A STUDY OF THE BMI AND BLOOD PRESSURE INDICATORS FOR DIABETES MELLITUS IN CHILDREN IN BINH DINH, VIETNAM

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SUMMARY

The prevalence of risk factors for type 2 diabetes mellitus in developing countries, including Vietnam. Although the prevalence of diabetes mellitus is still relatively low in Vietnam, it has been increased rapidly in recent years and tended to rejuvenate. Rapid social development accompanied by changing behavior occurred in students such as: eating more fast food and effects from sedentary lifestyles. In this study, we use a cross-sectional study with a comparison of risk factors on children from 6 to 10 of 3 areas with different GDP of Binh Dinh province. Moreover, we investigate the anthropometric characteristics of 6,514 students, collecting data, and analyzing data using SPSS software. The study began in April 2016 and ended in April 2018. The Student's BMI depend on the living circumstances of each region. Students in the urban have the highest BMI (18.90 kg/m^2), followed by the students in the rural (15.90 kg/m^2) and the lowest is students in the mountainous areas (15.03 kg/m^2). Male students have a higher BMI than female students (boys = 17.11±3.53 kg/m^2, girls = 16.40±2.97 kg/m^2). The blood pressure indicators do not have any difference between genders and living areas. All of these risk factors are precursors to diabetes mellitus at an early age today and whose outcome has been determined. Our study can help to prevent a rapid increase in the number of diabetes mellitus cases in Vietnam, particularly among children.

Keywords: Type 2 diabetes mellitus, children, risk factors, BMI.

INTRODUCTION

Diabetes mellitus is a chronic and metabolic disease characterized by elevated levels of blood glucose (or blood sugar), which leads over time to serious damage to the heart, blood vessels, eyes, kidneys, and nerves. The most common is type 2 diabetes mellitus, usually adults, which occurs when the body becomes resistant to insulin or does not make enough insulin. Until recently, type 2 diabetes mellitus was considered a rare disease mellitus in childhood and adolescence (Addams, Lammon, 2007). However, the outbreak of type 2 diabetes mellitus during childhood and adolescence is a result of the worldwide epidemic of obesity and sedentariness, which is a concern and has been considered an emerging public health problem (Macêdo *et al*., 2010). In Asia, in countries such as Taiwan, there are already more than twice as many type 2 diabetes mellitus cases as there are type 1 diabetes mellitus cases. In Japan, the incidence of type 2 diabetes mellitus went up from 1.7 to 2.6 cases in every 100,000 children between 1980 and 2002 (Urakami *et al*., 2007).

Risk factors for diabetes mellitus and hypertension have been ever increasing among children in most parts of the world, including Vietnam, the country has been fluctuating in recent years. Vietnam is one of the countries undergoing rapid development with type 2 diabetes mellitus increasingly popular. Rapid economic growth and urbanization accompanied by social, environmental and behavioral change occurred in Vietnam which is one of the diabetes mellitus and hypertension risk factors increasing reasons. In addition, Unhealthy diets, physical inactivity, passive smoking, the possibility of non-diagnosed cases and all poor knowledge consequences have all been shown to be modifiable risk factors for type 2 diabetes mellitus (Nguyen *et al*., 2015). These factors are all potentially contributing to the accelerating prevalence of diabetes mellitus among children in Vietnam. If preventive measures are not adopted, society will bear severe problems accrued from complications of the early onset of type 2 diabetes mellitus.

Binh Dinh is one of the provinces in Vietnam with high diabetes mellitus incidence. The economic development of the region led to the concomitant shifts in behaviors and nutrition of children. School children between the ages of 6 and 10 are subject to major changes in nutrition and anthropometry. However, nutrition transition proceeds at different paces and the economic- and nutritional status can differ significantly within populations and Primary school is a location to detect local differences in the prevalence of disease and to guide disease control programs (Van Lierop *et al*., 2008). In this study, we make an effort to identify risk factors associated with diabetes mellitus

and hypertension, targeting school children in Binh Dinh through three specific locations urban (Quy Nhon), rural (Phu My, Phu Cat), and mountainous areas (An Lao, Van Canh). Thus, by this work, the information could help identify the current state of obesity in children in Binh Dinh, Vietnam as an indicator of the nutrition transition and make suggestions to obviate these risk factors associated with non-medical means.

MATERIALS AND METHODS

Subjects of study

This is a cross-sectional study, comparison and institutional base study among children aged 6 to 10 at primary schools in Binh Dinh province, Vietnam. The study began in April 2016 and ended in April 2018. Five randomly selected districts, 2 mountain districts (Van Canh, An Lao), 2 rural districts (Phu My, Phu Cat) and Quy Nhon City. The selected communities were representative of the entire province with respect to socioeconomic characteristics and ecological conditions. A total of 6,514 students study at primary schools, including 2,335 urban students, 2,139 rural students and 2,040 students in the mountains.

Inclusion criteria

All the above data is provided by the Department of Education of Binh Dinh. Hospital-based studies.

Exclusion criteria

Type 1 diabetes mellitus.

Anthropometric measurements

Children were advised to wear loose light clothing and assemble before school or during break as per their convenience for anthropometric measurement. Their shoes, any accessories and outer layers of clothing were removed, after which standing height was measured to the nearest 0.1 cm and body weight obtained to the nearest 0.1 kg on calibrated digital scales. Scales were recalibrated after each use.

Body Mass Index (BMI)

BMI calculation formula: $BMI = \frac{Weight(kg)}{\left[Height(m)\right]^2}$ (Keys A., 1972).

Measuring blood pressure arteries

These children are measured in blood pressure by the Omron blood pressure, which is exactly 3mmHg or 2% of the readings being treated with blood pressure.

Statistical Analysis

Repeat all experiments three times. ANOVA statistical software was used for data analysis with significance level $p < 0.01$.

RESULTS

This study is done to evaluate the rate of risk factors such as the body mass index (BMI), blood pressure for diabetic mellitus premise, by researching eating habits and lifestyles between male and female students in various regions in Binh Dinh province, Vietnam. This is a basic study done base on primary schools in three regions with different GDP income in Binh Dinh province. The total number of students studied is 6,514, at various age from 6 to 10, including 2,335 urban students, 2,139 rural students and 2,040 in the mountains (Table 1).

Height and weight are the basic morphological indicators, which are frequently used in human biometric surveys. Results of the high and weight of primary school students in Binh Dinh province are presented in Table 1. In general, there is an increase in the height and weight of students from 6 to 10 years old. The height in male and female students has differences between the ages of 6 and 9 years old. From 7 to 9 years old, the height of male students is higher than that of female students, but at the age of ten, the latter is higher than the former.

The average height of students in the city is higher than that of the students in the countryside, and the lowest is in the mountains. The height of the 10-year-old students in three areas: urban, rural and mountainous regions is 140.73±6.68 cm, 138.70±7.15 cm and 134.47±6.13 cm respectively.

Weight is the second morphological indicator in the anthropometric investigation. Male students' average weight is higher than female students at the same age. The weight of students in different areas has a significant disparity: the average weight of students in urban is more than rural students from 6 to 7 kg and mountainous students from 7 to 10 kg.

Based on the height and weight basis, the average BMI of 6,514 students in Binh Dinh is obtained from Table 1, Table 3. BMI of male students from 6 to 10 years old is higher than that of female students. Like the other morphological indicators, the BMI of students in three other regions has a significant difference. In three study areas, students in the city have the highest BMI, followed by the students in the countryside and the lowest is the mountain students (Figure 1a). For example, the 10-year-old students in urban, rural and mountainous regions with a BMI, in turn, 19.72±4.45 kg/m^2, 16.73±2.88 kg/m^2, 15.51±2.46 kg/m^2.

The systolic and diastolic blood pressure of children ascends from 6 to 10 years old (Table 2). The blood pressure of male and female students has no difference at all ages. The blood pressure of students in different regions also has no difference. In comparison with the standard reference by American Academy of Pediatrics (National Institute of Health., 2004). it is seen that the systolic and diastolic blood pressure across the percentiles is higher at all ages and there is no considerable difference between male and female students.

The increasing prevalence of risk factors like excessive unhealthy food and eat junk food, a high BMI and sedentary lifestyles are ominous signs indicating that the precursors exist for lifestyle diseases like diabetes mellitus and hypertension. The BMI of urban children is higher than in rural children and mountain children. This indicator of the urban children of Binh Dinh province is much higher than that of the WHO, in the countryside that is within the WHO standard and in the mountainous region smaller than WHO. It has since been revealed that economic development has an important influence on the health of human life. In areas with a growing economy, the diet is preference for food outside the home (fast food, restaurant meals, etc.), coupled with a higher intake of carbonated drinks or sugary fruit juices indicating a high risk of obesity and overweight in children. Ahmed *et al*. and James *et al*. have shown the association of carbonated beverages with obesity and overweight which are precursors of diabetes mellitus and hypertension. Likewise, El Mouzan *et al*. and Amin *et al*. showed a positive correlation between frequency of fast food intake among Saudi school children and increasing obesity and development of metabolic syndrome later in life.

Besides, lazy mobility is also a risk of causing obesity and hypertension. Children in urban or children in families with economic conditions tend to be less active than children in difficult economic areas. They usually exercise 0 minutes per day, the entertainment time mainly considers television, gaming and the internet. The children are in urban, their parents forced them to study at the school all day, at school, studying and going to sleep. Precisely for that reason, that urban children do not have time to release their energy and lead to high obesity. This is also the factor that trigger increasingly rejuvenating diabetes mellitus.

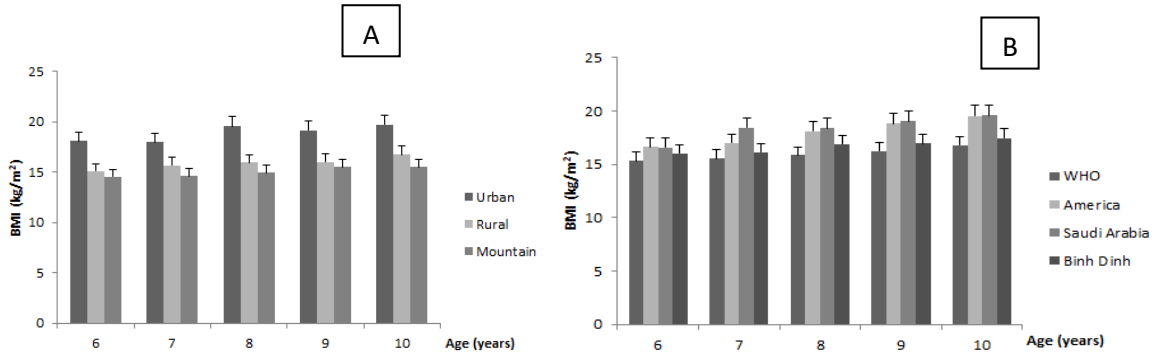

Figure 1. Student BMI chart from 6 to 10 years old

A. BMI Primary students of the three regions of Binh Dinh Province

B. The BMI index of Binh Dinh province versus the world

CONCLUSIONS

This study highlights the prevalent risk factors for diabetes mellitus and hypertension at an early age which can potentially lead over time to the development of the disease. Mostly, it has been observed that unhealthy diets, sedentary lifestyles and elevated BMI indicators are quite common in urban children. It is also seen that parents need more awareness about these risk factors and need to encourage their children to lead a healthy and active life. Based on the findings of this study, we recommend a collaborative effort by the government agencies and non-government organizations to promote healthy behavior and lifestyle within the school and home environments.

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NGHIÊN CỨU CÁC CHỈ SỐ HUYẾT ÁP VÀ BMI CỦA BỆNH ĐÁI THÁO ĐƯỜNG Ở TRẺ EM TẠI TỈNH BÌNH ĐỊNH, VIỆT NAM

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TÓM TẮT

Các yếu tố nguy cơ gây đái tháo đường type 2 đang tăng cao ở các nước đang phát triển, trong đó có cả Việt Nam. Mặc dù tỷ lệ mắc bệnh đái tháo đường ở Việt Nam còn tương đối thấp, nhưng đã tăng nhanh trong những năm gần đây và có xu hướng trẻ hóa. Sự phát triển nhanh chóng của xã hội, kèm theo những thay đổi về lối sống ở những người trẻ như ăn thức ăn nhanh, ít vận động… đó là những nguyên nhân gia tăng yếu tố nguy cơ gây đái tháo đường. ***Phương pháp:*** Trong nghiên cứu này, chúng tôi sử dụng nghiên cứu cắt ngang kết hợp với so sánh để nghiên cứu các yếu tố nguy cơ gây đái tháo đường của trẻ em từ 6 - 10 tuổi tại ba khu vực có thu nhập GDP khác nhau ở tỉnh Bình Định. Trong nghiên cứu của chúng tôi có 6,514 học sinh tiểu học tham gia kiểm tra nhân trắc học, dữ liệu được thu thập và phân tích bằng phần mềm SPSS. Thời gian nghiên cứu từ tháng 4 năm 2016 đến tháng 4 năm 2018. ***Kết quả:*** Chỉ số BMI của học sinh tùy thuộc vào từng khu vực sống của chúng: Học sinh ở thành thị có chỉ số BMI cao nhất (18,90 kg/ m^2), tiếp theo là học sinh ở nông thôn (15,90 kg/ m^2) và thấp nhất là học sinh ở khu vực miền núi (15,03 kg/ m^2). Học sinh nam có chỉ số BMI cao hơn học sinh nữ (nam = 17,11 ± 3,53 kg/ m^2, nữ = 16,40 ± 2,97 kg/ m^2). Chỉ số huyết áp không có sự khác biệt giữa các nhóm. ***Kết luận:*** Tất cả các yếu tố nguy cơ này là tiền thân của bệnh đái tháo đường ở tuổi trẻ hiện nay. Nghiên cứu của chúng tôi có thể giúp ngăn chặn sự gia tăng nhanh chóng số ca mắc bệnh đái tháo đường ở Việt Nam, đặc biệt là ở trẻ em.

Từ khóa: Đái tháo đường type 2, trẻ em, yếu tố nguy cơ, BMI.

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Table 1. Distribution of mean anthropometric characteristics of school children

Index	Age (years)	Urban			Rural			Mountain		
		Total (n = 2,335)	Boys (n = 1,180)	Girls (n = 1,155)	Total (n = 2,139)	Boys (n = 1,093)	Girls (n = 1,046)	Total (n = 2,040)	Boys (n = 1,025)	Girls (n = 1,015)
Weight (kg)	6	25.84 ± 5.34	26.77 ± 5.54	24.98 ± 5.01	21.04 ± 4.37	21.63 ± 4.72	20.39 ± 3.88	19.13 ± 4.00	19.13 ± 4.33	19.13 ± 3.66
	7	28.11 ± 6.75	29.59 ± 7.14	26.12 ± 5.62	23.51 ± 4.47	24.01 ± 4.54	22.97 ± 4.43	21.24 ± 4.63	21.46 ± 4.89	21.03 ± 4.36
	8	33.17 ± 7.01	32.83 ± 7.68	33.49 ± 7.15	26.33 ± 5.06	26.67 ± 4.99	25.98 ± 5.12	23.72 ± 5.19	23.21 ± 5.03	24.26 ± 5.31
	9	35.05 ± 7.60	36.17 ± 8.20	33.89 ± 6.52	28.61 ± 6.18	29.33 ± 6.23	27.84 ± 6.05	26.43 ± 5.66	27.03 ± 5.41	25.85 ± 5.85
	10	39.39 ± 10.65	41.02 ± 12.50	37.84 ± 8.27	32.43 ± 7.26	32.48 ± 7.65	32.39 ± 6.89	28.24 ± 6.02	29.61 ± 6.74	26.81 ± 4.77
Height (cm)	6	119.15 ± 5.63	119.49 ± 5.18	118.83 ± 6.02	117.52 ± 5.44	118.16 ± 5.47	116.84 ± 5.34	114.24 ± 6.07	113.96 ± 6.21	114.53 ± 5.92
	7	124.39 ± 6.23	125.15 ± 6.10	123.37 ± 6.27	122.05 ± 5.67	123.11 ± 5.30	120.88 ± 5.85	120.2 ± 5.70	120.15 ± 5.72	120.26 ± 5.68
	8	129.78 ± 5.85	130.07 ± 5.88	129.52 ± 5.83	128.13 ± 5.55	128.27 ± 5.22	127.98 ± 5.89	125.44 ± 6.06	125.14 ± 5.91	125.76 ± 6.22
	9	134.78 ± 5.82	134.69 ± 5.52	134.87 ± 6.13	133.21 ± 6.64	133.80 ± 6.57	123.57 ± 6.67	130.08 ± 6.06	130.90 ± 5.90	129.28 ± 6.12
	10	140.73 ± 6.68	140.06 ± 6.23	141.36 ± 7.03	138.70 ± 7.15	137.99 ± 7.19	139.38 ± 7.07	134.47 ± 6.13	114.53 ± 5.79	134.26 ± 6.48
BMI (kg/m^2)	6	18.10 ± 3.00	18.64 ± 3.14	17.60 ± 2.77	15.12 ± 2.22	15.36 ± 2.30	14.86 ± 2.10	14.55 ± 2.13	14.59 ± 2.21	14.52 ± 2.05
	7	17.98 ± 3.27	18.70 ± 3.47	17.02 ± 2.71	15.7 ± 2.22	15.74 ± 2.16	15.65 ± 2.28	14.60 ± 2.34	14.75 ± 2.43	14.45 ± 2.25
	8	19.55 ± 3.44	19.24 ± 3.48	19.83 ± 3.38	15.94 ± 2.28	16.13 ± 2.30	15.75 ± 2.25	14.97 ± 2.41	14.71 ± 2.33	15.23 ± 2.47
	9	19.17 ± 3.29	19.79 ± 3.62	18.53 ± 2.76	16.02 ± 2.66	16.30 ± 2.79	15.72 ± 2.49	15.50 ± 2.35	15.66 ± 2.20	15.33 ± 2.48
	10	19.72 ± 4.45	20.70 ± 5.30	18.80 ± 3.24	16.73 ± 2.88	16.91 ± 3.05	16.57 ± 2.70	15.51 ± 2.46	16.19 ± 2.76	14.80 ± 1.85

*Values are presented as mean ± SEM, *p < 0.01*

Table 2. Distribution of the blood pressure of the students

Index	Age (years)	Urban			Rural			Mountain		
		Total (n = 2,335)	Boys (n = 1,180)	Girls (n = 1,155)	Total (n = 2,139)	Boys (n = 1,093)	Girls (n = 1,046)	Total (n = 2,040)	Boys (n = 1,025)	Girls (n = 1,015)
Systolic BP (mmHg)	6	102.59 ± 6.28	102.44 ± 7.72	102.73 ± 4.55	102.57 ± 5.18	102.26 ± 5.21	102.92 ± 5.13	102.59 ± 6.41	102.11 ± 6.72	103.07 ± 6.07
	7	104.52 ± 9.09	104.54 ± 8.93	104.50 ± 9.33	104.81 ± 5.30	104.95 ± 5.03	104.65 ± 5.60	105.37 ± 9.34	104.98 ± 9.72	105.77 ± 8.96
	8	105.51 ± 9.14	105.21 ± 9.93	105.78 ± 8.37	105.46 ± 4.71	105.62 ± 4.75	105.29 ± 4.68	106.35 ± 9.22	106.50 ± 9.39	106.18 ± 9.06
	9	109.04 ± 12.16	108.31 ± 12.84	108.80 ± 11.39	108.52 ± 7.42	108.58 ± 6.58	108.45 ± 8.24	108.38 ± 10.42	108.68 ± 10.49	108.09 ± 10.36
	10	110.21 ± 12.47	110.92 ± 13.52	109.55 ± 11.38	110.22 ± 5.54	110.39 ± 5.49	110.05 ± 5.6	110.24 ± 9.66	110.04 ± 8.86	110.44 ± 10.45
Diastolic BP (mmHg)	6	63.34 ± 3.14	63.15 ± 2.08	63.51 ± 3.88	63.50 ± 1.42	62.91 ± 1.06	64.14 ± 1.49	63.32 ± 3.68	63.20 ± 2.18	63.43 ± 4.74
	7	64.53 ± 5.41	64.66 ± 5.94	64.35 ± 4.61	63.88 ± 1.69	63.35 ± 1.41	64.47 ± 1.77	64.58 ± 5.31	64.46 ± 5.66	64.69 ± 4.95
	8	65.68 ± 4.38	65.93 ± 4.53	65.46 ± 4.24	65.70 ± 2.23	65.74 ± 1.90	65.67 ± 2.53	65.64 ± 5.42	65.71 ± 5.61	65.56 ± 5.23
	9	66.64 ± 5.60	66.46 ± 5.36	66.83 ± 5.85	66.76 ± 3.52	66.91 ± 3.55	66.60 ± 3.49	66.43 ± 5.54	66.55 ± 5.83	66.32 ± 5.27
	10	67.40 ± 5.52	67.22 ± 5.59	67.56 ± 5.46	67.32 ± 3.21	67.13 ± 3.26	67.50 ± 3.15	67.61 ± 5.22	67.27 ± 5.26	67.97 ± 5.17

*Values are presented as mean ± SEM, *p < 0.01*

Table 3. The BMI index of Binh Dinh versus the world

Age (years)	BMI (kg/m^2)								*P
	WHO (WHO., 2007)		**America (**Fryar CD *et al*., 2016)		**Saudi Arabi (**Ahmed Syed Meraj., 2017)		**Binh Dinh (2016 - 2018)**		
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	
6	15.38	15.32	16.5	16.7	18.3	15.3	16.26	15.78	< 0.01
7	15.59	15.52	17.4	17.0	18.7	18.2	16.62	15.71	< 0.01
8	15.87	15.86	17.9	18.1	19.1	17.7	16.70	17.08	< 0.01
9	16.22	16.32	18.0	19.6	18.7	19.4	17.34	16.57	< 0.01
10	16.66	16.89	19.5	19.5	20.2	19	18.05	16.88	< 0.01