increase of healthy cooking methods by parents.

On the other side, in the control group, the parental provision of fruits and vegetables to children decreased significantly from 75.2% to 68.4% ($p < 0.001$) (Table XIII) despite their increased encouragement of fruits and vegetables consumption.

Table XIII: Family eating habits repartition among schoolchildren before and after the intervention in the two groups.

	Intervention group			Control group		
	Pre assesement n(%)	Post assesement n(%)	p	Pre assesement n(%)	Post assesement n(%)	p
At least 5 days a week , one of your parents :						
Encourage you to consume more fruits and vegetables	1232 (64.0)	1505 (69.8)	<0.001	1014 (48.9)	1272 (62.6)	<0.001
Provide you fruits and vegetables in meals or snacks	1101 (57.6)	1447 (67.9)	<0.001	1559 (75.2)	1382 (68.4)	<0.001
Prepare for you grilled or steamed or boiled food	541 (28.6)	644 (30.5)	<0.001	406 (19.7)	521 (26.0)	0.200
Prepare for you fried meals	256 (13.4)	253 (11.9)	0.100	213 (10.3)	234 (11.6)	0.200

4.2.1.3.4. Evolution of excess weight:

The mean of Body Mass Index (BMI) among schoolchildren in the intervention group decreased significantly from $20.8 \pm 4 \text{ kg / m}^2$ to $20.3 \pm 4.3 \text{ kg / m}^2$ ($p < 0.001$). Whereas in control group, it increased significantly from $20.0 \pm 4.1 \text{ kg / m}^2$ to $20.4 \pm 4.2 \text{ kg / m}^2$ ($p = 0.004$).

Otherwise, the excess of weight among schoolchildren decreased in the intervention group from 27.6% to 26% against an increase in the control group from 20.1% to 25.6%. (Figure 9)

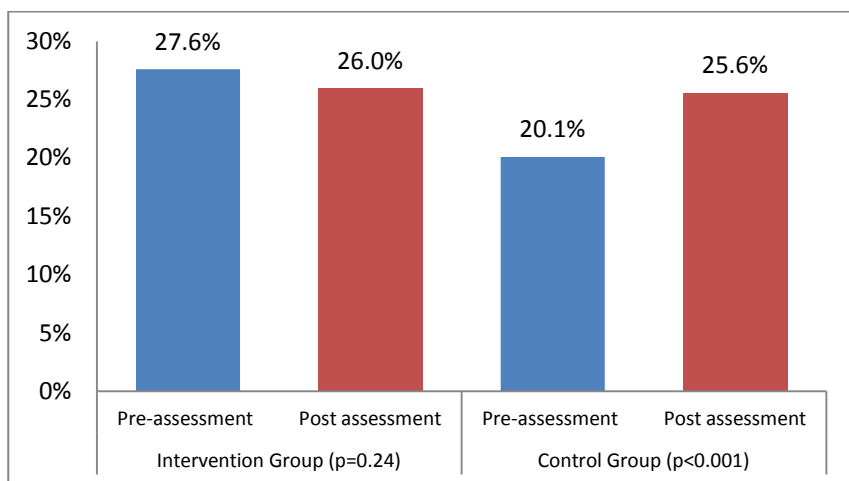


Figure 9: Evolution of excess of weight before and after the intervention in the two groups.

In the intervention group, proportion of boys with normal weight increased significantly from 73.1% to 77.2% ($p = 0.03$) and proportion of boys with overweight decreased significantly from 20.4% to 16.9% ($p = 0.04$). When it comes to obesity, it did not decrease significantly in this group.

While in the control group, the proportion of obese boys increased significantly from 4.9% to 7.6% ($p = 0.01$). (Table XIV)

For girls, there was no significant change in terms of overweight in the intervention group. However, in the control group the proportion of girls in normal weight decreased significantly from 79.9% to 76.2% ($p = 0.03$) and the proportion of obese girls increased significantly from 4.2% to 6.3% ($p = 0.03$). (Table XIV)

Table XIV : Weight status by sex among the schoolchildren before and after the intervention in the two groups.

		Boys			Girls		
		Pre assesement n(%)	Post assesement n(%)	p	Pre assesement n(%)	Post assesement n(%)	p
Intervention group	Normal weight	707(73.1)	798 (77.2)	0.03	689 (71.8)	807 (74.0)	0.2
	Overweight	197(20.4)	175(16.9)	0.04	199 (20.7)	207 (19.0)	0.3
	Obese	63 (6.5)	61 (5.9)	0.57	72 (7.5)	77 (7.1)	0.7
Control group	Normal weight	772(80.1)	756 (77.8)	0.20	886 (79.9)	810 (76.2)	0.03
	Overweight	145 (15)	142 (14.6)	0.80	176 (15.9)	186 (17.5)	0.30
	Obese	47 (4.9)	74 (7.6)	0.01	47 (4.2)	67 (6.3)	0.03

In the intervention group, the proportion of schoolchildren aged 14 years and older with overweight decreased significantly from 20.2% to 16.6% ($p = 0.04$). In the control group, the proportion of obesity increased significantly for both age groups. (Table XV)

Table XV: Weight status by age among schoolchildren before and after the intervention in the two groups.

		<14 years			≥14 years		
		Pre assesement	Post assesement	p	Pre assesement	Post assesement	p
		n(%)	n(%)		n(%)	n(%)	
Intervention group	Normal weight	755 (70.3)	860 (73.8)	0.07	641(75.1)	745 (77.7)	0.20
	Overweight	224 (20.9)	223 (19.1)	0.30	172 (20.2)	159 (16.6)	0.04
	Obese	95 (8.8)	83 (7.1)	0.10	40 (4.7)	55 (5.7)	0.30
Control group	Normal weight	756 (77.9)	826 (76.1)	0.30	902 (81.8)	740 (78.0)	0.03
	Overweight	164 (16.9)	175 (16.1)	0.60	157 (14.2)	153 (16.1)	0.20
	Obese	50 (5.2)	85 (7.8)	0.01	44 (4.0)	56 (5.9)	0.03

4.2.2. Results in workplace settings

4.2.2.1. Description of the studied population:

At the pre-assessment, we enrolled 914 employees of Sousse in the intervention group and 861 in the control group. The response rate was 74.6%. At the post-assessment, the studied population was composed of 1098 and 1015 employees in the intervention and control groups respectively. The response rate was 71.9%.

Table XVI: Evolution of the response rate of the two groups in workplace

		Intervention group n (response rate %)	Control group n (response rate %)	Total n (response rate %)
Pre-assessment	Entreprises n=6	914 (76.7)	861 (72.5)	1775 (74.6)
Post-assessment	Entreprises n=6	1098 (67.5)	1015 (77.5)	2113 (71.9)

At the pre-assessment, the intervention group was composed of 64.7% of men versus 65.5% at the post assessment. The control group was composed of 59% of men at the pre-assessment versus 61.4% at the post assessment. The differences were not significant in the two groups (table XVII).

Table XVII: Distribution of the participants in the two groups at pre and post assessment according to the sex

Sex	Intervention group			Control group		
	Pre n (%)	Post n (%)	p	Pre n (%)	Post n (%)	p
Men	591 (64.7)	719 (65.5)	0.70	508 (59.0)	623 (61.4)	0.29
Women	323 (35.3)	379 (34.5)		353 (41.0)	392 (38.6)	
Total	914 (100.0)	1098 (100.0)		861(100.0)	1015 (100.0)	

At the pre-assessment, the mean age of the intervention group employees was 32.25 ± 8.11 years. It was 33.86 ± 8.10 years at the post assessment ($p < 0.001$).

At the pre-assessment, the mean age of the control group employees was 35.40 ± 8.79 years. It was 38.90 ± 8.77 years at the post assessment ($p < 0.001$).

The studied population was composed mostly of workers or technician without significant difference at the pre-assessment and the post assessment neither in the control group ($p = 0.07$) nor in the intervention group ($p = 0.26$).

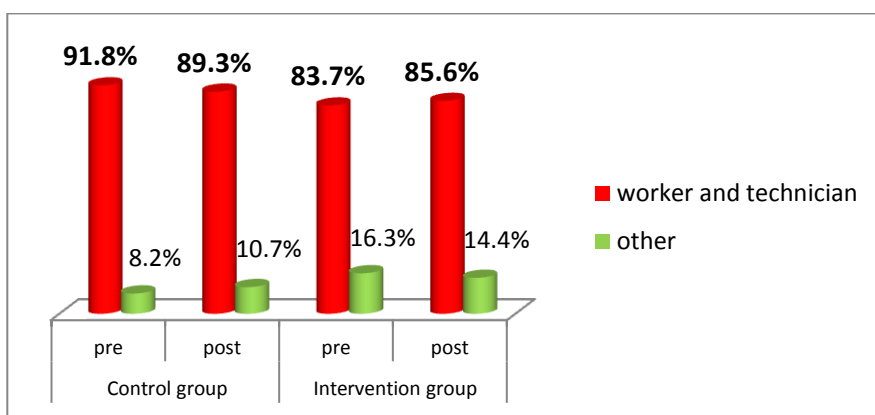


Figure 10: Distribution of the participants in the intervention program according to the profession in intervention and control group

4.2.2.2. Evolution of the knowledge and perceptions on non-communicable diseases risk factors before and after intervention among the employees in workplace of Sousse:

For eating habits:

In the intervention group, the workers improved their knowledge on the relation between the food they consumed and the risk of developing non-communicable diseases. The observed improvement was significant ($p < 0.001$) for the relation between dietary habits and the risk to develop cardio-vascular diseases, diabetes mellitus and cancers.

Likewise for the control group, we observed significant improvements of the knowledge (Table XVIII).

Table XVIII: Evolution of the knowledge on the relation between eating habits and the risk to develop non-communicable diseases of the employees in the two groups

Do you think that what you are consuming can change the risk?	Intervention group			Control group		
	Pre n (%)	Post n (%)	p	Pre n (%)	Post n (%)	p
Cardio-vascular diseases	506 (56.2)	797 (72.7)	<0.001	464 (55.2)	715 (71.4)	<0.001
Diabetes mellitus	593 (65.4)	862 (78.7)	<0.001	542 (65.0)	787 (78.3)	<0.001
Cancers	337 (37.5)	675 (61.8)	<0.001	313 (37.9)	626 (63.0)	<0.001

The table XIX shows significant improvement of the perceptions among the employees in the intervention group about the importance of some eating habits for health (changing the methods of cooking, eating more fiber and more fruits and vegetables, eating less sugar, salt and fat).

Table XIX: Evolution of the participants' perceptions on the influence of healthy diet on health before and after the intervention in both groups

It's important for health	Intervention group			Control group		
	Pre n (%)	Post n (%)	p	Pre n (%)	Post n (%)	p
Changing cooking methods	740 (82.2)	961 (87.6)	0.001	728 (88.0)	855 (85.0)	0.06
Eating more fibre	777 (86.2)	988 (90.1)	0.008	745 (88.6)	871 (87.0)	0.30
Eating more fruits and vegetables	834 (92.6)	1047 (95.6)	0.004	779 (93.1)	900 (89.7)	0.01
Eating less sugar	800 (88.9)	1034 (94.4)	<0.001	745 (89.2)	896 (89.4)	0.89
Eating less fat	802 (89.3)	1036 (94.4)	<0.001	758 (90.7)	899 (89.4)	0.35
Eating less salt	794 (88.2)	1021 (93.2)	<0.001	745 (89.4)	890 (88.7)	0.63

For physical activity:

In the intervention group, the employees improved significantly ($p < 0.001$) their knowledge on the benefits of practicing 30 minutes of physical activity per day at least 5 days a week. Likewise for the control group, we observed significant improvements of the knowledge (tableau XX).

Table XX: Evolution of the participant's knowledge on the benefits of the practicing 30 minutes of physical activity per day at least for 5 days a week in both groups

	Intervention group			Control group		
practicing thirty minutes of physical activity per day at least for 5 days a week	Pre n (%)	Post n (%)	p	Pre n (%)	Post n (%)	p
Reduce risk of diseases	661 (73.3)	966 (88.4)	<0.001	626 (75.0)	878 (87.3)	<0.001
Improve heart and lung fitness	683 (75.8)	978 (89.5)	<0.001	658 (78.8)	886 (88.2)	<0.001
Gain muscle	592 (65.9)	916 (83.9)	<0.001	606 (72.9)	822 (81.8)	<0.001
Help losing weight	514 (57.5)	834 (76.5)	<0.001	532 (63.6)	779 (77.7)	<0.001
Prevent depression	546 (60.9)	873 (79.9)	<0.001	520 (61.4)	782 (78.0)	< 0.001
Reduce stress	562 (62.6)	894 (81.8)	<0.001	526 (62.9)	799 (79.7)	<0.001
Do better on job	571 (63.2)	865 (79.1)	<0.001	554 (66.3)	800 (79.8)	<0.001

For tobacco use:

The proportion of employees who recognized that cigarettes labeled light aren't less harmful than regular cigarettes increased significantly in the intervention group ($p<0.001$). However, it decreased in control group ($p=0.13$).

In control group, the improvement of knowledge that tobacco use is addictive was 9.5% versus 17% in intervention group.

The increase of the proportion of participants in control group who think smoking of narguile as harmful for health was 8.8% versus 12.1% in intervention group. These improvements were statistically significant ($p<0.001$) in the two groups (figure 11).

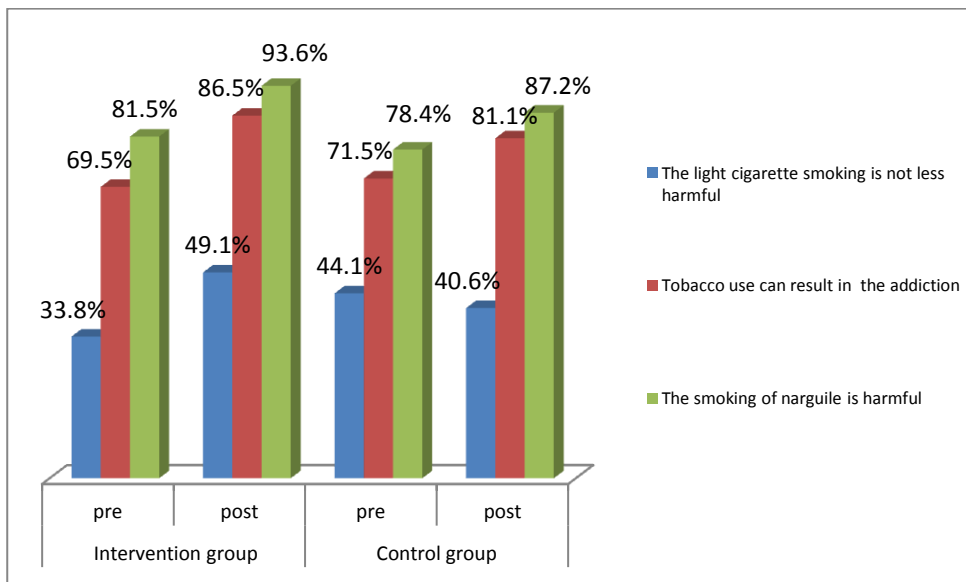


Figure 11: Evolution of the knowledge about tobacco use among employees in the two groups

4.2.2.3. Evolution of employees behaviors in workplace:

For eating habits:

In the intervention group, the employees decreased 2.2% the habit of adding salt on food ($p=0.05$). The employees in the control group decreased this habit in 1.5% ($p=0.67$).

We assessed the habit of eating snacks among the employees participating to the study. The intervention group increased insignificantly the habit of choosing fried food ($p=0.42$). It increased significantly the habit of choosing fruits or vegetables as a snack ($p=0.01$) and decreased significantly the consumption of milk and dairy products ($p=0.02$). The evolution in the control group consisted in an increase of the consumption of fried food, a decrease of the consumption of fruits or vegetables and a decrease in the consumption of milk and dairy products. All these trends observed among the control group were statistically significant (table XXI).

Table XXI: Evolution of snacks consumed by the participants in the two groups

	Intervention group			Control group		
	Pre n (%)	Post n (%)	p	Pre n (%)	Post n (%)	p
Choose fried foods	178 (19.8)	232 (21.3)	0.42	128 (15.2)	203(20.5)	0.003
Choose fruits and vegetables	140 (15.6)	217 (19.9)	0.01	258 (30.6)	208 (21.1)	<0.001
Choose milk and dairy products	214 (23.8)	211 (19.4)	0.02	235 (27.8)	187 (18.9)	<0.001

The intervention group improved significantly the behavior of consuming at least five servings of fruits and vegetables daily ($p=0.04$) whereas in the control group, the observed improvement was not significant ($p=0.57$) (table XXII).

Table XXII: Evolution of the consumption of 5 fruits and vegetables daily among the employees participating to the study in the two groups

Eating at least 5 servings of fruits and vegetables daily	Intervention group			Control group		
	Pre n (%)	Post n (%)	p	Pre n (%)	Post n (%)	p
yes	421 (47.5)	558 (52.1)	0.04	504 (60.9)	613 (62.2)	0.57
no	466 (52.5)	513 (47.9)		323 (39.1)	372 (37.8)	

When we adjust for sex, the habit of eating at least five fruits and vegetables daily was not significantly improved among men and women in the intervention group. While for the control group, men reduced significantly ($p = 0.001$) this habit and women improved it significantly ($p < 0.001$).

After adjustment for the age, this habit was improved among participants who were aged 40 years old or more in the intervention group ($p = 0.05$) (table XXIII).

Table XXIII: Evolution of the consumption of 5 fruits and vegetables per day among the employees participating to the study in the two groups according to the sex and the age

Eating at least 5 portions of fruits and vegetables per day	Intervention group			Control group		
	Pre n (%)	Post n (%)	p	Pre n (%)	Post n (%)	p
Men	281 (48.6)	375 (53.7)	0.07	365 (73.9)	395 (64.9)	0.001
Women	140 (45.3)	183 (49.1)	0.33	139 (41.7)	218 (58.0)	<0.001
≤ 40 years	346 (46.5)	430 (49.7)	0.21	287 (54.4)	318 (55.9)	0.61
>40 years	69 (51.9)	128 (62.4)	0.05	207 (72.9)	295 (70.9)	0.57

For physical activity:

The employees participating to the intervention program improved significantly their physical activity level in both groups (Table XXIV).

Table XXIV: Evolution of the behavior of practicing 30 minutes of physical activity per day during 5 day per week at least in the two groups

Practicing 30 minutes of physical activity daily during 5 days per week	Intervention group			Control group		
	Pre n (%)	Post n (%)	p	Pre n (%)	Post n (%)	p
yes	253 (28.3)	414 (37.9)	<0.001	262 (31.2)	426 (42.9)	<0.001
no	642 (71.7)	679 (62.1)		577 (68.8)	568 (57.1)	

This improvement was significant for men and women in both groups. After stratification by age, only employees above 40 years old in the intervention group improved significantly their physical activity level ($p < 0.001$) (Table XXV). In the control group, the improvement remained significant after adjustment for age and sex.

Table XXV: Evolution of the behavior of practicing 30 minutes of physical activity per day during 5 day per week in the two groups adjusted for sex and age

	Intervention group			Control group		
	Pre n (%)	Post n (%)	p	Pre n (%)	Post n (%)	p
Men	196 (33.8)	315(44.0)	<0.001	168 (33.4)	284 (46.6)	<0.001
Women	57 (18.1)	99 (26.3)	0.01	94 (28.0)	142(36.9)	0.01
≤ 40 years	228 (30.2)	305 (34.6)	0.06	160 (29.8)	254 (43.6)	<0.001
>40 years	22 (16.8)	109 (51.7)	<0.001	97 (33.7)	172 (41.7)	0.03

For tobacco use:

In the intervention group, the prevalence of tobacco use was 39.2% at the pre-assessment and 37.5% at the post assessment ($p=0.43$). In the control group, it was 31.7% at the pre-assessment and 30.6% at the post assessment ($p= 0.62$). These trends were not significant (Table XXVI).

Table XXVI: Evolution in tobacco use prevalence in both groups

Are you a current smoker?	Intervention group			Control group		
	Pre n (%)	Post n (%)	p	Pre n (%)	Post n (%)	p
yes	350 (39.2)	410 (37.5)	0.43	250 (31.7)	308 (30.6)	0.62
no	542 (60.8)	683 (62.5)		539 (68.3)	699 (69.4)	

After adjustment for sex and age (Table XXVII), the prevalence of tobacco-use among men decreased from 59.1% to 56.7% in intervention group ($p=0.35$) and it decreased from 52.2% to 49.4% in control group ($p = 0.38$).

The prevalence of tobacco use among women was 1.3% at the pre-assessment in the intervention group and decreased to 0.5% at the post assessment. This improvement was not significant ($p=0.42$). It was 0.3% in the control group without any improvement.

Age didn't seem to have any impact on the evolution of tobacco-use after the intervention.

Table XXVII: Evolution in tobacco use prevalence in both groups
adjusted for sex and age

	Intervention group			Control group		
	Pre n (%)	Post n (%)	p	Pre n (%)	Post n (%)	p
Men	346 (59.1)	408 (56.7)	0.38	249 (52.2)	307 (49.4)	0.35
Women	4 (1.3)	2 (0.5)	0.42	1 (0.3)	1 (0.3)	-
≤ 40 years	289 (38.7)	341 (38.7)	0.99	136 (27.0)	158 (26.9)	0.96
> 40 years	53 (39.3)	69 (32.7)	0.21	112 (41.0)	150 (35.7)	0.16

4.2.2.4. Evolution of other risk factors after the intervention:

The prevalence of obesity increased significantly both in the intervention ($p = 0.01$) and the control groups ($p < 0.001$). However, the prevalence of overweight has not increased significantly in both groups (Table XXVIII).

Table XXVIII: Evolution of the obesity and overweight in the two groups

	Intervention group			Control group		
	Pre n (%)	Post n (%)	p	Pre n (%)	Post n (%)	p
Overweight	281 (31.4)	386 (35.3)	0.07	308 (37.5)	407 (40.6)	0.18
Obesity	134 (15.0)	225 (20.6)	0.01	161 (19.6)	274 (27.3)	<0.001

The evolution of overweight adjusted for age and sex was not significant in the intervention group. Whereas, we noticed a significant increase of the overweight prevalence among women in the control group (Table XXIX).

In the intervention group, obesity increased significantly among men as well as women and only in participants aged less than 40 years (Table XXIX). In the control group, obesity increased significantly among women and in the two groups of age (Table XXIX).

Table XXIX: Evolution of the obesity and overweight in the two groups adjusted for sex and age

		Intervention group			Control group		
		Pre n (%)	Post n (%)	p	Pre n (%)	Post n (%)	p
Over- weight	Men	190 (32.5)	264 (36.8)	0.11	207 (43.1)	264 (42.7)	0.89
	Women	91 (29.4)	122 (32.4)	0.39	101 (29.6)	143 (37.1)	0.03
	≤ 40 years	225 (30.0)	301 (34.0)	0.07	174 (32.7)	211 (3.1)	0.23
	>40 years	52 (39.1)	85 (40.5)	0.79	133 (47.8)	196 (46.9)	0.80
Obesity	Men	71 (12.2)	120 (16.7)	0.02	107 (22.3)	162 (26.2)	0.13
	Women	63 (20.3)	105 (27.9)	0.02	54 (15.8)	112 (29.1)	<0.001
	≤ 40 years	93 (12.4)	159 (18.0)	0.001	93 (17.5)	137 (23.4)	0.01
	>40 years	39 (29.3)	66 (31.4)	0.68	67 (24.1)	137 (32.8)	0.01

In the intervention group, the prevalence of hypertension decreased significantly from 16.2% to 12.8% ($p=0.03$). However after adjustment for sex and age, this improvement was only significant for participants aged 40 years or less ($p=0.04$) (Table XXX).

In the control group, the proportion of hypertension increased significantly from 13.3% to 23.3% ($p < 0.001$). After adjustment, this increase was significant according to sex and age (Table XXX).

Tableau XXX: Evolution of the hypertension in the two groups adjusted for sex and age

Hyper-tension	Intervention group			Control group		
	Pre n (%)	Post n (%)	p	Post n (%)	Post n (%)	p
Men	105 (17.9)	103 (14.3)	0.08	86 (17.1)	184 (29.6)	<0.001
Women	41 (13.1)	37 (9.8)	0.17	26 (7.7)	52 (13.3)	0.01
≤ 40 years	98 (13.0)	85 (9.6)	0.04	56 (10.4)	98 (16.5)	0.003
>40 years	46 (34.3)	55 (26.1)	0.10	56 (19.2)	138 (32.8)	<0.001

4.2.3. Results in community settings

4.2.3.1. Description of the studied population:

At the pre-assessment, our studied population was composed of 940 adults in the intervention group and 940 in the control group. At the post assessment, the population was composed of respectively 1001 and 976 participants. The response rates were almost similar at the pre and post assessment for the intervention group but we noticed a small response rate decline in the control group at the post assessment.

Table XXXI: Evolution of the response rate of the two groups

	Intervention group n (response rate %)	control Group n (response rate %)	Total n (response rate %)
Pre-assessment	940 (73.5)	940 (73.1)	1880 (73.3)
Post-assessment	1001 (74.3)	976(62.5)	1977 (67.9)

The intervention group was composed of 56.8 % of women at the pre assessment versus 55.8% at post assessment ($p = 0.67$). The control group was composed of 71.2% of women at the pre assessment versus 65.7% at the end of the study ($p = 0.01$).

The table XXXII below shows the distribution of participants according to the sex.

Table XXXII: Distribution of the adults participating to the program in the two groups at the pre and the post assessment according to sex

Sex	Intervention group			Control group		
	Pre n (%)	Post n (%)	p	Pre n (%)	Post n (%)	p
Men	406 (43.2)	442 (44.2)	0.67	271 (28.8)	335 (34.3)	0.01
women	534 (56.8)	559 (55.8)		669 (71.2)	641 (65.7)	

The mean age of participants in the intervention group at the pre assessment was 37.20 ± 13.22 years old. It was 39.25 ± 13.61 years after ($p = 0.001$).

The mean age of participants in the control group at the pre-assessment was 38.61 ± 13.73 years. It was 40.43 ± 13.96 years after ($p = 0.004$).

Figure 12 describes the employment status of participants according to sex in each group at pre and post assessment.

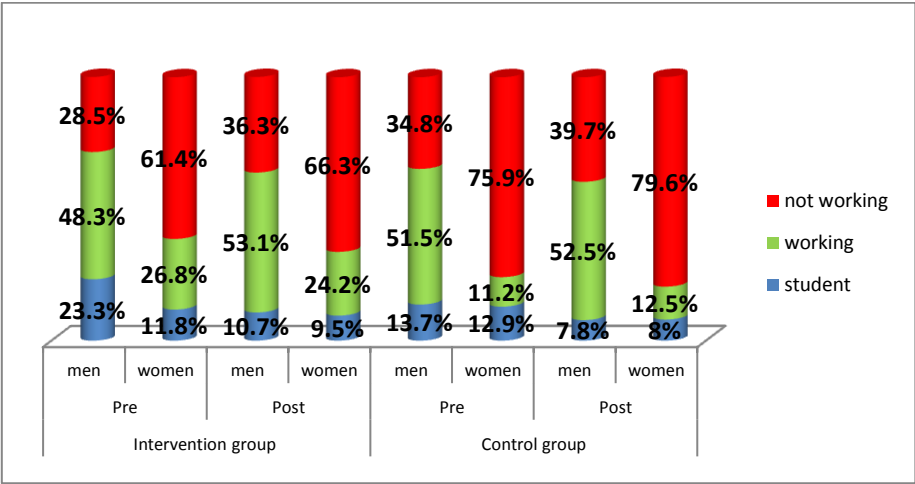


Figure 12: Distribution of adults participating in the intervention program in both groups by occupational status

4.2.3.2. Evolution of the knowledge and perceptions on the risk factors of non-communicable diseases before and after intervention among the participants:

For eating habits:

The adults of Sousse participating in the intervention group improved their knowledge about the relation between eating habits and the risk of developing NCDs. This observed improvement was statistically significant (<0.001) for all of the cardiovascular diseases, diabetes and cancers. The same for was observed in the control group which improved significantly this knowledge (Table XXXIII).

Table XXXIII: Evolution of the knowledge on the link between
alimentation and the risk to develop non-communicable diseases among
the adults participating in the two groups

Do you think that what you are consuming can change the risk?	Intervention group			Control group		
	Pre n (%)	Post n (%)	p	Pre n (%)	Post n (%)	p
Cardio-vascular diseases	707 (75.2)	890 (88.9)	<0.001	715 (76.1)	848 (86.9)	<0.001
Diabetes mellitus	793 (84.4)	901 (90.0)	<0.001	777 (82.7)	873 (89.4)	<0.001
Cancers	462 (49.1)	850 (84.9)	<0.001	425 (45.2)	802 (82.2)	<0.001

Other knowledges were identified among participants (Table XXXIV). In the control group the proportion of adults recognizing the importance of changing cooking methods declined significantly ($p = 0.006$). In the intervention group, the proportion of adults recognizing the importance of eating less salt increased significantly ($p = 0.02$).

Table XXXIV: Evolution of the participants' perceptions on the influence of healthy diet on health before and after the intervention in both groups

It's important for health	Intervention group			Control group		
	Pre n (%)	Post n (%)	p	Pre n (%)	Post n (%)	p
Changing cooking methods	897 (95.4)	940 (93.9)	0.14	907 (96.5)	915 (93.8)	0.006
Eating more fibre	877 (93.3)	943 (94.2)	0.40	903 (96.1)	922 (94.5)	0.10
Eating more fruits and vegetables	908 (96.6)	970 (96.9)	0.70	907 (96.5)	915 (93.8)	0.33
Eating less sugar	907 (96.5)	971 (97.0)	0.52	910 (96.8)	944 (96.7)	0.91
Eating less fat	916 (97.4)	970 (96.9)	0.47	911 (97.0)	944 (96.7)	0.71
Eating less salt	891 (94.8)	970 (96.9)	0.02	906 (96.4)	941 (96.4)	0.97

For physical activity:

Adults in the intervention group had significantly improved their knowledge about all the benefits of practicing 30 minutes of physical activity daily five days a week ($p < 0.001$). For the control group, there was a statistically significant improvement in the knowledge that doing 30 minutes of physical activity daily, five days a week help to reduce risk of diseases ($p = 0.03$), gain muscle ($p < 0.001$) and do better job ($p < 0.001$).

The participants' knowledge's of the benefits of practicing 30 minutes of physical activity are detailed in the table XXXV below.

Table XXXV: Evolution of the participants' knowledge on the benefits of the practice of 30 minutes of physical activity per day at least 5 days a week in both groups

practicing thirty minutes of physical activity per day at least for 5 days a week	Intervention group			Control group		
	Pre n (%)	Pre n (%)	p	Pre n (%)	Post n (%)	p
Reduce risk of diseases	867 (92.5)	976 (97.7)	<0.001	879 (93.7)	933 (95.9)	0.03
Improve heart and lung fitness	869 (92.6)	973 (97.4)	<0.001	885 (94.2)	931 (95.7)	0.15
Gain muscle	812 (86.6)	963 (96.4)	<0.001	847 (90.2)	919 (94.5)	<0.001
Help losing weight	823 (87.7)	938 (94.0)	<0.001	879 (93.6)	880 (90.4)	0.01
Prevent depression	861 (91.8)	969 (97.0)	<0.001	881 (93.8)	921 (94.7)	0.43
Reduce stress	855 (91.2)	965 (96.6)	<0.001	887 (94.5)	915 (94.0)	0.69
Do better on job	844 (90.0)	969 (97.1)	<0.001	856 (91.2)	925 (95.1)	<0.001

For tobacco use:

In the intervention group, the proportion of adults who knew that smoking can cause myocardial infarction (MI) increased significantly from 88.5% to 91.5% ($p = 0.03$) but not in the control group. In the control group the proportion of adults who believed that cigarettes labeled light aren't less harmful than regular cigarettes increased from 5% to 13.2% ($p < 0.001$). However, the proportion of those who thought that the smoking of narguile is harmful decreased significantly in the control group ($p = 0.02$) (Table XXXVI).

Table XXXVI: Evolution of the knowledge about tobacco use among adults in the two groups

	Intervention group			Control group		
	Pre n (%)	Pre n (%)	p	Pre n (%)	Post n (%)	p
Tobacco use can result in cerebral stroke	767 (81.6)	885 (88.5)	0.68	793 (84.4)	838 (85.9)	0.83
Tobacco use can result in myocardial infarction (MI)	832 (88.5)	915 (91.5)	0.03	828 (88.1)	862 (88.4)	0.82
The light cigarette is not less harmful	143 (15.2)	182 (18.2)	0.08	47 (5.0)	129 (13.2)	<0.001
The smoking of narguile is harmful	851 (90.5)	925 (92.7)	0.09	881 (93.7)	887 (91.0)	0.02

4.2.3.3. Evolution of adult participants behaviors:

For eating habits:

The intervention group decreased by 4.8% the habit of adding salt to food, this improvement was statistically significant ($p = 0.01$) from 26.9% to 22.1%. The control group decreased by 4.1% the same habit ($p = 0.01$) from 15.8% to 11.7%.

We assessed the habit of eating snacks among adults participating in the study. The intervention group increased not significantly the habit of choosing fried food. It decreased significantly the habit of choosing fruits or vegetables ($p = 0.04$) and the habit of choosing milk and dairy products ($p < 0.001$). The changes in the control group consisted in a decrease of fried food consumption, but also a decrease in the

consumption of fruits and vegetables as well as milk and dairy products between meals. These trends among the control group were significant (Table XXXVII).

Table XXXVII: Evolution of snacks consumed by the participants in the intervention program in the two groups

	Intervention group			Control group		
	Pre n (%)	Pre n (%)	p	Pre n (%)	Post n (%)	p
Choose fried food	113 (12.1)	141 (14.2)	0.19	124 (13.2)	97 (10.0)	0.03
Choose fruits and vegetables	189 (20.3)	166 (16.7)	0.04	263 (28.0)	158 (16.2)	<0.001
Choose milk and dairy products	243 (26.1)	168 (16.9)	<0.001	197 (21.0)	117 (12.0)	<0.001

The intervention group improved significantly (p <0.001) the habit of eating at least five servings of fruits and vegetables per day from 39.4% to 58.4%. The same for the control group, a significant improvement (p <0.001) was observed from 51.4% to 67.9%.

This habit (eating at least 5 servings of fruit and vegetables per day) was significantly improved in the two groups after adjusting for age and sex (table XXXIII).

Table XXXIII: Evolution of the behavior of consuming 5 fruits and vegetables daily in the two groups according to sex and age

	Intervention group			Control group		
	Pre n (%)	Post n (%)	p	Pre n (%)	Post n (%)	p
Men	161 (39,8)	244 (55,6)	<0.001	122 (45,0)	234 (69,9)	<0.001
Women	207 (39,1)	235 (60,6)	<0.001	361 (54,0)	429 (66,9)	<0.001
≤ 40 years	202 (37,5)	257 (51,6)	<0.001	272 (51,0)	317 (64,2)	<0.001
>40 years	162 (41,6)	304 (66,2)	<0.001	209 (51,9)	343 (71,6)	<0.001

For physical activity:

The adults of Sousse participating to the study improved significantly the behavior of doing recommended level of physical activity in the two groups (Table XXXIX).

Furthermore, after adjusting by sex, this improvement was still significant for men and women in the two groups. However, the improvement among men (26.3%) was higher than that among women (8.2%) in the intervention group (Table XXXX).

The same results were seen after adjusting by age, where we noticed that the improvement is still significant in the two groups (Table XXXX).

Table XXXIX: Evolution of the behavior of practicing 30 minutes of physical activity daily during 5 days a week among adults in the two groups

	Intervention group			Control group		
	Pre n (%)	Post n (%)	p	Pre n (%)	Post n (%)	p
yes	141 (15.1)	400 (40.1)	<0.001	141 (15.0)	375 (38.5)	<0.001
no	795 (84.9)	597 (59.9)		799 (85.0)	598 (61.5)	

Table XXXX: Evolution of the behavior of practicing 30 minutes of physical activity daily during 5 days a week among the participants in the two groups according to sex and age

	Intervention group			Control group		
	Pre n(%)	Post n(%)	p	Pre n(%)	Post n(%)	p
Men	73 (18.1)	195 (44.4)	<0.001	62 (22.9)	145 (43.4)	<0.001
Women	57 (18.1)	99 (26.3)	<0.001	79 (11.8)	230 (36.0)	<0.001
≤ 40 years	93 (17.2)	209 (39.1)	<0.001	76 (14.3)	200 (40.6)	<0.001
>40 years	46 (11.8)	191 (41.3)	<0.001	64 (15.9)	175 (36.7)	<0.001

For tobacco use:

In the intervention group, the prevalence of tobacco use was 26.2% at the pre-assessment and 23.2% after ($p = 0.13$). In the control group, the prevalence increased significantly from 14.4% before the intervention to 18.3% after ($p = 0.02$) (Table XXXXI).

Table XXXXI: Evolution of the prevalence of tobacco use among the participants in the two groups

Are you a current smoker?	Intervention group			Control group		
	Pre n (%)	Post n(%)	p	Pre n(%)	post n(%)	p
yes	242 (26.2)	232 (23.2)	0.13	135 (14.4)	178 (18.3)	0.02
no	683 (73.8)	768 (76.8)		804 (85.6)	797 (81.7)	

After adjusting for sex and age (Tableau XXXXII), the prevalence of tobacco use among men decreased significantly ($p=0.03$) in the intervention group from 52.9 % to 45.6 %.

Table XXXXII: Evolution of the prevalence of tobacco use among the participants in the two groups according to sex and age

	Intervention group			Control group		
	Pre n (%)	Post n (%)	p	Pre n (%)	Post n (%)	p
Men	213 (52.9)	201(45.6)	0.03	127(46.9)	169(50.4)	0.38
Women	29 (5.6)	31(5.5)	0.99	8(1.2)	9(1.4)	0.73
≤ 40 years	133 (24.9)	122 (22.8)	0.43	82(15.4)	97(19.6)	0.07
>40 years	106 (27.6)	110(23.7)	0.18	52(12.9)	81(16.9)	0.09

4.2.3.4. Evolution of other NCD's risk factors after the intervention:

The prevalence of obesity increased significantly in the control group ($p=0.04$) (Table XXXXIII).

Table XXXXIII: Evolution of the obesity and overweight in the two groups

	Intervention group			Control group		
	Pre n(%)	Post n(%)	p	Pre n(%)	Post n(%)	p
Overweight	308 (33.8)	351 (35.4)	0.47	292 (31.6)	308 (31.9)	0.88
Obesity	243(26.7)	296 (29.8)	0.12	271 (29.3)	324 (33.5)	0.04

After adjusting for sex and age (Table XXXXIV), the prevalence of overweight increased significantly from 33.2% to 40.9% ($p = 0.02$) among male participants in the intervention group.

Table XXXXIV: Evolution of the obesity and overweight in the two groups according to the sex and the age

Risk factor	Characteris-tics	Intervention group			Control group		
		Pre n (%)	Post n (%)	p	Pre n (%)	Post n (%)	p
Over-weight	Men	130 (33.2)	179 (40.9)	0.02	91 (34.2)	126 (38.1)	0.33
	Women	178 (34.2)	172 (31.0)	0.26	201 (30.5)	182 (28.7)	0.56
	≤ 40 years	158 (30.0)	168 (31.6)	0.57	154 (29.3)	161 (33.0)	0.20
	>40 years	149 (39.2)	183 (39.7)	0.88	137 (34.6)	146 (30.7)	0.40
Obesity	Men	66 (16.9)	78 (17.8)	0.72	53 (19.9)	72 (21.8)	0.58
	Women	177 (34.0)	218 (39.4)	0.07	218 (33.1)	252 (39.7)	0.06
	≤ 40 years	89 (16.9)	102 (19.2)	0.33	86 (16.4)	95 (19.5)	0.20
	>40 years	154 (40.5)	194 (42.1)	0.64	183 (46.2)	228 (48.0)	0.71

The prevalence of hypertension decreased significantly ($p = 0.04$) in the intervention group globally from 35.8% to 31.4%. In the control group, this proportion increased from 29.3% to 30.3% without significant

difference ($p = 0.62$). In the intervention group, after adjustment for sex and age (Table XXXXV), a significant decrease ($p = 0.004$) in the prevalence of hypertension was observed for participants aged less than 40 years, it decreased from 22.6% to 15.7%. No significant change was observed in the control group.

Table XXXXV: Evolution of the hypertension in the two groups according to the sex and the age

Hyper-tension	Intervention group			Control group		
	Pre n (%)	Post n (%)	p	Pre n (%)	Post n (%)	p
Men	160 (41.6)	164 (37.4)	0.218	81 (30.2)	113 (33.7)	0.360
Women	165 (31.5)	147 (26.6)	0.079	193 (28.9)	183 (28.5)	0.877
≤ 40 years	119 (22.6)	83 (15.7)	0.004	73 (13.8)	73 (14.8)	0.646
>40 years	204 (54.0)	228 (49.5)	0.193	197 (49.1)	221 (46.1)	0.376

5. Discussion, conclusion and perspectives

5.1. Discussion

Noncommunicable diseases (NCDs) are the leading causes of death globally, killing more people each year than all other causes combined. Available data show that nearly 80% of deaths from NCDs occur in low- and middle-income (35). NCDs are mostly the result of unhealthy behaviors such as poor diet, lack of physical activity, tobacco and excessive alcohol consumption. Tunisia, which is undergoing an epidemiological transition, faces the challenge of the fight against non-communicable diseases and their risk factors (38).

Despite their rapid growth and inequitable distribution, much of the health and social consequences caused each year by NCD-related deaths could be avoided by well-known cost-effective and feasible interventions (35). Thus, the prevention of noncommunicable diseases is more effective if it is done by a combination of a population and individual approach to the prevention of major risk factors (65). The principle of actions at the community level is not only targeting the community to bring about change in behavior. They also aim to enable these communities to encourage them to act as an agent of change and encourage them to use their own resources for action. The overall strategy includes educating the community to be more informed of existing risk factors. It also includes assistance to provide simple tools and technologies to facilitate the choice of healthy lifestyles (66).

It is in this context that we proposed to evaluate the feasibility and effectiveness of a community based prevention program for major risk factors of noncommunicable diseases in the region of Sousse to possibly generalize later in different region of Tunisia. This program consisted of an intervention at the community level through a quasi-experimental study design in three main settings namely the schools, the workplace and the community. The intervention group was in the delegations of Sousse Erriadh and Sousse Jawhara and the control group was in the delegation of Msaken with similar social and economic conditions. A representative sample in the three settings was used to assess the main risk factors for noncommunicable diseases in both the intervention and control group with an assessment before and after the intervention. The choice of intervention and control areas took into account the distance between the two groups to avoid any possible contamination but also the fact that the control area should not be very far to ensure the feasibility of data collection.

This is the first intervention at the community level done in Tunisia through a quasi-experimental research design with a control group and power based samples. However, the absence of randomization in this case could be the cause of non comparability of the two groups representing then a certain limit in this study. But more important than the comparability between the two groups is, rather to be considered, the comparability intra group before and after the intervention.

The intervention lasted three years. This time duration may seem limited compared to other international studies, however we do not have other studies with such an important time in Tunisia especially as the conditions under which the intervention took place with the occurrence of the Tunisian revolution in the middle of the project that increased the efforts to involve new leaders and adapt to the new socio-political conditions.

One limitation of this study is that the majority of the tested variables was reported by the participants themselves. Self-evaluation of participants for their diet, physical activity and smoking habits could be biased especially when small changes in behavior were measured. However, other parameters measured by trained interviewers after standardization of data collection, have also been improved in the intervention group such as weight and blood pressure.

The socio-political conditions after the revolution also made it that the authorities and policy makers at the Ministry of Health and other sectors (Ministry of Interior, education, finance, urban design...) had other priorities and challenges than the fight against non-communicable diseases and their risk factors. Thus, multi-sectoral and structural measures that are most important in this area were very limited in our program given the circumstances described above.

We noticed after all, an improvement of key risk factors in the intervention group. However, this trend was also observed in the control group for some variables. We can explain this improvement by the fact that the control group continued to receive existing awareness actions and may also have access to certain interventions disseminated by the media. For obvious ethical considerations, we could not prevent interventions that already exist in the two groups, but our results demonstrate the superiority of our intervention that is more intensive and interactive. On the other hand, contamination is also possible since the interventions that we have done could reach the control group because the population of Msaken is not far from the city of Sousse where we hosted open spaces at large supermarkets for example and we intervened through awareness programs in local radio that could be heard in the area Msaken. "Hawthorne" effect is also possible because the participants were interested in improving their health after being interviewed.

Behavior change is achieved primarily by the mass media on the one hand and interpersonal communication on the other. Influencing human behavior through mass communication is a difficult and complex task that can compete with existing interests such as the preference of listeners or advertisements that can generate a lot of money. Interpersonal communication channels (small group meetings, door to door, visits, etc.) tend to be more useful in changing attitudes and behaviors (67). In our program, open days were used to educate the

general population and provide educational and personalized messages, so we resorted to widespread household distribution of educational pamphlets. The use of mass media has been primarily through the local radio stations as they were the most accessible and especially to selectively target the intervention community.

To improve the effectiveness and feasibility of our program, several society actors have been targeted in their respective sectors such as children in schools and adults in the workplace. Shea et al (68, 69) in a review of five programs for the prevention of cardiovascular disease throughout the community have identified effective strategies for community mobilization: social marketing, education program in middle school and in the workplace, screening and referral of high-risk individuals, the education of health professionals and changes in physical environments. Thus, it is necessary to identify key stakeholders for effective intervention such as policy makers, citizens, non-governmental organizations, volunteers and other resources. As a result, decisions that affect people's health concern not only health services or "health policy", but decisions in many policy areas have their influence on these determinants of health. Indeed, health is strongly influenced by lifestyle and environment, for example how people live, work, eat and drink, travel, spend their leisure time, etc ... It is not only individual choices, but they often have social, cultural, economic and environmental determinants (70).

There are many examples of successful interventions at community level for the prevention and control of noncommunicable diseases in different parts of the world which include for example the Pawtucket Heart Health program of the United States of America and the Isfahan Healthy Heart program in Iran (71-76). Valuable lessons have been learned from the implementation of projects in developed countries (77) and evaluation of various community-based interventions (78).

The majority of these programs have targeted several areas as is the case for our program with the aim of targeting different segments of society and potentiate the effect of interventions in different sectors. The school is a privileged area that can target a large number of young people. The intervention implemented in Finland since 1978 in the community has, in fact, included a school-based intervention "The North Karelia Youth Project". This intervention lasted two years, it was intensive for two colleges, less intensive for the rest of the area colleges with two reference colleges. It was effective on eating habits, was able to improve lipid parameters but failed to lower blood pressure. For smoking habits, intervention could be effective long after. This was explained by the social approach combined with the involvement of the media and the community intervention conducted concomitantly (79-81). Thus, to have a successful school program, it must be combined with other community actions and have a fairly long period of intervention; this was also observed in the program of Isfahan in Iran (82, 83).

The "Child and Adolescent Trial for Cardiovascular Health" program (CATCH) is one of the largest randomized controlled school trials sponsored by the National Institutes of Health in the US. Between 1990 and 1994, the intervention program was implemented with a total of 5106 students in the third year of diverse ethnic backgrounds and educated in public schools. Students came from 96 schools (56 in the intervention group and 40 in the control group) in four states (California, Louisiana, Minnesota and Texas). The program focused on the school environment and school programs for physical education, nutrition and smoking. This program has also shown interest in the education of the whole family. Evaluations were made with schoolchildren, teachers, specialists in physical education and school canteens staff. At the end, the intervention was able to change the fat content of school lunches, increase moderate to vigorous physical activity and improve eating habits and physical activity.

After a decline of 5 years follow up, the results of the CATCH intervention were: maintaining the level of energy expenditure and time spent in moderate intensity physical activity during physical education classes in intervention groups versus a decline in response in control groups as well as improved levels of intervention and interest in physical education classes (84, 85).

Literature reviews on intervention programs in schools to promote healthy lifestyles among students provides data for the development

and implementation of effective interventions (86-89). Indeed, the best interventions are those that include a program on several components such as intervention in classes, parental and the school involvement through tasting programs and involvement of school cafeterias. These studies also emphasize the importance of fruits and vegetables accessibility (86-89), a suitable environment for physical activity (90, 91) or restrictions on youth access to tobacco for an effective program (92, 93). Another important aspect in the effectiveness of an intervention is the influence of parents in their behavior and their adherence to the intervention (94-97).

In our program, the actions on the environment have been limited to the confines of the colleges by improving access to healthy foods in cafeterias with encouragement for schoolchildren who consumed foods and improved anti tobacco law enforcement. However, we believe that greater involvement of the school staff is necessary for the success of this kind of program. We need to create a dynamic and a culture to emphasise the importance of the fight against risk factors for chronic diseases in several disciplines, not only in the natural sciences or physical activity courses. It is also important to develop the spirit of volunteerism or include more interactive sessions in the curriculum of schoolchildren to target these risk factors. Indeed, teachers need training and awareness to serve as role models. On the other hand, we must improve the infrastructure of sport facilities in schools and ensure

the value of physical activity sessions. Parents were involved through meetings and workshops conducted in colleges.

Parental involvement can be done in schools but also in the context of interventions programs in occupational settings where adults spend most of their time. The work environment has potentially important effects on the behavior of workers' health and risk factors for several diseases. Previous research has shown, for example, that stress at work, long hours at work, social norms supporting tobacco consumption and shift work contribute to increased smoking habit and are obstacles to smoking cessation (98-100). Similarly, it is clear that the organization of work has a role in the prevalence of obesity (101, 102). Therefore, the WHO states that the importance of health promotion in the workplace is increasingly recognized (103). Recent research has shown that effective programs were those that offered multiple interventions on risk factors combined with a combination of group and individual education (104). These programs have been successful on both the health of employees (104) but also with a decrease in the cost of health care needs (105). Moreover, this benefit may be an argument to convince employers of the benefits of these actions and make them relevant and acceptable programs for employees. Indeed, effective interventions for health promotion in the workplace depend in part on the interest and willingness of employers to support these programs and employees to participate (106). We also noticed this in our program since the

interventions were easier to build and more frequent in companies where employers were more motivated and involved.

Various intervention actions have been made in different countries with awareness, care of obesity in the workplace (107), smoking cessation (107, 108), sometimes with incentives and bonuses (106) for those who managed to lose weight or quit smoking. Other actions have targeted businesses cafeterias by improving access to fruits and vegetables (109-111). This promotion followed several channels ranging from personalized education and through the development of employee skills to achieve group interventions based on partnerships between employers and employees the introduction of environmental change and integrated and community programs (106).

Indeed, structural and environmental changes in the workplace can improve and enhance the effect of the intervention to promote healthy lifestyles (112). In our program, we tried in some companies to make some changes such as banning smoking in the workplace trying to create spaces for smokers. We also tried to educate businesses managers to report refreshment foods high in sugar and fat and we have encouraged them to sell fruit and vegetables. These actions were limited and unfortunately it seems that it is also the case in many other international interventions (112). However, there is substantial evidence that policies that prohibit smoking in the workplace can reduce cigarette consumption, increase attempts to quit smoking and reduce the overall

prevalence of smoking (113-115). The smoke-free workplaces were also effective in reducing exposure to passive smoking (116, 117).

A systematic review published in 2005 (112) has included 13 randomized controlled trials of interventions with environmental assessment of physical activity, diet and risk indicators for health. This review concluded that intervention to promote health programs affecting the environment in the workplace had a significant impact on the promotion of healthy eating. Indeed, 10 of the 13 studies raised studies have shown positive effects of certain strategies such as labeling of food, tools (brochures and posters), broadening the availability of healthy foods. On the other hand, the three studies that have acted on the environment to promote physical activity have yielded inconclusive results. This could be explained by a relatively low methodological quality (encouraging the use of stairs, spaces to walk outside the company).

A recent work of the National Institutes of Health in the United States (107) published in 2010 detailed a quasi-experimental study that included 227 workers in engines industry to assess the effectiveness of a four months intervention to promote smoking cessation and weight control. The intervention program consisted of five call visits handled by trained telephone counselors using motivational interviewing techniques. This study had a positive impact on smoking cessation; the rate of smoking cessation was higher among participants compared to

those who did not participate. After completion of this four months intervention, no overall improvement in the management of overweight was observed. However, smokers who participated in the intervention program and who stopped smoking gained an average of 2.7 kg.

Another review of the literature (118), published in 2010 included 31 randomized controlled trials with the goal of promoting physical activity, and / or improving eating habits, weight control, lipid mass, blood pressure, lipid and / or glucose. Intervention programs were diversified (counseling, group education, exercises). This literature review has shown the effectiveness of the intervention program on lifestyles in the workplace on the control of lipid mass and weight control among people with cardiovascular risk. Indeed, these at-risk populations appeared to benefit most from interventions to promote healthy lifestyles. On the other hand, for the other studied variables, the effectiveness of the intervention was not proven as it was the case of blood pressure that has not significantly improved in most studies as well for the populations at high risk or the general population.

Guidelines for health promotion in the workplace suggest that these programs should be given at different levels to facilitate sustainable behavior change. At the individual level, a program should include several educational strategies. At the organizational level, employers and the various agencies such as the occupational health should strengthen and encourage positive action on health (for example, by

providing healthy food options in the cafeteria). Finally, at the community level, these programs of health promotion in the workplace can be actively disseminated by employees to their families and social networks (119, 120) and represent a major component of interventions at the community level.

During the last two decades, we have noticed an increased interest in interventions to promote health at the community level. This is due to the fact that risk factors for noncommunicable diseases are determined by individual behaviors that themselves depend largely on social and environmental context. This has led many researchers and public health professionals to implement actions and compains to change not only individual behavior but also social norms, public policy and physical environment (121, 122). These programs have so many advantages as they target the population on a large scale and therefore have great potential to improve the level of risk and morbidity in the general population rather than approaches that target only a small proportion of at high risk patients (123).

Among the most effective interventions, one can cite the example of Finland (124), that started from the 70s in North Karelia in response to local people's representatives petition for urgent and effective assistance to reduce the burden of mortality due to coronary heart disease in the region. In cooperation with the authorities and local and national experts, as well as WHO, the North Karelia project was

formulated and implemented to carry out a comprehensive intervention through community organizations with the action of the population itself. Multisectoral actions were used, involving health and other services, schools, NGOs, media campaigns, local media, supermarkets, food industry, agriculture and legislation. After the initial period of the project (1972-1977), the interventions were actively enforced nationally. The main results of this integrated intervention program is the decline in mortality from ischemic heart disease in people under 65 by 73% after 25 years of intervention. Risk factors for cardiovascular disease have also decreased, such as smoking, cholesterol, blood pressure with an increased use of vegetable oils rather than butter. The key to the success of this program according to Pekka Puska (124) was the organization of the community, the collaborative work with many organizations and a strong participation. The intervention program was flexible, based on continuous monitoring and feedback to take advantage of opportunities that occur naturally. The intervention used several strategies: from the use of innovative media, communication activities and the systematic involvement of primary health care (particularly GPs and public health nurses) to environmental change, collaboration with the food industry and changes in policy and legislation. The project worked closely with the national authorities; its activities benefited and contributed to the national health policy. Over the years, the project was expanded to include broader objectives of integrated prevention of major noncommunicable diseases and health promotion and the prevention of risks related to lifestyles from

childhood (11). It is on this principle that Finland has developed the slogan "Health in all policies". In the Finnish view, the core of "health in all policies is to examine the determinants of health that are primarily controlled by the policies of sectors other than health. The desire is to adapt the laws and regulations in the context of policy development at all levels of governance in Europe (125).

The North Karelia program since served as a model based for international interventions such as the Isfahan program in Iran that was proven successful. The heart health program (Isfahan Healthy Heart Program IHHP) is a quasi-experimental intervention with a comprehensive and multi-sectoral approach targeting the whole population (n = 2,180,000) in three districts of central Iran. An evaluation on samples before (2000 - 2001) and after (2007), was made in the intervention and control area with adjustment for age, education level and income area. Samples in 2000-2001 and 2007 included respectively 6175 and 4719 participants in the intervention area, and 6339 and 4853 in the control area. Multiple procedures were performed for the promotion of a healthy diet, regular physical activity, tobacco control and stress management. The prevalence of abdominal obesity, hypertension, hypercholesterolemia, hypertriglyceridemia and high LDL-C decreased significantly in the intervention area compared to the control area in both sexes. However, the reduction of overweight and obesity was significant only in women. No changes were significant in the prevalence of diabetes mellitus (126). The beneficial effects of this

intervention in changing behavior and promoting healthy lifestyles has also been demonstrated (127). The process evaluation of the intervention (128, 129) allowed the researchers to suggest that the activities of intersectoral action and community collaborations resulting from the program have created synergies with existing national health policies, although some of them have not been fully implemented (126). The anti-smoking law is one example. It prohibits smoking in public places and the sale of cigarettes to minors, but it was not fully implemented. The IHHP program used these laws to facilitate certain procedures. Another national health policy that existed was mandatory attendance at classes for all young men and women who intend to get married. In these classes, participants were educated on family planning and reproductive health. An association that was working with the IHHP project added a ten-minute training on the promotion of healthy lifestyles in the course. The comprehensive multisectoral approach effectively increased the level of intervention in which individuals in the intervention area were exposed, which resulted in reductions in risk behaviors that have in turn resulted in favorable changes in the cardiovascular risk factors (126).

The Stanford project in three communities showed that individual education for people at high risk associated with the mass media campaign after one year of intervention was more effective in reducing the consumption of saturated fats, smoking, mean serum cholesterol

and systolic blood pressure that that of a mass media campaign alone. The latter was more effective than if there was no intervention (5).

Other prevention strategies have been conducted in various provinces of Canada where they focused on the social determinants of health to promote healthy eating and physical activity in order to fight against chronic diseases. One study examined provincial initiatives implemented between 1st January 2006 and 1st September 2011 which were classified interventions on lifestyle, structural and environmental actions. The results indicate better skills in health promotion, partnerships, infrastructure change. These interventions have been adapted to each environment and selected according to the needs and characteristics of each province were able to ensure the sustainability of these actions with a lower cost (130, 131).

Thus, community-based prevention and control of cardiovascular diseases began in Europe and the United States in early 1970. While most of these programs have been conducted in developed countries, the strong increase of the burden of noncommunicable diseases in many developing countries has led to similar activities in these countries too. Many of them were carried out in conjunction with the "Inter-Health" WHO program (11), which began in 1986. Its aim was to demonstrate how an integrated program could be implemented in all populations parts of the world at all stages of the epidemiological transition. Since then, a large amount of literature has presented its findings and discussed their experiences. The results indicated that

these programs could be generalized, were profitable and could influence health policy. In the 1980s, there has been a focus of expanded cardiovascular diseases to noncommunicable diseases (NCDs), mainly due to common risk factors programs. Currently, we must direct attention to the developing countries, where the prevalence of noncommunicable diseases is growing. Theory and experience show that prevention programs for noncommunicable diseases at the community level should be planned, implemented and evaluated according to the principles and clear rules, working with all sectors of the community, and maintain close contact with national authorities. Given the burden they represent and globalization, there is a great need for international collaboration. Practical networks with common but adaptable to local cultures flexibly guidelines have proven to be very useful (132).

A significant reduction in the burden of noncommunicable diseases is possible through interventions at the level of the population, which are cost effective and can even be generating income, as is the case with tobacco and alcohol after increasing taxes, for example. But effective interventions, such as measures of tobacco control and salt reduction, are not implemented on a large scale due to insufficient political commitment, as well as non-health sectors, lack of resources and the limited involvement of key stakeholders. For example, less than 10% of the world population is fully protected by one of the anti tobacco

measures contained in the WHO Framework Convention on Tobacco Control (35).

Many interventions for prevention and control of noncommunicable diseases exist. However, even in the richest countries, choices must be made in favor of the highest priority interventions to be implemented because the health resources are finite and in most countries very limited. A number of criteria are to consider, including the burden of disease, cost-effectiveness, equity, feasibility of implementation of specific interventions and political considerations.

In preparation for the high-level meeting of the United Nations, WHO has identified a set of evidence called "best buys" interventions that are not only profitable but also very appropriate and feasible to implement within the constraints of local health systems in low- and middle-income countries (133). Of course, many other interventions are available to reduce chronic diseases in the population or in individuals who can still contribute to the fight against NCDs (134, 135). WHO has developed a costing tool for countries to add or replace interventions based on needs or national priorities (136).

To help countries to fight against this burden, WHO has developed in May 2013 an action plan for the prevention and control of noncommunicable diseases for the period 2013-2020 (137). The Global Action Plan provides Member States and WHO international partners a roadmap and policy options which, when implemented collectively

between 2013 and 2020, will contribute to work on nine global targets for the fight against NCDs to achieve by 2025, a relative reduction of 25% of premature mortality by NCDs.

5.2. Conclusion et perspectives:

The "Together in Health" project for the prevention of risk factors for NCD is an example of a loco-regional initiative. This initiative has shown that it is possible to design and implement activities to promote health in various settings with the support of the community. It also showed that such actions can have a positive impact on the risk factors of NCDs, which could presage a decrease in their burden later on. Such initiatives can only be beneficial if they became widespread in oil stains manner within a structure organized by the government. The results of the project "Together in Health" show that it is time to act.

Prevention of non-communicable diseases and health promotion, a major public health challenge, go through a citizen empowerment, community and socio-political commitment. The only example in the fight against smoking helps confirm because this is not the action of the health care system alone that will fight against this flaw. Increasing the price of tobacco, smoking bans in public places, legislation on advertising gradually contribute to a change in smoking habits, provided that these procedures are properly applied. Public and political authorities must continue the efforts already undertaken in these many areas with the help of civil society through NGOs and health

professionals. Control programs should take advantage of already existing laws to increase their chances of success.

Thus, an integrated approach to the prevention and management of NCDs is needed at the national level. It should be conducted by the government and benefit from the involvement of the entire community. It is important to foster multidisciplinary stakeholders but also to focus on collaborations and synergies between different sectors related to health (NGO sectors, political, socio-economic, medical and paramedical).

Another guarantee of success of multidisciplinary actions is the understanding of the community ("community diagnosis") which will ensure the proper coordination of all partners and their involvement with the beneficiaries right from the start of the process. Finally, we must encourage multiple sites of action and do everything possible to help facilitate positive health choices (ensuring access to healthy food, initiate health paths, provide affordable infrastructure for recreation activities and physical activity, fight against passive smoking). This can be facilitated by the combination of well-planned across a broad population and actions involving primary health care, media actions, voluntary organizations such as NGOs, the food industry and supermarkets, workplaces, schools and local media...

Many activities have so far received only limited evaluation, they are also often considered for the very short term. In addition, it is especially evaluation of the effectiveness of actions while assessing the efficiency of actions and methods used and their sustainability would be equally relevant.

It remains important to address the prevention and health promotion in a comprehensive and sustainable development. WHO recommends to assess and monitor the burden imposed by NCDs and their determinants for public health and incorporates the fight against this burden in the relevant socio-economic policies of poverty reduction strategies. It also provides support to the adoption of approaches involving all departments, ensuring to take appropriate intersectoral action on public health and focusing on social determinants of NCDs, particularly with regard to the programs of equitable financing and access to primary health care.

Finally, given the global burden of noncommunicable diseases and the impact of globalization on modern lifestyles and health, it is necessary to have an international collaboration. Practical networks sharing common guidelines but adapted flexibly to local cultures have proven to be very useful in this context.

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