FAMILY INTEGRATED SELF-MANAGEMENT EDUCATION ON LIPID PROFILE IN TYPE 2 DIABETES MELLITUS PATIENTS: META-ANALYSIS

Akhmad Azmiardi[1)], Bhisma Murti[2)], Ratih Puspita Febrinasari[3)], Didik Gunawan Tamtomo[4)]

[1)]Doctoral Program of Public Health, Universitas Sebelas Maret
[2)]Masters Program in Public Health, Universitas Sebelas Maret
[3)]Department of Pharmacology, Faculty of Medicine, Universitas Sebelas Maret
[4)]Faculty of Medicine, Universitas Sebelas Maret

ABSTRACT

Background: Self-management education is an essential part of diabetes care and family support is known to be a critical component of in self-care to achieve better health outcome such as lipid profile. This study aimed to review systematically the effect of family integrated with self-management education on lipid profiles in patient with type 2 diabetes.
Subjects and Method: Systematically searching was carried out on electronic databases, including PubMed, Cochrane Library, ProQuest, Springer link, Science direct, Scopus, and Google scholar for English language articles published from 2000 until 2020. Randomized controlled trials that evaluated the family integrated self-management education in patients with type 2 diabetes were included. The effect size was estimated as standard mean difference (SMD), with a confidence interval (CI) of 95% utilizing a fix-effects model.
Results: Eight randomized controlled trials were encompassed in the meta-analysis. Family integrated self-management education compared with usual care show that total cholesterol (SMD= -0.08; 95% CI -0.20 to 0.05; p=0.25), triglyceride (SMD= 0.03; 95% CI -0.11 to 0.17; p=0.71), HDL (SMD= -0.01; 95% CI -0.32 to 0.29; p=0.95), and LDL (SMD= 0.05; 95% CI= -0.22 to 0.32; p=0.73) were statistically did not significant. This finding show that family integrated in self-management education had no effect on lowering lipid profile
Conclusion: Family integrated in self-management education has no effect on lowering lipid profile among people with type 2 diabetes.

Keywords: meta-analysis, family, self-management, lipid profiles, type 2 diabetes

Correspondence:
Akhmad Azmiardi. Doctoral Program of Public Health, Universitas Sebelas Maret. Jl. Ir. Sutami 36A, Surakarta, Central Java. Email: aazmiardi@gmail.com

BACKGROUND

Diabetes mellitus is global public health issue with a substantial effect on the cost of living and human health. Type 2 diabetes mellitus (T2DM) is a metabolic problem in the production and response to insulin or insulin resistance and accounts for around 90% of all diabetes cases (American Diabetes Association, 2018; Galicia-Garcia *et al.*, 2020). The number of people with type 2 diabetes is rising in almost every country and 80 percent of adults with diabetes live in low- and middle-income countries (Lin *et al.*, 2020; Lam *et al.*, 2021).

The International Diabetes Federation (IDF) has estimated a rise of

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693 million people with diabetes by 2045 (Cho *et al.*, 2018). For people with diabetes, there is a marginally higher chance of mortality than in the population without diabetes. Type 2 diabetes is a chronic disease with a major characteristic called hyperglycemia. Hyperglycemia is triggering defects in insulin secretion and/or its mechanism of action, causing disorders in distinct organs and systems (Jiménez *et al.*, 2020). A high level of hyperglycemia in diabetes is able to lead to micro and macrovascular complications.

Macrovascular complications in type 2 diabetes mellitus can cause several diseases including cardiovascular disease, stroke, and peripheral artery disease (Rangel *et al.*, 2019). There are several factors showed a strong association with macrovascular complication in type 2 diabetes including high Body Mass Index (BMI), high systolic/diastolic blood pressure, high total cholesterol, high triglyceride, high LDL, low HDL, increased intake of unhealthy foods, sedentary lifestyle, and smoke or do not engage in diabetes self-management behavior (Baena-Díez *et al.*, 2016).

Diabetes self-management education is important aspect in managing the disease to prevent the complication and developing the disease (Haas *et al.*, 2014). In order to initiate and maintaining self-management of diabetes, the role of family is becoming key success to reach better outcome and health condition. Prior systematic review and meta-analysis about the effect of family involvement in DSME on glycemic control for patients with type 2 diabetes that included 17 randomized control trial showed that family involvement in DSME effective to increases glycemic control for patients with type 2 diabetes than standard diabetes self-management education (Azmiardi *et al.*, 2021).

However, there are limited reports and review about whether there is a difference in the lipid profiles between the family integrated diabetes self-management education and standard diabetes management education. This study aimed to review systematically the effect of family integrated with self-management education on lipid profiles in patient with type 2 diabetes. The findings will promote the preparation of evidence-based interventions and help inform future studies.

SUBJECTS AND METHOD

1. Study Design

This was a meta-analysis of randomized controlled trials (RCT's) study that reported by Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) guideline (Page *et al.*, 2021).

2. Searching Strategy

A systematic search of electronic databases and grey literature for relevant papers published in English between 2000 and 2020 was undertaken. Multiple journal databases were used to find relevant articles, including PubMed, SpringerLink, Science Direct, Google Scholar, and EBSCO. The search method included medical subject (MeSH) keywords and PICO framework articles (participants, intervention, comparison, and outcomes). "Type 2 diabetes" AND "self-

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management" AND "diabetes self-management education" AND "family support" AND "Lipid Levels" OR "Lipid Profiles" OR “Total cholesterol” AND “Triglyceride” AND “Low density lipo-protein” AND “LDL cholesterol” AND “High density lipo protein” AND “HDL cholesterol” were utilized in combinations. In addition, for grey literature searches, nonprofit publications such as the Centers for Disease Control and Prevention (CDC), the World Health Organization (WHO), and the American Diabetes Association (ADA) were used.

3. Inclusion and Exclusion Criteria

The inclusion criteria for this study were a randomized controlled trial design, patients with type 2 diabetes, intervention utilizing the DSME program, intervention groups with DSME integrated with family were included and lipid profiles including total cholesterol, triglyceride, LDL and HDL as outcomes. In control group studies included usual care, standard care or waitlist assignment. Non-randomized control trials, studies, intervention did not utilize DSME, no family component, and studies that did not assess lipid profiles as outcome were excluded.

Study Selection

A screening process was conducted by two authors independently (AA and BM). First screening was done by the titles and abstracts of studies. Selected studies then reviewed full paper independently based on predefined exclusion and inclusion criteria and then data were extracted. Any disagreement was resolved by reaching a consensus.

4. Data Extraction

Two author independently (BM and DT) extracted data from included articles into the structured table. The extracted data consisted of the first author, year of publication, study design, settings, country, mean participant age, sample size, duration of intervention, definitions of intervention and control and also lipid profiles.

Bias and quality appraisal

The Cochrane Collaboration tool was used for assessment risk of bias. The Cochrane Collaboration tool had categories including selection bias, performance bias, detection bias, attrition bias, reporting bias, and other bias (Higgins *et al.*, 2011). This tool used the relevant criteria for classification as low, unclear, or high risk. Publication bias was assessed by funnel plot. The funnel plot is a scatter plot based on the predicted effect size on the sample size. The funnel plots will be distributed symmetrically if there is no publishing bias. On the other hand, if the funnel is asymmetrical, publication bias is indicated (Godavitarne *et al.*, 2018).

Statistical Analysis

Review Manager 5.2 was used to performed the analysis. Mean and standard deviation were used for analysis. The result of analysis was presented as in standard mean differences, 95% CI, and heterogeneity (I^2). Then, the data heterogeneity employed Cochran's Q and I^2, with p-values <0.05 for Cochran's Q values and $I^2 \geq 50\%$, suggesting substantial heterogeneity (Higgins, 2003). The meta-analysis result was presented in forest plot. A forest plot is a diagram displaying each experiment's details in

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the meta-analysis and predictions of the total effects (Lewis *et al.*, 2001).

RESULTS

1. Study Characteristics

Figure 1 show the PRISMA flow chart. The initial search resulted in 636 articles obtained from PubMed, SpringerLink, Science Direct, Google Scholar, and EBSCO databases. After removing 19 duplicate articles, 615 articles remained. 598 records were excluded due title and abstracts screening and resulted 17 articles for full review. Due several reasons only 8 articles were selected for meta-analysis. Two studies reported their lipid profile findings in mmol/l and these were converted mg/dl to for analysis.

Table 1 shows the characteristics of the included studies. The number of respondents from all articles included were 947 respondents. The respondents' mean age was ranging from 49.1 to 60.3 years. The sample sizes were ranging from 12 to 113. The duration of diabetes ranging from 3.8 to 15.7 years. The majority of the studies were carried out in the United States (S. A. Brown *et al.*, 2002; Castejón *et al.*, 2013; García *et al.*, 2014; Ing *et al.*, 2016; McElfish *et al.*, 2019), Thailand (Withidpanyawong *et al.*, 2019), Taiwan (Kang *et al.*, 2010), and Brazil (Gomes *et al.*, 2017). Due to the heterogeneity of the study findings, the quality of evidence was rated as moderate.

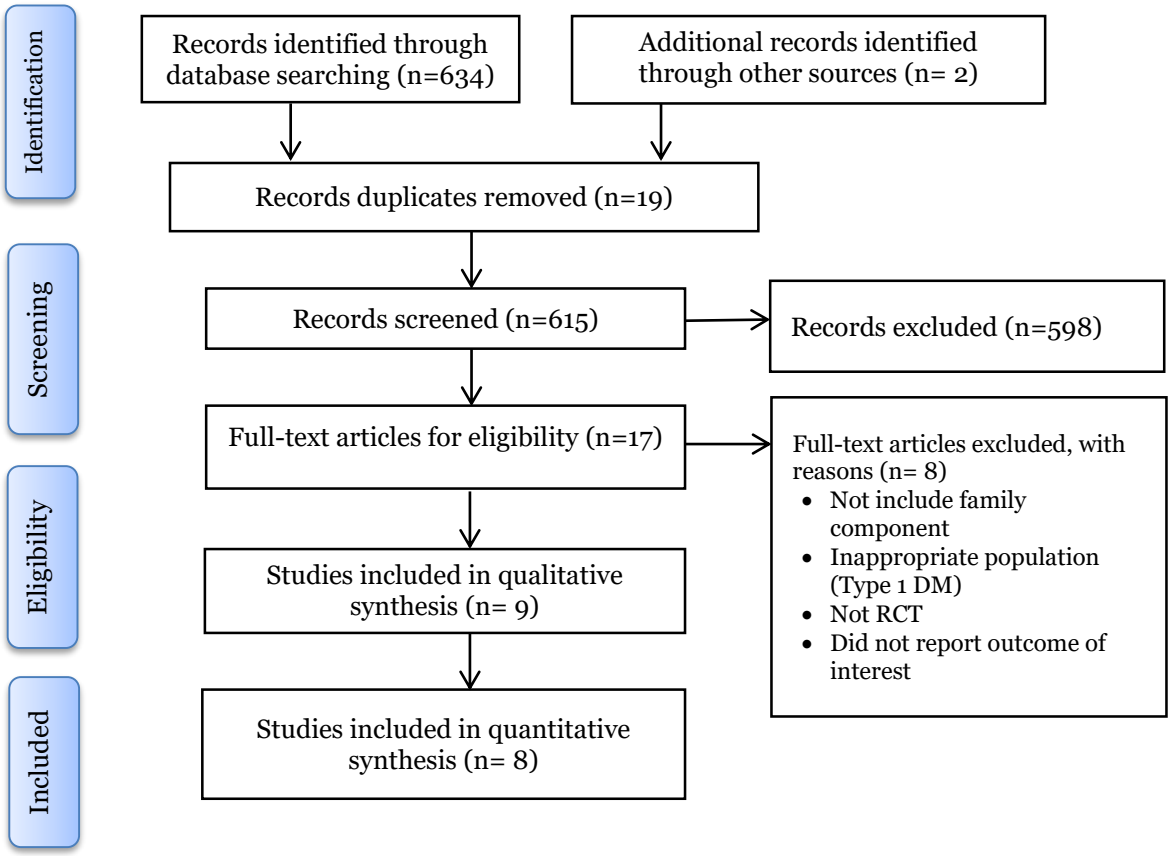

Figure 1. PRISMA flow chart

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Table 1. Summary of 6 randomized controlled trials family involvement in DSME on glycemic control in patients with type 2 diabetes included in the analysis

Author	Year	Country	Design	Diabetes duration (year)		Mean age		Definition of Family	Family involvement in DSME intervention	Control	Duration
				IG	CG	IG	CG				
Brown et al., 2002	2002	US	RCT	7.6	8.1	54.7	53.3	First degree relative	The intervention involved: (1) 3 months of weekly instructional sessions on nutrition, self-monitoring of blood glucose, exercise, and other self-care topics; and (2) 6 months of biweekly support group sessions, family participation, to promote behavior changes.	Usual care	12 month
Kang et al., 2010	2010	Taiwan	RCT	3.8	4.4	55.3	51.7	Family members, or relative.	Comparing family partnership intervention care (FPIC) with conventional care (CC) across a number of outcome measures in patients with poorly controlled type 2 diabetes	Usual care	6 month
Castejón et al., 2013	2014	US	RCT	-	-	54	55	Family member	discussion and counseling sessions on medication, nutrition, exercise, and self-care to promote behavior changes by pharmacists. Sessions were culturally adapted for language, diet, family participation, and cultural beliefs.	Usual care	3 month
García et al., 2014	2015	US	RCT	6.2	7.2	50	49.1	Not-mentioned	8 weeklies, in-home, one-on-one educational and behavior modification sessions with a nurse focusing on symptom awareness, glucose self-testing and appropriate treatments, followed by eight biweekly support telephone session	Wait-listed control	6 month
Ing et al., 2016	2016	Hawaii	RCT	-	-	54.62	54.42	Not-mentioned	Comparing social support groups (SSG) to a control group, SSG receipt family involvement program	Usual care	6 month
Gomes et al., 2017	2017	Brazil	RCT	15.7	7.82	60.43	60.43	A family member or relatives.	The intervention group included a family caregiver, diabetes education provided through telephone calls to patients' family members and caregivers.	Usual care	12 month
Withidpanyawong et al., 2019	2018	Thailand	RCT	5.61	6.35	60.53	58.13	Living in the same Household	A pharmacist delivered the educational sessions and encouraged family members to take an active role in self-management practices for the intervention patients. The control patients received usual care.	Usual care	9 month
McElfish et al., 2019	2019	US	RCT	-	-	52.2	52.2	Living in Same households	The adapted DSME included 10 h of content delivered over an 8-week period and covered eight core elements of DSME. the adapted DSME curriculum engaged family members in the educational sessions delivered by certified educators.	Usual care	12 month

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Table 2. Summary of lipid profiles in included studies

Author	Year	Country	Design	Total Cholesterol				Triglyceride				LDL				HDL			
				Sample (N)		IG	CG	Sample (N)		IG	CG	Sample (N)		IG	CG	Sample (N)		IG	CG
Brown *et al.*, 2002	2002	US	RCT	112	113	189.88 (36.35)	187.64 (42.66)	113	113	214.43 (194.93)	198.65 (148.38)	-	-	-	-	-	-	-	-
Kang et al. (2010)	2010	Taiwan	RCT	28	28	196.68 (32.56)	192.29 (35.18)	28	28	153.04 (62.35)	160.14 (89.12)	28	28	124.92 (29.67)	124.25 (30.81)	28	28	47.75 (8.87)	45.32 (9.66)
Castejon(Castejón et al., 2013)	2014	US	RCT	19	24	169.0 (38.79)	175.0 (42.13)	19	24	198.0 (113.33)	228.0 (186.16)	19	24	91.0 (38.53)	96.8 (26.45)	19	24	37.3 (10.46)	38.3 (12.73)
García et al., 2014	2015	US	RCT	39	33	164.1 (54.33)	195.6 (55.14)	39	33	166.3 (181.72)	224.2 (183.25)	39	33	89.95 (37.47)	106.88 (39.63)	39	33	43.9 (12.49)	44.4 (12.63)
Ing et al., 2016	2016	Hawaii	RCT	22	12	177,12 (32,92)	174,24 (35,52)	22	12	216,78 (175,14)	215,92 (140,63)	22	12	105,13 (34,53)	96,11 (34,63)	22	12	42,47 (12,93)	35,73 (9,71)
Gomes et al., 2017	2017	Brazil	RCT	82	82	166.71 (32.85)	165.4 (43.44)	82	82	210.94 (144.03)	182.78 (134.49)	82	82	95.83 (27.09)	94.27 (33.61)	82	82	34.85 (9.34)	36.28 (8.91)
Withidpanyawong et al., 2019	2018	Thailand	RCT	88	92	195.3 (49.17)	196.4 (44.38)	88	92	68.44 (35.85)	69.61 (32.81)	88	92	119.06 (46.86)	100.6 (39.58)	88	92	45.63 (9.23)	45.64 (8.91)
McElfish et al., 2019	2019	US	RCT	83	90	168.22 (36.54)	179.42 (41.10)	-	-	-	-	-	-	-	-	79	87	36.16 (10.75)	36.31 (9.57)

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2. Total cholesterol

A meta-analysis was conducted using data from 8 studies. The comparison between the family integrated self-management education on total cholesterol did not show the significant result compared with usual care (SMD= -0.08; 95% CI -0.20 to 0.05; p= 0.25) (Figure 2). The heterogeneity was very low (I^2= 18%), and it was statistically non-significant (p=0.29) therefore, a fixed effect model was used. Funnel plot on included studies showed that there was publication bias, it was indicated by the circles location that was in the asymmetrically (Figure 3).

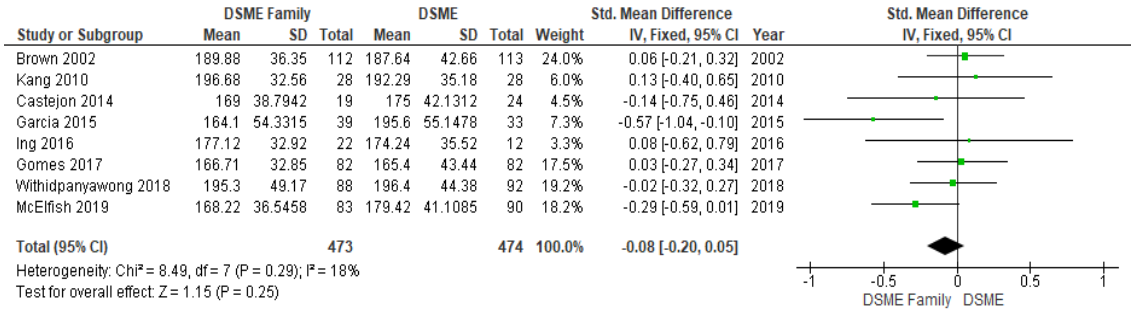

Figure 2. Forest plot of total cholesterol

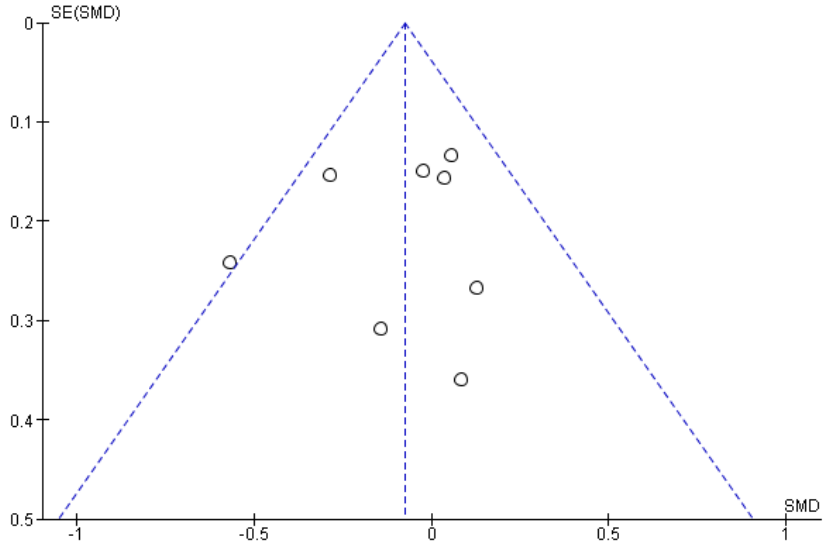

Figure 3. Funnel plot of total cholesterol

3. Triglyceride

A meta-analysis was conducted using data from 7 studies. The comparison between the family integrated self-management education on triglyceride did not show the significant result compared with usual care (SMD= 0.03; 95% CI -0.11 to 0.17; p=0.71) (figure. 4). The heterogeneity was very low (I^2= 0%), and it was statistically non-significant (p= 0.57) therefore, a fixed effect model was used. Funnel plot on included studies showed that there was no publication bias, it was indicated by the circles location that was in the symmetrically (Figure 5).

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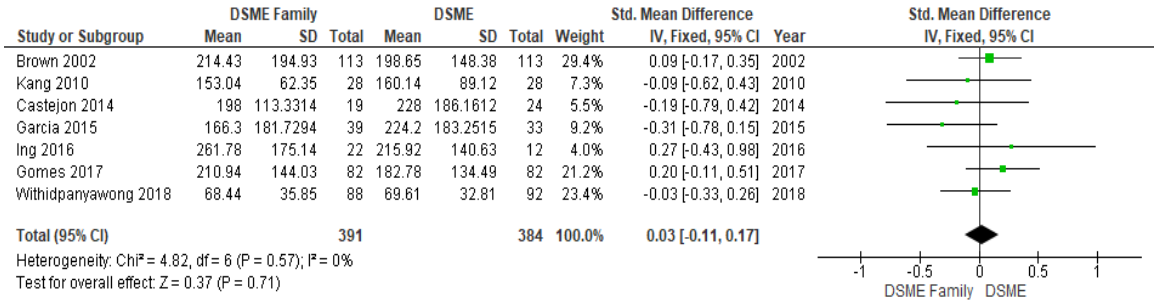

Figure 4. Forest plot of triglyceride

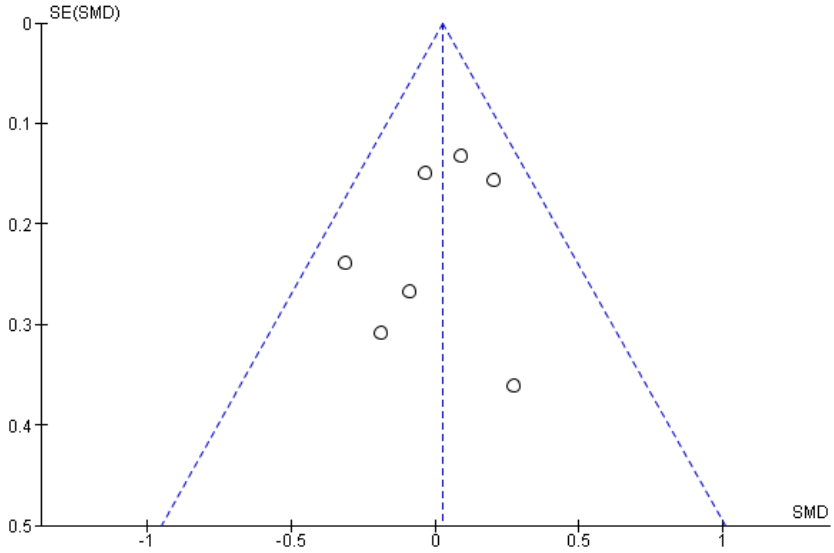

Figure 5. Funnel plot of triglyceride

4. HDL Cholesterol

A meta-analysis was conducted using data from 7 studies. The comparison between the family integrated self-management education on HDL did not show the significant result compared with usual care (SMD= -0.01; 95% CI -0.32 to 0.29; p=0.95) (Figure 6). The heterogeneity was very low (I^2= 0%), and it was statistically non-significant (p= 0.64) therefore, a fixed effect model was used. Funnel plot on included studies showed that there was publication bias, it was indicated by the circles location that was in the asymmetrically (Figure 7).

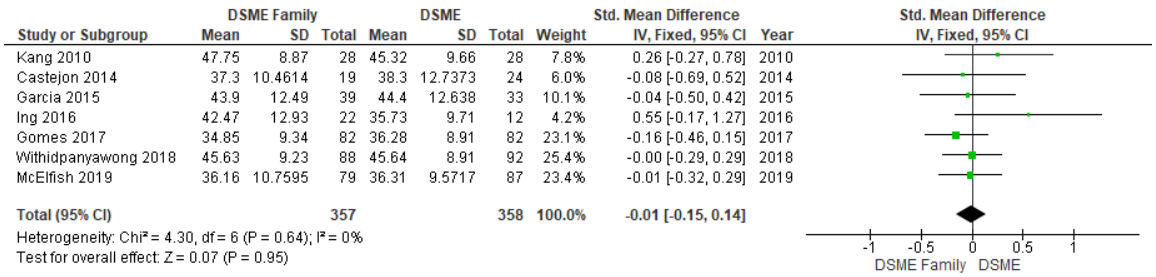

Figure 6. Forest plot of HDL Cholesterol

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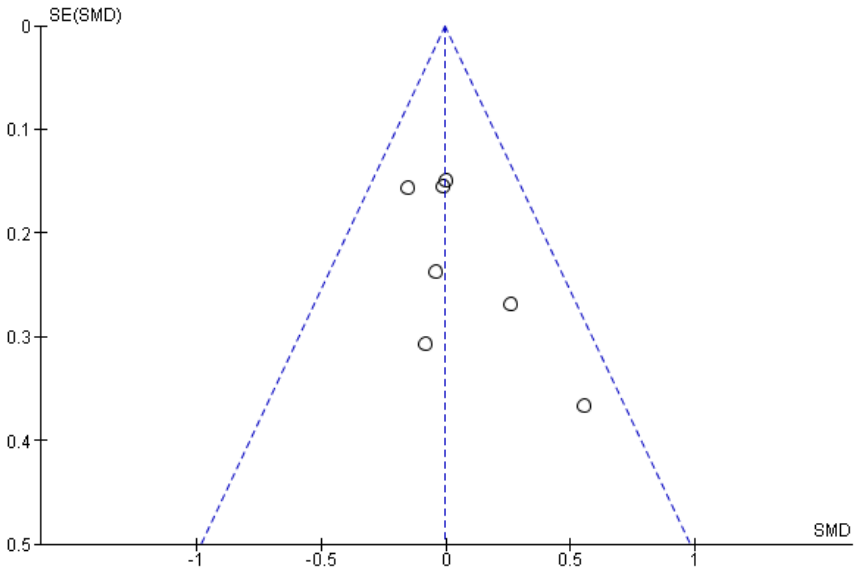

Figure 7. Funnel plot of HDL Cholesterol

5. LDL Cholesterol

A meta-analysis was conducted using data from 4 studies. The comparison between the family integrated self-management education on LDL show significant result compared with usual care (SMD= 0.05; 95% CI= -0.22 to 0.32; p=0.73) (figure 8). The heterogeneity was low (I^2= 54%), and it was statistically non-significant (p=0.06).

Therefore, a random effect model was used. Funnel plot on included studies showed that there was no publication bias, it was indicated by the circles location that was in the symmetrically (figure 9).

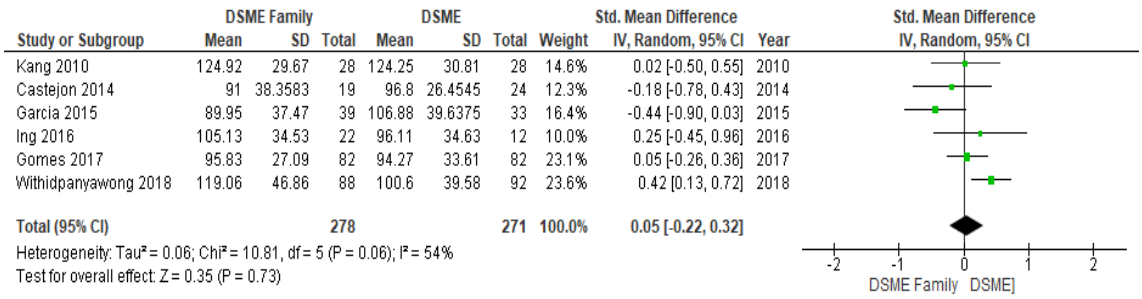

Figure 8. Forest plot of LDL Cholesterol

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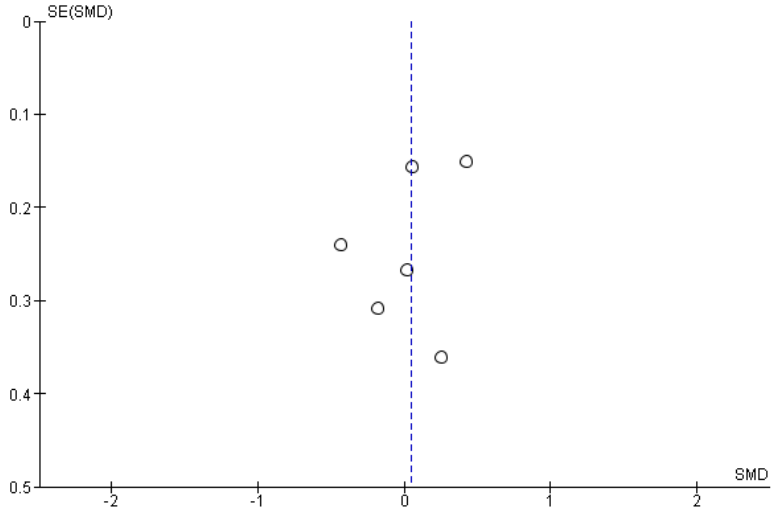

Figure 9. Funnel plot of LDL Cholesterol

DISCUSSION

As chronic disease type 2 diabetes are managed in a variety of ways to maintain health condition, including routine treat-ment as well as health education (Bekele *et al.*, 2021). As an effective method, diabetes self-management education also considered the role of family support as important element to a successful diabetes management (Fiallo-Scharer *et al.*, 2019).

Present meta-analysis was to review studies on family integrated with self-management education on lipid profiles in patient with type 2 diabetes. In this meta-analysis, only randomized control trials were included. This review included eight randomized control trial studies with 947 respondents. Total cholesterol, triglyceride, HDL and LDL cholesterol were assesses in this meta-analysis.

From eight articles included in this study, the findings show the comparison between the family integrated self-management education compared with usual care show that total cholesterol, triglyceride, HDL and LDL did not significant. This finding is in line with prior meta-analysis about group based diabetes self-management education compared to routine treatment for people with type 2 diabetes mellitus that found there were no differences between the groups in mortality rate, body mass index, blood pressure and lipid profile (Steinsbekk *et al.*, 2015).

This insignificant finding could be due to the difficulty in following the diet and the difficulty and complexity in losing weight and lipid profile. Self-care adherence issue that is often faced by diabetic patients is maintaining a better behavior after the end of the intervention period. at the beginning of intervention clinical outcomes including lipid profile showed a significant decrease (< 3 month) but with increasing time the clinical parameters seemed to return to close to the results of measurements at baseline. This results can be seen in several existing studies (Brown *et al.*, 2002; Ing *et al.*, 2016; Withidpanyawong *et al.*, 2019). As an example a study by (Ing et al., 2016) revealed that the mean total cholesterol level among the

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participants decreased significantly in the initial measurement (Mean= −11.38; SD= 36), in the three month (Mean= 3.14; SD= 23.57) and in the sixth month (Mean= −5.43; SD= 49.94) (Ing *et al.*, 2016).

Interventions targeting glucose, blood pressure, and lipid profile concurrently have the potential reduction in cardiovascular events and the risk of microvascular complications. Reduction of hbA1C and improvement of blood pressure and lipid profile is expected to have a major impact on the prevention of morbidity and mortality (Boer *et al.*, 2017).

Application of diabetes self-management for educational intervention that aims to determine its effect on lifestyle, body mass index and cholesterol. Lifestyle changes that tend to be unhealthy, nutrition, communication, interpersonal communication/ support and stress management in addition to diabetes also increase cholesterol, HDL and LDL and body mass index (Evert *et al.*, 2013).

Our findings are less clear in several areas. Because it is not possible to clearly identify whether the patient, provider, intervention or combination is most effective. The results also did not indicate the location of care such as hospital, primary care, or community as the best place for intervention. Other features appear to have a positive effect, but definitive conclusions cannot be made due to the low number of studies identified. These features require further study to design interventions, delivery of comprehensive co-management education and family support to be part of problem solving.

This meta-analysis has several limitations. First, the researchers limited the selection of publications only to articles in the English language. Second, only peer-reviewed and published papers were evaluated. There was no assessment of grey literature, unpublished work, or dissertation studies. Third, the number of studies is frequently limited by the selective publication. Fourth, only main databases were used for articles searching. Fifth there were considerable variations found in the intervention programs' components. In conclusion, the current evidence suggests that family integrated in self-management education improves LDL levels in patients with type 2 diabetes.

AUTHOR CONTRIBUTION

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FUNDING AND SPONSORSHIP

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CONFLICT OF INTEREST

We declare that there was no conflict of interest.

REFERENCES

American Diabetes Association (2018). 2. Classification and Diagnosis of Diabetes: Standards of Medical Care in Diabetes—2018. Diabetes Care. 41(1): S13–S27. doi:10.2337/dc18-S002.

Azmiardi A, Murti B, Febrinasari, Ratih P, Didik GT (2021). The effect of family involvement in diabetes self-management education on glycemic control in patients with type 2 diabetes

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mellitus: a systematic review and meta-analysis. J Public Heal Dev. 19(3): 164–190. https://he-01.tci-thaijo.org/index.php/AIHD-MU/article/view/251881.

Baena-Díez JM, Peñafiel J, Subirana I, Ramos R, Elosua R, Marín-Ibañez A, Guembe MJ, et al. (2016). Risk of cause-specific death in individuals with diabetes: A competing risks analysis. Diabetes Care; 39(11): 1987–1995. doi:10.2337/dc16-0614.

Bekele BB, Negash S, Bogale B, Tesfaye M, Getachew D, Weldekidan F and Balcha B (2021). Effect of diabetes self-management education (DSME) on glycated hemoglobin (HbA1c) level among patients with T2DM: Systematic review and meta-analysis of randomized controlled trials. Diabetes Metab Syndr Clin Res Rev. 15(1): 177–185. doi:10.-1016/j.dsx.2020.12.030.

Boer IH de, Bangalore S, Benetos A, Davis AM, Michos ED, Muntner P, Rossing P, et al. (2017). Diabetes and Hypertension: A Position Statement by the American Diabetes Association. Diabetes Care. 40(9): 1273–1284. doi:10.-2337/DCI17-0026.

Brown S, Garcia A, Kouzekanani K, Hanis C (2002). Culturally Competent Diabetes Self. Diabetes Care. 25(2): 259–268.

Brown SA, Garcia AA, Kouzekanani K, Hanis CL (2002). Culturally competent diabetes self-management education for Mexican Americans: The Starr County border health initiative. Diabetes Care; 25(2): 259–268. doi:10.-2337/diacare.25.2.259.

Castejón AM, Calderón JL, Perez A, Millar C, McLaughlin-Middlekauf J, Sangasubana N, Alvarez G, et al. (2013). A community - Based pilot study of a diabetes pharmacist intervention in latinos: Impact on weight and hemoglobin A1c. J Health Care Poor Underserved; 24(4): 48–60. doi:10.1353/hpu.2014.0003.

Cho NH, Shaw JE, Karuranga S, Huang Y, da Rocha Fernandes JD, Ohlrogge AW and Malanda B (2018). IDF Diabetes Atlas: Global estimates of diabetes prevalence for 2017 and projections for 2045. Diabetes Res Clin Pract. 138: 271–281. doi:10.1016/j.diabres.2018.02.023.

Evert AB, Boucher JL, Cypress M, Dunbar SA, Franz MJ, Mayer-Davis EJ, Neumiller JJ, et al. (2013). Nutrition therapy recommendations for the management of adults with diabetes. Diabetes Care [Preprint]. doi:10.2337/-dc13-2042.

Fiallo-Scharer R, Palta M, Chewning BA, Rajamanickam V, Wysocki T, Wetterneck TB, Cox ED (2019). Impact of family-centered tailoring of pediatric diabetes self-management resources. Pediatr Diabetes. 20(7): 1016–1024. doi:10.1111/pedi.12-899.

Galicia-Garcia U, Benito-Vicente A, Jebari S, Larrea-Sebal A, Siddiqi H, Uribe KB, Ostolaza H, et al. (2020). Pathophysiology of Type 2 Diabetes Mellitus. Int J Mol

Sci. 21(17): 1–34. doi:10.3390/-IJMS21176275.

García AA, Brown SA, Horner SD, Zuñiga J and Arheart KL (2014). Home-based diabetes symptom self-management education for Mexican Americans with type 2 diabetes. Health Educ. Res. 30(3): 484–496. doi:10.1093/-her/cyv018.

Godavitarne C, Robertson A, Ricketts DM, Rogers BA (2018). Understanding and interpreting funnel plots for the clinician. Br J Hosp Med. 79(10): 578–583. doi:10.-12968/hmed.2018.79.10.578.

Gomes LC, Coelho ACM, Gomides D dos S, Foss-Freitas MC, Foss MC and Pace AE (2017). Contribution of family social support to the metabolic control of people with diabetes mellitus: A randomized controlled clinical trial. Appl Nurs Res. 36: 68–76. doi:-10.1016/j.apnr.2017.05.009.

Haas L, Maryniuk M, Beck J, Cox CE, Duker P, Edwards L, Fisher E, et al. (2014). National standards for diabetes self-management education and support. Diabetes Educ. 38: 5.

Higgins JPT (2003). Measuring inconsistency in meta-analyses. BMJ. 327(7414): 557–560. doi:10.113-6/bmj.327.7414.557.

Higgins JPT, Altman DG, Gotzsche PC, Juni P, Moher D, Oxman AD, Savovic J, et al. (2011). The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. BMJ. 343(2): d59-28–d5928. doi:10.1136/bmj.d-5928.

Ing CT, Zhang G, Dillard A, Yoshimura SR, Hughes C, Palakiko D-MM, Kehauoha BP, et al. (2016). Social support groups in the maintenance of glycemic control after community-based intervention. J Diabetes Res. 1–8. doi:10.11-55/2016/7913258.

Jiménez PG, Martín-Carmona J, Hernández EL (2020). Diabetes mellitus. Med Programa Form Médica Contin Acreditado. 13 (16): 883–890. doi:10.1016/j.-med.2020.09.010.

Kang CM, Chang SC, Chen PL, Liu PF, Liu WC, Chang CC and Chang WY (2010). Comparison of family partnership intervention care vs. conventional care in adult patients with poorly controlled type 2 diabetes in a community hospital: A randomized controlled trial. Int J Nurs Stud. 47(11): 1363–1373. doi:10.1016/-j.ijnurstu.2010.03.009.

Lam AA, Lepe A, Wild SH and Jackson C (2021). Diabetes comorbidities in low- and middle-income countries: An umbrella review. J Glob Health. 11. doi:10.7189/-JOGH.11.04040.

Lewis S and Clarke M (2001). Forest plots: Trying to see the wood and the trees. Br Med J. 1479–1480. doi:10.1136/bmj.322.7300.1479.

Lin X, Xu Y, Pan X, Xu J, Ding Y, Sun X, Song X, et al. (2020). Global, regional, and national burden and trend of diabetes in 195 countries and territories: an analysis from 1990 to 2025. Sci. Reports 2020. 10(1): 1–11. doi:-10.1038/s41598-020-71908-9.

McElfish PA, Long CR, Kohler PO, Yeary KHK, Bursac Z, Narcisse

MR, Felix HC, et al. (2019). Comparative effectiveness and maintenance of diabetes self-management education interventions for Marshallese patients with type 2 diabetes: A randomized controlled trial. Diabetes Care; 42(5): 849–858. doi:-10.2337/dc18-1985.

Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, Shamseer L, et al. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 372: n71. doi:10.1136/-bmj.n71.

Rangel ÉB, Rodrigues CO and de Sá JR (2019). Micro- and macrovascular complications in diabetes mellitus: Preclinical and clinical studies. J Diabetes Res. 1–5. doi:10.1155/2019/2161085.

Steinsbekk A, Rygg LØ, Lisulo M, By Rise M, Fretheim A (2015). Group based diabetes self-management education compared to routine treatment, waiting list control or no intervention for people with type 2 diabetes mellitus. Cochrane Database Syst. Rev. (12). doi:10.1002/146-51858.CD003417.pub3.

Withidpanyawong U, Lerkiatbundit S, Saengcharoen W (2019). Family-based intervention by pharmacists for type 2 diabetes: A randomised controlled trial. Patient Educ Couns. 102(1): 85–92. doi:10.1016/j.pec.2018.08.-015.