SURAT KETERANGAN

Yang bertanda tangan dibawah ini :

Nama : Dr. NUR ROCHMAH dr., Sp.A(K)
NIP : 197904292008012007
Pangkat/ Gol : Penata – III/c
Jabatan fungsional : Lektor

Adalah benar sebagai Corresponding Author pada artikel :

Judul	:	Distribution of Body Mass Index and Random Plasma Glucose as Early Detection of Diabetes Mellitus in Indonesian Students
Nama Jurnal	:	International Journal of Scientific Advances
Nomor ISSN	:	2708-7972
Volume, Nomor, bulan, tahun	:	3, 5, 2022
Penerbit	:	International Journal of Scientific Advances
Alamat Web Jurnal	:	https://www.ijscia.com/full-text-volume-3-issue-5-sep-oct-2022-754-757/

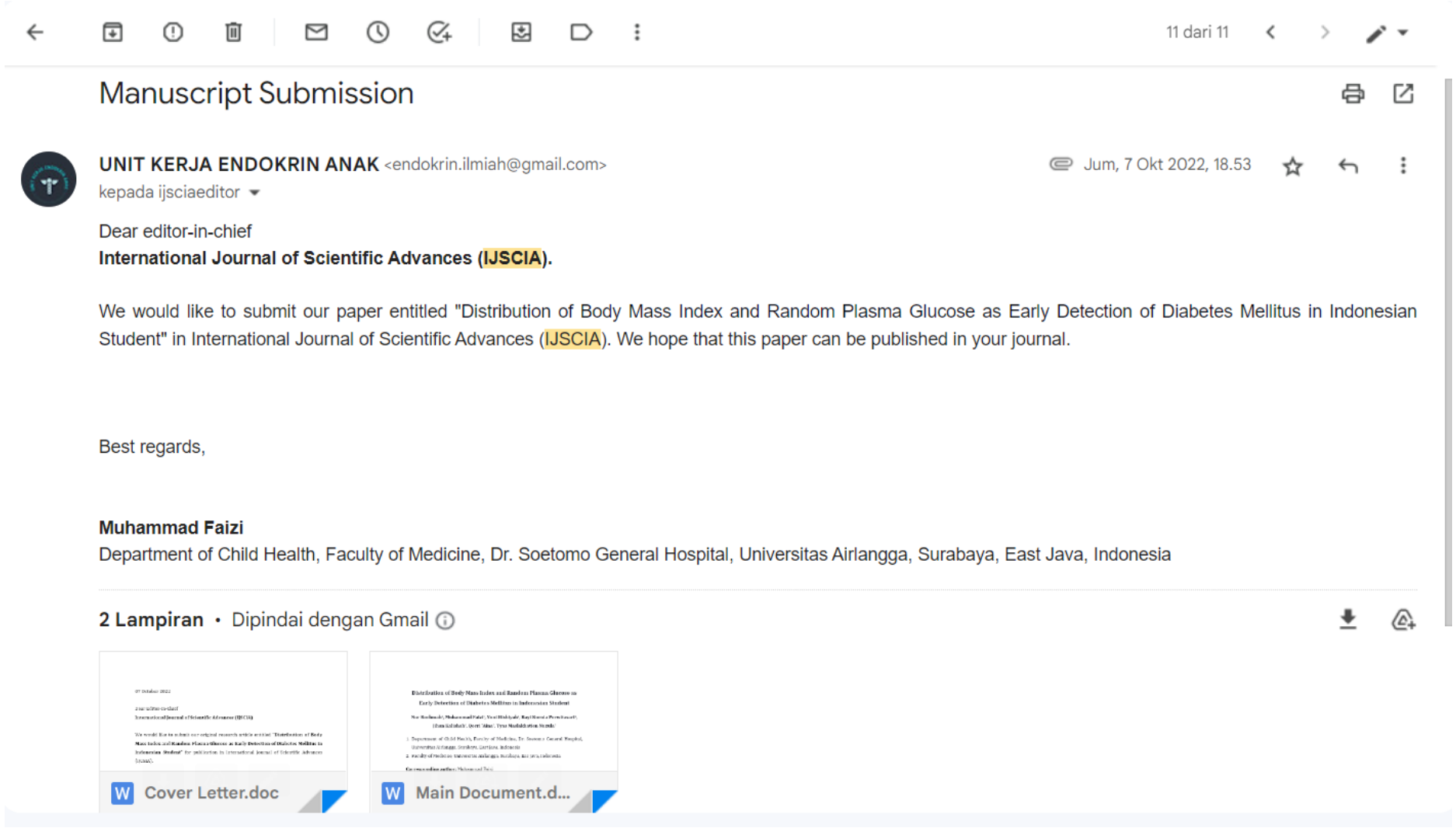
Bukti korespondensi tidak bisa dilampirkan secara lengkap mulai dari tahap submit, proses viewer, proses layout editing dan sampai bukti accepted. Karena proses submit hanya melalui email.

Demikian Surat keterangan ini kami buat untuk dipergunakan sebagaimana mestinya.

Surabaya, 7 Agustus 2023

Dr. NUR ROCHMAH dr., Sp.A(K)

Bukti Submit



07 October 2022

Dear Editor-in-Chief

International Journal of Scientific Advances (IJSCIA)

We would like to submit our original research article entitled **"Distribution of Body Mass Index and Random Plasma Glucose as Early Detection of Diabetes Mellitus in Indonesian Student"** for publication in International Journal of Scientific Advances (IJCSIA).

Diabetes mellitus (DM) is a long-term metabolic condition marked by abnormally high blood sugar levels brought on by deficiencies in insulin secretion, insulin action, or both. Approximately, 87% of adolescents have a sedentary lifestyle and a poor diet. It can result in obesity and raise the risk of metabolic disorders, including diabetes in old age. Until recently, early detection of diabetes mellitus was still not widely done in Indonesia, especially in the student population. Therefore, we aimed to measure BMI and random plasma glucose in Indonesian student

We hope that this article could be considered for publication in International Journal of Scientific Advances (IJCSIA).

Sincerely yours,

Muhammad Faizi
Department of Child Health, Faculty of Medicine, Dr. Soetomo General Hospital, Universitas Airlangga, Surabaya, East Java, Indonesia
Address: Mayjend Prof. Dr. Moestopo No 6-8, Surabaya, East Java, Indonesia, 60286
Email: Muhammad.faizi@fk.unair.ac.id

Distribution of Body Mass Index and Random Plasma Glucose as Early Detection of Diabetes Mellitus in Indonesian Student

Nur Rochmah[1], Muhammad Faizi[1], Yuni Hisbiyah[1], Rayi Kurnia Perwitasari[1], Jihan Kalishah[2], Qorri 'Aina[2], Tyas Maslakhatien Nuzula[2]

1. Department of Child Health, Faculty of Medicine, Dr. Soetomo General Hospital, Universitas Airlangga, Surabaya, East Java, Indonesia
2. Faculty of Medicine, Universitas Airlangga, Surabaya, Eas Java, Indonesia

Corresponding author: Muhammad Faizi

Department of Child Health, Faculty of Medicine, Dr. Soetomo General Hospital, Universitas Airlangga,
Address: Mayjend Prof. Dr. Moestopo No. 6-8, Surabaya, East Java, Indonesia, 60286.

Email: muhammad.faizi@fk.unair.ac.id

Tel. +628123402094

Abstract

Background. Diabetes mellitus (DM) is a chronic metabolic disorder characterized by abnormal elevated blood glucose levels resulting from defects in insulin secretion, insulin action, or both. The prevalence of DM in children and adolescents is increasing worldwide. Until recently, early detection of DM was still not widely done in Indonesia. Therefore, this study aimed to measure BMI and random plasma glucose in Indonesian student.

Methods. This descriptive study involving 8th and 9th grade students at Alif Laam Miim Islamic Boarding School Surabaya aged 13 - 18 years old. Height and weight were measured using standard anthropometry. Capillary blood samples were taken on the index or middle finger of the students using a single-use lancet. Statistical analysis was conducted with SPSS using the T-test, Mann-Whitney, and Chi square test.

Results. This study included 95 subjects with the mean age of 14.65 ± 1.83 years old. There is no significant difference of BMI ($p = 0.63$) and random plasma glucose ($p = 0.09$) between males and females. The distribution of BMI for underweight, healthy weight, overweight, and obesity were 6.32%; 64.21%; 14.74%; 14.74% respectively. None of them had a high range of random plasma glucose.

Conclusion. Indonesian student in Surabaya had a healthy weight and a normal range of plasma glucose.

Keywords: Diabetes Mellitus, Body Mass Index, Random Plasma Glucose, Children, Adolescence

Introduction

Diabetes mellitus (DM) is a long-term metabolic condition marked by abnormally high blood sugar levels brought on by deficiencies in insulin secretion, insulin action, or both [1]. Based on their etiopathogenetic, there are two groups of DM types, including type 1 and type 2 DM. Type 1 Diabetes Mellitus (T1DM) is defined by an inability to produce insulin due to the destruction of pancreatic-cells, which is typically the outcome of T-cell-mediated autoimmunity. In contrast, Type 2 Diabetes Mellitus (T2DM) is characterized by insulin resistance and insufficient insulin secretory compensation [2].

T1DM was the most prevalent form of diabetes in children, whereas T2DM was more prevalent in adults and obese individuals [3]. Recent research indicates that the prevalence of T2DM in children and adolescents has increased over the past several decades [2, 4, 5]. The prevalence of T2DM in children and adolescents has increased due to the lifestyle factors, which also contribute to the global rise in obesity [4]. In the United States, the prevalence among adolescents with T2DM is increasing from 9 to 12.5 cases per 100.000 youth [5]. The incidence of T2DM in children increases with age and the peak age onset of T2DM occurs at puberty [6]. Childhood onset of T2DM is associated with greater risk of microvascular and macrovascular complication [5]. The Indonesian Pediatric Society (IPS) had only recorded 1,249 Indonesian children with T1DM from 2017–2019. The prevalence of T1DM in Indonesia raises over 10 years, from 3.88 per 100 million in 2000 to 28.19 per 100 million in 2010. The diagnosis and treatment of T1DM in children is often delayed. In Indonesia, the number of T1DM with Diabetic Ketoacidosis (DKA) at diagnosis remained high (71%) [7]. Consequently, screening for DM in children is essential in order to provide an early diagnosis and intervention to prevent future problems. The screening for diabetes mellitus consisted of measuring glycemia and doing a risk assessment for DM [8].

In 2010, the proportion of adolescents in Indonesia was around 43.5 million people. Badan Pusat Statistik (BPS) Indonesia said that there are 426,786 adolescents aged 10-19 in Surabaya [9]. Approximately, 87% of adolescents have a sedentary lifestyle and a poor diet. It can result in obesity and raise the risk of metabolic disorders, including diabetes in old age [10]. The World Health Organization (WHO) has suggested Body Mass Index (BMI) assessment as the simplest method for classifying obesity [11]. BMI measurement is a simple and inexpensive method for screening for obesity and other weight disorders [12]. Until recently, early detection of diabetes mellitus was still not widely done in Indonesia, especially in the student population. Therefore, we aimed to measure BMI and random plasma glucose in Indonesian student.

Methods

This descriptive study involving 8th and 9th grade students at Alif Laam Miim Islamic Boarding School Surabaya aged 13 - 18 years old. This study was approved by the Faculty of Medicine Health Research and Ethics Committee with ethical clearance number 139/EC/KEPK/FKUA/2022. Informed consent was already obtained from the subject's guardians. Height and weight were measured using standard anthropometry done by healthcare professionals. Height was measured to the nearest 0.1 cm using a wall-mounted tape measure (Onemed) while body weight was measured to the nearest 0.1 kg (Onemed). Capillary blood samples were taken on the index or middle finger of the students using a single-use lancet to measure random plasma glucose (*ACCU CHECK).* Students who refused to have their height, weight, and random plasma glucose measured were excluded from this study.

Body Mass Index (BMI) was calculated by dividing weight in kilograms with the square of height in meters. BMI was categorized for underweight (<5th percentile), healthy weight (5th percentile - <85th percentile), overweight (>85th percentile - <95th percentile), and obesity (≥95th percentile) based on the BMI-for-age percentile growth charts [12]. Random plasma Glucose was categorized by normal (<200

mg/dL) and high (≥200 mg/dL) [13]. Data was entered in and statistical analysis was performed using SPSS version 17 with p-value < 0.05 was considered as statistically significant. The variables were expressed as mean ± standard deviation and frequency (percentage). Difference variable in numeric data between male and female was analyzed using T-test or Mann-Whitney U test based on the Kolmogorov-Smirnov normality test. Meanwhile, categoric data was analyzed with Chi-square or Fisher-exact to compare frequencies.

Result

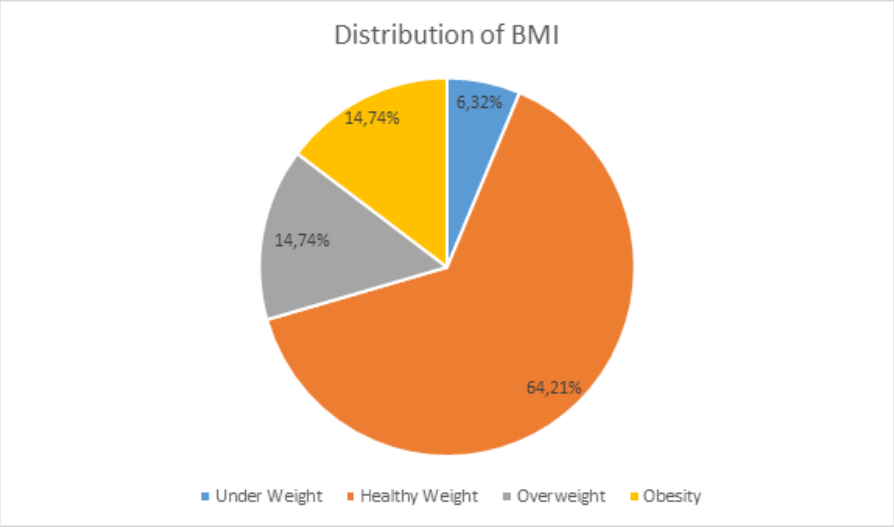
This study enrolled 95 students in Surabaya. The demographic characteristics of subjects are shown in Table 1. The mean age of the subject is 14.65 ± 1.83 years old. There is no significant difference of BMI (p = 0.63) and random plasma glucose (p = 0.09) between males and females. BMI was further classified into four categories based on the CDC criteria [12]. The distribution of the BMI based on the categories can be seen in Figure 1. From 95 students, none of them had a high range of random plasma glucose that can be seen in Table 3.

Table 1. Demographic Characteristics of Samples

Characteristic	**All (n = 95)**	**Males (n = 42)**	**Females (n = 53)**	**p-value**
Age (years)	14.65 ± 1.83	14.80 ± 1.06	14.79 ± 1.04	0.96
Anthropometry				
Height (m)	1.57 ± 0.08	1.64 ± 0.05	1.52 ± 0.07	0.00*
Weight (kg)	56.03 ± 13.06	60.80 ± 14.78	52.33 ± 10.0	0.00*
Body mass index (kg/m^2)	22.60 ± 4.57	22.48 ± 4.78	22.68 ± 4.47	0.63
Random plasma glucose (mg/dL)	95.10 ± 9.25	93.07 ± 10.86	96.32 ± 7.68	0.09
Parental Ethnicity				0.58
Javanese	79 (83.2)	37 (88.1)	42 (79.2)	
Madura	13 (13.7)	4 (9.5)	9 (17.0)	
Other	3 (3.2)	1 (2.4)	2 (3.8)	
History of family with DM*				0.55
Yes	16 (16.8)	6 (14.3)	10 (18.9)	
No	79 (83.2)	36 (85.7)	43 (81.1)	

DM, Diabetes Melitus; *, statistically significant

Figure 1. Distribution of Body Mass Index (BMI)



BMI, Body Mass Index

Table 2. Distribution of Random Plasma Glucose

Category	**Total (n)**	**Percent (%)**
Normal (<200 mg/dL)	95	100%
High (>200 mg/dL)	0	0

Discussion

This study reveals that the majority of students had a healthy BMI (64.21%) and that the proportion of students with overweight and obesity is the same (14.74%). The prevalence of overweight is approximately 18% and obesity is approximately 30.7%, which is quite low compared to previous studies conducted among university students in Indonesia [14]. Higher prevalence of obesity and overweight compared to this study also found in other countries like Boston (34% of females and 32% of

males), India (27%), Qatar (46% of males and 44% of females), and Morocco (42%) [15-18]. However, Norwegian has a lower number of children and adolescents with obesity (5.2% of males and 8.0% of females) [19]. A significantly lower prevalence of overweight and obesity in our study compared to other nations may be attributable to the fact that the study population resides in a boarding school that provides daily meals. The school also has a tight policy prohibiting kids from purchasing food from outside the school. It restricts kids' access to junk food and other unhealthy foods that may contribute to obesity. Another study with boarding school students as the population found a reduced prevalence of overweight and obesity among children and teenagers [20].

The screening program will be influenced by a number of variables, such as: 1) disease (severity, prevalence, potential pre-clinical detection, extended latency period, improved outcomes with early identification); 2) screening test (validity, reliability, ease of use, ability to detect disease pre-clinically); and 3) screening program [21]. The ADA suggests evaluating children and teenagers who are overweight and have two risk factors, such as acanthosis nigricans, hypertension, hyperlipidemia, or a first- or second-degree relative with a history of type 2 diabetes. The ADA and the American Academy of Pediatrics advise screening at-risk patients every two years beginning at age 10 or the start of puberty before age ten [22]. Elevated blood glucose levels lead to the development of problems during the lengthy pre-clinical phase of diabetes. So many healthcare guidelines now advise screening for the disease in order to detect diabetes early. The objective is to identify asymptomatic patients so that earlier treatment can have a positive effect on the disease's progression. The most probable culprits in the development of T1DM are genetic susceptibility, environmental factors, vitamin D processing, and viruses. There is no substantial evidence indicating the root cause as of yet [21].

None of the students in this study had a high range of RPG based on ADA criteria (>200 mg/dL). In our study, around 26 children had RPG 100 mg/dL and the maximum value of RPG was 123 mg/dL in one child. It contrasts with a study from

India who found that 5.3% of the obese children population in their study had an elevated RPG (>130 mg/dL) [23]. Study from Qatar also found 6% of boys and 2% of girls with elevated blood sugar (RPG ≥140 mg/dL and/or Fasting Plasma Glucose ≥ 100 mg/dL) [17]. Nevertheless, in a study with samples of the US adult population without diagnosed diabetes, a single RBG ≥100 mg/dL was found strongly associated with undiagnosed diabetes and was the single strongest predictor of undiagnosed diabetes outperforming other risk factors [24]. International Diabetes Federation (IDF) also recommends that individuals with RPG value 100 - 199 mg/dL should undergo a formal diabetes testing [8]. Until now, the recommended screening and diagnostic tools for prediabetes and diabetes are Fasting Plasma Glucose (FPG), Oral Glucose Tolerance Test (OGTT) and HbA1c [13]. In actual practice, however, most practitioners employ RPG as a screening tool because it may be performed and prescribed on the same day as the patient's visit [25, 26]

To the best of our knowledge, this is the first study in Indonesia that shows a distribution of BMI and RPG as early detection of DM in children and adolescents. Nevertheless, this study had several limitations: first, a small amount of population size was used in this study; second, even though BMI was the easiest way to use for screening obesity, it can't measure total amount of body fat in the body directly; third, this study uses RPG as a screening test of dysglycemia instead of FPG, OGTT, or HbA1c.

Conclusion

Our study showed that most adolescents in a boarding school in Surabaya had a healthy weight and a normal range of plasma glucose. However, it's important to continuously do BMI and glucose screening as an early detection of DM, especially in overweight and obesity adolescents. Further studies with more complete and bigger data are needed to make a better analysis between BMI and RPG as an early detection of DM.

References

1. American Diabetes Association (ADA). (2012). Classification and Diagnosis of Diabetes: Standards of Medical Care in Diabetes. *Diabetes care*, *43*(1), S14-S31. doi: 10.2337/dc20-S002.
2. Craig, M. E., Jefferies, C., Dabalea, D., Balde, N., Seth, A., Donaghue K.C. (2014). Definition, epidemiology, and classification of diabetes in children and adolescents. *Pediatric Diabetes*, *15*(S20), 4–17. doi:10.1111/PEDI.12186.
3. Tan S.Y., Mei Wong J.L., Sim Y.J., Wong S.S., Mohamed Elhassan S.A., Tan S.H., *et al*. (2018). Type 1 and 2 diabetes mellitus: A review on current treatment approach and gene therapy as potential intervention. *Diabetes & Metab Syndr, 13*(1), 364-372. *doi*: 10.1016/j.dsx.2018.10.008.
4. Botero, D., & Wolfsdorf, J.I. (2005). Diabetes mellitus in children and adolescents. *Archives of Medical Research*, *36*(3), 281–290. doi: 10.1016/J.ARCMED.2004.12.002.
5. Koren, D., & Evotsky, L.L. (2021). Type 2 Diabetes Mellitus in Childhood and Adolescence. *Pediatrics in Review, 42*(4), 167-179. doi: 10.1542/pir.2019-0236
6. Dileepan, K., & Max Feldt, M. (2013) Type 2 Diabetes Mellitus in Children and Adolescents, *Pediatrics in Review*, *34*(12), 541–548. doi: 10.1542/PIR.34-12-541.
7. Pulungan, A.B., Fadiana, G., & Annisa, D. (2021). Type 1 Diabetes Mellitus in Children: Experience in Indonesia. *Clinical Pediatric Endocrinology, 30*(1), 11-18. doi: 10.1297/cpe.30.11
8. International Diabetes Federation (IDF). (2012). Global Guideline for Type 2 Diabetes. Belgium: IDF.
9. Badan Pusat Statistik (BPS) Indonesia. (2013). Statistik Indonesia 2011. Jakarta: BPS

10. Pramono, A., *et al.* (2014). Kontribusi Makanan Jajan dan Aktivitas Fisik terhadap Kejadian Obesitas pada Remaja di Kota Semarang. *Gizi Indonesia, 37*(2), 129–136. doi: 10.36457/GIZINDO.V37I2.158.
11. Behera, A.A., Behera B.K., Dash, S., & Mishra, S. (2014). Effect of body mass index on gender difference in lung functions in Indian population. *Int J Clin Exp Physiol, 1*(3),229-231.
12. Centre for Disease Control (CDC) (2021). About Child and Teen BMI. accessed on: https://www.cdc.gov/healthyweight/assessing/bmi/childrens_bmi/about_childrens_bmi.html
13. American Diabetes Association (ADA). (2020). Classification and Diagnosis of Diabetes: Standards of Medical Care in Diabetes-2020. *Diabetes Care, 43*(Supp1), 14-31. Doi: 10.2337/dc20-S002
14. Oktariza, R.T., Kalanjati, V.P., & Tirthaningsing, N.W. (2021). Body Mass Index, Waist-Hip Ratio and Fasting Glucose amongst the University Students. *Fol Med Indones*, *57*(1), 53-57. Doi: 10.20473/fmi.v57i1.14661
15. Field, A.E., Cook, N. R., Gilman, M.W. (2005). Weight Status in Childhood as a Predictor of Becoming Overweight or Hypertensive in Early Adulthood. *Obes Res*, *13*(1), 163-169. Doi: 10.1038/oby.2005.21
16. Khadilkar, V.V., Khadilkar, A.V., Cole, T.J., Chiplonkar, S.A., & Pandit, D. (2011). Overweight and Obesity Prevalence and Body Mass Index Trends in Indian Children. *Int J Pediatr Obes, 6*(2-2), 2016-224. Doi: 10.3109/17477166.2010.541463.
17. Mamtani, R., Lowenfels, A.B., Sheikh. J., Cheema D., Al-Hamaq A., Matthis, S.A., *et al.* (2014). Adolescent prediabetes in a high-risk Middle East Country: a cross-sectional study. *JRSM Open, 5*(8), 1-5. Doi: 10.1177/2054270414536550
18. Mehdad, S., Hamrani, A., Kari, K.E., Hamdouchi, A.E., Barakat A., Mzibri M.E., *et al*. (2012). Body Mass Index, Waist Ciurcumferenece, Body Fat, Fasting Blood Glucose in a Sample of Moroccan Adolescents Aged 11-17 Years. *J Nutr Metab,* 510458. Doi: 10.1155/2012/510458

19. Bjorge, T., Engeland, A., Tversal, A., Smith, G.D. (2008). Body Mass Index in Adolescence in Relation to Cause-specific Mortality: A Follow Up of 230.000 Norwegian Adolescents. *American Journal of Epidemiology*, *168*(1), 30-37. Doi: 10.1093/aje/kwn096
20. Kola-Raji, B.A., Balogun, M.R., & Odugbemi, T.O. (2017). A comparative study of nutritional status of adolescents from selected private and public boarding secondary schools in Ibadan, South Western Nigeria. *Journal of Medicine in the Tropics*, *19* (1), 49-55. Doi: 19. 49. 10.4103/jomt.jomt_43_16.
21. Peer, N., Balakrishna, Y., & Durao, S. (2020). Screening for type 2 diabetes mellitus. *Cochrane Database of Systematic Reviews*, *5*. https://doi.org/10.1002/14651858.CD005266.pub2
22. Pippit, K., Li, M., & Gurgle, H.E. (2016). Diabetes Mellitus: Screening and Diagnosis. *American Family Physician, 93* (2), 103-109
23. Khadilkar, A.V., Lohiya, N., Mistry, S., Chiplonkar, S., Khadilkar, V., Kajale, N., *et al*. (2019). Random Blood Glucose Concentrations and their Association with Body Mass Index in Indian School Children. *Indian Journal of Endocrinology and Metabolism, 23*(5), 529-535. Doi: 10.4103/ijem.IJEM_536_19
24. Bowen, M.E., Xuan, L., Lingvay, I., Halm, E.A. (2015). Random Blood Glucose: A Robust Risk Factor for Type 2 Diabetes. *J Clin Endocrinol Metab, 100*(4), 1503-1510. Doi: 10.1210/jc.2014-4116
25. Lee, J.M., Gebremariam, A., Wu, E.L., LaRose, J., Gurney, J.G. (2011). Evaluation of Nonfasting Tests to Screen for Childhood and Adolescent Dysglycemia. *Diabetes Care, 34*(12), 2597-2602. Doi: 10.2337/dc11-0827
26. Saudek, C.D., Herman, W.H., Sacks, D.B., Bergenstal, R.M., Edelman, D.M., Davidson, M.B. (2008). A New Look at Screening and Diagnosing Diabetes Mellitus. *J Clin Endocrinol Metab, 93*(7):2447-2453. Doi: 10.1210/jc.2007-2174

Bukti Review

Editor IJSCIA <ijsciaeditor@gmail.com>
kepada saya

Jum, 7 Okt 2022, 19.12

Inggris > Indonesia Terjemahkan pesan Nonaktifkan untuk: Inggris

Dear author,

Thank you for sending us your manuscript entitled: **" Distribution of Body Mass Index and Random Plasma Glucose as Early Detection of Diabetes Mellitus in Indonesian Student ".**

We endeavor to let you know its status in the next few days (typically 1-3 days).

Best regards
--
Editor-in-Chief
International Journal of Scientific Advances
IJSCIA

On Fri, Oct 7, 2022 at 6:54 PM UNIT KERJA ENDOKRIN ANAK <endokrin.ilmiah@gmail.com> wrote:

> Dear editor-in-chief
> **International Journal of Scientific Advances (IJSCIA).**
>
> We would like to submit our paper entitled "Distribution of Body Mass Index and Random Plasma Glucose as Early Detection of Diabetes Mellitus in Indonesian Student" in International Journal of Scientific Advances (IJSCIA). We hope that this paper can be published in your journal.
>
> Best regards

Editor IJSCIA <ijsciaeditor@gmail.com>
kepada saya

Min, 9 Okt 2022, 03.09

Inggris > Indonesia Terjemahkan pesan Nonaktifkan untuk: Inggris

Dear author,

Thank you for giving us the opportunity to consider your work.
Reviewers are recommending that your manuscript should be accepted. The following are their comments:

Reviewer #1: The descriptive study is forthcoming and interesting to read. It is well discussed **but the authors kept using "student" instead of "students"**. I recommend that it should be accepted.
Reviewer #2: This paper discusses a very interesting topic, and should therefore be accepted.

Thank you for your fine contribution.

You now have the following actions to perform:
1. Should you need to make any improvements and other final checks on your manuscript, do so and revert back to us for processing.
2. Pay the article processing fee using the invoice link as follows: https://www.paypal.com/invoice/p/#22LJZ47Y39QSPD9Z

Do not forget to immediately send the proof to us (ijsciaeditor@gmail.com).

Your article would be published online in the current issue once this has been done.

Warm regards

Bukti Publish

UNIT KERJA ENDOKRIN ANAK <endokrin.ilmiah@gmail.com>

9 Okt 2022, 22.35

kepada Editor

Dear editor of IJSCIA,

Thank you for the review and acceptance of our manuscript. We already paid the processing fee for this manuscript. We attach the invoice and the revised manuscript. Thank you.

Best Regards,

Muhammad Faizi

2 Lampiran • Dipindai dengan Gmail

Invoice - 0147.pdf

Main Document - ...

INVOICE

International Journal of Scientific Advances
Website: www.ijscia.com

Invoice No#: 0147
Invoice Date: 08 Oct 2022

PAID

0,00 $
AMOUNT DUE

BILL TO
endokrin.ilmiah@gmail.com

#	ITEMS & DESCRIPTION	QTY/HRS	PRICE	AMOUNT($)
1	Publication fee Title: Distribution of Body Mass Index and Random Plasma Glucose as Early Detection of Diabetes Mellitus in Indonesian Student	1	49,00 $	49,00 $

Subtotal	49,00 $
TOTAL	49,00 $ USD
Amount paid	49,00 $
AMOUNT DUE	0,00 $ USD

Distribution of Body Mass Index and Random Plasma Glucose as Early Detection of Diabetes Mellitus in Indonesian Students

Nur Rochmah[1], Muhammad Faizi[1], Yuni Hisbiyah[1], Rayi Kurnia Perwitasari[1], Jihan Kalishah[2], Qorri 'Aina[2], Tyas Maslakhatien Nuzula[2]

1. Department of Child Health, Faculty of Medicine, Dr. Soetomo General Hospital, Universitas Airlangga, Surabaya, East Java, Indonesia
2. Faculty of Medicine, Universitas Airlangga, Surabaya, Eas Java, Indonesia

Corresponding author: Muhammad Faizi

Department of Child Health, Faculty of Medicine, Dr. Soetomo General Hospital, Universitas Airlangga,
Address: Mayjend Prof. Dr. Moestopo No. 6-8, Surabaya, East Java, Indonesia, 60286.

Email: muhammad.faizi@fk.unair.ac.id

Tel. +628123402094

Abstract

Background. Diabetes mellitus (DM) is a chronic metabolic disorder characterized by abnormal elevated blood glucose levels resulting from defects in insulin secretion, insulin action, or both. The prevalence of DM in children and adolescents is increasing worldwide. Until recently, early detection of DM was still not widely done in Indonesia. Therefore, this study aimed to measure BMI and random plasma glucose in Indonesian students.

Methods. This descriptive study involving 8th and 9th grade students at Alif Laam Miim Islamic Boarding School Surabaya aged 13 - 18 years old. Height and weight were measured using standard anthropometry. Capillary blood samples were taken on the index or middle finger of the student using a single-use lancet. Statistical analysis was conducted with SPSS using the T-test, Mann-Whitney, and Chi square test.

Results. This study included 95 subjects with the mean age of 14.65 ± 1.83 years old. There is no significant difference of BMI ($p = 0.63$) and random plasma glucose ($p = 0.09$) between males and females. The distribution of BMI for underweight, healthy weight, overweight, and obesity were 6.32%; 64.21%; 14.74%; 14.74% respectively. None of them had a high range of random plasma glucose.

Conclusion. Indonesian students in Surabaya had a healthy weight and a normal range of plasma glucose.

Keywords: Diabetes Mellitus, Body Mass Index, Random Plasma Glucose, Children, Adolescence

Introduction

Diabetes mellitus (DM) is a long-term metabolic condition marked by abnormally high blood sugar levels brought on by deficiencies in insulin secretion, insulin action, or both [1]. Based on their etiopathogenetic, there are two groups of DM types, including type 1 and type 2 DM. Type 1 Diabetes Mellitus (T1DM) is defined by an inability to produce insulin due to the destruction of pancreatic-cells, which is typically the outcome of T-cell-mediated autoimmunity. In contrast, Type 2 Diabetes Mellitus (T2DM) is characterized by insulin resistance and insufficient insulin secretory compensation [2].

T1DM was the most prevalent form of diabetes in children, whereas T2DM was more prevalent in adults and obese individuals [3]. Recent research indicates that the prevalence of T2DM in children and adolescents has increased over the past several decades [2, 4, 5]. The prevalence of T2DM in children and adolescents has increased due to the lifestyle factors, which also contribute to the global rise in obesity [4]. In the United States, the prevalence among adolescents with T2DM is increasing from 9 to 12.5 cases per 100.000 youth [5]. The incidence of T2DM in children increases with age and the peak age onset of T2DM occurs at puberty [6]. Childhood onset of T2DM is associated with greater risk of microvascular and macrovascular complication [5]. The Indonesian Pediatric Society (IPS) had only recorded 1,249 Indonesian children with T1DM from 2017–2019. The prevalence of T1DM in Indonesia raises over 10 years, from 3.88 per 100 million in 2000 to 28.19 per 100 million in 2010. The diagnosis and treatment of T1DM in children is often delayed. In Indonesia, the number of T1DM with Diabetic Ketoacidosis (DKA) at diagnosis remained high (71%) [7]. Consequently, screening for DM in children is essential in order to provide an early diagnosis and intervention to prevent future problems. The screening for diabetes mellitus consisted of measuring glycemia and doing a risk assessment for DM [8].

In 2010, the proportion of adolescents in Indonesia was around 43.5 million people. Badan Pusat Statistik (BPS) Indonesia said that there are 426,786 adolescents aged 10-19 in Surabaya [9]. Approximately, 87% of adolescents have a sedentary lifestyle and a poor diet. It can result in obesity and raise the risk of metabolic disorders, including diabetes in old age [10]. The World Health Organization (WHO) has suggested Body Mass Index (BMI) assessment as the simplest method for classifying obesity [11]. BMI measurement is a simple and inexpensive method for screening for obesity and other weight disorders [12]. Until recently, early detection of diabetes mellitus was still not widely done in Indonesia, especially in the student population. Therefore, we aimed to measure BMI and random plasma glucose in Indonesian students.

Methods

This descriptive study involving 8th and 9th grade students at Alif Laam Miim Islamic Boarding School Surabaya aged 13 - 18 years old. This study was approved by the Faculty of Medicine Health Research and Ethics Committee with ethical clearance number 139/EC/KEPK/FKUA/2022. Informed consent was already obtained from the subject's guardians. Height and weight were measured using standard anthropometry done by healthcare professionals. Height was measured to the nearest 0.1 cm using a wall-mounted tape measure (Onemed) while body weight was measured to the nearest 0.1 kg (Onemed). Capillary blood samples were taken on the index or middle finger of the student using a single-use lancet to measure random plasma glucose (*ACCU CHECK).* Students who refused to have their height, weight, and random plasma glucose measured were excluded from this study.

Body Mass Index (BMI) was calculated by dividing weight in kilograms with the square of height in meters. BMI was categorized for underweight (<5th percentile), healthy weight (5th percentile - <85th percentile), overweight (>85th percentile - <95th percentile), and obesity (≥95th percentile) based on the BMI-for-age percentile growth charts [12]. Random plasma Glucose was categorized by normal (<200

mg/dL) and high (≥200 mg/dL) [13]. Data was entered in and statistical analysis was performed using SPSS version 17 with p-value < 0.05 was considered as statistically significant. The variables were expressed as mean ± standard deviation and frequency (percentage). Difference variable in numeric data between male and female was analyzed using T-test or Mann-Whitney U test based on the Kolmogorov-Smirnov normality test. Meanwhile, categoric data was analyzed with Chi-square or Fisher-exact to compare frequencies.

Result

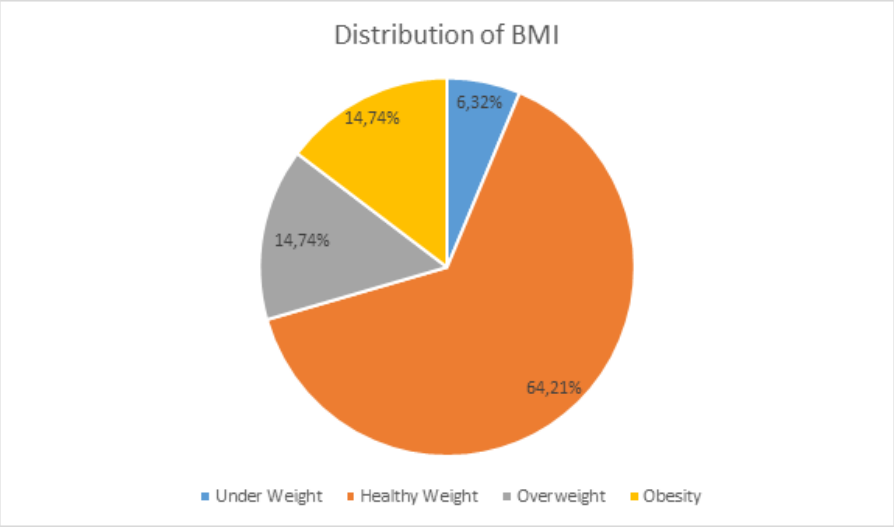
This study enrolled 95 students in Surabaya. The demographic characteristics of subjects are shown in Table 1. The mean age of the subject is 14.65 ± 1.83 years old. There is no significant difference of BMI (p = 0.63) and random plasma glucose (p = 0.09) between males and females. BMI was further classified into four categories based on the CDC criteria [12]. The distribution of the BMI based on the categories can be seen in Figure 1. From 95 students, none of them had a high range of random plasma glucose that can be seen in Table 3.

Table 1. Demographic Characteristics of Samples

Characteristic	**All (n = 95)**	**Males (n = 42)**	**Females (n = 53)**	**p-value**
Age (years)	14.65 ± 1.83	14.80 ± 1.06	14.79 ± 1.04	0.96
Anthropometry				
Height (m)	1.57 ± 0.08	1.64 ± 0.05	1.52 ± 0.07	0.00*
Weight (kg)	56.03 ± 13.06	60.80 ± 14.78	52.33 ± 10.0	0.00*
Body mass index (kg/m^2)	22.60 ± 4.57	22.48 ± 4.78	22.68 ± 4.47	0.63
Random plasma glucose (mg/dL)	95.10 ± 9.25	93.07 ± 10.86	96.32 ± 7.68	0.09
Parental Ethnicity				0.58
Javanese	79 (83.2)	37 (88.1)	42 (79.2)	
Madura	13 (13.7)	4 (9.5)	9 (17.0)	
Other	3 (3.2)	1 (2.4)	2 (3.8)	
History of family with DM*				0.55
Yes	16 (16.8)	6 (14.3)	10 (18.9)	
No	79 (83.2)	36 (85.7)	43 (81.1)	

DM, Diabetes Melitus; *, statistically significant

Figure 1. Distribution of Body Mass Index (BMI)



BMI, Body Mass Index

Table 2. Distribution of Random Plasma Glucose

Category	**Total (n)**	**Percent (%)**
Normal (<200 mg/dL)	95	100%
High (>200 mg/dL)	0	0

Discussion

This study reveals that the majority of students had a healthy BMI (64.21%) and that the proportion of students with overweight and obesity is the same (14.74%). The prevalence of overweight is approximately 18% and obesity is approximately 30.7%, which is quite low compared to previous studies conducted among university students in Indonesia [14]. Higher prevalence of obesity and overweight compared to this study also found in other countries like Boston (34% of females and 32% of

males), India (27%), Qatar (46% of males and 44% of females), and Morocco (42%) [15-18]. However, Norwegian has a lower number of children and adolescents with obesity (5.2% of males and 8.0% of females) [19]. A significantly lower prevalence of overweight and obesity in our study compared to other nations may be attributable to the fact that the study population resides in a boarding school that provides daily meals. The school also has a tight policy prohibiting kids from purchasing food from outside the school. It restricts kids' access to junk food and other unhealthy foods that may contribute to obesity. Another study with boarding school students as the population found a reduced prevalence of overweight and obesity among children and teenagers [20].

The screening program will be influenced by a number of variables, such as: 1) disease (severity, prevalence, potential pre-clinical detection, extended latency period, improved outcomes with early identification); 2) screening test (validity, reliability, ease of use, ability to detect disease pre-clinically); and 3) screening program [21]. The ADA suggests evaluating children and teenagers who are overweight and have two risk factors, such as acanthosis nigricans, hypertension, hyperlipidemia, or a first- or second-degree relative with a history of type 2 diabetes. The ADA and the American Academy of Pediatrics advise screening at-risk patients every two years beginning at age 10 or the start of puberty before age ten [22]. Elevated blood glucose levels lead to the development of problems during the lengthy pre-clinical phase of diabetes. So many healthcare guidelines now advise screening for the disease in order to detect diabetes early. The objective is to identify asymptomatic patients so that earlier treatment can have a positive effect on the disease's progression. The most probable culprits in the development of T1DM are genetic susceptibility, environmental factors, vitamin D processing, and viruses. There is no substantial evidence indicating the root cause as of yet [21].

None of the students in this study had a high range of RPG based on ADA criteria (>200 mg/dL). In our study, around 26 children had RPG 100 mg/dL and the maximum value of RPG was 123 mg/dL in one child. It contrasts with a study from

India who found that 5.3% of the obese children population in their study had an elevated RPG (>130 mg/dL) [23]. Study from Qatar also found 6% of boys and 2% of girls with elevated blood sugar (RPG ≥140 mg/dL and/or Fasting Plasma Glucose ≥ 100 mg/dL) [17]. Nevertheless, in a study with samples of the US adult population without diagnosed diabetes, a single RBG ≥100 mg/dL was found strongly associated with undiagnosed diabetes and was the single strongest predictor of undiagnosed diabetes outperforming other risk factors [24]. International Diabetes Federation (IDF) also recommends that individuals with RPG value 100 - 199 mg/dL should undergo a formal diabetes testing [8]. Until now, the recommended screening and diagnostic tools for prediabetes and diabetes are Fasting Plasma Glucose (FPG), Oral Glucose Tolerance Test (OGTT) and HbA1c [13]. In actual practice, however, most practitioners employ RPG as a screening tool because it may be performed and prescribed on the same day as the patient's visit [25, 26]

To the best of our knowledge, this is the first study in Indonesia that shows a distribution of BMI and RPG as early detection of DM in children and adolescents. Nevertheless, this study had several limitations: first, a small amount of population size was used in this study; second, even though BMI was the easiest way to use for screening obesity, it can't measure total amount of body fat in the body directly; third, this study uses RPG as a screening test of dysglycemia instead of FPG, OGTT, or HbA1c.

Conclusion

Our study showed that most adolescents in a boarding school in Surabaya had a healthy weight and a normal range of plasma glucose. However, it's important to continuously do BMI and glucose screening as an early detection of DM, especially in overweight and obesity adolescents. Further studies with more complete and bigger data are needed to make a better analysis between BMI and RPG as an early detection of DM.

References

1. American Diabetes Association (ADA). (2012). Classification and Diagnosis of Diabetes: Standards of Medical Care in Diabetes. *Diabetes care*, *43*(1), S14-S31. doi: 10.2337/dc20-S002.
2. Craig, M. E., Jefferies, C., Dabalea, D., Balde, N., Seth, A., Donaghue K.C. (2014). Definition, epidemiology, and classification of diabetes in children and adolescents. *Pediatric Diabetes*, *15*(S20), 4–17. doi:10.1111/PEDI.12186.
3. Tan S.Y., Mei Wong J.L., Sim Y.J., Wong S.S., Mohamed Elhassan S.A., Tan S.H., *et al*. (2018). Type 1 and 2 diabetes mellitus: A review on current treatment approach and gene therapy as potential intervention. *Diabetes & Metab Syndr, 13*(1), 364-372. *doi*: 10.1016/j.dsx.2018.10.008.
4. Botero, D., & Wolfsdorf, J.I. (2005). Diabetes mellitus in children and adolescents. *Archives of Medical Research*, *36*(3), 281–290. doi: 10.1016/J.ARCMED.2004.12.002.
5. Koren, D., & Evotsky, L.L. (2021). Type 2 Diabetes Mellitus in Childhood and Adolescence. *Pediatrics in Review, 42*(4), 167-179. doi: 10.1542/pir.2019-0236
6. Dileepan, K., & Max Feldt, M. (2013) Type 2 Diabetes Mellitus in Children and Adolescents, *Pediatrics in Review*, *34*(12), 541–548. doi: 10.1542/PIR.34-12-541.
7. Pulungan, A.B., Fadiana, G., & Annisa, D. (2021). Type 1 Diabetes Mellitus in Children: Experience in Indonesia. *Clinical Pediatric Endocrinology, 30*(1), 11-18. doi: 10.1297/cpe.30.11
8. International Diabetes Federation (IDF). (2012). Global Guideline for Type 2 Diabetes. Belgium: IDF.
9. Badan Pusat Statistik (BPS) Indonesia. (2013). Statistik Indonesia 2011. Jakarta: BPS

10. Pramono, A., *et al.* (2014). Kontribusi Makanan Jajan dan Aktivitas Fisik terhadap Kejadian Obesitas pada Remaja di Kota Semarang. *Gizi Indonesia, 37*(2), 129–136. doi: 10.36457/GIZINDO.V37I2.158.
11. Behera, A.A., Behera B.K., Dash, S., & Mishra, S. (2014). Effect of body mass index on gender difference in lung functions in Indian population. *Int J Clin Exp Physiol, 1*(3),229-231.
12. Centre for Disease Control (CDC) (2021). About Child and Teen BMI. accessed on: https://www.cdc.gov/healthyweight/assessing/bmi/childrens_bmi/about_childrens_bmi.html
13. American Diabetes Association (ADA). (2020). Classification and Diagnosis of Diabetes: Standards of Medical Care in Diabetes-2020. *Diabetes Care, 43*(Supp1), 14-31. Doi: 10.2337/dc20-S002
14. Oktariza, R.T., Kalanjati, V.P., & Tirthaningsing, N.W. (2021). Body Mass Index, Waist-Hip Ratio and Fasting Glucose amongst the University Students. *Fol Med Indones*, *57*(1), 53-57. Doi: 10.20473/fmi.v57i1.14661
15. Field, A.E., Cook, N. R., Gilman, M.W. (2005). Weight Status in Childhood as a Predictor of Becoming Overweight or Hypertensive in Early Adulthood. *Obes Res*, *13*(1), 163-169. Doi: 10.1038/oby.2005.21
16. Khadilkar, V.V., Khadilkar, A.V., Cole, T.J., Chiplonkar, S.A., & Pandit, D. (2011). Overweight and Obesity Prevalence and Body Mass Index Trends in Indian Children. *Int J Pediatr Obes, 6*(2-2), 2016-224. Doi: 10.3109/17477166.2010.541463.
17. Mamtani, R., Lowenfels, A.B., Sheikh. J., Cheema D., Al-Hamaq A., Matthis, S.A., *et al.* (2014). Adolescent prediabetes in a high-risk Middle East Country: a cross-sectional study. *JRSM Open, 5*(8), 1-5. Doi: 10.1177/2054270414536550
18. Mehdad, S., Hamrani, A., Kari, K.E., Hamdouchi, A.E., Barakat A., Mzibri M.E., *et al*. (2012). Body Mass Index, Waist Ciurcumferenece, Body Fat, Fasting Blood Glucose in a Sample of Moroccan Adolescents Aged 11-17 Years. *J Nutr Metab,* 510458. Doi: 10.1155/2012/510458

19. Bjorge, T., Engeland, A., Tversal, A., Smith, G.D. (2008). Body Mass Index in Adolescence in Relation to Cause-specific Mortality: A Follow Up of 230.000 Norwegian Adolescents. *American Journal of Epidemiology*, *168*(1), 30-37. Doi: 10.1093/aje/kwn096
20. Kola-Raji, B.A., Balogun, M.R., & Odugbemi, T.O. (2017). A comparative study of nutritional status of adolescents from selected private and public boarding secondary schools in Ibadan, South Western Nigeria. *Journal of Medicine in the Tropics*, *19* (1), 49-55. Doi: 19. 49. 10.4103/jomt.jomt_43_16.
21. Peer, N., Balakrishna, Y., & Durao, S. (2020). Screening for type 2 diabetes mellitus. *Cochrane Database of Systematic Reviews*, *5*. https://doi.org/10.1002/14651858.CD005266.pub2
22. Pippit, K., Li, M., & Gurgle, H.E. (2016). Diabetes Mellitus: Screening and Diagnosis. *American Family Physician, 93* (2), 103-109
23. Khadilkar, A.V., Lohiya, N., Mistry, S., Chiplonkar, S., Khadilkar, V., Kajale, N., *et al*. (2019). Random Blood Glucose Concentrations and their Association with Body Mass Index in Indian School Children. *Indian Journal of Endocrinology and Metabolism, 23*(5), 529-535. Doi: 10.4103/ijem.IJEM_536_19
24. Bowen, M.E., Xuan, L., Lingvay, I., Halm, E.A. (2015). Random Blood Glucose: A Robust Risk Factor for Type 2 Diabetes. *J Clin Endocrinol Metab, 100*(4), 1503-1510. Doi: 10.1210/jc.2014-4116
25. Lee, J.M., Gebremariam, A., Wu, E.L., LaRose, J., Gurney, J.G. (2011). Evaluation of Nonfasting Tests to Screen for Childhood and Adolescent Dysglycemia. *Diabetes Care, 34*(12), 2597-2602. Doi: 10.2337/dc11-0827
26. Saudek, C.D., Herman, W.H., Sacks, D.B., Bergenstal, R.M., Edelman, D.M., Davidson, M.B. (2008). A New Look at Screening and Diagnosing Diabetes Mellitus. *J Clin Endocrinol Metab, 93*(7):2447-2453. Doi: 10.1210/jc.2007-2174

Editor IJSCIA <ijsciaeditor@gmail.com>
kepada saya

Inggris > Indonesia Terjemahkan pesan

Dear author,

Payment received.
We will process your revised manuscript for publication and duly inform you once it is published.

Best regards

Dear author,

Your article is now published online!
You may find the published article on the journal's website *Or* via this link: Distribution of Body Mass Index and Random Plasma Glucose as Early Detection of Diabetes Mellitus in Indonesian Students

The DOI will become active shortly within the next 30 days.

Authors are encouraged to share their articles in the public domain.

Thank you and warm regards

Editor-in-Chief
International Journal of Scientific Advances (IJSCIA)