

Conference Paper

Description of Cognitive Function in Diabetes Mellitus: A Literature Review

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Cognitive decline in diabetes mellitus is not fully understood, though is generally ascribed to blood sugar levels exceeding normal (hyperglycemia), hypoglycemia conditions and insulin resistance. Cognitive function consists of aspects of memory, attention, executive function, perception, language, and psychomotor functions which affect the decline in cognitive function, especially in people with Diabetes Mellitus. This study aims to summarize the results of research on cognitive function in people with Diabetes Mellitus. The research method used was a literature review with an assessment using JBI critical appraisal tools. Articles were sourced via the PubMed database and Google Scholar using the search term 'Cognitive Function AND Diabetes Mellitus'. The inclusion criteria were studies with quantitative design, full text, a population comprised of patients with Diabetes Mellitus, written in Indonesian or English. Six articles were reviewed, all the results state that patients with Diabetes Mellitus experienced a decrease in cognitive function, especially in the Executive Function, Visuospatial, and the Memory Domains.

Keywords: Cognitive function, Diabetes mellitus, Literature review

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1. Background

Diabetes Mellitus is a chronic disease that occurs when the pancreas is unable to make insulin, or when the body is unable to properly utilize the insulin it produces. Diabetes Mellitus is a contributor to 70% of total disease deaths in the world [1]. Data (International Diabetes Federation) IDF Atlas (2019) shows that the direct costs of handling diabetes reach more than 727 billion USD per year or around 12% of global health financing[2].

Diabetes Mellitus is known as the Silent killer because the sufferer often doesn't realize it and when complications are known to have occurred [3]. Diabetes Mellitus sufferers are at risk of developing serious complications because people with Diabetes Mellitus have twice the risk of developing coronary heart disease, are five times more

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prone to gangrene, are seven times more prone to kidney failure, and 25 times more prone to retinal damage that results in blindness in people with Diabetes Mellitus than in non-Diabetes Mellitus patients [4]. Apart from the complications mentioned above, complications from Diabetes Mellitus can also occur in the brain which can affect cognitive function abilities.

Cognitive function is a complex function that involves aspects of memory, attention, executive function, perception, language, and psychomotor functions. Each aspect is a complex part, as in the memory aspect itself, there are processes for encoding, storing, and retrieving information and can become short-term, long-term, and working memory [5].

The risk of cognitive decline in people with type 1 diabetes mellitus and diabetes mellitus 2 sufferers is not known with certainty. The cause of decreased cognitive function in Diabetes Mellitus is thought to be due to a chronic condition that occurs when blood sugar levels exceed normal due to the body's inability to produce the hormone insulin or due to inadequate use of insulin, resulting in impaired blood flow to the brain which can increase the risk of dysfunction. cognitive [6].

Decreased cognitive function in type 1 Diabetes Mellitus is associated with decreased information processing speed, psychomotor efficiency, attention, mental flexibility, and visual perception [7]. Diabetes Mellitus type 2 is associated with memory deficits, decreased psychomotor speed, and decreased frontal / executive lobe function. Chronic hyperglycemia conditions, long duration of DM, insulin resistance, presence of vascular risk factors (for example, hypertension and obesity), and microvascular and macrovascular complications are associated with an increased risk of developing cognitive dysfunction [7]. It can be concluded that Diabetes Mellitus type 1 and Diabetes Mellitus type 2 have the same risk of reduction..

The impact of decreased cognitive function especially in children with Diabetes Mellitus type 1 has an impact on academic performance. Diabetes Mellitus type 2, especially in the elderly, has an impact with poor diabetes self-management, requires more help during self-care and an increased risk of hospitalization [8].

2. Methods

2.1. Study Design

This type of this research is a literature review method to determine the results of research on the description of cognitive function in elderly people with diabetes mellitus.

2.2. Search Strategy

The literature search was carried out through an analysis of keywords contained in the following databases: Google Scholar and PubMed. The two databases were chosen because they are the largest databases in the health and medicine fields. Searching for articles in the database uses the boolean “AND” and “OR” operators which are used to expand or define a search, making it easier to determine which articles or journals to use. The boolean operators are combined with the keywords used in English, namely “(Cognitive function), AND (Diabetes Mellitus).

2.3. Inclusion / Exclusion Criteria

The search focused on journals that examined “Overview of Cognitive Function in Diabetes Mellitus sufferers” with inclusion criteria including: Quantitative Design, using quantitative methods published in the last 5 years (January 2015 to May 30, 2020), Full text article, Respondents with Diabetes Mellitus, Have never done a cognitive examination before, Indonesian and English language journals, while the exclusion criteria included: systematic review articles or literature reviews, randomized controlled trial research design.

2.4. Data Extraction

The data was extracted by the researcher and summarized using the JBI data extraction tool. The data taken by the researcher included the name and year of the study, the place of origin of the study, the focus of the study, the research method, the characteristics of the respondent (age and gender), the sample, the instrument, the place of the study, and the results of the study.

2.5. Methodological Assessment

The quality assessment of each article was carried out using the JBI standard format (the Joanna Briggs Institute critical assessment tool) and the PRISMA guidelines. We used the PRISMA guidelines for protocol review and study selection. The process of selecting the articles reviewed consists of 4 steps based on PRISMA *guidelines, namely: identification, Screening, Eligibility, and Included.*

The quality assessment of each journal or article is carried out using the standard format from The Joanna Briggs Institute (JBI). In total there are 8 checklist items which include an explanation of the inclusion and exclusion criteria, subject and place of research, valid instruments, specific standard instruments, confounding factors, valid and reliable measured results, correct use of statistics. There are four answer choices in the JBI, namely yes = if it matches the JBI checklist item, no = if it does not match the checklist, unclear = if the research journal is explained but not complete, not applicable = cannot be applied. The conclusion is based on the results of the review and directly from the results of the review, the more yes answers in the JBI critical appraisal column, the better and more valid the journal will be.

2.6. Summary of search results

Based on the results of the assessment using the JBI critical appraisal, the average result of the six journals is 100%

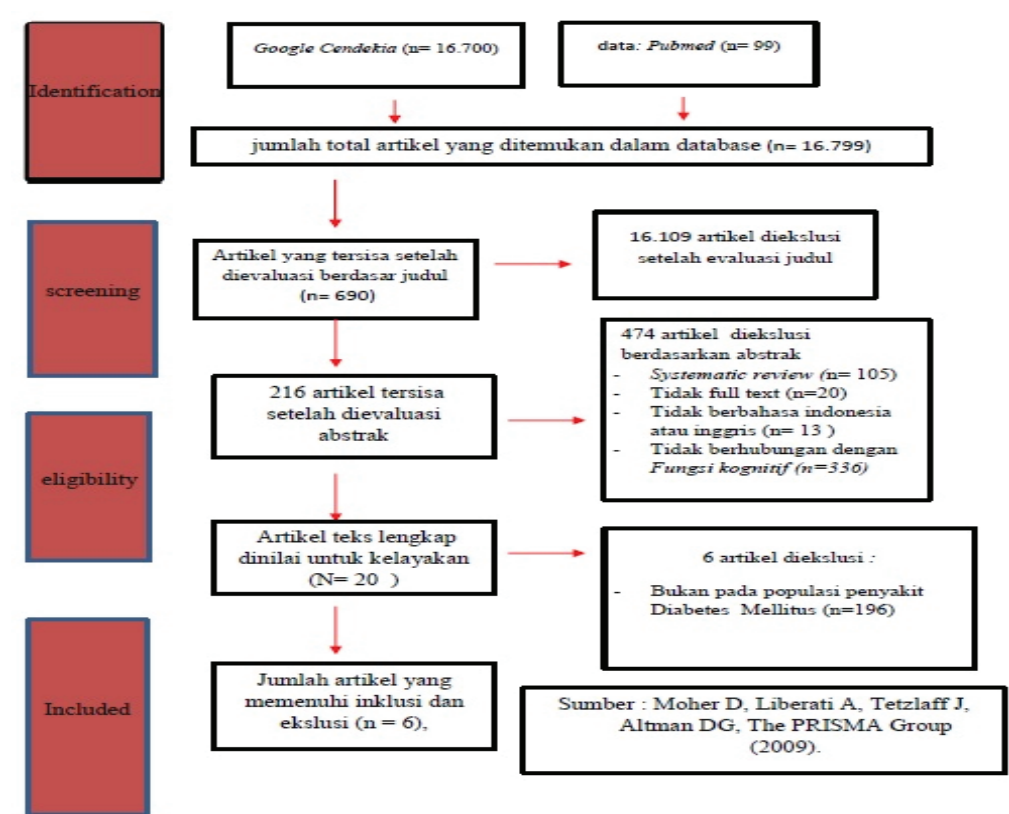


Figure 1: flowchart PRISMA

3. Results

A review conducted on 6 research articles [9] concluded that 38 (54.29%) type 2 diabetes mellitus patients experienced mild cognitive decline (MCI) (MoCA score <26) and 32 (45.71%) have normal cognitive function (MoCA score \geq 26). From the MoCA test instrument, the domains of executive function, naming, attention, language, and memory showed statistically significant differences between the domains in cognitive good patients (NC) and the domains in patients with mild cognitive impairment (MCI). HbA1c, FBS, and PPBS levels showed a negative correlation with the MoCA score.

Research [10] concluded that cognitive disorders in this study were important, namely as many as 47 subjects (48.5%) had cognitive impairment even after excluding the main factors contributing to cognitive decline such as age, history of stroke, intracranial bleeding, surgery, tumors and infections. The Indonesian version of the MoCA (MoCA-INA) has proven to be very sensitive in detecting mild cognitive impairment. The MoCA scores indicate seven domains of cognitive impairment. Delay records were the domain with the least cognitive impairment (94.8%), then language, and visuospatial / executive function whereas naming was the least cognitive impairment domain (10.3%).

Research by [11] concluded that obese participants with diabetes, especially those with central obesity reported poorer cognitive function and a higher risk of dementia than normal weight patients with type 2 diabetes. Memory, especially the term memory, appears to affect cognitive decline. This study also showed a clear reduction in general cognitive decline in obese subjects with diabetes compared with non-diabetic subjects with diabetes.

The research by [12] concluded that the scores of both the MMSE and MoCA instruments in the T1DM group resulted in a lower assessment than the control group. For the MMSE scale, the orientation score and language function in the Diabetes Mellitus type 1 group were lower than in the control group. For the MoCA Scale, scores of attention and concentration, visuospatial / executive function, memory, language function and abstraction) were lower in the T1DM group than in the control group.

Research by [13], 174 (33.73%) met the criteria for cognitive impairment, while 342 (66.27%) had cognitive abnormalities. The risk of cognitive decline is higher in women, from the results of the study found that there were 98 women (56.33%) and 76 people (43.67%). About 18% of the subjects in this study were diagnosed with > 10 years of diabetes, which can affect the prevalence of cognitive impairment. This study also obtained scores for cognitive measurement domains on attention domain, executive function and low short-term memory and this domain has an effect on cognitive decline.

Research by [14] T-test showed that the T2 DM group had significantly lower scores for MMSE and MoCA than the control group (all $p < 0.05$). Diabetes Mellitus type 2 negatively affects MMSE scores, the sub-tests (i.e., attention and language) of the MMSE, the MoCA, and the sub-tests (i.e., visuospatial / executive reasoning, attention, and language skills) of the MoCA (all $p < 0, 05$). Diabetes Mellitus type 2 did not significantly affect all of the MMSE and MoCA.

The conclusion of the five journals is that 6 articles of them have a significant relationship between cognitive function and Diabetes Mellitus and it can be seen from these 6 articles that Diabetes Mellitus sufferers have a significantly lower cognitive assessment, especially compared to the control group. Domain of cognitive function Memory and executive function are mostly experienced from the 6 articles analyzed.

TABLE 1: Characteristics of Included Studies (N = 6).

No	Author, year and Place	Methods	Result	JBI Score
1.	Lalithambika, <i>et al</i> , (2020). India	Desain: Cross Sectional Sample: 70 patients with Type 2 Diabetes Mellitus (Men 57, Women 13) Age: 35-67 Years Instrument: Montreal Cognitive Assessment (MoCA) English Version	- 38 (54.29%) patients with type 2 diabetes mellitus had MCI (MoCA score < 26) and 32 (45.71%) had normal cognitive function (MoCA score ≥ 26) of the two instruments - From the MoCA test, the domains of executive function, naming, attention, language, and memory showed statistically significant differences between the NC and MCI domains.	87,5%
2.	Damanik, <i>et al</i> , (2019) Jakarta, Indonesia	Desain: Cross Sectional Sample: 97 Diabetes Mellitus type 2 patients (Men 52, Women 45) Age: Respondent aged < 60 years Instrument: Montreal Cognitive Assessment (MoCA) Indonesia Version	- MoCA (MoCA-INA) is proven to be very sensitive in detecting mild cognitive impairment - The MoCA score shows there are seven cognitive impairment domains. Delay record is the domain with the most cognitive impairment (94.8%), then language, and visuospatial / executive function whereas naming is the least cognitive impairment domain (10.3%).	100%

No	Author, year and Place	Methods	Result	JBI Score
3.	Zhou Zhang, <i>et al</i> , (2019), China	<p>Desain: <i>Cross Sectional</i> Sample: 105 Diabetes Mellitus type 2 patients (Men 59, Women 46) 35 people who are fat and 35 people who are not with type 2 diabetes and 35 healthy Age: Respondent aged <60 years Instrument: - Montreal Cognitive Assessment (MoCA) Beijing Version, - Mini-Mental Status Exam (MMSE)</p>	<ul style="list-style-type: none"> - Obese participants with diabetes, were found to have worse cognitive function and a higher risk of cognitive decline than patients of normal weight with diabetes - The domain of executive function and memory, especially short-term memory, affects the decline in cognitive function - Duration of diabetes, age, sex, years of education, and alcohol and smoking habits affect congenital function, especially in T2 DM respondents with obesity. 	100%
4.	Ding, et al,(2019), Suzhou, China	<p>Desain: <i>Critical Trial</i> Sample: 118 adults with 70 Diabetes Mellitus type 1 andm 48 healthy without chronic disease) (Men 62, Women 56) Age: >18 years (average age 31 years) Instrument: - Montreal Cognitive Assessment (MoCA) - Mini-Mental Status Exam (MMSE) \</p>	<ul style="list-style-type: none"> - The scores of both the MMSE and MoCA instruments in the T1DM group were lower than the control group. - MMSE scale, the orientation and language function scores in the T1DM group were lower than in the control group. - MoCA Scale, scores of attention and concentration, visuospatial / executive function, memory, language function and abstraction) were lower in the T1DM group than in the control group. - Duration of diabetes, age, and education affect cognitive declin 	100%
5.	Shallu Khullar, et al,(2017). Punjab, India.	<p>Desain: <i>Cross Sectional</i> Sample: 516 Diabetes Mellitus type 2 (Men 289, Women 227) Age: 35-65 Years Instrument: - Mini Mental State Examination (MMSE) - A-test trail making - B-test trail making</p>	<ul style="list-style-type: none"> - 174 (33.73%) met the criteria for cognitive impairment, while 342 (66.27%) had normal cognitive. - 18% of the study respondents were diagnosed with> 10 years of diabetes affecting the prevalence of cognitive impairment. Attention, executive function, and memory, especially short-term memory, influence cognitive decline. 	100%

No	Author, year and Place	Methods	Result	JBI Score
6	Yue wang, et al, (2015), China	<p>Desain: Cross Sectional</p> <p>Sample: 454 participants. 188 patients with Diabetes Mellitus Type 2 and 266 control groups (patients with DM T2 Men 95, Women 93, Control groups 138 Men, 128 Women)</p> <p>Age: The average age was 60 years</p> <p>Instrument:</p> <ul style="list-style-type: none"> - Montreal Cognitive Assessment (MoCA) Beijing Version, - Mini-Mental Status Exam (MMSE) 	<ul style="list-style-type: none"> - DM T2 group had significantly lower scores on both the MMSE and MoCA questionnaires than the control group (all p <0.05). - DM T2 affects the MMSE score, the sub-test (ie, attention and language) of the MoCA, the sub-test (ie, visuospatial / executive function, attention, and language skills) of the MoCA (all p <0.05). - MoCA scores age, gender, educational status, affect cognitive - MoCA instrument Better at measuring cognitive function than MMSE 	100%

4. Discussion

Based on the results of a literature search from 16,799 articles obtained, there were 6 articles that met the inclusion criteria. These studies identify a picture of cognitive function in people with Diabetes Mellitus. Of these 6 articles, there is a significant relationship between cognitive function and Diabetes Mellitus and it can be seen in the study of 6 articles that people with Diabetes Mellitus have a significantly lower cognitive assessment, especially from the control group. Domain of cognitive function Memory and executive function were widely experienced from the 6 journals analyzed.

The domain of cognitive function is the Executive Function domain, the Memory domain. The executive function domain influences decision making, for example to determine what actions need to be taken to carry out a task [15]. A decrease in cognitive function in memory is associated with new memory. Old memory is usually relatively good or slightly decreased, but the entry of new information can decrease [16].

Age also affects cognitive function, the older the more the risk of experiencing cognitive impairment. Increasing age, body functions are physiologically decreased, and there is a decrease in insulin secretion or resistance so that the ability of the body's function to control high blood glucose is less than optimal

Long suffering from Diabetes Mellitus affects cognitive function decline. According to Fitriani, [17], the longer you suffer from diabetes mellitus, the ability to work memory

decreases and experiences a significant deterioration in the speed of completing tasks and executive functions which are part of working memory.

Education affects the duration of cognitive decline. The effect of education can indirectly affect a person's cognitive function, including training (direct training). Of the few used to measure cognitive function. The MoCA instrument is considered more sensitive and has a higher specificity for detecting decreased cognitive function with MoCA sensitivity (90%) and specificity (100%).

5. Conclusion

Based on the results of the review literature from 6 articles, it can be concluded that all of the results of the review of Diabetes Mellitus sufferers experienced a decrease in cognitive function, especially in the Executive Function domain, and the memory domain, which was the most dominant, experienced a decrease in cognitive function. Age, duration of suffering, and education affect cognitive decline. The MoCA instrument is an instrument that is superior, more sensitive and has a higher specificity for detecting cognitive decline than others, especially the MMSE instrument.

The results of this literature review can be used as teaching and learning materials for students in health universities as a form of increasing understanding regarding diseases that almost attack all organs of the body including the heart, blood vessels, eyes, kidneys, to the nervous system. The results of this literature review are useful in relation to improving health services, and also support increased motivation for client compliance in living a healthy lifestyle. This literature review can be an overview of early detection that can be done in people with diabetes mellitus.

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Conflict of Interest

The authors have no conflict of interest to declare

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