

A Review Article: The Combination of Physical Activity and Healthy Diet in Adolescents to Prevent Diabetes Mellitus

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Keywords: Physical Activity, Healthy Diet, Diabetes Mellitus, Adolescents

Abstract: Diabetes Mellitus is a metabolic disorder marked by hyperglycemia and caused by insulin deficiency or insulin resistance. Teenagers can be affected by diabetes mellitus as well as adults and the elderly. Disease prevention efforts are one method of reducing the risk factor. A combination of physical activity and healthy diet can help control risk factors, especially in teenagers. Purpose: for the investigation and identification of various research findings relating to the influence of physical activity and healthy diet on the prevention of diabetes mellitus in adolescents Method: a method study which we use in the form of analytical content to build a review article by identifying, reviewing, and evaluating all related research with an influence on the combination of physical activity and healthy diet in adolescents. The source of data in review articles is *Google scholar*, *PubMed*, and *Science Direct* with the key words "Diabetes mellitus", "Physical activity", and "healthy diet. We found 5.000 related articles using search engines as our article data source. Out of 100 articles, only 10 articles were eligible for literature review. People who don't do physical activity have a higher risk of having diabetes mellitus by 3,198 times, compared to people who do physical activity heavily every day. People who consume food processed from flour like a biscuit have a 1.198 times greater risk of having diabetes mellitus compared with people who never consume food processed from flour. Activity physically is greatly influenced by its intensity, so it will have an effect on the rate of glucose in the blood. Based on the literature review, we do show that in the age group of adolescents, prevention of diabetes mellitus can be conducted with combining physical activity with dietary pattern. This thing is related to insulin secretion, so glucose homeostasis can be more awake. Nonetheless, more research is needed to account for other diabetes risk factors, such as overweight and obesity, genetics, and a healthy lifestyle pattern.

1 INTRODUCTION

Diabetes mellitus is a disturbance of metabolism with hyperglycemia as a consequence of deficiency of insulin hormone and insulin resistance. Diabetes mellitus will harm various organs such as the eye, kidney, system nerves, and cardiovascular systems if it is not controlled (Khazrai et al. 2014). In 2011, diabetes mellitus was a horrific disease, killing as many as 7.3 million people in Indonesia. By 2030, diabetes mellitus is estimated to have reached a death rate of 11.8 million (Kekenusa et al, 2013).

The disease can be prevented by promoting physical activity and a healthy diet in adolescents. Diabetes Mellitus has factors with possible risks changed, like pattern eating and physical activity. Diabetes mellitus does not only affect the elderly, but it can also affect teenagers. aged more than 15 years old by 2%. Meanwhile, in 2013, people with diabetes mellitus at the age of more than 15 years fell by 1.5%. According to results, blood sugar examination in 2013 with diabetes mellitus

increased as much as 6.9%, while in 2018 it experienced an enhancement of as much as 8.5%. About 8.5% of people with diabetes mellitus type II know if they suffer from diabetes mellitus type II. (Infodatin, 2020)

There are some risk factors for diabetes mellitus: genetics, a family history of diabetes, heredity, environment, level of education, and unhealthy lifestyle habits such as smoking, drinking alcohol, eating red meat, drinking sugar-sweetened beverages (SSB), and eating eggs. Besides that, teenagers who have a history of descendants from parents with diabetes mellitus have a 6 times greater risk of suffering from diabetes mellitus by 75% (Kekenusa et al., 2013). While recognizing and controlling various factors risking the appearance of diabetes mellitus, this expected effort for the prevention of metabolic disease does not happen.

Diabetes prevention efforts can be avoided or reduced using this method. To do modification of lifestyle, diet control, and weight control. Diabetes mellitus is reduced by 16% for every pound lost. Enhancement Physical activity is also important for weight loss as it reduces the risk of diabetes mellitus by 44% (Hamman et al., 2006). The purpose of this review literature is to investigate and identify various research findings related to the influence of physical and healthy diet settings in adolescents on diabetes mellitus.

2 METHODS

Method study, which we use in the form of analytical content to build a review article by identifying, reviewing, and evaluating all related

research with an influence on activity, physical activity, and healthy diet in adolescents . The source of data in review articles is Google scholar, Pubmed, and Science Direct with the key words "Diabetes mellitus", "Physical activity", and "healthy diet".

3 RESULTS

From article data sources from search engines, we found 5,000 related articles. Analysis of our selected articles with suitable articles with destination. Our research is of 10 articles. Three journals that discuss physical activity; three journals that discuss healthy eating patterns; two journals that discuss perceptions and family history; and two journals that discuss the combination of physical activity and consumption of a healthy diet.

Table 1. Analysis of Articles on The Combination of Physical Activity and Healthy Diet in Adolescents to Prevent Diabetes Mellitus

Writer	year	Method	Results	Conclusion
Siti Maimunah	2020	Design of observational analytic use case control. This was done on all Diabetes Mellitus patients in room-take care stay with a comparison of 1:60, 60 people with type 2 diabetes mellitus and 60 people as controls who did not suffer from diabetes mellitus. Research was conducted for 24 days.	Diabetes Mellitus relationship with activity physique show results chi-square test analysis , with P value is $0.069 > \alpha = 0.05$ which indicates that no there is connection Among activity physique with incidence of type 2 Diabetes Mellitus with genetics show P-Value value of $0.000 < \alpha = 0.05$. This thing show that factor genetics linked with 4,215 times risk more tall affected by Diabetes Mellitus compared with those who don't have history genetics. This thing show that people who don't eat healthy have 2,494 times more likely big for suffer from Diabetes Mellitus compared those who don't .	The relationship between Diabetes Mellitus and physical activity shows results from a chi-square test analysis with a P value of $0.069 > \alpha = 0.05$, which indicates that there is no connection among active physiques with an incidence of type 2 diabetes mellitus with genetics, showed a P-Value of $0.000 < \alpha = 0.05$. This thing shows that factor genetics is linked with a 4,215-fold increased risk of being affected by diabetes mellitus compared with those who don't have a history of genetics. This shows that people who don't eat healthy have a 2,494 times greater likelihood of suffering from diabetes mellitus compared to those who don't .
Dyah Ayu Lestari	2022	Pre-experiment design, which is a pre-test post-test one group. To 40 respondents, 25 years > 35 years, men and women.	Test outcome resulted in pre-test and post-test blood sugar levels of $0.000 (0.05)$ in the obedience pattern eating pre-test and post-test. Tt show there is an influence between	According to research, healthy eating patterns and physical activity have an impact significantly on blood sugar

Ni Nyoman Veridiana	2019	Descriptive research with 722,329 participants who have the following subject categories: 15 years old or older, people with diabetes mellitus, as for variables dependent, that is diabetes mellitus patients, and variables independent, that is behavior consumption (fresh fruit and vegetables, food risky, eat processed from flour), and physical activity. This research was conducted by means of a questionnaire, and the data was analyzed to see the relationship between one variable and another variable.	<p>pattern diet and blood sugar levels in diabetes mellitus patients . Blood sugar level of 0.000 (0.05) on activity physical pre-test and post-test. This thing shows there is an influence on physical and blood sugar levels in diabetes mellitus patients.</p> <p>The most dominant variable was physical activity, with a p-value of 0.000. People who have the habit of doing activities of mild have a chance to be hit DM 3,198 times compared to those who have the habit of doing activities of heavy, while people who have the habit of doing moderate activity The lower chance of getting DM is 1,933 times compared to strenuous activity after controlled by the behavior of consumption of biscuits, fruit, vegetables, sweet foods, sweet drinks, fatty foods, fried foods, and instant noodles. The analysis also reveals a significant relationship on behavioral variables: consumption of processed flour in the form of biscuits OR: 1.198 (95% CI: 1.096-1.309), which means that people who have the habit of consuming processed flour in the form of biscuits have a 1.198 times greater chance of having DM than those who never eat biscuits.</p>	<p>levels in diabetes mellitus patients.</p> <p>The results of this research show that physical activity is the most important risk factor dominant to the incidence of DM in Indonesia after being controlled by other variables; consumption of fruit, vegetables, sweet foods/drinks, fatty/cholesterol/fried foods, instant noodles, and biscuits. Regular physical activity can control blood sugar levels.</p>
Lisavina Juwita	2018	The study used a theoretical approach with the number of participants, 18 people diagnosed with type 2 diabetes mellitus. This was conducted for 4 months. This research was conducted from one's experience into theory by interviewing the participants.	<p>Participants made several lifestyle changes in the form of physical activity with an average duration of 30–60 minutes; maintaining dietary intake by consuming vegetables and fruit; replacing rice and side dishes with a frequency of eating 2 to 3 times a day with a portion of 2 tablespoons; and not adding to diabetes mellitus therapy management, which consists of pharmacological therapy, alternative therapy, and support therapy; adherence to control of self-awareness; and family support. The participant no longer feels ill</p>	<p>There is a relationship between family support and self-efficacy in the form of a person's belief to monitor and plan self-care behavior to improve the quality of life, and to live a healthier life.</p>

Juniar Ayuning	2020	Quantitative methods and theories, with respondent categories: 18-24 years old, living in Yogyakarta, children, grandchildren or nephews of Prolanis (Chronic Disease Program). Qualitative research took 50 respondents while quantitative took 14 respondents, by means of respondents filling out <i>food records</i> and also physical activities carried out. This is done to find out how the respondent's knowledge of nutrition and health is. Not only that, this interview also includes whether there is a kinship with people with diabetes, whether there are changes in diet, physical activity of family members or themselves.	as a result of the results, and he or she can resume normal activities and live a normal life. After the interview, there were several results, namely no there is connection Among stay one home and not with member family people with diabetes against pattern eat and active v bag physique respondents ($p = 0.310$ and $p = 0.297$). Not there is also a relationship Among have history diabetic family from nuclear family and family big to pattern eat and be active physique respondents ($p=0.276$ and $p=0.547$). However there are factors that influence pattern eat like example perception vulnerability will diagnosed with diabetes because have history diabetic family and have more weight. And there are perception that pattern eat healthy could down diabetes risk . Likewise on physical activity.	There is a relationship between family support and self-efficacy in the form of a person's belief that they can monitor and plan self-care behaviors to improve their quality of life and to live a healthier life.
Addisu Dabi Wake	2020	The theoretical comparison method Professionals explain the importance and effect of physical activity on people with diabetes mellitus because physical activity is considered to increase insulin resistance, blood pressure control, glycemic control, quality of life, capacity for physical and fitness cardiorespiratory reduction, obesity, lipid profile, cardiovascular risk, etc.	Several studies recommend the use of physical activity because it can support and improve glycemic control and glucose control and also delay the development of other comorbidities that are common in diabetics. Generally, physical activity can improve metabolic health throughout the body in diabetic patients.	The importance of doing physical activity for people with type 2 diabetes mellitus is that physical activity can increase blood glucose levels, which has a significant role in reducing insulin resistance, increasing the production of type 4 glucose transporters, reducing visceral adipose tissue, and many other benefits.
Suryanti S.	2021	Analysis method with a cross-sectional study, with a respondent category of whole people who come for treatment at Bhayangkara's Hospital, as many as	From the results analysis, it is seen that there were 16 respondents with high risk and 14 respondents (21.9 %) who were active physically and suffering from diabetes mellitus, while 2 respondents (3.1 %) did not suffer from	Physical activity and eating patterns have a connection with diabetes mellitus. It is expected for the community so that they can arrange their eating patterns and also be physically active.

		193 patients for 3 months, with a method through an interview using a questionnaire for measuring variables.	DM. The results show a P value of 0.035. This implies that there is a link between physical activity and the prevalence of diabetes mellitus. Based on the pattern of eating of 46 respondents with pattern eating normally, there are 23 respondents (35.9%) who suffer from diabetes mellitus and 23 respondents (35.9%) who do not suffer from diabetes mellitus. In the case of pattern eating, there are 28 respondents, 25.0% (16) of whom have diabetes mellitus and 3.9% (2) of whom do not. The results show a p value of 0.010 0.05. This implies that there is a link between diabetes mellitus incidents and pattern eating.	
Waqas Sami	2020	Quantitative methods and questionnaires with subject categories show that women and men aged between 35 and 55 years of age are diagnosed with type 2 diabetes mellitus. The subjects were given a questionnaire with several questions, one of which was "whether the subjects have eaten healthy foods," and "whether the subjects do not eat taboo foods for diabetics."	There are 70.84% more subjects who say "yes" but they eat red meat. Consuming milk has a ratio of 1.408 ($p = 0.015$) but there are 58.38% more subjects who say "yes", as well as <i>junk food</i> , which has a ratio of 2.347 ($p = 0.001$) but there is a 70.12% greater in subjects who say "yes". As a result, it demonstrates that there is still a lack of education among the subjects regarding the content of the food they will consume.	The importance of educating patients with diabetes mellitus about being aware of what content is contained in the food they consume cannot be overstated. Patients must also be educated about how to read what content is in the food they consume.
Jennifer A. Andersen	2022	Survey method with respondent category: >18 years old and living, working, and/or receiving health care in the state of Arkansas during the study period, with a total of 809 respondents. This study was conducted by means of respondents doing physical activity for at least 30 minutes a day for a period of one week. Respondents also had to eat five or more servings of fruits and vegetables. This study was carried out for one week. The study was	Compared with women, men reported engaging in physical activity in one additional day ($\beta=1.05, p=0.040$), respondents who thought they were in good health engaged in more days of physical activity ($\beta =1.64, p=0.004$) compared to respondents who think their health is quite good. Respondents in college reported eating 5 servings of fruit and vegetables on fewer days than high school students or below ($\beta = 1.51, p=0.049$). This thing conducted for prevent increase rate glucose blood so that avoid they from	The significance of eating at least 5 servings of fruits and vegetables per day and engaging in physical activity for at least 10 minutes per day

		also done during COVID-19.	complications disease if infected COVID-19	
Mala Azitha	2018	The design study is an analytical cross-sectional, with the criteria of respondents being all patients with diabetes mellitus who come to the polyclinic of internal medicine, namely 120 people. By surveying the patients who come to the polyclinic of internal medicine about the physical activities carried out and also researching whether there is a relationship between physical activity and blood sugar levels in the body.	From the results of research that has been done, the number of patients who do light physical activity with normal fasting blood sugar levels is as many as 24 people (28.6%) and patients with increased fasting blood sugar levels is as many as 60 people (71.4%). Patients who engage in moderate-to-heavy activity had their blood sugar levels fasting by as many as 12 people (33.3%), while those who did not had their blood sugar levels fasting by 24 people (66.7%). As a result, it is possible to conclude that activity physique has no relation to glucose blood fasting patients.	Familiarize yourself as early as possible with doing physical activity. It doesn't have to be heavy; just walking for 30 minutes is enough so that we get used to it in our old age and are not easily exposed to dangerous diseases.

4 DISCUSSIONS

Based on the results of the review of the 10 journals above, it can be concluded that a combination of a healthy diet and physical activity can prevent the occurrence of diabetes mellitus in adolescents. This is in accordance with studies (Hamman et al. 2006) that show having a healthy diet and regular and consistent physical activity can help prevent diabetes because blood glucose levels will be more controlled, weight will decrease, and it can help reduce calories in the body. Likewise, with results from other studies, others also show that a combination of eating well with physical activity could prevent the occurrence of diabetes due to its ability to control blood sugar (Masi *et al.* 2017). So, as with the results of previous studies, we show that combining physical activity with a healthy diet is sufficient to prevent diabetes, particularly in adolescents.

Maimunah (2020), describes that people who don't consume healthy food and do not notice the nutritional intake they consume have a potency of 2,494 times more likely to have diabetes mellitus compared with people who consume healthy food as well as notice the intake of nutrition. This is in line with studies Suryani et al (2016), which state that people who don't have a healthy diet are at a much

greater risk of being affected by diabetes mellitus compared with people who maintain a healthy diet.

According to the findings of Lestari et al. (2022), the obedience pattern has a significant impact on blood sugar levels in patients with diabetes mellitus of 0.000 (0.05), as well as physical activity 0.000 (0.05), indicating the existence of an impact on blood sugar levels in patients with diabetes mellitus. As with the findings of Anderson et al. (2022), the amount of fruit and vegetables consumed increased ($= 1.51, p = .049$), as did physical activity ($= 1.51, p = .049$) to prevent the rate of glucose increase. Furthermore, Suryani et al. (2016) found an indigo P Value = 0.035 0.05 in patients with diabetes mellitus who engage in physical activity, indicating an existence of contact between physical activity and the incidence of diabetes mellitus, while the pattern of eating healthily shows p value = 0.010 0.05, indicating an existence of contact between the pattern of eating healthily and the incidence of diabetes mellitus.

Third, results studies Nurjana, et al (2019), show that people who do not engage in physical activity have a 3,198-fold increased risk of developing diabetes mellitus compared to people who engage in physical activity heavily every day. People who consume food processed from flour like a biscuit have a 1.198 times greater risk of having diabetes mellitus compared with the general population who do not consume food processed from flour.

Juwita dan Febrina (2018), also recommends maintain a healthy eating pattern that includes consuming fruit and vegetables, replacing rice and side dishes with a frequency of 2 to 3 times a day with a portion of 2 tablespoons and do not add, and performing DM therapy management such as, for example, pharmacological therapy, alternative therapy, and supportive therapy, and most importantly, adherence to control from self-awareness and also support from family. This is also in line with (Wigiyandiaz *et al.* 2020) who said that awareness could originate from a perception of a teenager having diabetes mellitus because of family history. This is also in line with Kekenusa *et al* (2013), who also said that teenagers with a family history of having diabetes mellitus have a 5 times greater risk of having diabetes mellitus compared with teenagers who don't have a family history of having diabetes mellitus.

This is a little contrary to the results of a study from Azitha *et al.* (2018), who said that activity physique has no connection with the rate of glucose in blood in patients with diabetes mellitus. Activity physically is greatly influenced by its intensity, so it will have an effect on the rate of glucose in the blood. It's important to provide education to youth about how to do physical activity correctly and the right way to consume healthy food.

In accordance with studies Sami *et al.* (2020), which show many people who don't understand what content just from the food they consume, there are 70.84% of people who consume meat but confess to having consumed healthy food. Apart from that, there are also 58.38 % who are still consuming milk, and 70.12% who are still consuming *junk food*. Things like this demonstrate a lack of diabetic education.

Besides that, we also do comparison theory and produce the same result. That is, physical activity could help prevent the occurrence of diabetes (Wake 2020). It says that physical activity can support and improve glycemic control and glucose control and also delay the development of other comorbidities that are common in people with diabetes. Physical activity can also improve whole-body metabolic health in diabetic patients

5 CONCLUSIONS

Based on a literature review, we do show that in the age group of adolescents, prevention of diabetes

mellitus can be conducted with a combination of physical activity and dietary pattern. Because this is related to insulin secretion, so glucose homeostasis can be more awake. Despite this, the existence of other diabetes risk factors, such as overweight and obesity, genetics, and a good life pattern, requires further research.

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