Determinant of Diabetes Mellitus Focusing on Differences of Indonesian Culture: Case Studies in the Java and Outer Java Region in Indonesia

Oktia W. K. Handayani¹*, Efa Nugroho¹ and Bertakalswa Hermawati¹

¹ Department of Public Health, Semarang State University, Semarang, Indonesia

Abstract:
Background: In 2017, Indonesia was ranked 6th in the world, with 10.3 million DM sufferers. Indonesia consists of many islands with diverse communities, diverse social and cultural environments, which allow different factors to affect the increasing number of DM cases.

Objective: This research objective is to analyze the differences in the factors of the social environment, cultural environment, knowledge and behavior that are potential to DM in Java and outside Java.

Methods: This research uses a quantitative approach with independent sample t-test data analysis techniques. The population was DM type 2 patients, with a sample size of 294 people. The technique was to determine the sample by accidental sampling in patients who seek treatment during prolanis (chronical disease management program) activities. The independent variables consist of social environment, cultural environment, knowledge and behavior. The dependent variable is DM disease. Data is equipped with qualitative data.

Results: The results showed that there were differences between Javanese and Outer Java respondents on social environmental factors (t value 6.682), cultural environment (t value 5.752), knowledge (t value 7.079) and behavior (t value 16.579) with each Sig 0.000 value. All factors that are variables in this study have higher values in the Java region compared to those outside Java, and the highest difference is in the social environment variable (average difference of 3,979), which has an effect on very high behavioral differences (average differences average 6,037).

Conclusion: It can be concluded that there are differences in the social environment, cultural environment, knowledge, and behavior that influence the incidence of diabetes mellitus in Indonesian society.

Keywords: Diabetes Mellitus, Social culture, Behavior, Island, Lifestyle, Cultural environment, Knowledge.

1. INTRODUCTION
Diabetes Mellitus (DM) is considered as a non-communicable disease and is also a metabolic disease characterized by chronic hyperglycemia due to impaired insulin secretion, insulin performance or both [1 - 5]. DM patients cannot absorb glucose properly, so glucose builds up in the blood and causes hyperglycemia. The number of DM patients is increasing every year, in 2017, DM patients in the world reached 425 million and it is estimated that in 2045 it will reach 629 million [6 - 9]. The world health agency predicted an increase in the number of people with DM in Indonesia, from 8.4 million in 2000 to around 21.3 million in 2030 [10 - 13]. In 2017, Indonesia also ranked 6th in the world, with 10.3 million sufferers, and 73.7% of people with DM in Indonesia do not realize they have DM [6, 14]. Most cases of DM in the world are DM type 2 [15, 16], which is DM that occurs because the amount of insulin produced is likely to be normal or decreased and there is a decrease in tissue sensitivity in responding to insulin. The cause of this type 2 diabetes is a lifestyle, especially food consumption and lack of physical activity [2].

DOI: 10.2174/1874944502013010323, 2020, 13, 323-340
Diabetes is a major cause of blindness, heart attacks, stroke, kidney failure and amputations [17 - 19]. While diabetes and complications are the third leading cause of death in Indonesia [20, 21]. In 2013, DM caused one of the biggest health expenditure expenses in the world, which was around 11% of total health expenditure [22, 23]. From 2010 to 2030, losses from Gross Domestic Products worldwide due to DM are estimated at around 1.7 trillion dollars [24 - 27]. DM is ten years faster in the Southeast Asian Region than in people from the European region, and mostly occurs at productive ages. The large medical expenses result in economic pressures and family financial burdens, thereby increasing the severity of symptoms and grievance in people with diabetes [28, 29].

Modifiable risk factors for diabetes are closely related to unhealthy behavior, namely overweight [30 - 34], abdominal obesity [35 - 40], lack of physical activity [41 - 45], unhealthy diet [46 - 50] and smoking [50, 51], which can arise due to lack of knowledge, social environment, and cultural environment [52 - 61].

The novelty of this study begins with the thought that Indonesia, which is made up of many islands with diverse communities and diverse social and cultural environments, allows different factors to influence the increasing number of DM cases. As illustrated in the picture of the top 10 regions with the most DM cases in Indonesia in 2013, where 4 areas were in Java and 6 other regions were outside Java. The results of a study stated that various socio-cultural and psychosocial problems are factors that play an important role in the incidence of diabetes and cause diabetes treatment to be ineffective [62, 63]. The results of this research are also considered to be related to interventions that manage to reduce DM cases in various regions. This research objective is to analyze the differences in the factors of the social environment, cultural environment, knowledge, and behavior that are potential to DM in Java and outside Java.

2. METHODS

The research was conducted in Semarang for Java and in Gorontalo for outside Java, based on the top 10 regions with the most DM cases in Indonesia. This research used a quantitative approach by using independent sample t-test data analysis techniques. The population was type 2 DM sufferers, the sample size was calculated by the formula given by Naing et al. [64], and a sample of at least 140 people was determined for each region, so that the total sample at the end of the research was 294 people. The technique was to determine the sample by accidental sampling in patients seeking treatment during prolanis activities at the Public Health Center (Puskesmas), so that the determined sample criteria are DM type 2 patients who come to prolanis activities, can communicate well, and are willing to be respondents in this study.

The independent variables consist of 1) social environment (in the form of relationships formed as a result of interactions between individuals and individuals or groups of people, in the form of aspects of help, mutual assistance, a sense of family and family relationships), cultural environment (in the form of habits, values, beliefs, myths that affect the incidence of DM), knowledge and behavior. The dependent variable is DM disease. The instruments used consisted of questionnaires, checklist sheets and observation sheets. The data obtained, in addition to quantitative data, also includes qualitative data. The validity and reliability test of the questionnaire was carried out on the question / statement item using the Cronbach Alpha coefficient formula, with samples in DM patients at other health centers who were not used as research samples. This study uses a quantitative approach, and because the data is normally distributed, then the data analysis is performed with an independent sample t-test.

The process of data collection was approved and permitted by the Medical and Health Research Ethics Committee (HREC) Universitas Negeri Semarang with the number 022/KEPK/EC/2019.

3. RESULTS

Semarang is located on the island of Java (with an area of 128,297 km²), while Gorontalo is located on the island of Sulawesi (with an area of 174,600 km²) which includes 5 large islands in Indonesia. Java island is an area where there is the Capital City of the Government of Indonesia, besides that, in Java, there are also 5 provinces, and Semarang is the capital of Central Java Province. Whereas Sulawesi Island has 6 provinces and Gorontalo is the capital of Gorontalo Province.

3.1. Respondents Characteristics

Characteristics of respondents in this research include age, gender, education level and income (Table 1).

Table 1. Respondents characteristics.

| Characteristics | Category | Java | Outside Java |
|-----------------|----------|------|--------------|
| Age             | 15-25 years | 0    | 37 24.7      |
| Age             | 26-35 years | 4    | 14         |
| Age             | 36-45 years | 12   | 24               |
| Age             | 46-55 years | 40   | 41 27.3       |
| Age             | 56-65 years | 59   | 20 13.3       |
| Age             | >65 years   | 29   | 7   4.7        |
| Age             | Total       | 144  | 150 100       |
### Table 2. Results of differences in variables of social environment, cultural environment, knowledge and behavior in Java and Outside Java

| Characteristics | Category                        | Java                  | Outside Java          |
|-----------------|--------------------------------|-----------------------|------------------------|
| Gender          | Male                           | 33 (22.9)             | 62 (41.3)              |
|                 | Female                         | 111 (77.1)            | 88 (58.7)              |
|                 | Total                          | 144 (100)             | 150 (100)              |
| Education level | No formal education            | 8 (5.6)               | 1 (0.7)                |
|                 | Elementary school uncompleted  | 18 (12.5)             | 0 (0)                  |
|                 | Elementary                     | 44 (30.6)             | 35 (23.3)              |
|                 | Junior High                    | 28 (19.4)             | 31 (20.7)              |
|                 | Senior High                    | 38 (26.4)             | 62 (41.3)              |
|                 | Graduate                       | 7 (4.9)               | 21 (14)                |
|                 | Post Graduate                  | 1 (0.7)               | 0 (0)                  |
|                 | Total                          | 144 (100)             | 150 (100)              |
| Family Income   | < IDR 1,000,000                | 70 (48.6)             | 95 (63.3)              |
|                 | > IDR 1,000,000 - IDR 2,000,000| 49 (34)               | 37 (24.7)              |
|                 | > IDR 2,000,000 - IDR 3,000,000| 15 (10.4)             | 12 (8)                 |
|                 | > IDR 3,000,000 - IDR 4,000,000| 3 (2.1)               | 4 (2.7)                |
|                 | > IDR 4,000,000 - IDR 5,000,000| 5 (3.5)               | 1 (0.7)                |
|                 | > IDR 6,000,000 - IDR 7,000,000| 2 (1.4)               | 0 (0)                  |
|                 | > IDR 7,000,000                | 0 (0)                 | 1 (0.7)                |
|                 | Total                          | 144 (100)             | 150 (100)              |

The characteristics based on the age of respondents in the Java region were mostly 56-65 years old (41%), and respondents outside the Java region were mostly 46-55 years old (27.3%). The characteristics based on gender in the Java region were mostly women (77.1%) and regions outside Java were mostly women (58.7%). Based on the level of education in Java, there were mostly elementary school graduates (30.6%) and those outside Java were mostly high school graduates (41.3%). Based on the income of the Javanese family, it was mostly less than IDR. 1 million (48.6%) and the regions outside Java were mostly less than IDR. 1 million (63.3%).

3.2. Differences in Social Environment Variables, Cultural Environment, Knowledge and Potential Behavior of DM in Java and Outside Java

Based on Table 2, the difference in the average value of the variable scores on respondents in Java and outside Java is 3.979 (social environment), 2.356 (cultural environment), 3.154 (knowledge), 6.037 (behavior), and based on the results of the independent t-test, we get conclusions as follows: 1) there are differences in social environment variables between Java respondents and those outside Java. 2) there are differences in cultural environment variables between Java respondents and those outside Java. 3) there are differences in knowledge variables between Java respondents and those outside Java. 4) there are differences in behavioral variables between Java respondents and those outside Java. Based on the average difference of each variable, it is known that the behavior variable has the highest average difference between Java and outside Java compared to other variables, and overall, the average value of each variable is higher in the Java area.

In this study, the results of the qualitative data obtained are:

The existing social environment in the form of: sharing
knowledge or health information from members of the community, helping one another among community members in a state of illness and needing help, a sense of caring for the circumstances of the neighbors around them. In Java, this social environment still seems strong, whereas outside Java, the community is more likely to have high ego values.

The cultural environment in the form of: eating habits with a large portion of carbohydrates, like foods with a sweet taste, lack of physical activity, cannot manage stress properly, healthy conditions do not have the highest value, trust, there is still dependence or dominance with herbs, herbal medicines.

In Java, the main carbohydrate that is the staple food is rice, while outside Java, besides rice, it also consumes cassava or corn, sometimes also sago to replace rice.

4. DISCUSSION

The social environment, cultural environment and knowledge between Java and outside Java respondents are statistically different. The existing social environment in the form of: 1) the sharing of knowledge or information from members of the community including health and diabetes related issues, 2) if there are sick people in their environment and need help, then community members will help so that health problems that occur immediately can be overcome, 3) a sense of caring in their environment, such as visiting the sick, motivating to seek treatment, because they feel they are still part of the family in the sense of living in the same area or the same RT. The environment is a factor that can suppress the emergence of DM cases. In Java, this social environment still seems strong, especially in rural or suburban areas, while outside Java, the community tends to be more independent or with a higher ego value, this causes the social environment to be the factor that has the highest difference between Java and outside Java. Deari's research results stated that there are social structures, such as family networks and church groups, very strong in Fiji that have the potential to increase understanding of changes in healthy lifestyle behavior, for the prevention of DM cases that appear to be increasing [65].

The cultural environment that has the potential for the emergence of DM cases in this research is in the form of habits, values, beliefs that will directly affect the incidence of DM. The cultural environment in the form of: 1) eating habit in large quantities with a large portion of carbohydrates and like sweetness, lack of exercise or physical activity, providing less rest time or sometimes excessive and sometimes less, and cannot manage stress properly, 2) the value associated with DM in the community has not been a concern, such as being healthy does not have the highest value, so a person does not maintain his lifestyle with healthy food and proper portion, adequate exercise, 3) trust in treatment, where the community is still dependent or dominant with herbal medicines that are known based on information from the environment and various media. In Java, the main carbohydrate source is rice which is consumed in large quantities, while outside of Java, besides rice, cassava or corn is consumed as the source, sometimes also sago. The results found that eating habits related to culture in one area were related factors in the prevention and treatment of DM type 2 [66].

Herbal medicines and similar ones (traditional herbs and treatments) for regions outside Java are of more variety. The results of research in the City of Swahili Lamu, Kenya, found that herbal medicine was an important component for the treatment of diabetes in the community. The effect of education, economic and cultural status and the possibility of health services that are not easily accessible or unreachable, is a system of mutual influence, so holistic thinking to address the increasing number of cases of DM and treatment of DM patients is an important consideration [67]. On the other hand, research in Sudan stated that there is also a belief that honey is considered by fundamentalist Muslims as a 'cure' for all diseases, including diabetes, which can adversely affect the glycemic control of diabetic patients [68].

The tradition lived will relate to culture, lifestyle and family responsibilities, which must be a very important concern in the context of treatment efforts and care for people with DM [69]. As well as the traditions exist in the regions of Java and outside Java, each with a different social and cultural environment that forms a lifestyle that has the potential for the emergence of DM cases in the community. Other research that affirms the results of this study was the high incidence of DM Type 2 in the population of Latin American society, which was likely due to a combination of genetic vulnerability factors, lifestyle and culture. Other research also confirms that interventions addressing social and cultural issues are generally more effective [70].

A research conducted by Dariush found that in people with 4 risk factors of low-risk lifestyle (physical activity, eating patterns, smoking, and drinking alcohol) had an 82% lower incidence of diabetes. When a good body mass index is added to the other 4 low-grade lifestyle factors, the incidence of DM was 89% lower. Overall, 9 out of 10 new cases of diabetes emerged due to these 5 lifestyle factors [70]. Cultural elements in the form of beliefs or cultural values are important factors that can affect the health status and the care process and the results of care for people with DM [71]. In the United States, cultural beliefs, practices, and attitudes have been demonstrated to have a vital role in diabetes Self-management Behavior (SMB) among African Americans, Asian Americans, and Mexican Americans. Studies among these populations have ascertained the effectiveness of tailoring self-care behavior to the cultural needs of the community in question [72 - 75]. People in Swahili Kenya also have a unique set of cultural beliefs and practices that play a vital role in matters related to health, illness, and well-being [67, 76]. Besides that, the differences in race, ethnicity and tradition can affect differences in health treatment and health care [77 - 79]. Although the results of other research stated that the level of education related to the knowledge is a more dominant factor related to the DM case, rather than the factor of ethnic differences [80].

Community’s knowledge can help to assess causes, risk of diabetes and motivate them to seek proper treatment and care [81]. The community’s knowledge related to DM can be affected by regions in different island conditions. In this study, respondents' knowledge was higher in the Java Island area (an average of 30.194) compared to those from outside Java (an
The result of this research gets a view that knowledge related to DM in Java and outside Java has a difference in the average value of 3.154 and the average value of knowledge is higher in the Java area. Even if we look closely at the description of the education level of respondents in areas outside Java, they have the highest percentage at the high school level (41.3%) or higher than the Java region at the elementary level (30.6%). This situation was possible because the people in Java were in the central area of government and the center of technological development, so that various information and health services were easier to obtain.

Social environment, cultural environment and knowledge are interrelated factors. All factors that are variables in this research have higher values in the Java region compared to those outside Java, and the highest difference is in the social environment variable (average difference of 3.979), which has an effect on very high behavioral differences (average differences average 6.037). The results showed that these factors are closely related to the behavior of a person who forms his lifestyle, particularly an unhealthy one, which facilitates the onset of symptoms of DM, such as lack of physical activity, unhealthy eating habit, smoking, overweight and abdominal obesity [58, 59]. Various socio-cultural and psychosocial problems are factors that play an important role in the incidence of diabetes and cause the treatment to be ineffective, which needs to be holistically understood [62, 63]. This finding is also aligned with the result of research which stated that, family support and the role of relatives are very valuable to improve medical adherence or have an important role in the curing process of the disease [28, 29, 85]. Whereas lifestyle is the main reason for the increase in diabetes cases [62, 86 - 88].

CONCLUSION

From the results of the study, it can be concluded: there are differences in the social environment, cultural environment, knowledge and behavior between Java respondents and those outside Java. Social environment, cultural environment and knowledge are factors that are interrelated with the behavior and emergence of DM cases. All factors that are variables in this study have higher values in the Java region compared to those outside Java, and the highest difference is in the social environment variable (average difference of 3.979), which has an effect on the very high behavioral difference (average difference average 6.037).

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Health Research Ethics Committee (HREC) of Semarang State University, Indonesia with document number: 022 / KEPK / EC / 2019.

HUMAN AND ANIMAL RIGHTS

No animals were used in this research. All human research procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Helsinki Declaration of 1975, as revised in 2013.

CONSENT FOR PUBLICATION

Written informed consent was obtained from all the participants prior to publication.

AVAILABILITY OF DATA AND MATERIALS

The data supporting the findings of the article is available in the SIMLITABMAS (Research and Community Service Information System) Ministry of Research, Technology, & Higher Education of the Republic of Indonesia which can be accessed at http://simlitabmas.ristekdikti.go.id/, with the document number 192 / SP2H / LT / DRPM / 2019.

FUNDING

This research received a grant from the Ministry of Research, Technology, & Higher Education of the Republic of Indonesia. Grant document number192/SP2H/LT.DRPM/2019.

CONFLICT OF INTEREST

The author declares no conflict of interest, financial or otherwise.

ACKNOWLEDGEMENTS

We thank all respondents who participated in this study and The Ministry of Research, Technology, and Higher Education of the Republic of Indonesia for financial help in this research.

REFERENCES

[1] World Health Organization. Definition, Diagnosis and Classification of Diabetes Mellitus and Its Complication. Geneva (CH): report of Who consultation. 1999.
[2] American Diabetes Association. Classification and Diagnosis of Diabetes. Diabetes Care 2016; 39(Suppl. 1): S13-22. [http://dx.doi.org/10.2337/dc16-S005] [PMID: 26696675]
[3] Shah A, Afzal M. Prevalence of diabetes and hypertension and
association with various risk factors among different Muslim populations of Manipur, India. J Diabetes Metab Disord 2017; 12(1): 52.

[4] Zenebe T, Merga H, Habte E. A community-based cross-sectional study of magnitude of dysglycemia and associated factors in Southwest Ethiopia. Int J Diabetes Dev Ctries 2019; 39(4): 749-55.

[5] Khamtana P, Meebunyan Y, Sirmannaret I. Exploring the type 2 diabetes management in the primary care setting in abstract. Open Public Health J 2019; 12: 56-60.

[6] International Diabetes Federation. IDF Diabetes Atlas. 8th ed. 2017.

[7] Cho NH, Shaw JE, Karuranga S, et al. IDF Diabetes Atlas: Global estimates of diabetes prevalence for 2017 and projections for 2045. Diabetes Res Clin Pract 2018; 138: 271-81.

[8] Pang GM, Li FX, Yan Y, et al. Herbal medicine in the treatment of patients with type 2 diabetes mellitus. Chin Med J (Engl) 2019; 132(1): 78-85.

[9] Gomes MB, Rathmann W, Charbonnel B, et al. Treatment of type 2 diabetes mellitus worldwide: Baseline patient characteristics in the global DISCOVER study. Diabetes Res Clin Pract 2019; 151: 20-32.

[10] World Health Organization. Screening For Type 2 Diabetes. Geneva (CH): Report of a World Health Organization and International Diabetes Federation Meeting.

[11] Amiruddin R, Ansar J, Sidik D. Diabetic Mellitus Type 2 in Wajo South Sulawesi, Indonesia. Int J Curr Res Acad Rev 2014; 2(12): 1-8.

[12] Kirana DN. Nutrition Intake as a Fasting Plasma Glucose Regulation Control in DMT2 Patients. KNeL Life Sciences The 1st Payung Negeri International Health Conference.

[13] Hardiman SL, Bernathus IN, Rustati PK, Susiyanti E. Waist circumference as a predictor for blood glucose levels in adults. Universa Med [Internet]. 2009; 28(2): 77-82.univmed.org/journal/index.php/medicina/article/view/232

[14] Ariffin B, Idrus LR, van Asselt ADI, et al. Health-related quality of life in Indonesian type 2 diabetes mellitus outpatients measured with the Bahasa version of EQ-5D. Qual Life Res 2019; 28(5): 1179-90.

[15] Animaw Y, Seyoum Y. Increasing prevalence of diabetes mellitus in a developing country and its related factors. PLoS One 2017; 12(11): e0187670

[16] Cannon A, Handelsman Y, Heile M, Shannon M. Burden of Illness in a developing country and its related factors. PLoS One 2017; 12(11)e0187670

[17] Lathifah NL. Hubungan Deras Pulsa darat dan Kadar Gula Darah Dengan Keluhan Subyektif Penderita Diabetes Miltius. J Berk Epidemiol 2017; 5(2): 231-9.

[18] IDF Diabetes Complications [Internet]. Available from: https://www.idf.org/aboutdiabetes/complications.html

[19] CDC. About Diabetes [Internet]. 2019. Available from: https://www.cdc.gov/diabetes/basics/diabetes.html

[20] Soewono P, Ferrari A, Tahapary DL. Challenges in diabetes management in Indonesia: A literature review. Global Health 2013; 9(1): 63.

[21] Mboi N, Murty Surbakti I, Trindadini I, et al. On the road to universal health care delivery in Indonesia, 1990-2016: A systematic analysis for the Global Burden of Disease Study 2016. Lancet 2018; 392(10147): 581-91.

[22] Alhowaish AK. Economic costs of diabetes in Saudi Arabia. J Family Community Med 2013; 20(1): 1-7.

[23] da Rocha Fernandes J, Ogurtsova K, Linnenkamp U, et al. IDF Diabetes Atlas estimates of 2014 global health expenditures on diabetes. Diabetes Res Clin Pract 2016; 117: 48-54.

[24] Tayibnainis AZ, Waryaningih LE. Unsatification patient in healthy industrial in Indonesia. Int J Human Soc Sci Invnt 2016; 5(9): 58-68.

[25] Falcionielli N, Sernani P, Brugués A, et al. Event Calculus Agent Minds Applied to Diabetes Monitoring.Lect Notes Comput Sci. 2017; 10642: pp. 258-74.

[26] Ayele BH, Shore H, Shunu A, Mengesha MM. Diagnosed and Undiagnosed Diabetes Mellitus among Urban Adults: A population based cross-sectional study. Cold Spring Harb Lab 2019.

[27] Vasu K, Esvarappa SM. Diabetes and Evolution. Curr Sci 2019; 117(9): 1403-4.

[28] Patil SD, Deshmukh JS, Patil CR. Social factors influencing diabetes mellitus in adults attending a tertiary care hospital in Nagpur: A cross sectional study. Int J Res Med Sci 2017; 5(11): 4988-92.

[29] Tol A, Sharifirad G, Shojaeazadeh D, Tavassoli E, Azadbakht L. Socio-economic factors and diabetes consequences among patients with type 2 diabetes. J Educ Health Promot 2013; 2(12): 12. [PMID: 24083262]

[30] Al-Gobalan AS, Al-Alfi MA, Khan MZ. Mechanism linking diabetes mellitus and obesity. Diabetes Metab Syndr Obes 2014; 7: 587-91.

[31] Berumen J, Orozco L, Betancourt-cravito M, et al. Influence of obesity, parental history of diabetes, and genes in type 2 diabetes: A case-control study. 2019; pp. 1-15. [PMID: 30156443]

[32] Berumen J, Orozco L, Betancourt-cravito M, et al. Influence of obesity, parental history of diabetes, and genes in type 2 diabetes: A case-control study. 2019; pp. 1-15. [PMID: 30156443]

[33] Twigg T, Risum J, Derazne E, et al. Diabetes risk among overweight and obese metabolically healthy young adults. Diabetes Care 2014; 37(11): 2989-95.

[34] Conway BN, Han X, Munro HM, et al. The obesity epidemic and rising diabetes incidence in a low-income racially diverse southern United States cohort. PLoS One 2018; 13(1):e0190993

[35] Freemantle N, Holmes J, Hockey A, Kumar S. How strong is the association between abdominal obesity and the incidence of type 2 diabetes? Int J Clin Pract 2008; 62(9): 1391-6.

[36] Min T, Stephens JW. Targeting abdominal obesity in diabetes. Diabetes Metab (Lond) 2015; 5: 301-9.

[37] Despre J, Lemieux I, Bergeron J, et al. Abdominal obesity and the metabolic syndrome: Contribution to global cardiometabolic risk.Arterioscler Thromb Vasc Biol. 2008; pp. (6):0309-49.

[38] Haffner SM. Abdominal obesity, insulin resistance, and cardiovascular risk in pre-diabetes and type 2 diabetes. Eur Heart J Suppl 2006; 8: 26-5.

[39] Premanthan M, Bauvanavongdopha H, Mahesh S, Suresh M. Original Article Correlation of abdominal adiposity with components of cardiometabolic syndrome, anthropometric parameters, and insulin resistance, in obese and non obese, diabetics and non diabetics: A cross sectional observational study. Indian J Endocrinol Metab 2014; 18(5).

[40] Mainous AG III, Tanner RJ, Jo A, Anton SD. Prevalence of prediabetes and abdominal obesity among health-weight adults: 18-year trend. Ann Fam Med 2016; 14(4): 304-10.

[41] Mohan V, Goodecke JH, Ojuka EO, Diabetes M, Nadu T. Diabetes and physical activity. Indian J Med Res 2016; 143(4): 530-1.

[42] Colberg SR, Sigal RJ, Yardley JE, et al. Physical activity/exercise and diabetes: a position statement of the american diabetes association. Diabetes Care 2016; 39(11): 2088-95.

[43] Sigal RJ, Kenny GP, Wasserman DL, Castaneda-Sceppa C. Physical activity/exercise and type 2 diabetes. Diabetes Care 2004; 27(10): 2518-9.

[44] Brugnara L, Murillo S, Novials A, et al. Low physical activity and its association with diabetes and other cardiovascular risk factors: A nationwide , population-based study. PLoS One 2016; 11(8): 1-12.

[45] Duclos M, Verges B, Coliche V, Guezennec Y, Reach G, Strauch G. Physical activity and type 2 diabetes. In: Recommendations of the SFD ( Francophone Diabetes Society ) diabetes and physical activity working group 2013; 39: pp. 205-16.
Determinant of Diabetes Mellitus

The Open Public Health Journal, 2020, Volume 13 | 329

[46] Sami W, Anani T, Butt NS, Hamid MRA, Hamid A. Effect of diet on type 2 diabetes mellitus: A review. Int J Health Sci (Qassim) 2017; 11(2): 65-71. [PMID: 28539866]

[47] Steyn NP, Mann J, Bennett PH, et al. Diet, nutrition and the prevention of type 2 diabetes. 2004; 7; pp: 147-65. [http://dx.doi.org/10.1079/PHN2003586]

[48] NeuenSchwander M, Ballon A, Weber KS, et al. Role of diet in type 2 diabetes incidence: umbrella review of meta-analyses of prospective observational studies. 2019. [http://dx.doi.org/10.1016/bmj.j2368]

[49] Biemrazaei S, Ghasivand R, Feizi A, Iran B. Relationship between Dietary Patterns and Incidence of Type 2 Diabetes. 2019.

[50] Jannasch F, Kero J, Schulze MB. Dietary patterns and type 2 diabetes: A systematic literature review and meta-analysis of prospective studies. J Nutr 2017; 147(6): 1174-82.

[51] Maddatu J, Anderson-Baucum E, Evans-Molina C. Smoking and the risk of type 2 diabetes. Trans Res 2017; 184: 101-7. [http://dx.doi.org/10.1016/j.trl.2017.02.004] [PMID: 28336465]

[52] Wang S, Chen J, Wang Y, et al. Cigarette smoking is negatively associated with the prevalence of type 2 diabetes in middle-aged men with normal weight but positively associated with stroke in men. J Diabetes Res 2019. 1853018

[53] Akter S, Okarhi H, Kowahara K, Miyamoto T. Smoking, smoking cessation, and the risk of type 2 diabetes among Japanese adults: Japan epidemiology collaboration on occupational health study. PLoS One 2015; 10(7): e0132166.

[54] Mariano S, Milnerowicz H. The impact of smoking on the development of diabetes and its complications. DiaB Vas Dis Res 2017; 14(4): 265-76.

[55] White WB, Cain LR, Benjamin EJ, et al. High-intensity cigarette smoking is associated with incident. J Am Heart Assoc 2018; 12(2): e007413.

[56] Liu X, Bragg F, Yang L, et al. smoking and smoking cessation in relation to risk of diabetes in chinese men and women: A 9-year prospective study of 0.5 million people. Lancet Public Health 2018 Apr; 1(4): e167-76.

[57] Raharjo BB, Woro KHO, Ngorho E, Hermawati B. Local potentials as capital for planning nutrition programs for urban fringe areas in developing countries. Pak J Nutr 2016; 15: 1026-33. [http://dx.doi.org/10.3923/pjn.2016.1026.1033]

[58] Harding AH, Day NE, Khaw KT, et al. Dietary fat and the risk of clinical type 2 diabetes: the European prospective investigation of Cancer-Norfolk study. Am J Epidemiol 2004; 159(1): 73-82. [http://dx.doi.org/10.1093/aje/kwh004] [PMID: 14696662]

[59] Teixeira L. Regular physical exercise training assists in preventing type 2 diabetes development: focus on its antioxidant and anti-inflammatory properties. Biomed Cent Cardiovasc Diabetol 2011; 10(2): 1-15.

[60] Schröders J, Wall S, Hakimi M, Dewi FST, Weinheil L, Nichter M, et al. How is Indonesia coping with its epidemic of chronic noncommunicable diseases? A systematic review with meta-analysis. In: PLoS ONE 2017; 12: pp 1-31.

[61] McNaughton D. 'Diabesity' down under: overweight and obesity as cultural signifiers for type 2 diabetes mellitus. Crit Public Health 2013; 23(3): 274-88. [http://dx.doi.org/10.1080/0958196X.2013.766671] [PMID: 23914074]

[62] Aye TT, Aung MW, Os ES. Diabetes mellitus in Myanmar: Socio-cultural challenges and strength. J Soc Heal Diabetes 2014; 2: 9-13.

[63] Rovner BW, Casten RJ, Harris LF. Sociocultural Influences on Diabetes Self-Management Behaviors in Older African Americans. Diabetes Spectr 2013; 26(1): 29-33. [http://dx.doi.org/10.1037/diaspect.26.1.29] [PMID: 25324677]

[64] Naing L, Wint T, Ruidi BN. Practical issues in calculating the sample size for prevalence studies. Arch Oraf Sci 2006; 1: 9-14.

[65] Dearsie C, Dubois S, Simmons D, Macmillan F. A qualitative exploration of fijian perceptions of diabetes: Identifying opportunities for prevention and management. Int J Environ Res Public Health 2019; 16: 1-16.

[66] Kalkarni KD. Food, culture, and diabetes in the united states. Clin Diabetes 2004 Oct; 12(2): 190-2. [http://dx.doi.org/10.1037/diaclin.22.4.190]

[67] Abdulrehman MS, Wootth W, Jenkins S, Kossman S, Hunter GL. Exploring cultural influences of self-management of diabetes in coastal kenya: An ethnography. Glob Qual Nurs Res 2016; 3233339316614825

[68] Ahmed AM. Cultural aspects of diabetes mellitus in Sudan. Pr Diab Int 2003; 20(6): 226-9. [http://dx.doi.org/10.1002/pdi.508]

[69] Hsu WC, Yoon HH, Iii JRG, Edward E, Jr W, Caballero AE, et al. Building cultural competency for improved diabetes care: asian americans and diabetes mellitus in older adults: the cardiovascular health study. Arch Intern Med 2009; 169(8): 798-807. [http://dx.doi.org/10.1001/archinternmed.2009.21] [PMID: 19398692]

[70] Rebolledo JA, Arellano R. Cultural differences and considerations when initiating insulin. Diabetes Spectr 2016 Aug; 29(3): 185-90. [http://dx.doi.org/10.1177/2333393616641825] [PMID: 28462335]

[71] Dearie C, Dubois S, Simmons D, Macmillan F. A qualitative exploration of fijian perceptions of diabetes: Identifying opportunities for prevention and management. Int J Environ Res Public Health 2019; 16: 1-16.

[72] Basu S, Garg S. The barriers and challenges towards addressing the social and cultural factors influencing diabetes self-management in Indian populations. J Soc Heal Diabetes 2017; 3(17): 71-76. [http://dx.doi.org/10.1055/s-0038-1676245]

[73] Mozaffarian D, Kamineni A, Carnethon M, Djoussé L, Mukamal KJ, Siscovick D. Lifestyle risk factors and new-onset diabetes mellitus in older adults: the cardiovascular health study. Arch Intern Med 2009; 169(8): 798-807. [http://dx.doi.org/10.1001/archinternmed.2009.21] [PMID: 19398692]
Begic E, Arnautovic A, Masic I. Assessment Of Risk Factors For Diabetes Mellitus Type2. Mater Sociomed 2016; 28(3): 187-90. [http://dx.doi.org/10.5455/msm.2016.28.187-190] [PMID: 27482159]

Pubudu De Silva A, Padmal De Silva SH, Liyanage IK, et al. Social, cultural and economical determinants of diabetes mellitus in Kalutara district, Sri Lanka: a cross sectional descriptive study. Int J Equity Health 2012; 11(1): 76. [http://dx.doi.org/10.1186/1475-9276-11-76] [PMID: 23237051]

Al-Sejari M. Sociocultural characteristic, lifestyle, and metabolic risk factors among a sample of kuwaiti male university students. Am J Men Health 2017; 11(2): 308-17. [http://dx.doi.org/10.1177/1557988316680937] [PMID: 27903953]