

# Evaluation of Glycemia, Glycosylated Hemoglobin and Body Mass Index in Adolescents <sup>†</sup>

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**Abstract:** Early screening of diabetes is crucial. This study's objectives are to evaluate the levels of glycemia, HbA1c and body mass index (BMI) in students of secondary schools, to describe and frame the levels evaluated and detect potential cases of pre-diabetes or unknown diabetes. A Level I descriptive study with a sample of 234 students allows us to discover that 89% had unaltered blood levels of glycemia. Furthermore, 5% had altered glycemia levels and 69% of female and 73% of male students had a normal BMI value. Of the students, 21% and 16% of females and males, respectively, were overweight, and 9% of males were "Obese".

**Keywords:** blood glucose; glycosylated hemoglobin; teenagers; BMI; diabetes



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## 1. Introduction

The assessment of blood glucose, glycosylated hemoglobin and BMI are increasingly important to prevent diseases [1–3]. Measuring these at schools plays a key role in education for healthy lifestyle habits. Some measurements have already been taken, namely the removal of some carbohydrate-rich foods at bars and training at curricular units in the health area [4]. Diabetes is characterized by an increase in the level of glucose in the blood, i.e., hyperglycemia, and is associated with several complications, including retinopathy, nephropathy, neuropathy and an increased risk of cardiovascular disease. Type 2 diabetes in children [5] and young people is clearly related to the increase in childhood obesity, as a result of the currently lived sedentary lifestyle and a predominantly hypercaloric diet [6]. In this research paper, we evaluated the levels of glycemia, glycosylated hemoglobin, body mass index (BMI) and measurement of weight-for-height/length [2] in students of secondary schools. As a secondary outcome, we described and framed the levels assessed, detected potential cases of prediabetes or detected unknown positive cases or severe acute malnutrition cases [6], clarifying and referring to medical consultation to confirm the pathology. An informed consent form was drawn up and delivered to secondary schools, so that parents would be aware of the contents of screening and they could consent or refuse the participation of their child.

## 2. Materials and Methods

The sample consisted of 234 students with ages between 14 and 19 years from two secondary schools (Moita e Ramada) that were selected using the convenience method. Of the students, 145 were from the E.S. (secondary school) of Moita (62%) and 89 are students from E.S. da Ramada (38%). A mixed methodology (quantitative and qualitative) and a Level I descriptive study were employed.

Informed consents were given to those responsible for the education of the students. Only after we had obtained their consent we proceeded to the collection and assessment of the aforementioned parameters.

Cases with values of glycemia under 70 mg/dL resulting from prolonged periods of fasting were excluded.

In order to measure glycemia, we used glucometers and the respective glucose strips of this device. In the case of BMI measurement, a tape measure placed on the wall was used to determine height and a calibrated scale to determine weight. In addition to this, we used another tape to measure the abdominal circumference of young people. For capillary blood sampling, we used cotton wool and alcohol for disinfection and lancets to prick one of the fingers, in order to obtain a drop of capillary blood to analyze. After pricking we put a band-aid on it to stop the bleeding.

For the measurement of glycated hemoglobin, we use the HbA1c measurement device provided by Siemens Healthcare Diagnostics Portugal, as well as HbA1c, which consists of a cartridge with a reagent and capillary titrator. All instruments were calibrated and controlled before use.

### 3. Results and Discussion

The average height of the students in the sample was 1.68 m and the average weight of the pupils in the sample was 64 kg. The density of pupils decreased as higher weight values were considered.

The BMI values of the pupils in the sample ranged from 15.1 to 34.9 kg/m<sup>2</sup> (when rounded to the nearest unit), having an average value of 22.5 kg/m<sup>2</sup>. For females, the mean value was 22.8 kg/m<sup>2</sup>. For males, the average was 22.2 kg/m<sup>2</sup>.

In this investigation, we encountered a great majority of students (89%) with unaltered blood levels of glycemia and 5% (11 cases) with altered glycemia levels.

From the 11 elevated cases of glycemia, 4 were tested with high values of HbA1c ( $\geq 6$ ). Of those four students, three were "Overweight" based on their BMI. These results, although not expressive, may be indicative of a positive relationship between overweight and glycemic overweight, and the level of glycemia of an individual. In fact, being overweight may be one of the causes of possible changes in blood glucose levels, which may eventually lead to diabetes.

Both female and male students presented a very similar distribution. The majority of female and male students (69% female students and 73% male students) had a normal BMI value (values from 18.5 to <25 that fall within the healthy weight range). There was also a considerable proportion of overweight students (21% females and 16% males had BMI values within 25.0 to <30), and "Obese" (9% males had BMI values of 30 or higher). At the opposite end, no pupils suffered from "Severe Acute Malnutrition" (weight-for-height/length < -3SD or mid-upper arm circumference < 115 mm), and only a very residual percentage of students suffered from "Moderate Acute Malnutrition" (1% female and 2% male students). These results, although not very significant in number, may be indicative of a positive relationship between overweight and positive relationship between overweight and an individual's glycemic level. In fact, overweight weight may be one of the causes of possible alterations in glycemia levels, with the possibility of eventually developing diabetes. All red-flag cases were reported to those responsible for students' education in a closed envelope.

In future, it is important to carry out similar actions in a timely manner, to raise awareness among teachers and students of the importance of this screening for their health and promote greater adherence, motivating parents and guardians to encourage their children to participate.

With this screening work in schools, we have also been able to demonstrate how important it is for higher-education establishments, due to their capabilities and involving students and teachers, to provide a service of social responsibility to the community.

The two screening actions in Moita and Ramada secondary schools explained that there should be a joint effort in the educational establishments with the respective curricular units, students and teachers, in order to create greater proximity with the community, promoting an active attitude of solidarity, and thus contributing to their contribution to the promotion of citizenship.

In this study, there are some questions that should be deepened, and which, due to the results obtained, become urgent. It is necessary to have a screening with a larger sample, taking into consideration the lifestyles in urban and rural areas, cross-reference results obtained using different geographical regions and with different geographic regions with different lifestyles, eating habits and social conditions. Thus more studies should be conducted to assess the gaps in health literacy among the younger age groups, in order to promote more training and awareness on diabetes.

The percentage of young people with pre-diabetes in this study is worrying and there is a need for in-depth research using a larger, if not massive, sample of Portuguese schools, as there is a challenge ahead which must be considered with seriousness. To this end, faculties must play a fundamental role in researching and deepening the various issues mentioned in this document. Additionally, creating multidisciplinary teams to promote health literacy and prevention in the fight against diabetes is a social responsibility in the context of academic classes.

Thus, we believe that our work leaves an open door for further investigations on diabetes in adolescents, which, although may represent an enormous effort within institutions, should be seen as a necessary and fundamental challenge for the preservation of a healthy life among the community.

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