PREDICTING LIKELY DIABETICS AMONG TAXI DRIVERS IN ALGERIA BASED ON RISK FACTORS PREVALENCE

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ABSTRACT

The purpose of this paper is to evaluate the probability of developing type 2 diabetes among the" taxi drivers of the county of Tlemcen in the next 10 years based on risk factors prevalence and give them feedback as an incentive to prevent or delay the onset of type 2 diabetes. To evaluate the potentially existing risk of developing type 2 diabetes, the Finnish Diabetes Risk score was used to design a questionnaire that was randomly administered to 178 taxi drivers. Data were analyzed using IBM SPSS v.26 at 0.05 and our survey was performed in September 2019. We found that the probability of developing the disease among the taxi drivers who were over 55 years was higher than those who were under 55 years. In addition, eating fruits and vegetables regularly had no significant impact on reducing the risk of developing type 2 diabetes whereas physical activity showed a significant impact. Also, taxi drivers were characterized by a lack of physical activity and 35.3% of them did not have health insurance. An active policy can be initiated by including discounts in sports clubs for people below 55 years old, and free access for those over 55.

KEY WORDS

Type 2 diabetes; obesity; Taxi drivers; Algeria.

JEL CLASSIFICATION: I12, I 31

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التنبؤ باحتمالية الإصابة بداء السكري من النوع الثاني لدى سائقي سيارات الأجرة في الجزائر بناء على عوامل الخطر

ملخص

الغرض من هذه الورقة هو تقييم احتمالية الإصابة بداء السكري من النوع الثاني لدى سائقي سيارات الأجرة في ولاية تلمسان في السنوات العشر المقبلة بناءً على انتشار عوامل الخطر، وإعطائهم ملاحظات كحافز من أجل منع أو تأخير ظهور المرض. لتقييم المخاطر المحتملة للإصابة بداء السكري من النوع الثاني، تم استخدام درجة الخطر الفنلندية لداء السكري (FINDRISC) لتصميم استبيان تم توزيعه بشكل عشوائي على 178 سائق سيارة أجرة. تم تحليل البيانات باستخدام برنامج IBM SPSS نسخة 26 عند 0.05 وأجري الاستطلاع في سبتمبر 2019. أظهرت النتائج أن احتمالية الإصابة بالمرض لدى سائقي سيارات الأجرة الذين تزيد أعمارهم عن 55 عاما كانت أقل من أولئك الذين تقل أعمارهم عن 55 عاما. بالإضافة إلى ذلك، فإن تناول الخضر والفواكه بشكل منتظم لم يكن له تأثير إحصائي معنوي لتخفيض احتمالية الإصابة بالمرض بعكس النشاط البدني الذي أظهر تأثيرا معنويا. كما تميز سائقي سيارات الأجرة بقلة النشاط البدني وأن 35.3٪ منهم ليس لديهم تأمين صحي. وعليه، يمكن بدء سياسة نشطة من خلال تقرير خصومات على مستوى الأندية الرياضية بالنسبة للأشخاص الذين تقل أعمارهم عن 55 عامًا، والدخول المجاني لمن هم فوق 55 عامًا.

الكلمات المفتاحية:

داء السكري من النوع الثاني، السمنة، سائقي سيارات الأجرة، الجزائر.

تصنيف جال: I12

PRÉVOIR LE DIABÈTE DE TYPE 2 CHEZ LES CHAUFFEURS DE TAXI EN ALGÉRIE EN SE BASANT SUR LA PRÉVALECE DES FACTEURS DE RISQUE

RÉSUMÉ

Le but de cet article est d'évaluer la probabilité de développer un diabète de type 2 chez les chauffeurs de taxi de la wilaya de Tlemcen au cours des 10 prochaines années sur la base de la prévalence des facteurs de risque, et de leur donner un feedback comme incitation afin de prévenir ou retarder l'apparition de la maladie. Pour évaluer le risque de développer un diabète de type 2, le score finlandais de risque du diabète (FINDRISC) a été utilisé pour concevoir un questionnaire qui a été administré au hasard à 178 chauffeurs. Les données ont été analysées à l'aide du logiciel IBM SPSS v.26 à 0,05 et notre enquête a été réalisée en septembre 2019. Nous avons constaté que la probabilité de développer la maladie chez les chauffeurs de taxi de plus de 55 ans était plus élevée par rapport à ceux qui avaient moins de 55 ans. En outre, la consommation régulière de fruits et légumes n'avait pas d'impact significatif sur la réduction du risque de développer le diabète de type 2 alors que l'activité physique montrait un impact significatif. De plus, les chauffeurs de taxi se caractérisaient par un manque d'activité physique et 35,3% d'entre eux n'avaient pas d'assurance maladie. Une politique active peut être initiée en incluant des réductions dans les clubs sportifs pour les moins de 55 ans et un accès gratuit pour les plus de 55 ans.

MOTS CÉES

Diabète de type 2, obésité, chauffeurs de taxi, Algérie.

JEL CLASSIFICATION: I12, I 31

INTRODUCTION

As part of the 2030 Agenda of Sustainable Development (United Nations, 2015) and the 2063 Agenda (African Union Commission, 2015), the Member States of both the United Nations and the African Union have set an ambitious goal to reduce premature mortality from noncommunicable diseases –including diabetes– by one-third and ensure the well-being of all the citizens.

Diabetes mellitus, simply called diabetes, is a chronic condition that occurs when the pancreas does not produce enough insulin (a hormone that regulates glucose in the blood), or when the body is unable to use the insulin it produces effectively. The lack of insulin or the inability of the cells to respond to it leads to elevated glucose in the blood, (scientifically referred to as hyperglycaemia) (IDF, 2019). The first instance refers to Type 1 diabetes (known as insulin-dependent or childhood-onset diabetes) whereas the second is Type 2 diabetes (formerly called non-insulin-dependent or adult-onset diabetes) which represents the vast majority of all cases (IDF, 2019). Moreover, if the disease is not controlled, it may cause blindness, kidney failure, cardiovascular diseases, and lower limb amputation (DeFronzo et al., 2015; WHO, 1999).

The global burden of diabetes is affecting nearly half a billion people of which 80% come from low and middle-income countries (IDF, 2019; WHO, 2016). In 2019, approximately 54.8 million people are living with diabetes in the Middle East and North Africa. About 50% of them were undiagnosed (IDF, 2019). According to the International Diabetes Federation forecast, if health measures are not taken, the number of diabetics may rise to 107.6 million people in 2045, be it an increase of 96.5%. Diabetes in this region is responsible for 16.2% of all deaths among adults in 2019, and about half occurred with people under 60 years. There is a great disparity regarding the prevalence of diabetes in the MENA region. The prevalence rate in Algeria is 14.4%, with approximately 6 million persons living with diabetes (WHO, 2017).

Diabetes is a serious threat to population health and causes financial pressures on the public health systems. The amount of healthcare expenditure dedicated to diabetes in the MENA region totalled USD

24.9 billion and this is expected to increase by 55% by 2045 (IDF, 2019). Besides the economic burden on the health care system, persons with diabetes are more likely to incur catastrophic personal health expenditures (Smith-Spangler et al., 2012). The high out-of-pocket spending and loss of family income associated with disability and premature death impose a substantial cost on society (American Diabetes Association, 2018). In 2019, the amount spent per person with diabetes in MENA was estimates to be USD 1751.2 in Qatar, USD 1237.3 in the United Arab Emirates, while Algeria and Egypt spent USD 795.4 and USD 279.1, respectively (IDF, 2019).

Nevertheless, the complications of diabetes and its consequences can be easily prevented especially when detected early. Adopting a healthy lifestyle, such as improving one's diet and doing physical activities, positively affects the patient and significantly reduces the risk of developing type 2 diabetes.

On the other hand, the Ottawa charter in 1986 defined health promotion as the process of enabling people to increase control over, and to improve, their health. This includes access to information, life skills, and opportunities for making healthy lifestyle choices to reach a state of complete physical, mental and social well-being.

In the context of this definition, the researcher's intervention has aimed to evaluate the probability of developing type 2 diabetes in taxi drivers of the Wilaya of Tlemcen in the next 10 years based on risk factors prevalence and give them feedback as an incentive to adopt a healthy lifestyle.

The structure of the paper is organized as follows: section two is dedicated to the literature review; Section 3 describes the methodology; results and discussions are presented in section 4 and conclusion.

1- LITERATUREREVIEW

In Type 2 diabetes, hyperglycemia is the result of inadequate production of insulin and the inability of the body to fully respond to it. This is defined as insulin resistance. Insulin is an essential hormone produced by the beta cells in the pancreas that allows the glucose in our blood to enter the cells and fuel our bodies. During a state of insulin resistance, the body breaks down carbohydrates from foods and drinks

and turns them into glucose. The pancreas responds to this by prompting insulin but because this insulin cannot work properly, blood glucose keeps rising so a state of relative inadequate production of insulin can develop (Diabetes UK, 2019; IDF, 2019).

For a long time, Type 2 diabetes occurred only in adults. However, it has begun to occur with children, adolescents, and younger adults too due to rising levels of obesity, physical inactivity, and poor diet (IDF, 2019; WHO, 2016).

Many people can have no symptoms or they do not notice them. This implies that the true time of onset is difficult to determine. As a result, there is often a long pre-detection period and people can live with Type 2 diabetes up to ten years before being diagnosed, and during a long period, high glucose levels can damage the heart, blood vessels, eyes, kidneys, and nerves, and increases the risk of heart diseases and stroke (American Diabetes Association, 2011; WHO, 1999).

As far as the risk factors of Type 2 diabetes are concerned, some are potentially modifiable while others are not. Non-modifiable risk factors of Type 2 diabetes include ethnicity, family history of diabetes, and previous gestational diabetes combined with older age (Florez et al., 2015). Others, such as unhealthy diet, physical inactivity, overweight, obesity, and smoking are modifiable through behavioral and environmental changes (Forouhi & Wareham, 2014).

Overweight and obesity, physical inactivity, together with unhealthy eating are the strongest risk factor for Type 2 diabetes and are estimated to cause a large proportion of diabetes burden (Hsia & Cefalu, 2015). Higher waist circumference and higher Body Mass Index (BMI) are associated with increased risk of Type 2 diabetes (Vazquez et al., 2007).

Among dietary factors, recent evidence has also suggested that Type 2 diabetes increases because of its association with high intake of saturated fatty acids, high total fat intake and inadequate consumption of dietary fiber (FAO, 2010; Ley et al., 2014), high intake of sugar-sweetened beverages (Imamura et al., 2015; Malik et al., 2010). Active smoking also increases the risk of type 2 diabetes (Willi et al., 2007).

Diabetes is an important public health problem. About 90% of people living with diabetes have type 2 diabetes (American Diabetes Association, 2011; Bruno et al., 2005; Evans et al., 2000; Holman et al., 2015; IDF, 2019). The prevalence of type 2 diabetes in Algeria is 14.4%, which represents nearly 6 million persons. At the same time, a further 8.2% of the population with impaired fasting glucose are at high risk of developing diabetes (WHO, 2017).

Research in different parts of the world has shown that intensive interventions including the adoption of a healthy diet, increased physical activity, smoking cessation plan, and maintenance of healthy body weight can prevent Type 2 diabetes (Yates & Davies, 2015). In addition, programs focusing on individuals considered to have a high risk of developing type 2 diabetes are more cost-effective than those targeting low-risk individuals (Cavan et al., 2016).

The diabetes prevention programs in the USA, the Finnish Diabetes Prevention Study, and the Chinese Da Quing Study showed that active interventions could have a significant impact on glycemic and cardiovascular outcomes. These interventions are judged to be cost-saving, meaning that better health outcomes can be achieved and at the same time health funds can be saved (Cavan et al., 2016; Palmer & Tucker, 2012). The success of these programs depends on the feasibility of identifying, assessing high-risk groups. Many tools have been developed for use in diverse populations, such as:

FINDRISC (Finnish Diabetes Risk Score): a sample score using age, family history of diabetes, Body Mass Index BMI, waist circumference, history of anti-hypertensive drug treatment and high blood glucose, physical activity, and daily consumption of fruits and vegetables to estimate risk. AUSDRISK (Australian Diabetes Risk score): a 10-item questionnaire that estimates risk progression to Type 2 diabetes over 5 years. Questions are based on age, sex, ethnicity, family history of diabetes, history of abnormal glucose metabolism, smoking status, current hypertensive treatment, physical activity, fruit and vegetable consumption, and waist circumference. IDRS (Indian Diabetes Risk Score): a simplified risk score for identifying undiagnosed diabetics using four simple parameters- age, waist circumference, family history of diabetes, and physical activity. CANRISK (Canadian Diabetes Risk

Questionnaire): is a 12-item questionnaire that helps Canadians identify their risk of pre-diabetes or type 2 diabetes. These questions include age, gender, BMI, waist circumference, physical activity, fruits and vegetable consumption, blood pressure, high blood sugar, high birth weight babies, family history of diabetes, mother's and father's ethnicity, education.

Measurement of blood glucose (HbA1c or Oral Glucose Tolerance Test) remains the best predictor of type 2 diabetes risk. However, these methods listed above are cost-effective, inexpensive, and simple for identifying the risk of undiagnosed diabetes.

In this research work, the investigator attempts to evaluate the extent to which taxi drivers may develop type 2 diabetes using FINDRISC, and later to incentivize them by presenting an infographic that explains the main health solutions to prevent or delay the onset of type 2 diabetes.

2- METHODOLOGY

As a sample population, taxi drivers are chosen for two reasons. Firstly, the nature of their work, namely the transport of travelers over long distances (mean: 320 km/day), is characterized by a sedentary lifestyle, which has as its corollary overweight and obesity (Adedokun et al., 2019; Sena et al., 2008; Marcinkiewicz & Szosland, 2010). Secondly, taxi drivers work for their accounts. This results in low social security adherence (Merouani et al., 2014), the lack of a collective organization, and a lack of attention to their state of health.

The sampling method chosen is the simple random method (Taherdoost, 2016) and the sample size was 178 taxi drivers. We had two missing data. A questionnaire was designed following the FINDRISC method (Lindström & Tuomilehto, 2003) to assess the risk of developing diabetes in the next ten years (appendix 1). The FINDRISC score is calculated by adding only the points of the eight questions for each person. The following eight questions (variables) are age, family history of diabetes, waist circumference, body mass index, daily consumption of fruits and vegetables, physical activity, high

blood glucose, history of antihypertensive drug treatment. The score varies from 0 to 26 and can be divided into five levels (Table 1).

In addition, three questions were added to find out the use of tobacco, the health insurance, and the average distances traveled per day. These last three questions were not included in the score calculation.

Table n° 1. Level and probability of developing type 2 diabetes among taxi drivers

Score	Level of risk	Probability of developing the disease
0 – 7	Low	1 in 100
7 – 11	Slightly elevated	1 in 25
12 – 14	Moderate	1 in 6
15 – 20	High	1 in 3
21 – 26	Very high	1 in 2

Source: Finnish Diabetes Risk Score (FINDRISC)

Table 1 illustrates five risk levels of developing the disease with their probabilities. For example, if the score is between 12 and 14, the risk of developing type 2 diabetes is moderate, in other words, the probability is estimated to be one person in 6 developing the disease.

Height and weight were measured using a body weight scale and were used to determine Body Mass Index. BMI was calculated as weight (kg)/(height(m))^2. Participants were measured while wearing light clothing and socks without shoes. Waist circumference was measured with a tape measure. Data were analyzed using IBM SPSS v.26 and our survey was performed in September 2019.

An infographic, which contains four pieces of advice, has been presented in this research work both in Arabic and French. It includes the main positive and easy solutions such as: exercising and eating healthy to prevent the onset of type 2 diabetes. Our strategy is based on giving feedback as a social incentive to taxi drivers (Armellino et al., 2012) to adopt a healthy lifestyle by presenting the prevalence of their physical inactivity and obesity. The Adobe Illustrator CC 2018 was used to design the infographic in vector art.

3- RESULTS AND DISCUSSIONS

The results of our statistical analysis revealed for the whole population an average score of 10.87 (SD = 5.12). The analysis of the score for the whole population did not reveal a significant meaning. Accordingly, the researcher tried to approach the analysis by age (Table 2) and by risk factors.

Table n° 2. Scores and the probability of developing the diseases of each group defined by age

		Mean Score	Standard Deviation	Probability of developing type 2 diabetes
Age by class	Under 45 years	8.57	4.13	1 in 25 persons
	45–54 years	10.46	5.05	1 in 25 persons
	55–64 years	13.22	4.56	1 in 6 persons
	Over 65 years	12	6.02	1 in 6 persons
One way ANOVA				0.000**

*p=corresponding significance value, p**< 0.01, p* < 0.05*

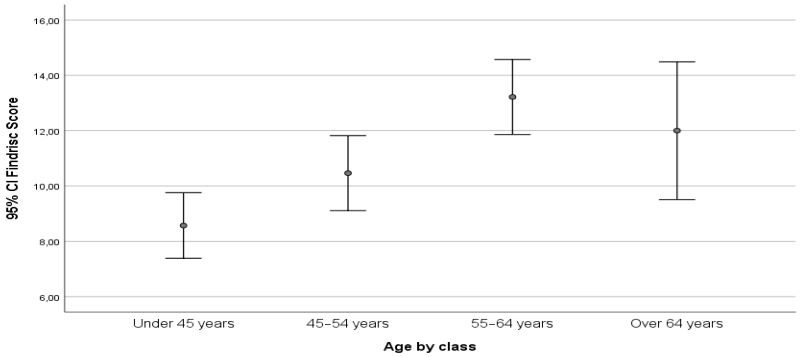
Source: Author's calculations based on respondents' answers

Table N°2 presents scores (mean and standard deviation) and the probability of developing type 2 diabetes of each group of taxi drivers defined by age. It can be noticed that the risk of developing the disease in people aged over 55 years was moderate (1 out of 6). One-way ANOVA showed that there was a significant difference for at least one group of taxi drivers defined by age ($F_{3,172}$ = 7.867, P<0.000). The significance level for the tests was set at p <0.05.

The mean values of the score are plotted in figure 1: taxi drivers who were between 55-64 years and over 64 years had a higher score (Mean 13.22 ± 4.56 and 12 ± 6.02) than those under 45 years (Mean 8.57 ± 4.13) and persons who are between 55-64 years had a higher score (Mean 13.22 ± 4.56) than those between 45-54 years. A Tukey HSD post hoc test revealed that the score of taxi drivers who are under 45 years are lower than those of 55–64 years (Mean difference = -4.64596, 95% CI [-7.2252, -2.0667], P<0.000); and those over 64 years (Mean difference = -3.42857, 95% CI [-6.5165, -0.3407], P<0.023). In addition, the score of taxi drivers who are between 45 – 54 years is lower than those of 55–64 years (Mean difference = -2.7531, 95% CI [-5.2531, -0.2531], P<0.025). We

confirm that the probability (score) of developing type 2 diabetes in taxi drivers who are over 55 years is higher than those who are under 55 years old.

Figure 1. The average FINDRISC score by age class

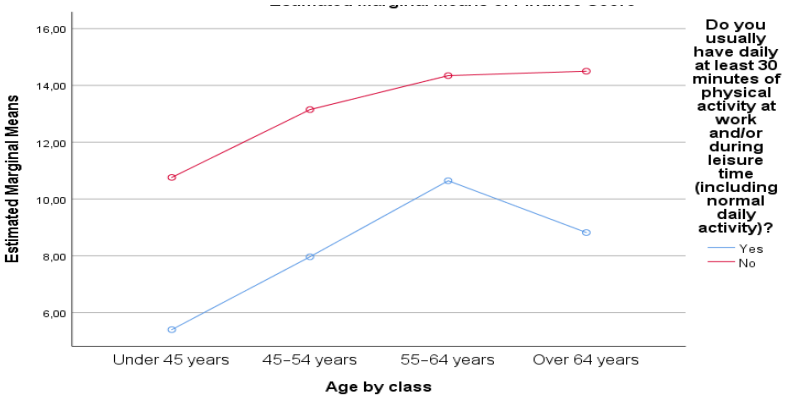


Source: Author's calculations based on respondents' answers 95% confidence intervals are plotted

In the next step, we carry out a two-way ANOVA to see which group of age had a high score of developing type 2 diabetes but it was also thought that scores for persons who practice physical activity and who do not practice, and who have good nutrition and not may be different.

First, there was no statistically significant interaction between age by class and physical activity ($F_{3,168}$=0.398, P<0.755). Then, we try to look into the main effects, both of which have P<0.000. Age: ($F_{3,168}$=8.727, P<0.000) and Physical activity: ($F_{1,168}$=53.047, P<0.000). We can see in Figure 2 that there is no interaction effect between age by class and physical activity as the line are reasonably parallel. In Figure 2, we notice that there was the same pattern of score across different categories of age in both who practice physical activity and who don't (age effect). There was also a physical activity effect - specifically, the score was higher in taxi drivers who do not practice sport in every category of age.

Figure 2. Estimated marginal means of FINDRISC Score



Source: Author's calculations based on respondents' answers

Second, there was no statistically significant interaction between age by class and fruits and vegetables (nutrition) ($F_{3,168}$=1.513, P<0.213). The main effect of fruits and vegetables ($F_{1,168}$=3.723, P<0.055) was not statically significant whereas the main effect of age was significant ($F_{3,168}$=3.931, P<0.010). We can conclude from these results that eating fruits and vegetables regularly had no statistically significant impact on reducing the risk of developing type 2 diabetes, unlike physical activity, which showed a significant impact.

Finally, the analysis of the probability of developing type 2 diabetes by risk factors can be divided into two parts:

a) Non-modifiable risk factors

Nearly half of the respondents had a family relationship with a diabetic, 84.7% of them had a very close relationship (parents, brothers, sisters, and own child) the population over 55 years represented 38.8%. Furthermore, the mean age of taxi drivers was 51.92 ± 11.03, 95% IC [50.28, 53.55].

b) Modifiable risk factors

When we performed a Pearson's correlation test between waist circumference, BMI, and FINDRISC score, not only we found a high and positive correlation between waist circumference and BMI (r=0.906, P<0.000) but also, we found a high and positive correlation between waist circumference and FINDRISC score (r=0.601, P<0.000) and a high and positive correlation between BMI and FINDRISC score (r=0.540, P<0.000). So, using a FINDRISC score, waist circumference, or BMI to measure the risk of developing type 2 diabetes remains the same.

The abdominal obesity was 56.3% of which 39.4% were over 55 years old. 25% of the population was overweight of which 43.2% of them were over the age of 55 years old. The Chi-square test revealed a significant difference (p<0.000). According to BMI, the rate of obesity was 30.9% of which 34,6% were over 55 years. The overweight rate was estimated at 43.3 %. from which 41.6% were over the age of 55 years (Chi-square test with p<0.014).

The results above can be explained by the physical inactivity of taxi drivers. 57.9% of the population were inactive of which 85.4% were under 64 years (Chi-square test with p<0.036). Nevertheless, it was found that 86.5% of the respondents ate fruits and vegetables every day (Mediterranean diet) while 80% of them said that they did not smoke. Other risk factors were revealed. 15.2% of the respondents had a high blood glucose level while 13.5% were hypertensive. Also, it was found that 35.3% of the population had no health insurance.

According to these results, it can be considered that this population is highly exposed to type 2 diabetes, especially people aged over 55 years. These people ought to consider practicing physical activity and paying attention to their weight to prevent themselves from developing type 2 diabetes.

CONCLUSION

Results of this study showed that the risk factors of developing type 2 diabetes among people under the age of 55 were very alarming even if the probability were moderate whereas taxi drivers over the age of 55 were at high or very high risk of developing the disease. An active policy can be initiated by including discounts in sports clubs for people

below 55 years old and free access for those over 55. In addition, this policy can reduce substantially the economic burden of type 2 diabetes. Our action can be extended by placing the infographic in bus shelters to give a long and permanent impact on taxi drivers.

Taxi drivers are advised to remain physically active, and eat healthy to keep a good waist circumference and prevent the onset of type 2 diabetes so that it remains limited in action and in time. It is difficult to spot every possible taxi driver who has this illness in the whole country. For this reason, a national initiative taken in every place should be enough to sensitize each one of them.

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Appendix 1: Questionnaire

Circle the right alternative

1- Age

- Under 45 years. 0 point

- 45 – 54 years. 2 points
- 55 – 64 years. 3 points
- Over 64 years. 4 points

2- Body Mass Index

- Lower than 25 kg/m². 0 point
- 25 – 30 km/m². 1 point
- Higher than 30 kg/m². 3 points

3- Waist circumference measured below the ribs (usually at the level of the navel) – Men.

- Less than 94 cm. 0 point
- 94 – 102 cm. 3 points
- More than 102 cm. 4 points

4- Do you usually have daily at least 30 minutes of physical activity at work and/or during leisure time (including normal daily activity)?

Yes. 0 point
No. 2 points

5- How often do you eat vegetables, fruit, or berries?

Everyday. 0 point
Not every day. 1 point

6- Have you ever taken medication for high blood pressure regularly?

- No. 0 point
- Yes. 2 points

7- Have you ever been found to have high blood glucose?
(eg in a health examination, during an illness)?

- No. 0 point
- Yes. 2 points

8- Have any of the members of your immediate family or other relatives been diagnosed with diabetes?

- No. 0 point
- Yes: grandparent, aunt, uncle or first cousin 3 points

(but no own parent, brother, sister or child)

- Yes: parent, brother, sister, or own child. 5 points

9- Do you smoke?

- Yes. - No.

10- Do you have health insurance?

- Yes. - No.

11- According to you, what is the average distance covered per day?

_____Km