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THE IMPLEMENTATION OF ADA SCREENING TOOLS TO DETERMINE THE BLOOD SUGAR TEST FLOW IN POSYANDU LANSIA

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ABSTRACT

Introduction: The high incidence of undiagnosed diabetes may increase the incidence of T2DM. Therefore, prediabetes screening activities are needed to detect prediabetes cases early to prevent them from developing into T2DM.

Methods*:* A descriptive research analysis with a cross-sectional approach was conducted in Posyandu Lansia in the area of Sumbersari Health Centre, Jember. The population of this study was all people who visited the Sumbersari Health Centre aged 40 years and over. The number of samples obtained as many as 246 with the sampling technique is systematic random sampling. The Data processing was done descriptively and using the ROC (Receiver Operating Characteristic) test to see the results of the diagnostic test of the ADA Diabetes Risk Test instrument at the Sumbersari Health Centre with a random blood sugar test comparison.

Results: From a total of 246 subjects, 159 had prediabetes. The sensitivity value at cut point 5 of 66% and specificity of 36% with a PPV value of 38% and NPV of 64%. While at the optimal cut-off point of 4, the sensitivity value is 90%, and the specificity value is 22%, with a PPV value of 40% and NPV of 77%. Moreover, the ROC curve has an AUC value that is statistically considered less effective, with a value of 56%.

Conclusion: ADA Diabetes Risk Test shows promising results for prediabetes screening in the Sumbersari population with high sensitivity for determining disease.

Keywords: *ADA Diabetes Risk Test, Diabetes Mellitus Type 2, Prediabetes*

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INTRODUCTION

Diabetes is one of the health problems that is often found in various countries in the world, including Indonesia. Diabetes mellitus cases globally increased from 463 million in 2019 to 537 million cases in 2021, with a prevalence of 10.5% and a death toll of 6.7 million cases, and it is expected to continue to increase yearly (International Diabetes Association, 2021). Indonesia is ranked 7th globally, with 12 million reported cases as of 2019 (Kementerian Kesehatan RI, 2018). East Java Province is among the top five provinces with the highest T2DM cases in Indonesia, with a prevalence of 2.6% as of 2018. T2DM cases in Jember Regency were reported to have 35,951 cases (Dinkes Jatim, 2021). The highest case of T2DM in the Jember Regency is in the Sumbersari Health Centre working area, with 5172 cases as of 2022. However, it should be noted that based on data from Infodatin Diabetes 2020, only 25% of people with diabetes in Indonesia know that they have diabetes (Kementrian Kesehatan RI, 2020), while other studies reveal that more than 1 in 2 people with diabetes live without knowing that they have diabetes (IDF, 2021).

The number of undiagnosed diabetes cases in Indonesia as of 2021 is 14.3 million, with a proportion of 73.7%. This data shows that the case of diabetes discovery in Indonesia is still low. Undiagnosed diabetes can increase the risk of complications. Screening tests identify individuals in a population, whether healthy or at high risk, so early treatment or prevention of disease onset can be carried out (WHO, 2020). Several prediabetes screening tests worldwide include the Australian Type 2 Diabetes Risk Assessment Tool, The Cambridge Risk Score, The Diabetes Algorithm, the Leicester Risk Assessment,

and the American Diabetes Association (ADA) Diabetes Risk Test.

The ADA Diabetes Risk Test is a diabetes screening tool recommended by the ADA since 2019 to be used as an early stage to determine the risk in cases of type 2 diabetes (American Diabetes Association, 2021). Previous research suggests that the ADA Diabetes Risk Test can diagnose diabetes with a sensitivity rate of 88% at a cut-off value 5 (Bang, 2009). The T2DM screening test system conducted in asymptomatic individuals is based on risk factors, including high-risk age, especially 40 years and above, family history of type 2 diabetes, lack of physical activity, history of gestational diabetes, heredity, and BMI category (Johns Hopkins Medicine, 2022). The risk factors used as a reference for T2DM screening are based on the dominant risk factors that cause T2DM and the triggering events of prediabetes. Screening tests that refer to risk factors can be used as a reference for prevention, considering that undiagnosed cases of T2DM in Indonesia are still very high.

Based on the above description, applying the ADA Screening Risk Test to find and prevent T2DM cases can help reduce the number of cases increasing yearly. Screening based on risk factors can capture more targets than a doctor's clinical diagnosis

METHOD

We conducted a two-month descriptive study in April and May 2023. The study included high-risk groups aged 40 years or older visiting Sumbersari Health Centre and Posbindu Lansia in the area of Sumbersari Health Centre. The exclusion criteria for this study were people with a T2DM history. The screening tool used in this study was the ADA Diabetes Risk Test questionnaire. In the same way, we used Random Glucose Blood Test (RGB) as the comparison.

Additionally, all participants provided informed consent before being enrolled in the study. Approval was granted by the Ethics Committee of the Faculty of Public Health, University of Jember (No.301/KEPK/FKM-UNEJ/II/2023, approval date: February 10, 2023). The total population of this study was 680 people. Meanwhile, the sample was 246 people with a sampling technique using systematic random sampling.

The ADA Diabetes Risk Test records the subject's age, gender, family history of T2DM, hypertension history, gestational diabetes history for women, physical activity category, and body mass index (BMI). Moreover, the diabetes risk data was collected in Bahasa Indonesia. The history of hypertension was asked using the "Did you ever experience high blood levels?" question. In contrast, the physical activity was asked using the "Do you think you are active at physical activity in a day or a week?" question. Body mass index (BMI) was measured by weight and height. For the standard of BMI, we used Indeks Massa Tubuh (IMT) for Indonesian people.

The Random Glucose Blood Test (RGB) was measured by trained laboratory staff. RGB Test was measured from all subjects after assessing their diabetes risk. RGB Test was chosen as a comparison instrument due to its ease to use with quick results. The samples of RGB were taken using the Sinoheart Safe Accu device (Kemenkes RI AKL 20101125337). The RGB level of the prediabetes category was ≥140 g/dL.

The data were analyzed using the SPSS 22.0 statistical software to assess the prevalence of prediabetes. The Receiver operating characteristic (ROC) analysis was used to determine the cut-off point of the diagnostic test. The validity (sensitivity and specificity), the Positive Predictive Value (PPV), and Negative Predictive Value (NPV) were calculated to assess the comparative value of the diabetes screening test.

RESULTS

The risk factors of T2DM are presented in Table 1. Based on age, the highest results were 60 years (89,7%). In gender, the male has higher prediabetes than women, with a percentage of 80,1%. For gestational diabetes, there was no found in the entire sample. The findings of prediabetes on family history of T2DM have a higher percentage than those without a family history of T2DM (73,3%).

On the other hand, the sample with a history of hypertension has a high rate of prediabetes (81,1%). Individuals who were not physically active with prediabetes were 81.3%. Meanwhile, prediabetes in the body mass index (BMI) category was high in obesity (97.8%).

Table 1
Respondent characteristics based on the risk factors of prediabetes

Respondent Characteristic	n	Normal	%	Pre diabetes	%
Age					
40-49	63	46	73	17	27,0
50-59	86	31	36,0	55	62,0
60 and older	97	10	10,3	87	89,7
Gender					
Female	158	70	44,3	88	55,7
Male	88	17	19,3	71	80,1
Diabetes Gestational History					
No	158	158	100	0	0
Yes	0	0	0	0	0
T2DM Family History					
No	170	67	39,4	103	60,6
Yes	76	20	26,3	56	73,7
Hypertension History					
No	140	67	47,9	73	52,1
Yes	106	20	18,9	86	81,1

Respondent Characteristic	n	Normal	%	Pre diabetes	%
Physical Activity Category					
No	108	21	19,4	87	80,6
Yes	138	66	47,8	72	52,2
IMT Category					
Thin	13	12	92,3	1	7,7
Normal	140	66	47,1	74	52,9
Overweight	47	8	17,0	39	83,0
Obese	46	1	2,2	45	97,8

Table 2 presents diagnostic test results. The area under the ROC curve was 0.56. Considering the validity grade test followed the recommended cut points for sensitivity and specificity as well as AUC, 'poor' or no discrimination, sensitivity or specificity 0.5, 0.7 to 0.8 is considered acceptable, 0.8 to 0.9 is considered excellent, and more than 0.9 is considered outstanding. In this study, the AUC value is poor or not statistically suitable for the Sumbersari populations. This study findings the level of sensitivity on cut-off point 5 was 66%, and the specificity was 36%, with PPV 0.38 and NPV 0.63.

Table 2
Diagnostic test results of the ADA Diabetes Risk Test

Cut Off	Risk	Pre-diabetes	Normal	Sensitivity	Specificity	PPV	NPV
>5	Pre-diabetes	61	98	0,663	0,359	0,383	0,639
	Normal	31	55				
>4	Pre-diabetes	82	119	0,891	0,222	0,407	0,772
	Normal	10	34				

Moreover, the group study's cases of prediabetes were 159 (64,6%). However, the level of sensitivity on cut-off point 4 was higher than 5. The sensitivity level was 89%, and the specificity was 22%, with PPV 0.40 and NPV 0.77. The case findings of prediabetes when cut-off point 4 were 201 (82.0%)

DISCUSSION

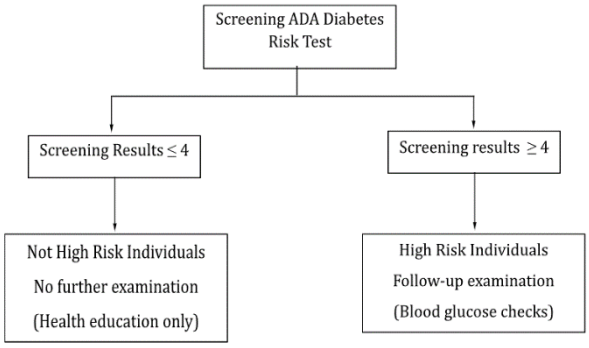
Referring to the ADA screening tool, there are seven risk factors for prediabetes: age, gender, history of gestational diabetes, family history of T2DM, hypertension history, physical activity category, and BMI category. Each risk factor has a different percentage. First is age; in this research, we found that the older subject, the higher the percentage of prediabetes. The condition is influenced by the ageing process that occurs in the body. Ageing can affect the cellular and molecular conditions of the body. According to Bellary et al., ageing contributes to the pathogenesis of T2DM directly through the decreased β-cell function that accentuates the lack of insulin secretion (Bellary, Kyrou, Brown, & Bailey, 2021). In line with research by Akhtar et al., those aged 60 years and above have a 10-fold risk of experiencing prediabetes compared to the young (Akhtar et al., 2022). The second risk factor is gender. The highest percentage for gender was in the male. Differences in biological conditions such as fat distribution and hormonal may support finding prediabetes cases in men. In addition, lifestyles such as cigarette consumption can also affect high blood sugar (Siddiqui, Zainal, Harun, Sheikh Ghadzi, & Ghafoor, 2020). Another study explained that besides being caused by different lifestyles, fat accumulation in men in the abdomen (visceral fat) is a primary risk factor for prediabetes and T2DM (Nordström, Hadrévi, Olsson, Franks, & Nordström, 2016). Fat accumulation in the body is known to increase the appearance of inflammation in the body and (low-grade inflammation) excessive release of TNF-α which can lead to insulin resistance (Fu, R. Gilbert, & Liu, 2012). Thirdly, is a diabetes gestational history in women. During the study, we did not find any cases of gestational diabetes. A possible reason for this is the low rate of complete sugar screening among pregnant women in the study area.

Moreover, another risk factor is the genetic history of T2DM. A total of 73,1%samples with a history of T2DM tested positive for prediabetes. This condition is related to the inheritance of genes that affect the function of cells on insulin secretion in the body. The estimated risk of T2DM from heredity ranges from 40%-70% (Goodarzi & Rotter, 2020). Individuals with a history of T2DM from one parent (father or mother) have a 40% risk. If both parents are T2DM sufferers, the risk percentage rises to 70%. At the same time, we found that people with a history of hypertension have a higher percentage than those without. Hypertension can affect the body's insulin sensitivity by overexpressing RAAS (*rennin-angiotensin-aldosterone system*) (Przezak, Bielka, & Pawlik, 2022). This failure can trigger cell imbalance, and it can lead to T2DM. The similarities in risk factors between hypertension and T2DM, such as insulin resistance, heredity, dyslipidemia, and obesity, make these two types of diseases interrelated (Petrie, Guzik, & Touyz, 2018).

Hence, 80.3% of samples who were not physically active were at risk of prediabetes. The reference standard for physical activity refers to the Indonesian Ministry of Health with a minimum of 30 minutes/day. Lack of physical activity can reduce blood glucose metabolism. So that the implementation of routine physical activities can increase glucose metabolism in the blood, thereby increasing insulin sensitivity (Amanat, Ghahri, Dianatinasab, Fararouei, & Dianatinasab, 2020). Lastly, the prediabetes risk factor is the BMI category. The BMI category was found to be high for obesity. Research conducted by Soans, obese individuals are estimated to be ten times more likely to develop T2DM than healthy individuals (Soans, 2020). Excess weight conditions can disrupt the function of triglyceride secretion in the pancreas and increase

the weight of fatty tissue, resulting in pro-inflammatory cytokines and insulin abnormalities (Klein, Gastaldelli, Yki-Järvinen, & Scherer, 2022). Obesity can also increase the secretion of the release of NEFAs (Nonesterified Fatty Acids) which can affect insulin sensitivity in the body (Al-Goblan, Al-Alfi, & Khan, 2014).

Our study showed that the sensitivity level is higher than the instrument's specificity level. The sensitivity value is 66%, and the specificity is 36%. The PPV value of 38%, and the NPV was 63%. With the optimal cut-off of 5, the prevalence of prediabetes was 159 (64,6%). Research conducted by Scanlan et al. showed similar results where the instrument's sensitivity level (77.8%) has a higher value than its specificity (41.7%) (Scanlan, Maia, Perez, Homko, & O'Brien, 2018). Comparable, if the cut-off point value is changed to 4, the sensitivity rate increases to 90% and the specificity to 22%. The PPV value was 41%, and the NPV was 77%. Lowering the cut-off point to 4 will increase the number of prediabetes cases to 201 cases (82%). Increasing sensitivity is chosen based on implementing the ADA Diabetes Risk Test screening to find truly sick cases among the asymptomatic population (Wareham & Griffin, 2001)



Figures 1. Screening ADA Diabetes Risk Test Flow

The high NPV value associated with the level of sensitivity is related to conditions where most diseases do not show symptoms. Treatment should be done as early as possible to avoid more severe conditions (Trevethan, 2017). Due to the high sensitivity and NPV of the ADA Diabetes Risk Test on cut-off point 4, the prediabetes screening test on Sumbersari Health Centre should use cut-off point 4 and then the optimal cut-off point 5. Figure 1 explains the flow of screening prediabetes. Individuals with a screening score of ≤ 4 can be categorized as non-risk individuals. Individuals who are not at risk will not be screened further but are still advised to be educated and understand the risks of T2DM. Individuals with screening scores≥ 4, categorized as at-risk, will be subjected to follow-up checks such as systematic random blood sugar collection at Posbindu Lansia or other blood glucose checks. The grouping of screening results can help detect prediabetes more quickly and easily. In addition, the screening check flow can also be time-efficient and reduce the number of tools used.

CONCLUSION

The ADA Diabetes Risk Test shows promising results as a diabetes screening tool in the Sumbersari population. By using the ADA Diabetes risk test instrument in elderly posyandu activities, it is expected to accelerate the discovery of prediabetes cases.

REFERENCES

Akhtar, S., Nasir, J. A., Ali, A., Asghar, M., Majeed, R., & Sarwar, A. (2022). Prevalence of type-2 diabetes and prediabetes in Malaysia: A systematic review and meta-analysis. *PLoS ONE*, *17*(January 1), 1–14. https://doi.org/10.1371/journal.pone.0263139

Al-Goblan, A. S., Al-Alfi, M. A., & Khan, M. Z. (2014). Mechanism linking diabetes mellitus and obesity. *Diabetes, Metabolic Syndrome and Obesity*, *7*, 587–591. https://doi.org/10.2147/DMSO.S67400

Amanat, S., Ghahri, S., Dianatinasab, A., Fararouei, M., & Dianatinasab, M. (2020). Exercise and Type 2 Diabetes. *Advances in Experimental Medicine and Biology*, *1228*, 91–105. https://doi.org/10.1007/978-981-15-1792-1_6

American Diabetes Association. (2021). 2. Classification and diagnosis of diabetes: Standards of medical care in diabetes-2021. *Diabetes Care*, *44*(January), S15–S33. https://doi.org/10.2337/dc21-S002

Bang, H. (2009). Development and Validation of a Patient Self-assessment Score for Diabetes Risk. *Annals of Internal Medicine*, *151*(11), 775. https://doi.org/10.7326/0003-4819-151-11-200912010-00005

Bellary, S., Kyrou, I., Brown, J. E., & Bailey, C. J. (2021). Type 2 diabetes mellitus in older adults: clinical considerations and management. *Nature Reviews Endocrinology*, *17*(9), 534–548. https://doi.org/10.1038/s41574-021-00512-2

Dinkes Jatim. (2021). *Profil Kesehatan Dinas Kesehatan Provinsi Jawa Timur 2021* (Dinas Kesehatan Provinsi Jawa Timur, Ed.). Surabaya.

Fu, Z., R. Gilbert, E., & Liu, D. (2012). Regulation of Insulin Synthesis and Secretion and Pancreatic Beta-Cell Dysfunction in Diabetes. *Current Diabetes Reviews*, *9*(1), 25–53. https://doi.org/10.2174/15733998130104

Goodarzi, M. O., & Rotter, J. I. (2020). Genetics Insights in the Relationship between Type 2 Diabetes and Coronary Heart Disease. *Circulation Research*, *126*(11), 1526–1548. https://doi.org/10.1161/CIRCRESAHA.119.316065

IDF. (2021). IDF Diabetes Atlas. Retrieved October 9, 2022, from IDF Diabetes Atlas website: https://diabetesatlas.org/

International Diabetes Association. (2021). IDF Diabetes Atlas 10th edition. In *International Diabetes Association* (Vol. 10). https://doi.org/10.1016/j.diabres.2013.10.013

Johns Hopkins Medicine. (2022). Screening Tests for Common Diseases. Retrieved October 13, 2022, from Johns Hopkins Medicine website: https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/screening-tests-for-common-diseases

Kementerian Kesehatan RI. (2018). *Laporan Nasional RISKESDAS 2018*. Jakarta.

Kementrian Kesehatan RI. (2020). *Infodatin 2020 Diabetes Melitus*.

Klein, S., Gastaldelli, A., Yki-Järvinen, H., & Scherer, P. E. (2022). Why does obesity cause diabetes? *Cell Metabolism*, *34*(1), 11–20. https://doi.org/10.1016/j.cmet.2021.12.012

Nordström, A., Hadrévi, J., Olsson, T., Franks, P. W., & Nordström, P. (2016). Higher prevalence of type 2 diabetes in men than in women is associated with differences in visceral fat mass. *Journal of Clinical Endocrinology and Metabolism*, *101*(10), 3740–3746. https://doi.org/10.1210/jc.2016-1915

Petrie, J. R., Guzik, T. J., & Touyz, R. M. (2018). Diabetes, Hypertension, and Cardiovascular Disease: Clinical Insights and Vascular Mechanisms. *Canadian Journal of Cardiology*, *34*(5), 575–584. https://doi.org/10.1016/j.cjca.2017.12.005

Przezak, A., Bielka, W., & Pawlik, A. (2022). Hypertension and Type 2 Diabetes—The Novel Treatment Possibilities. *International Journal of Molecular Sciences*, *23*(12). https://doi.org/10.3390/ijms23126500

Scanlan, A. B., Maia, C. M., Perez, A., Homko, C. J., & O'Brien, M. J. (2018). Diabetes risk assessment in Latinas: Effectiveness of a brief diabetes risk questionnaire for detecting prediabetes in a community-based sample. *Diabetes Spectrum*, *31*(1), 31–36. https://doi.org/10.2337/ds16-0051

Siddiqui, S., Zainal, H., Harun, S. N., Sheikh Ghadzi, S. M., & Ghafoor, S. (2020). Gender differences in the modifiable risk factors associated with the presence of prediabetes: A systematic review. *Diabetes and Metabolic Syndrome: Clinical Research and Reviews*, *14*(5), 1243–1252. https://doi.org/10.1016/j.dsx.2020.06.069

Soans, R. (2020). How Obesity and Diabetes Are Linked. Retrieved April 30, 2023, from Temple University Health System website: https://www.templehealth.org/about/blog/how-obesity-diabetes-are-linked

Trevethan, R. (2017). Sensitivity, Specificity, and Predictive Values: Foundations, Pliabilities, and Pitfalls in Research and Practice. *Frontiers in Public Health*, *5*(November), 1–7. https://doi.org/10.3389/fpubh.2017.00307

Wareham, N. J., & Griffin, S. J. (2001). Should we screen for type 2 diabetes? Evaluation against national screening committee criteria. *British Medical Journal*, *322*(7292), 986–988. https://doi.org/10.1136/bmj.322.7292.986

WHO. (2020). Screening programmes: a short guide. *WHO Press*, *1*, 1–70. Retrieved from https://apps.who.int/iris/bitstream/handle/10665/330829/9789289054782-eng.pdf