



PHYSICAL INACTIVITY AND ANXIETY WITH CARDIOMETABOLIC RISK FACTOR IN TYPE 2 DIABETES MELLITUS PATIENTS DURING CORONAVIRUS DISEASE 2019 PANDEMIC

PRAJITNO J.N., SUSANTO H., SOELISTIJO S.A.*

Department of Internal Medicine, Faculty of Medicine, Dr. Soetomo Teaching Hospital, Universitas Airlangga, Indonesia

Received 19.03.2020; accepted for printing 14.07.2020

ABSTRACT

COVID-19 is a pandemic that makes most people stay at home. Sedentary behavior caused by physical inactivity and anxious disorder significantly impact health condition, especially in type 2 diabetes mellitus population. This study aimed to obtain a correlation between physical inactivity and anxiety in health problems in type 2 diabetes mellitus patients, especially their effect on cardiometabolic risk.

We obtained 76 samples from the outpatient endocrinology clinic's medical record. Physical activity and anxiety were measured using a questionnaire. Anthropometry, blood pressure, and many laboratories marker for cardiometabolic risk would be our object to analyze.

There were increases in the cardiometabolic risk markers, including triglyceride, low-density lipoprotein cholesterol, total cholesterol, blood pressure during pandemic associated with decreased physical activity and anxiety. Moreover, increased triglyceride was correlated significantly with decreased physical activity ($p=0.006$), and HbA1c was correlated significantly with the increase of anxiousness ($p<0.05$), respectively.

COVID-19 pandemic impacts worsening cardiometabolic risk in type 2 diabetes mellitus patients due to limitations on physical activity and anxiety levels, significantly related to increases in triglyceride and HbA1C values.

KEYWORDS: COVID-19 pandemic, physical activity, anxiety, cardiometabolic risk, triglycerides, HbA1c, type 2 diabetes mellitus.

INTRODUCTION

During the coronavirus disease 2019 (COVID-19) pandemic period, most people follow the instruction for health protocol to stay at home. The COVID-19 pandemic has persistently affected all biological, psychological, social, and cultural aspects [Setyawan F, Lestari R, 2020]. That is also for the type 2 diabetes mellitus (T2DM) patient population. Most of them have to stay at home and do more sedentary behavior than before. Whereas the positive effect of exercise even helps to prevent the negative impact of chronic condition [Amelia R et al., 2018; Shafiq M et al., 2018]. Their limitations for activities, socializing, and

doing daily activities outside make some problems for their health. This limitation condition also has impacts the increase of cardiovascular disease risk in patients with diabetes.

Many previous studies reveal that physical inactivity can increase cardiovascular risk [Siedler M et al., 2020]. In other studies, stress conditions such as post-earthquake disaster, terrorism, or loss of a spouse can increase adverse cardiovascular events and mortality [Allgulander C, 2016; Ouakinin S, 2016]. T2DM patients are two to four times more likely to have cardiovascular disease [Majid A, 2009]. In the T2DM population, cardiovascular events remain the most common morbidity and mortality factor [Sanusi H, 2004; Bertoluci M, Rocha V, 2017; Rusdiana R et al., 2018]. Further, physical inactivity and stress condition can have harmful impacts on weight control cause an obesity [Morales M et al., 2016], blood glucose control [Deschênes S et al., 2016], increased coronary

ADDRESS FOR CORRESPONDENCE:

Soebagijo Adi Soelistijo, MD
Department of Internal Medicine, Dr. Soetomo Teaching Hospital, Universitas Airlangga, Prof. Dr. Moestopo Street No 4-6, Surabaya 60286, Indonesia
Tel: (+6231) 502-3865; Fax: (+6231) 502-3865
E-mail: soebagijo@yahoo.com

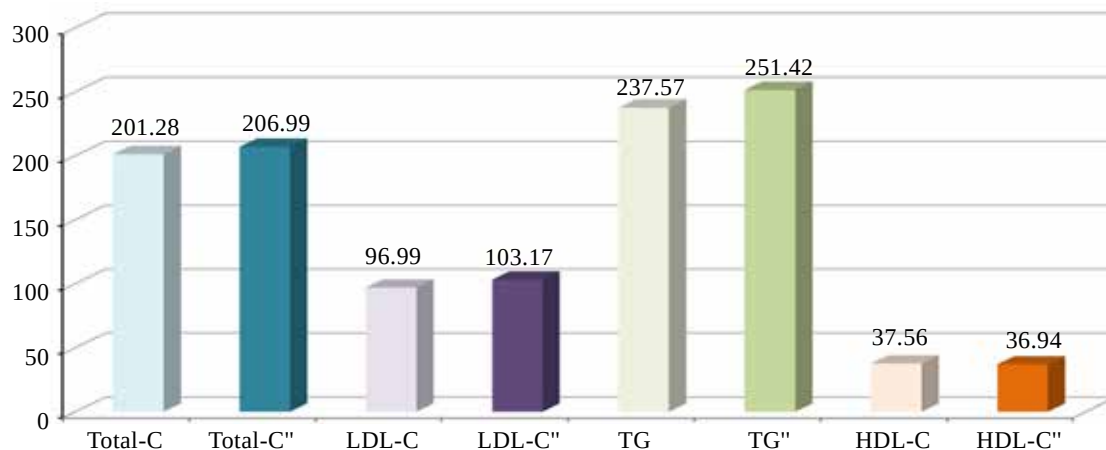


FIGURE 1. Changes of lipid profile component before and during COVID-19 pandemic.

risk [Catalina Romero C et al., 2013], and increased risk of dyslipidemia in T2DM patients [Klein F et al., 2012].

Nowadays, pandemic conditions make all people stay at home, work, school, and other daily activities must be done at home. All of this socialization, recreation, and relaxation activity limitations could affect health issues, including increased cardiometabolic risk (CMR) on the T2DM population. This study focuses on the impact of these limitations activity on CMR in the T2DM population.

MATERIAL AND METHODS

We collected the medical records from our outpatient endocrine clinics. The collection period was three months before the pandemic starting until three months after the pandemic began. We collected the demographic data, bodyweight, and height. We counted the body mass index (BMI) using world health organization criteria, the systolic and diastolic blood pressure, and some laboratory

results for identifying the CMR, including the blood glucose control. At their last visits, we invited them to fill out a questionnaire for the daily activity and anxiety scale. This study did not include those who were tethered to adding drugs, getting dose changes, and not routinely taking medication either for blood glucose control or for hypertension and lipid control and six

months of observation. This study also excluded those who had the habit of smoking, suffering from cardiovascular disease and cancer. All subjects had the same conditioning by following the government's health protocol to stay at home during the COVID-19 pandemic.

We used a brave questionnaire for anxiety called Generalized Anxiety Disorder 7-item (GAD-7), and it was classified for daily activities into rarely, sometimes, and often doing physical activities based on a self-completed questionnaire. CMR data distribution such as BMI, the lipid profile of high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), triglyceride (TG), and total cholesterol (TC), blood glucose control, and blood pressure were analyzed for the normality. When data were not normally distributed ($p < 0.05$), we analyzed using the Kruskal Wallis test. While they were normally distributed, we used the ANOVA test ($p > 0.05$).

RESULTS

Out of 76 patients eligible for the criteria, 55 % were female, and 45% were male with the age distribution between 38 to 76 years old. Some of them, 49 (64.5%), were still employees and still actively working, while 20 (26.3%) were in retirement positions, and 7 (9.2%) were housewives.

The changes of lipid profile component before and during COVID-19 pandemic are shown in figure 1. The mean TC level was $201.28 \pm 15.3 \text{ mg/dL}$. Before the pandemic, there was a slight increase of $206.99 \pm 16.58 \text{ mg/dL}$ on the three months of the COVID-19 pandemic. It also happened with LDL-C that was increased from $96.98 \pm 16.86 \text{ mg/L}$ to $103.17 \pm 18.50 \text{ mg/dL}$; TG from 237.57 ± 47.63 to



To overcome it is possible, due to the uniting the knowledge and will of all doctors in the world

251.42±37.31mg/dL. The blood pressure data showed an increase from 122.04±9.21 to 129.81±12.63 for systolic and 76.67±7.98 to 83.77±8.57 for the diastolic pressure. Figure 2 displays BMI changes during COVID-19 pandemic.

FIGURE 2.
BMI changes during COVID-19 pandemic

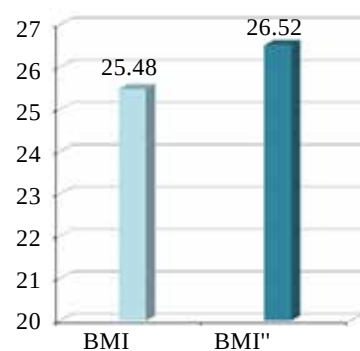


FIGURE 3.
HbA1C changes during COVID-19 pandemic

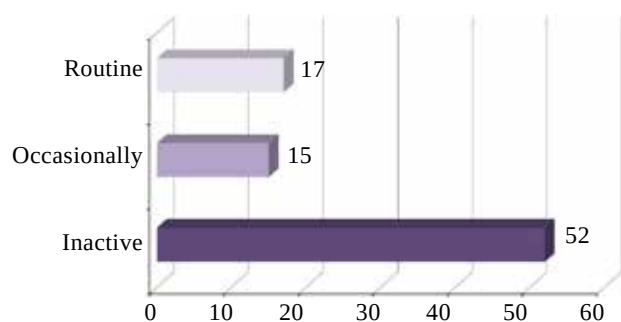
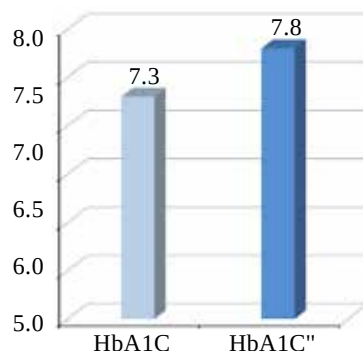


FIGURE 4. Proportion of subjects with their physical activity during pandemic

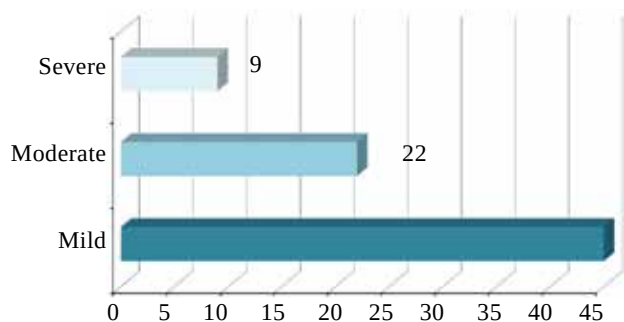


FIGURE 5. Number of subjects with degree of anxiety using Generalized Anxiety Disorder questionnaire

Worsening of CMR factors during the pandemic period was also seen in the blood glucose control parameters showing the increase of HbA1C value, fasting, and postprandial blood glucose (Fig. 3).

The result of physical activity of subjects during pandemic is shown in figure 4. We analyzed whether any correlation between CMR factor changes in T2DM patients and their physical activity. We found any correlation between daily physical activity and changes in CMR factors during the COVID-19 pandemic. Two components of CMR show a significant correlation with physical activity. We found that TG levels ($p=0.006$) and postprandial blood glucose ($p=0.028$) were significantly correlated with inactivity during the pandemic.

The pandemic condition with various news reports that contained various morbidity and mortality events certainly makes the community worried and anxious. Whether this anxiety condition is related to CMR changes during a pandemic, we try to analyze it. During a pandemic in this study anxiety conditions were measured using a brief scoring, Generalized Anxiety Disorder (GAD-7). Based on the GAD-7 questionnaire as shown in figure 5, there were nine subjects in the severe anxiety group, 22 subjects in moderate anxiety and 45 subjects in mild anxiety. The data shows nine subjects with severe anxiety, 8 (88.9%) were in the employee group, while only 1 (11.1%) came from the unemployed group. For 22 subjects with moderate anxiety, 14 (66.7%) were still actively work as an employee, and 7 (33.3%) persons were unemployed. It looks like those with actively working have more anxious.

We found a relationship between the level of anxiety and changes in CMR for T2DM patients. However, only changes in blood glucose control HbA1C and prandial blood glucose levels were significant ($p<0.05$).

DISCUSSION

Physical activity and anxiety were two main factors affecting CMR in adults with T2DM. Our subjects are 55% women and 45% of men with an age range between 38 to 76 years. This has no significant difference with subjects' demographic conducted in a Cochrane [Hadgraft N et al., 2020]. Along with other previous study [Knaeps S et al., 2018], the state of physical activity between men and women does not give any considerable difference. An increase of physically inactive habit or sedentary activity corre-

lates with the increase of several CMR parameters, such as blood pressure, LDL-C, TG, TC, and HDL-C [Lamb M et al., 2016; Knaeps S et al., 2018].

In this study, there was an increase of blood pressure, TC, LDL-C, and TG as a CMR in subjects during the COVID-19 pandemic, which they must be doing everything at home and decrease their physical activity. A decrease in physical activity also correlates with increasing CMR in several previous studies [Lamb M et al., 2016; Figueiró T et al., 2019]. However, we revealed a significant difference only in the TG level among all the subjects. This finding is similar to other reports that claimed TG is a factor the most significant changes in decreased physical activity [Green A et al., 2014]. Nevertheless, different results obtained from several studies found an increase in several cardiometabolic risks in subjects with decreased physical activity, including sedentary behavior [Nocon M et al., 2008; Figueiró T et al., 2019]. This difference could be happening because, in our study, there was no objective measurement in decreasing physical activity in daily living, even it from moderate-to-vigorous physical activity to light physical activity or become sedentary behavior like the other previous study [Green A et al., 2014; Lamb M et al., 2016; Figueiró T et al., 2019]. A previous report revealed no differences in CMR marker on sedentary behavior subjects with the light physical activity subjects group. Thus waist circumference, systolic blood pressure, fasting plasma glucose decrease, and HDL-C was increased respectively in the moderate-to-vigorous physical activity subjects group [Figueiró TH et al., 2019; Lamb MJE et al., 2016]. That was contradictive with other study revealing that TG and insulin resistance were significantly different between sedentary behavior group and light physical activity group in adulthood, respectively [Green A et al., 2014].

In adolescence school at home also can have a harmful impact on their metabolic condition. School at home makes physical relatively inactive than if they study at college. This condition was evident to increase metabolic syndrome risk in adolescence [Butler K et al., 2018]. However, work or school from home will give them extra time for TV viewing associated with increase snacking behavior and nutritional intake [Harris J et al., 2009] followed by impaired blood glucose and lipid profile control, especially in the T2DM population [Smith L, Hamer M, 2014; Petersen C et al., 2016]. An increase in time spent being physically active may be an essen-

tial strategy for glucose management in the early T2DM population [Hansen A et al., 2013; Mukai N et al., 2014; Lamb M et al., 2016]. Physically inactive people in sedentary time ≥ 10 hours tend to be 2-fold higher in developing T2DM and insulin resistance [Honda T et al., 2019].

This COVID-19 pandemic gives many anxiety-raised issues all over the world. In several Asian countries, this pandemic altered mental health, causing anxiety disorder toward this rapid spreading of COVID-19 infection [Cao W et al., 2020; Huang Y, Zhao N, 2020]. The public's anxiety increased because of continuous report from all of the media all over the world about COVID-19 widespread [Nasir N et al., 2020; Roy D et al., 2020]. The excessive anxiety recognized as a causal of sleep difficulties, and alter health condition [Allgulander C, 2010; Roy D et al., 2020]. Anxiety can develop into depression, sleep difficulties, paranoia, overweight, and sedentary behavior [Allgulander C, 2016], which in their way can be major risk factors for increase major cardiac events in coronary heart disease [El-Gabalawy R et al., 2014], playing a role in poor prognosis of patients with metabolic syndrome by increasing cardiovascular events [Ortega Y et al., 2017], and increase mortality risk in diabetes individual [Naicker K et al., 2017] one of them is by activation of inflammatory responses [Klein Hofmeijer-Sevink M, 2012].

This study reveals that increase in anxiety-related to an increase of CMR markers. This is similar to several study previous [Allgulander C, 2010; Naicker K et al., 2017; Ortega Y et al., 2017; Rebollo-Solleiro D et al., 2017; Smith K et al., 2018], although, there is a study stated the contrary [Hildrum B et al., 2009]. Moreover, the association between anxiety and CMR was reciprocal. Anxiety can increase CMR such as metabolic syndrome and diabetes, yet metabolic syndrome and diabetes also can cause anxiety and depression disorder [Albekairy A et al., 2018; Shinkov A et al., 2018].

Stress level and anxiety correlate significantly with blood glucose control [Vala M et al., 2016]. In our study, blood glucose control (HbA1c) significantly correlates with increased subject's anxiousness. The same aspect was obtained from other studies [Whitworth S et al., 2016; Rechenberg K et al., 2017]. Besides its relation to blood glucose control, anxiousness is associated with a decrease of self-monitoring-blood-glucose, increased BMI, and smoking status, respectively

[Whitworth S et al., 2016], henceforth plays a role in poor prognosis in T2DM patients. Therefore, we suggest that any intervention for anxiety disorder during pandemic COVID-19 in type 2 diabetes patients is highly needed.

CONCLUSION

COVID-19 pandemic impacts worsening CMR in T2DM patients due to limitations on physical activity and anxiety levels that are significantly related to increases in TG and HbA1C values.

REFERENCES

1. Albekairy A, Aburuz S, Alsabani B, Alshehri A, Aldehbi T., et al. Exploring factors associated with depression and anxiety among hospitalized patients with type 2 diabetes mellitus. *Med Princ Pract.* 2018; 26(6): 547-553
2. Allgulander C. Anxiety as a risk factor in cardiovascular disease. *Curr Opin Psychiatry.* 2016; 29: 13-17
3. Allgulander C. Morbid anxiety as a risk factor in patients with somatic diseases: a review of recent findings. *Mind Brain.* 2010; 1(1): 1-9
4. Amelia R, Lelo A, Lindarto D, Mutiara E. Analysis of factors affecting the self-care behaviors of diabetes mellitus type 2 patients in Binjai, North Sumatera-Indonesia. *Asian J Microbiol. Biotechnol Environ Sci.* 2018; 20(2): 361-367
5. Bertoluci MC, Rocha VZ. Cardiovascular risk assessment in patients with diabetes. *Diabetol Metab Syndr.* 2017; 9(25): 1-13
6. Butler KM, Ramos JS, Buchanan CA, Dalleck LC. Can reducing sitting time in the university setting improve the cardiometabolic health of college students? *Diabetes Metab Syndr Obes Targets Ther.* 2018; 11: 603-610
7. Cao W, Fang Z, Hou G, Han M, Xu X., et al. The psychological impact of the COVID-19 epidemic on college students in China. *Psychiatry Res.* 2020; 287: 112934
8. Catalina Romero C, Sainz JC, Cabrera M, Román J, Calvo E., et al. The relationship between job stress and dyslipidemia. *Scand J Public Health.* 2013; 41(2): 142-149
9. Deschênes SS, Burns RJ, Graham E, Schmitz N. Prediabetes, depressive and anxiety symptoms, and risk of type 2 diabetes: A community-based cohort study. *J Psychosom Res.* 2016; 89: 85-90
10. El-Gabalawy R, Mackenzie CS, Pietrzak RH, Saareen J. A longitudinal examination of anxiety disorders and physical health conditions in a nationally representative sample of US older adults. *Exp Gerontol.* 2014; 60: 45-56
11. Figueiró TH, Arins GCB, dos Santos CES, Cembranel F, de Medeiros PA., et al. Association of objectively measured sedentary behavior and physical activity with cardiometabolic risk markers in older adults. *PLoS One.* 2019; 14(1): 1-15
12. Green AN, McGrath R, Martinez V, Taylor K, Paul DR, Vella CA. Associations of objectively measured sedentary behavior, light activity, and markers of cardiometabolic health in young women. *Eur J Appl Physiol.* 2014; 114(5): 907-919
13. Hadgraft NT, Winkler E, Climie RE, Grace MS, Romero L., et al. Effects of sedentary behaviour interventions on biomarkers of cardiometabolic risk in adults: Systematic review with meta-analyses. *Br J Sports Med.* 2020; doi: 10.1136/bjsports-2019-101154
14. Hansen ALS, Carstensen B, Helge JW, Johansen NB, Gram B., et al. Combined heart rate- and accelerometer-assessed physical activity energy expenditure and associations with glucose homeostasis markers in a population at high risk of developing diabetes: The addition-pRO study. *Diabetes Care.* 2013; 36(10): 3062-3069
15. Harris JL, Bargh JA, Brownell KD. Priming Effects of Television Food Advertising on Eating Behavior. *Heal Psychol.* 2009; 28(4): 404-413
16. Hildrum B, Mykletun A, Midthjell K, Ismail K, Dahl AA. No association of depression and anxiety with the metabolic syndrome: The Norwegian HUNT study. *Acta Psychiatr Scand.* 2009; 120: 14-22
17. Honda T, Kishimoto H, Mukai N, Hata J, Yoshida D., et al. Objectively measured sedentary time and diabetes mellitus in a general Japanese population: The Hisayama Study. *J Diabetes Investig.* 2019; 10(3): 809-816
18. Huang Y, Zhao N. Generalized anxiety disorder, depressive symptoms and sleep quality during COVID-19 outbreak in China: a web-based cross-sectional survey. *Psychiatry Res.* 2020; 288 doi: 10.1016/j.psychres.2020.112954
19. Klein F, das Neves VJ, Costa R, Sanches A, Sousa T., et al. Dyslipidemia Induced by Stress. *Dyslipidemia – From Prevention to Treatment.* 2012; 369-391
20. Klein Hofmeijer-Sevink M, Batelaan NM, Van Megen HJGM, Penninx BW, Cath DC., et al. Clinical relevance of comorbidity in anxiety disorders: A report from the Netherlands Study of Depression and Anxiety (NESDA). *J Affect Disord.* 2012; 137(1-3): 106-112
21. Knaeps S, Bourgois JG, Charlier R, Mertens E, Lefevre J, Wijndaele K. Ten-year change in sedentary behaviour, moderate-To-vigorous physical

- activity, cardiorespiratory fitness and cardiometabolic risk: Independent associations and mediation analysis. *Br J Sports Med.* 2018; 52(16): 1063-1068
22. Lamb MJE, Westgate K, Brage S, Ekelund U, Long GH., et al. Prospective associations between sedentary time, physical activity, fitness and cardiometabolic risk factors in people with type 2 diabetes. *Diabetologia.* 2016; 59(1): 110-120
23. Majid A. Prevention and management of coronary artery disease in patients with diabetes mellitus. *Acta Med Indones.* 2009; 41(1): 41-44
24. Morales MIA, Pacheco Delgado V, Morales Bonilla JA. Influence of physical activity and nutritional habits on the risk of metabolic syndrome. *Enferm Glob.* 2016; 44: 222-234
25. Mukai N, Doi Y, Ninomiya T, Hirakawa Y, Nagata M., et al. Trends in the prevalence of type 2 diabetes and prediabetes in community-dwelling Japanese subjects: The Hisayama Study. *J Diabetes Investig.* 2014; 5(2): 162-169
26. Naicker K, Johnson JA, Skogen JC, Manuel D, Overland S., et al. Type 2 diabetes and comorbid symptoms of depression and anxiety: Longitudinal associations with mortality risk. *Diabetes Care.* 2017; 40(3): 352-358
27. Nasir NM, Baequni B, Nurmansyah MI. Misinformation related to COVID-19 in Indonesia. *J Adm Kesehat Indones.* 2020; 8(2): 51-59
28. Nocon M, Hiemann T, Müller-Riemenschneider F, Thalau F, Roll S, Willich SN. Association of physical activity with all-cause and cardiovascular mortality: A systematic review and meta-analysis. *Eur J Prev Cardiol.* 2008; 15(3): 239-246
29. Ortega Y, Cabre JJ, Piñol JL, Aragonés E, Basora J, Araujo A. Effect of depression and/or anxiety on the presentation of cardiovascular events in a large cohort with metabolic syndrome (S136) In 53rd EASD Annual Meeting of the European Association for the Study of Diabetes. *Diabetologia.* 2017; 60(1): S1-S608
30. Ouakinin SRS. Anxiety as a risk factor for cardiovascular diseases. *Front Psychiatry.* 2016; 7: 25
31. Petersen CB, Bauman A, Tolstrup JS. Total sitting time and the risk of incident diabetes in Danish adults (the DANHES cohort) over 5 years: A prospective study. *Br J Sports Med.* 2016; 50(22): 1382-1387
32. Rebollo-Solheiro D, Roldán-Roldán G, Díaz D, Velasco M, Larqué C., et al. Increased anxiety-like behavior is associated with the metabolic syndrome in non-stressed rats. *PLoS One.* 2017; 12(5): e0176554
33. Rechenberg K, Whittemore R, Grey M. Anxiety in Youth with Type 1 Diabetes. *J Pediatr Nurs.* 2017; 32: 64-71
34. Roy D, Tripathy S, Kar SK, Sharma N, Verma SK, Kaushal V. Study of knowledge, attitude, anxiety & perceived mental healthcare need in Indian population during COVID-19 pandemic. *Asian J Psychiatry.* 2020; 51: 102083
35. Rusdiana R, Savira M, Amelia R. The effect of diabetes self-management education on HbA1c level and fasting blood sugar in type 2 diabetes mellitus patients in primary health care in binjai city of north Sumatera, Indonesia. *Open Access Maced. J Med Sci.* 2018; 6(4): 715-718
36. Sanusi H. Impaired glucose tolerance, impaired fasting glycaemia and cardiovascular risk. *Acta Med Indones.* 2004; 36(1): 36-41
37. Setyawan FEB, Lestari R. Challenges of Stay-At-Home Policy Implementation During the Coronavirus (Covid-19) Pandemic in Indonesia. *J Adm Kesehat Indones.* 2020; 8(2): 15-20
38. Shafiq M, Fong AYY, Shyong Tai E, Nang EEK, Wee HL., et al. Cohort profile: LIFE course study in CARDiovascular disease Epidemiology (LIFEC-ARE). *Int J Epidemiol.* 2018; 47(5): 1399-1400
39. Shinkov A, Borissova AM, Kovatcheva R, Vlahov J, Dakovska L., et al. Increased prevalence of depression and anxiety among subjects with metabolic syndrome and known type 2 diabetes mellitus—a population-based study. *Postgrad Med.* 2018; 130(2): 251-257
40. Siedler M, Murad MH, Falck-Ytter Y, Dahm P, Mustafa RA., et al. Guidelines about physical activity and exercise to reduce cardiometabolic risk factors: Protocol for a systematic review and critical appraisal. *BMJ Open.* 2020; 10(1): e032656
41. Smith KJ, Deschênes SS, Schmitz N. Investigating the longitudinal association between diabetes and anxiety: a systematic review and meta-analysis. *Diabet Med.* 2018; 35(6): 677-693
42. Smith L, Hamer M. Television viewing time and risk of incident diabetes mellitus: The English Longitudinal Study of Ageing. *Diabet Med.* 2014; 31(12): 1572-1576
43. Vala M, Razmandeh R, Rambod K, Nasli Esfahani E, Ghodsi Ghasemabadi R. Mindfulness-based stress reduction group training on depression, anxiety, stress, self-confidence and hemoglobin A1C in young women with type 2 diabetes. *Iran J Endocrinol Metab.* 2016; 17(5): 282-290
44. Whitworth SR, Bruce DG, Starkstein SE, Davis WA, Davis TME, Bucks RS. Lifetime depression and anxiety increase prevalent psychological symptoms and worsen glycemic control in type 2 diabetes: The Fremantle Diabetes Study Phase II. *Diabetes Res Clin Pract.* 2016; 122: 190-197