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The relationship between screen time and pre-diabetes: a cross-section study

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Abstract: **To explore the relationship between screen time and pre-diabetes. A cross-section study. We selected 500 students in Shandong province by convenient sampling method. Screen time was surveyed by questionnaire. Fasting fingertip blood glucose was measured by Roche Accu-Chek Performa excellent blood glucose meter. We screen people with abnormal blood sugar then track the finding of hospital. With the increase of screen time, the risk of pre-diabetes increased. Compared with students with 0~2h per day screen time, the risk of pre-diabetes of those who spend >2h per day screen time increased by 9.171%. After multi-factor adjustment, the risk of pre-diabetes of those who take >2h per day screen time is still higher than those with 0 ~ 2h per day screen time, the adjusted OR is 1.942 (95% CI= 1.080~3.494). Our study show that the excessive screen time will cause higher the risk of pre-diabetes, and people are supposed to be encouraged to reduce screen time.**

Keywords: Screen time; Pre-diabetes; Cross-section study

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1. Introduction

Pre-diabetes, including impaired glucose tolerance and impaired fasting glucose, is defined as fasting blood glucose 6.1～7.0 mmol/L[1] according to WHO (1999) Standard. It is reported that the prevalence of pre-diabetes is reach up to 12.7%[2]. Pre-diabetes is an abnormal state of glucose metabolism between normal glucose metabolism and diabetes, and is a necessary stage for patients with type 2 diabetes (T_2D). Those who with pre-diabetes, compared with those have normal glucose tolerance, possess a higher risk of cardiovascular diseases[3], lower brain gray matter volume[4]. Also, pre-diabetes will bring an unfavorable outcome for diseases, such as infective endocarditis[5], ischemic stroke[6]..

Screen time is the most common sedentary time, and the connotation of screen time is constantly changing with the continuous development of technology. In early time, screen time is mainly refers to the time of watching TV[7]. In 2011，the American Academy of Pediatrics (AAP)[8] added the definition of "non-educational content" to the content of screen time. In 2013, AAP[9] recognized the emergence of new media (such as mobile phones and networks). So the definition of screen time gradually evolved into time of using TV, computer, mobile phone, and pad for entertainment. Now young people's screen time is getting longer with lifestyle changes, especially the prevalence of electronic products[10], which is one of the risk factors for obesity[11], depression[12], sleep disorders[13], metabolic syndrome[14],hypertension[15] and diabetes[16].

At present, most studies are discussing the relationship between screen time and diabetes, but there are few studies concentrate on the connection between screen time and reversible pre-diabetes. Therefore, we will explore the relationship between screen time and pre-diabetes in order to provide a basis for health education to prevent pre-diabetes.

2. Materials and methods

2.1. Study Samples

We selected 500 students who volunteer to participate the study from Shandong Province in a convenient sampling method. Inclusion criteria: 18 years old or older. Exclusion criteria: diabetic patients.

2.2. Research methods

The study used the questionnaire survey method to investigate the average daily screen time in the past week. The survey time was the absence of winter and summer vacations and statutory holidays in the previous week. The height, weight and blood pressure was measured using unified approach by trained person. The fasting fingertips blood sugar was measured by researcher himself using Roche Accu-Chek Performa Excellent Blood Glucose Meter to screening for people with abnormal blood sugar levels then tracking their findings at the hospital to determine if they were pre-diabetes.

2.3. Screen time

Screen time refers to the time using TV, mobile

phones, computers, and pads for entertainment in the past week, excluding the time for learning using electronic devices. The screen time is determined by the school day and the weekend screen time according to the formula "screen time=(school day screen time 5 + week screen time *2)/7". The school day screen time is equal to the sum of the electronic device entertainment time on the school day, and the weekend screen time is equal to the sum of the electronic device entertainment time on the weekend.

2.4. Ethical issues

Research methods and purposes was informed to subjects before the investigation, and informed consent was signed. For the people who has an abnormal blood sugar, we will offer a free prevention manual of diabetes and professional guidance.

2.5. Statistical analysis

SPSS 23.0 software was used to analysis. Descriptive data were expressed as mean ± SD and rate. The chi-square test was used to compare the qualitative data sets. The variance data were used to compare quantitative data groups. The binary logistic regression model was used to evaluate the screen time and the risk of pre-diabetes at different baselines. $P < 0.05$ was considered as statistically significant.

3. Results

3.1. General information of two groups

A total of 500 people were investigated in this study, including 235 (47%) males and 265 (53%) females. According to the common classification of screen time, the subjects were divided into two groups. Difference among drinking, consumption of fried foods daily and doing moderate or severe exercise daily is statistically significant ($P<0.05$). (Table 1)

Table 1. General information of two groups

Variable	group		χ^2/t	P
	0~2h(N=134)	>2h(N=366)		
Sex			1.015	0.314
Male	58	177		
Female	76	189		
Age	20.030±1.026	20.000+1.004	0.292	0.77
BMI	21.132±2.447	21.200±2.633	0.262	0.794
	103.060±7.80			
SBP	0	102.790±7.154	0.344	0.731
DBP	80.433±8.944	79.385±9.322	1.125	0.261
Household registration			1.904	0.168
Rural	98	289		
Town	36	77		
Smoking			2.326	0.127
Yes	3	20		
No	131	346		
Drinking			4.363	0.037
Yes	19	83		
No	115	283		
Consumption of fried foods daily			6.449	0.011
≥1time/day	47	175		
<1time/day	87	191		
Consumption of carbonated drinks daily			0.946	0.397
≥250ML/day	26	86		
<250ML/day	108	280		
Doing moderate or severe exercise daily			5.36	0.023

≥30min/day	26	109		
<30min/day	108	257		
Does the mother have gestational diabetes?			_	0.469
Yes	4	6		
No	130	360		
Whether premature birth			_	0.754
Yes	4	9		
No	130	357		
Birth weight			2.158	0.34
<2500g	9	35		
>4000g	15	53		
2500~4000g	110	278		
Whether there is a family history of diabetes			1.625	0.202
yes	24	85		
no	110	281		

Table 2. The relationship between screen time and the risk of pre-diabetes

Group	Prevalence	OR value	95%CI	Adjusted OR value[#]	95%CI
0~2h(N=134)	12.687%	1	-	1	-
>2h(N=366)	21.858%	1.925	1.093～3.390	1.942	1.080～3.494

[#]:Correction mixed factors of gender, age, BMI, SBP, DBP, household registration, smoking, drinking, consumption of fried foods daily, consumption of carbonated drinks daily, doing moderate or moderate exercisedaily, whether mothers are gestational diabetes, premature birth, birth weight Whether there is a family history of diabetes. -:No such item.

3.2. Screen time and the risk of pre-diabetes

As the average daily screen time increases, the risk of pre-diabetes continues to increase. Compared with students with 0~2h per day screen time, the risk of pre-diabetes of those who spend >2h per day screen time increased by 9.171%. After multi-factor adjustment, the risk of pre-diabetes of those who take >2h per day screen time is still higher than those with 0 ~ 2h per day screen time, the adjusted OR is 1.942 (95% CI= 1.080~3.494). (Table 2)

4. Discussion

Pre-diabetes has been a hot research topic recently. It is a great health problem not only because of its high prevalence in mostly healthy people, but also because it brings a serious of harmful outcomes. Pre-diabetes is an early stage of T2D, and indicates the future development of T2D which is an irreversible lifelong disease and brings economic burden and physical/mental damage[17-19]. Not only that, pre-diabetes also heralds a disadvantaged outcome for diseases, such as infective endocarditis and ischemic stroke. Pre-diabetes is a reversible process, and it is the only stage that is currently known to turn blood sugar back to normal. We will reduce the risk of T2D and decrease bad consequences if we can effectively intervene in this process. Pre-diabetes is currently the only stage where it is possible to return abnormal blood sugar to its normal range, so it is especially important to reduce the risk factors that can be changed in the stages of pre-diabetes.

Roche Accu-Chek Performa excellent blood glucose meter has a certain accuracy in testing blood sugar. We used a fasting fingertip blood glucose screening for abnormal population of fasting venous blood glucose, which is operated according to the 2010 Ministry of Health issued by the Ministry of Health portable medical blood glucose detector management and clinical practices (The operation specification in the trial). When it is found that the blood glucose of the fingertip may be abnormal, the research subject is informed and the result of the examination in the hospital is tracked. According to the provisions of the "Management of Portable Blood Glucose Detectors for Management and Clinical Practice (Trial)", the results of blood glucose meter tests in medical institutions should be compared and evaluated at least once every 6 months with the results of biochemical methods in the laboratory.

Moreover, the accuracy of the blood glucose meter test results of the medical institution and the laboratory biochemical test results of the institution are clearly defined: when the blood glucose concentration is <4.2 mmol/L, at least 95% of the test results have an error of±0.83 mmol/L. When the blood glucose concentration is ≥4.2mmol/L, at least 95% of the test results are within±20%. It has been confirmed that the institution's Accu-Chek Performa blood glucose meter can meet the accuracy standards set by the Ministry of Health[20]. According to the diagnostic criteria for pre-diabetes in WHO (1999) Standard, fasting venous blood glucose 6.1 ~ 7.0mmol / L is pre-diabetes. When we found fasting fingertip blood glucose≥5.9mmol / L, we will suggest the subject to check in hospital and track the result.

In our study, the longer the screen time, the higher the risk of pre-diabetes. The risk of pre-diabetes who spend >2h in screen time increased by 9.171% compared with who spend 0~2h per day screen time. After multi-factor adjustment, the risk of pre-diabetes of those who take >2h per day screen time is 1.942 time than those who take 0～2h per day screen time. Foreign research shows that screen time is positively related to T2DM, and it is closely related to obesity[11], depression[12], sleep disorders[13], metabolic syndrome[14], and hypertension[15]. This is consistent with the results of this study.

Excessive screen time increase the risk of pre-diabetes, which may be because it can affect life from various aspects. This can be reflected in basic information of our subjects. First, excessive screen time may lead to increase energy intake. Desserts, nuts and sugar drinks are often ate as snacks when watching TV and playing computer; It is surveyed that people who watch TV for a long time often consume more high-fat and high-sugar food[21]. At the same time, food-related advertisements on TV programs (especially fast-food advertisements) will also raise the intake of food. Watching TV can also delay the satiety of normal meals and reduce the tiredness of eating food[22]. Thereby we will unconsciously consume various foods and increase energy intake during screen time. In addition, when human spend their time on the screen, they may replace the original sports time on the weekend[23]. The research of Hui Xie[24] displays that physical activity levels are negatively correlated with watching TV and movies. Therefore, too longer screen time will affect human life in many ways, leading to the occurrence and development of pre-diabetes.

5. Conclusion

The results of this study show that the longer the screen time, the higher the risk of pre-diabetes. So people should be encouraged to reduce screen time. However, this study is a cross-sectional study, and follow-up studies are still needed to explore the causal relationship and pathophysiological mechanisms of screen time and pre-diabetes. What is more, how to improve parents and young people's awareness of regulating media use and reducing screen time remains to be further explored, although we have found that long screen time is harmful to health.

Conflict of Interest

All contributing authors declare no conflict of interest.

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