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REVIEW ARTICLE

The Effects of Physical Activity on Glycated Hemoglobin and Quality of Life in Adults with Diabetes Mellitus: A Systematic Review of the Literature and Meta-Analysis

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ABSTRACT

Background. Diabetes mellitus (DM) is a chronic metabolic disease that causes damage to organs and systems. Physical activity (PA) is essential for its prevention and control, promoting quality of life and reducing the disease's economic impact. **Objectives.** This study aimed to identify the effects of physical activity in young adults over 18 with DM. **Methods.** Systematic literature review, considering the PICO search carried out in international electronic databases (PUBMED, OVID, SCOPUS, WOS, SCIENCE DIRECT, And EBSCO) with keywords such as quality of life, exercise, and DM, clinical trials, assessment of methodological quality with the NIH quality assessment list of controlled intervention studies, risk of bias and statistical analysis with the RevMan program, following the guidelines of the Cochrane Collaboration. **Results.** Eight studies were included with results such that no differences are established compared to the experimental group in quality of life because Tau^2 is homogeneous with an I^2 of zero and a Chi^2 less than the degrees of freedom, and a confidence interval that shows it is not statistically significant. **Conclusion.** The intervention programs and the usual care group cannot detect glycated hemoglobin and PA changes. Regarding the quality of life, an effect is evident in the direction of the control group, so these groups' activities are directed that tend to improve well-being and quality of life through comprehensive interventions that address different spheres so that no differences are detected compared to the experimental group.

KEYWORDS: ***Diabetes Mellitus, Exercise Training, Physical Activity, Adult, Quality of Life.***

INTRODUCTION

From a life course perspective, demographic, social, economic, and other changes must be taken into account when considering health from multiple perspectives; it is evolutionary, it is a resource for human development, it is manifested in the form of health-disease patterns, and it is approached from a human rights perspective (1). This approach serves as a framework for understanding Diabetes mellitus (DM), which, as a non-communicable disease (NCD), requires monitoring for its prevention through appropriate lifestyle habits, including exercise or physical activity (PA). It is important to note that worldwide, DM is responsible for 71% of deaths in people aged 30-69 years old, in addition to the disability resulting from its effects and duration (2, 3).

In addition to the above, aspects such as increased life expectancy, the challenges of contemporary society such as technology, the impact of exposure to risk factors, and the recognition of critical growth and development periods at different life stages must be considered (1, 4). This leads to consideration of addressing DM at earlier ages, such as adulthood, in the case

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of this review, in those over 18 years of age. This perspective aligns with the World Health Organization (WHO), which states that children, adults, and older adults are more exposed to risk factors that lead to NCDs (5). Another aspect of NCDs is the burden on health and economic and social development, including premature mortality, years of life loss, reduced productivity, work absenteeism, loss of household income, increased demand for health services, and treatment costs (6, 7).

DM has a reported prevalence of 62 million people worldwide and is a chronic metabolic disease characterized by high blood glucose levels that cause damage to organs and systems, coupled with a physical inactivity rate of 39.3% in 2016 (8). The different types of diabetes include type 1 (involving β, resulting in insulin deficiency) and type 2 (problems with insulin secretion leading to insulin resistance). Physical activity is essential for preventing and controlling DM and is defined as the voluntary energy expenditure that includes movements that activate the musculature during any activity throughout the day (9). Prevention strategies recommend at least 150 minutes of moderate- or 75 minutes of vigorous-intensity activity per week (10). Prevention and management of DM are essential and more cost-effective, reducing morbidity and mortality. Lack of education and lifestyle change are the main difficulties in prevention.

DM is a public health challenge of this century because of its impact on the health-related quality of life (HRQoL) of individuals, understood as "those aspects related to the perception of health experienced and reported by patients" (11). As DM is a lifelong disease, the consequences are evident in the complications generated by the disease. The increase in global prevalence may be related to sociocultural factors such as increased longevity, obesity, sedentary lifestyle, and so on (12).

It is estimated that more than 450 million people worldwide have DM, which will increase to 693 million by 2045 (13). In Colombia, according to the OPS, DM will cause 9.1 deaths per 100,000 population in 2019, and it is estimated that 10.5% of people with diabetes are between the ages of 20 and 79, of which 90% are type 2 diabetes (14, 15). This prevalence is consistent with global estimates, identifying DM as one of the most prevalent diseases and a significant problem for this century.

Therefore, in addition to considering the physiological and functional effects of the disease, its impact on the quality of life of those affected, and the cost of treatment, DM is now considered a social disease due to its high economic cost to families and governments (12). Diabetic patients consume twice as many resources as non-diabetic patients within the health care system of each country, with costs increasing with chronic complications (16).

For these reasons, DM is now considered a public health problem (17) due to its physical and emotional impact, its progressive deterioration (18), and its long-term treatment (19). Cárdenas et al. affirm that the decrease in quality of life in people with DM is related to a decrease in "physical functioning," a decrease that is complicated when factors such as being female, older, physically inactive, living alone, or not covered by social security affiliation are also present (19). Efforts should focus on this population because of the importance of quality of life and not only on quantifying clinical parameters such as morbidity and mortality (20), a statement that is consistent with Mata et al. regarding the lower quality of life in the population with similar sociodemographic characteristics but without this disease (21). For these reasons, this article aims to recognize the effects of physical activity in young and adult individuals over 18 years old with DM.

MATERIALS AND METHODS

Protocol and registration. The systematic literature review (SLR) (22) was developed based on the PICO acronym, a transparent and reproducible search strategy (23). This review was registered in PROSPERO with the ID CRD42023394747 and was constructed as follows:

Population: Young adults over 18 years of age with type 2 DM, considering young and adulthood, according to the WHO (24).

Intervention: Performing PA, considered as body movements performed by muscle contraction that require energy expenditure (25), refers to any movement performed by the individual in daily life activities (26).

Comparison: Usual care (i.e., no PA), diet, nutrition, or other health programs.

Outcome: Primary outcomes included an assessment of the quality of life, understood as a concept encompassing multiple aspects such as functionality, cognitive activity, social interaction,

and others such as economic factors, spiritual or existential concerns, and body image, among others (27), and secondary outcomes included changes in blood glucose levels, body mass index (BMI), and other symptoms such as polydipsia, polyphagia, polyuria.

Literature search strategy. The search was conducted in international electronic databases, including PUBMED, OVID, SCOPUS, Web of Science (WOS), SCIENCE DIRECT, and EBSCO, and included articles in all languages to control for the Tower of Babel bias. According to Robinson and Dickersin (28), to establish a sensitive search equation for the selection and systematization of studies, the search terms were:

(adult OR "young adult") (Life Quality OR Health-Related Quality Of Life OR Health Related Quality Of Life OR HRQoL) (Exercises OR "Physical Activity"* OR "Activities, Physical" OR "Activity, Physical" OR "Physical Activities" OR "Exercise, Physical" OR "Exercises, Physical" OR "Physical Exercise" OR "Physical Exercises" OR "Acute Exercise"* OR "Acute Exercises" OR "Exercise, Acute"* OR "Exercises, Acute" OR "Exercise, Isometric"* OR "Exercises, Isometric" OR "Isometric Exercises" OR "Isometric Exercise"* OR "Exercise, Aerobic"* OR "Aerobic Exercise"* OR "Aerobic Exercises" OR "Exercises, Aerobic" OR "Exercise Training"* OR "Exercise Trainings" OR "Training, Exercise" * OR "Trainings, Exercise") ("Diabetes mellitus" OR "diabetes mellitus tipe 1" OR "diabetes mellitus tipe 2") ("clinical trial" OR "clinical trials as topic" OR "clinical trial" "random allocation" OR randomized") NOT aged OR elderly

Eligibility criteria. Inclusion criteria included articles from randomized controlled and non-controlled clinical trials. Articles with samples of people with gestational diabetes and juvenile diabetes were excluded. As with the review studies, at the time of the search, the strategy was based on the aforementioned English terms, which yielded results in Spanish and English.

Study selection. Two blinded reviewers carried out electronic searches, and the results were processed using the Rayyan program, which allows for the automatic identification of possible duplicates through word matching, which then has to be confirmed by the researchers and in the review phase by title and abstract, which was carried out independently by the researchers, maintaining the blinding and excluding those that did not meet the inclusion criteria; by reading the titles and abstracts, the texts to be reviewed in full text were identified and selected based on the inclusion criteria, with any discrepancies resolved by consensus. A total of 1474 were identified: Science Direct (470), Scopus (301), Ovid (578), Pubmed (26), WOS (23), and EBSCO (76). In EBSCO, 35 were eliminated for duplicates, and in Rayyan, 247 were eliminated in the text selection.

Methodological quality assessment. The methodological quality assessment of the included articles was assessed using the National Heart Lung and Blood Institute – NIH controlled intervention study appraisal checklist (29). After the final articles were identified according to the inclusion and exclusion criteria, the risk of bias was assessed using the RevMan program according to the Cochrane Collaboration guidelines (30).

RESULTS

A random effects model was used for the statistical analysis in the RevMan. This model assumes heterogeneity and random distribution in the studies. As they were continuous variables, standardized mean differences (SMD), mean (M), and difference of means (DM) were considered as parameters. Heterogeneity analysis was then performed using Chi^2, degrees of freedom, and p-value to determine I^2 and Tau^2. The combined analysis was calculated using standardized mean differences or differences of means for continuous variables with a 95% confidence interval (CI) and a significance level of $p<0.05$.

Clinical heterogeneity was assessed by treatment or intervention time, established protocols, treatment duration, subject characteristics, etc. In addition, statistical heterogeneity was estimated using I^2 with the following cut-off points: 0 to 40% may not be essential, 30% to 60% may represent moderate heterogeneity, 50% to 90% may represent substantial heterogeneity, and 75% to 100% may represent substantial heterogeneity according to Higgins and Green (30). Therefore, an analysis of quality-of-life in people with DM according to PA performance was performed, with effect estimates according to the described analysis model. Publication bias was analyzed using a funnel plot, and effect estimates were calculated using the Cochrane Review Manager 5.3 software.

Two blinded reviewers conducted electronic searches, and the results were processed using the Rayyan program. By reading the title and

abstract, texts to be reviewed in full text were identified and selected based on the inclusion criteria, with any discrepancies resolved by consensus. Once the articles to be included were obtained, the characteristics of each study were identified (sociodemographic information, sample characteristics, PA, exercise, diabetes mellitus, etc.). The selection process is shown in the flow figure and the PRISMA 2020 criteria (31), as shown in Figure 1.

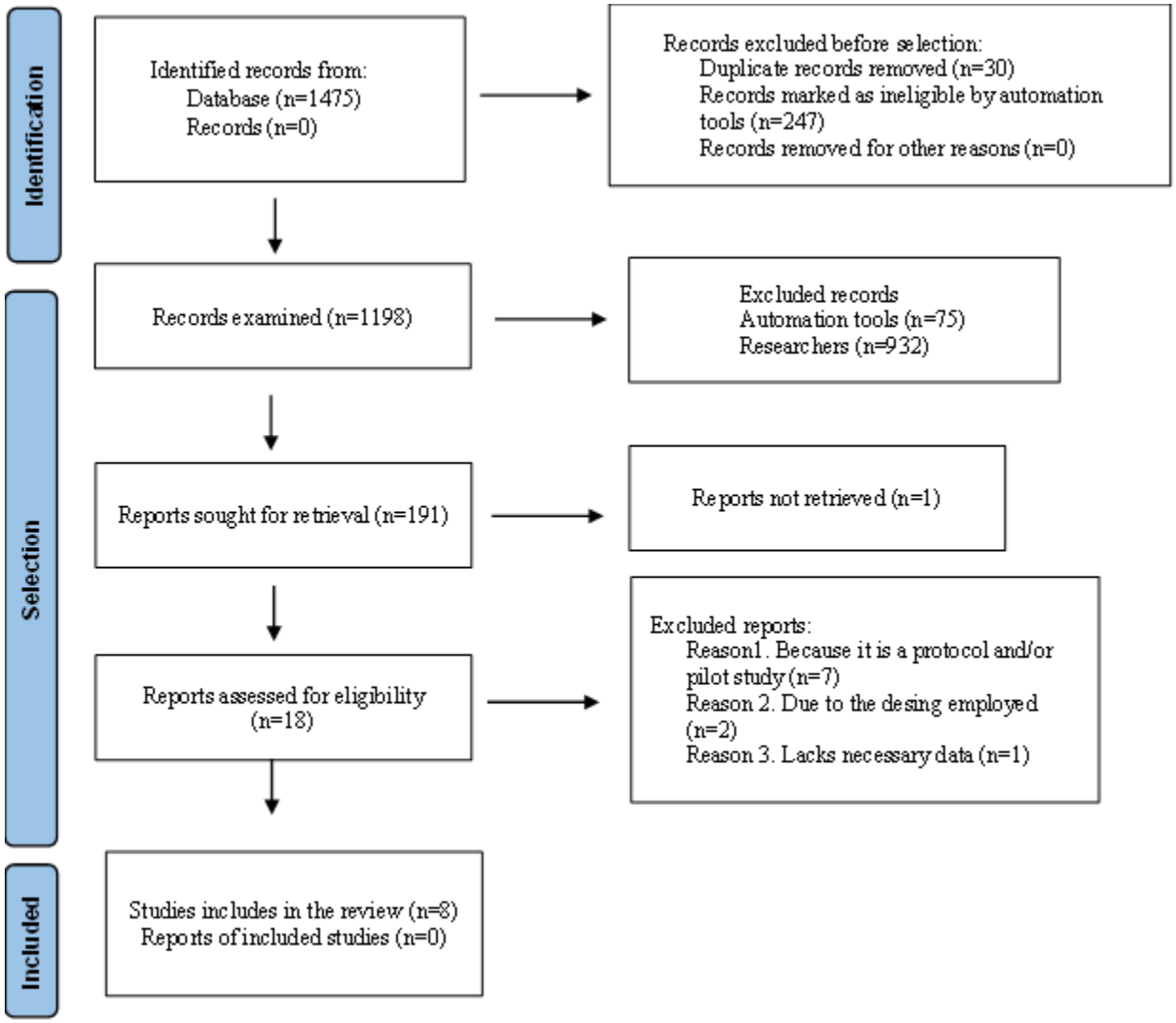

Figure 1. PRISMA 2020 flow diagram.

Data Extraction. Adults characteristics: The studies included 2447 subjects, of whom 1285 were assigned to the experimental group and 1162 to the control group, aged between 18 to 80 years old, all diagnosed with type 2 DM.

Characteristics of the intervention group: The population included in the different studies met inclusion criteria such as age, diagnosis of type 2 DM, and according to each study, were assigned to the control group with usual care and to the intervention group characterized by performing PA through different strategies or programs as described below (see Table 1):

Methodological Quality Assessment and Risks of Bias. The methodological quality of the included articles was assessed using the National Heart Lung and Blood Institute – NIH checklist (29). Regarding quality, parameters related to the blinding of assessors, participants, and providers are identified as less controlled, which is essential to ensure the data's reliability and, thus, the project's internal validity (see Table 2).

Table 1. Qualitative results

Study	Intervention	Population	BMI (kg/m^2)	Total sample size		Test	Results	Country/Year of Publication
				F	M			
Schmid et al. (32)	Yoga for 8 weeks, 2 times a week for 16 sessions	Over 18 years old, a total of 18 participants, 9 in each group. Mean age of 54.9±9.94	NR	12	6	RAND-36	Improve in pain, balance, upper and lower extremity strength, and quality of life.	USA/2018
Represas-Carrera et al. (33, 34)	Educational intervention promoting the Mediterranean diet and PA with a specific program and smoking cessation for 12 months	Subjects aged 45-75 years, a total sample of 694: 356 CG and 338 EG	CG: 31.14 EG: 31.98	134	222	EQ-5D-5L	Quality of life was maintained, lifestyle habits improved, and adherence to the Mediterranean diet increased.	Spain/2021
García et al. (35)	Multidisciplinary program with 3 face-to-face sessions separated by 4±2 weeks between them. and individual meetings for diabetes management with workstations in social work, PA, nursing, nutrition, and pharmacology workstations for 3 months	Over 18 years old, a total of 96 included participants distributed in 2 groups of 48, 60% women, EG: 59±9 years, CG: 60±9 years	NR	58	38	Diabetes Quality of Life Questionnaire	Quality of life and nutrition improved in the intervention group	Brazil/2022
Gram B et al. (36)	Supervised exercise with one group and Nordic walking with the second group for 4 months, the first 2 months training twice a week and the last 2 months once a week for 45 minutes; the control group had individual training with strength stretching and aerobic exercise, a minimum 30 minutes	Subjects aged 25 to 80 years, 68 participants with 2 groups of 22 and one of 24 people: EG1: 59±10; EG2: 62±10; CG: 61±10	CG: 32.8 EG1: 31.4 EG2: 32.4	31	37	SF-36	The Nordic walking group showed a significant decrease in BMI, with no significant differences in quality of life and PA.	Denmark/2010

NR: Not Report; CG: Control Group; EG: Experimental Group; F: Female; M: Male; EG1: Experimental Group 1 and EG2: Experimental Group 2.

Table 1. Continued.

Study	Intervention	Population	BMI (kg/m^2)	Total sample size F	Total sample size M	Test	Results	Country/Year of Publication
Mukherji et al. (37)	Impact program: structured exercise with combinations of exercises; one of the experimental groups did a combination of exercises once time for a week, and group 2 did a combination of exercises aerobic exercises 3 times a week for 26 weeks	Three groups with 119 subjects, each aged 18 to 80 years.	CG: 32.8 EG1: 30.9 EG2: 30.8	143	214	SF-12	No significant differences in any of the variables	USA/2022
Nicolucci et al. (38)	Theoretical session on diabetology and practical sessions with an exercise specialist. The control group received recommendations to increase daily PA and decrease sedentary time	150 subjects in each group, with a mean of CG: 62±10 and EG: 61±9.7	NR	116	184	WHO-5 SF-36	Significantly improve in quality of life and well-being, reducing the number of people with depression.	Italy/2022
Kempf et al. (39)	Exercise with Wii Fit Plus, Balance Board, 30 minutes daily for 12 weeks The control group received usual routine care consisting of quarterly doctor according to the diabetes management protocol with glycated hemoglobin, BMI, blood pressure, blood lipids, and titration therapy for 12 weeks	220 participants aged 50 to 75 years. EG: 120/ 62±11; CG: 100/60±9 years.	EG: 34.1 CG:33.2	119	101	WHO-5 SF-12	Significant improvement in glycemic control, BMI PA practice, and quality of life .	Germany/2013

NR: Not Report; CG: Control Group; EG: Experimental Group; F: Female; M: Male; EG1: Experimental Group 1 and EG2: Experimental Group 2.

The risk of bias assessment using RevMan shows low risks for selective reporting and randomization and high risks for blinding and incomplete data. In terms of analysis, there is no clarity on allocation concealment, which could lead to selection and confounding bias. In addition, blinding participants, therapists, and evaluators is a weakness of the studies, which could lead to confirmation and observer bias (Figure 2).

Low risk of bias was found to be 100% for random sequence generation, which controls for bias in reporting and selection of systematic differences between reported and unreported findings, and 75% for incomplete data to control for attrition bias.

On the other hand, 50% is found to be due to other biases. Finally, there is evidence of deficiencies in the blinding of staff, participants, and reviewers, indicating detection bias.

Statistical heterogeneity was determined from the random effects model, and clinical heterogeneity included protocols, follow-up periods, intervention times, sociodemographic characteristics, etc

Table 2. Methodological quality assessment

N	Reference	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Total %
1	Schmid et al. (32)	G	G	CD	M	NR	G	G	G	G	NR	G	NR	R	G	60.7
2	Represas-Carrera et al. (33)	G	G	P	P	P	G	G	G	F	NR	G	G	G	G	64.3
3	Represas et al. (34)	G	G	P	P	P	G	F	G	F	NR	G	G	G	G	64.3
4	García et al. (35)	G	G	G	F	P	G	G	G	G	NR	G	G	G	G	82.1
5	Gram B et al. (36)	G	G	NR	NR	NR	G	G	G	G	G	G	G	G	G	78.6
6	Mukherji et al. (37)	G	NR	NR	NR	NR	G	P	G	P	G	G	G	G	G	57.1
7	Nicolucci et al. (38)	G	G	P	P	NR	G	G	G	G	G	G	G	G	G	78.6
8	Kempf, et al. (39)	G	G	G	G	NR	G	P	G	F	F	G	G	G	G	78.6
	Total %	100	87.5	25	18.8	0	100	62.5	100	68.8	37.5	100	87.5	87.5	100	

G: good; F: fair; P: poor; NR: not reported; CD: cannot be determined; Q: Question.

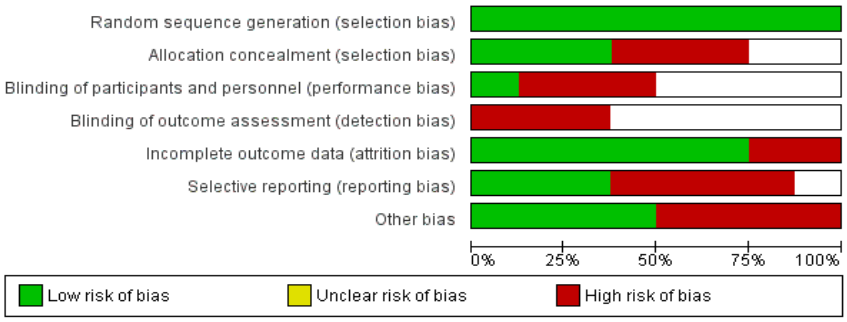

Figure 2. Summary of risks of bias.

Glycated Hemoglobin. Changes in glycated hemoglobin (Figure 3) cannot be determined with the intervention programs and the usual care group, considering that tau^2 is heterogeneous (0.58), I^2 is over 50% (97%), degrees of freedom are lower than Chi^2 with p-value the 0.00001, and the confidence interval (CI: -0.76-0.97) includes data from both the control and experimental groups. This may be due to the different laboratory analysis techniques, such as chromatography and the DCA Vantage Analyzer, and the lack of reporting of other techniques used in different texts.

Physical Activity. Changes in physical activity (Figure 4) cannot be determined for the intervention programs compared to the usual care group, considering that the tau^2 is heterogeneous (0.35), the I^2 is above 50% (89%), the degrees of freedom are lower than the Chi^2 value with p-value

the 0.00001, and the CI includes (IC: -0.36-0.77) data from both the control and experimental groups. This may be due to the different tests used to measure physical activity in the studies, such as the IPAQ, bicycle ergometer, self-report, and the 6-minute walk test.

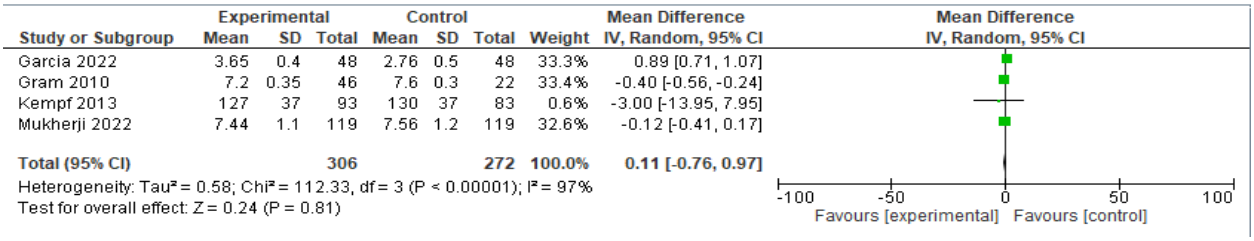

Figure 3. Heterogeneity of glycated hemoglobin.

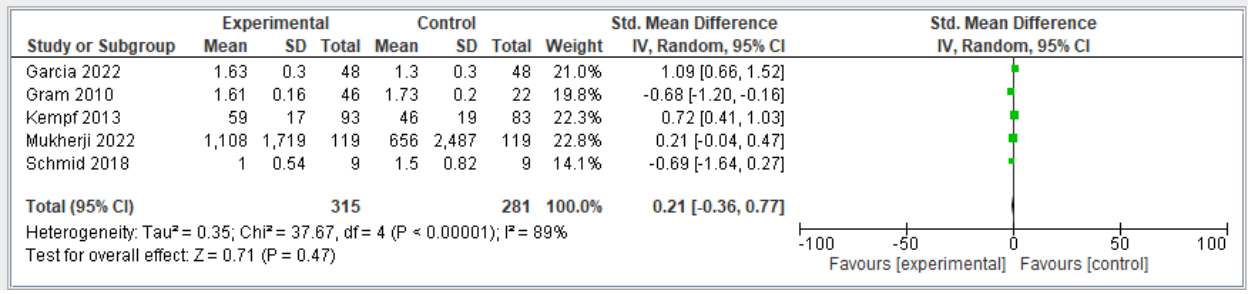

Figure 4. Heterogeneity of physical activity.

For glycated hemoglobin and PA, Figures 5 and 6 show publication bias, firstly due to the small number of articles, and secondly, other possibilities for bias are recognized, such as language, availability, cost, duplication, and citation.

Meta-Analysis and Effect Estimation. Regarding QoL (Figure 7), there is an effect in favor of the control group, which means that activities aimed at improving well-being and QoL in these groups are oriented toward comprehensive interventions that address different areas. Thus, no differences are observed concerning the experimental group. Likewise, Tau^2 is homogeneous (0.00) with an I^2 of zero and a Chi^2 (0.01) lower than the degrees of freedom and a confidence interval (IC: -2.60-8.09) that shows it is not statistically significant.

In the QoL (Figure 8), it is observed in Figure 8 that there is publication bias due to the small number of articles included and the presence of biases such as language, availability, cost, duplication, and citation.

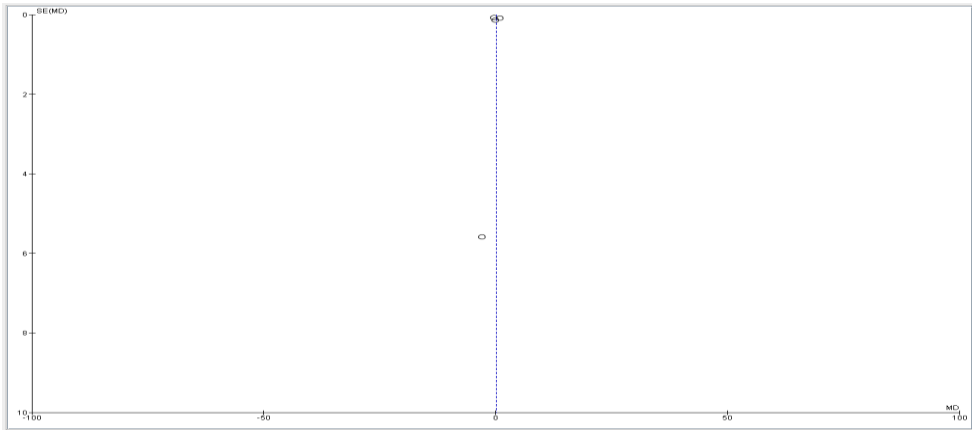

Figure 5. Funnel plot glycated hemoglobin.

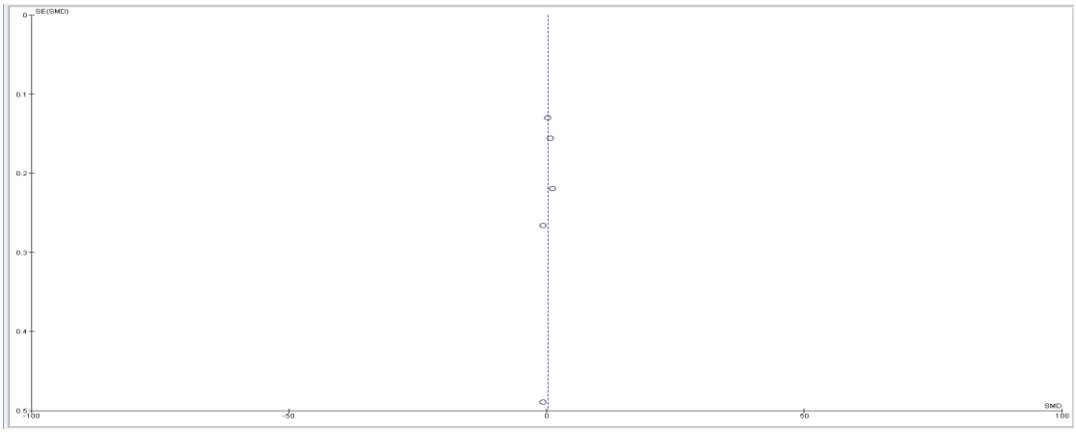

Figure 6. Funnel plot physical activity.

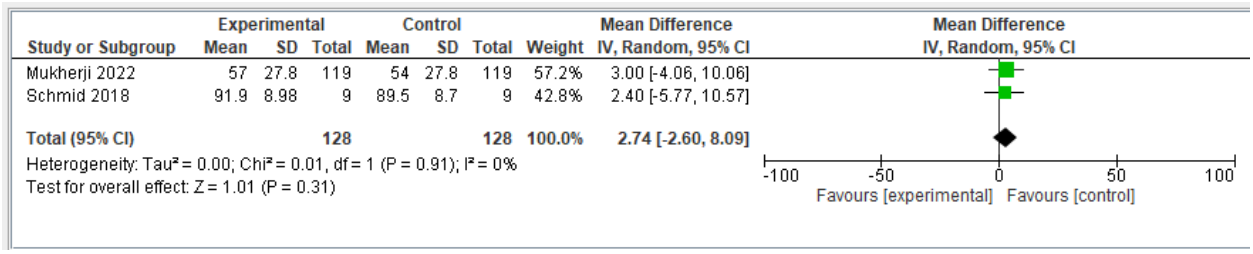

Figure 7. Heterogeneity of quality of life.

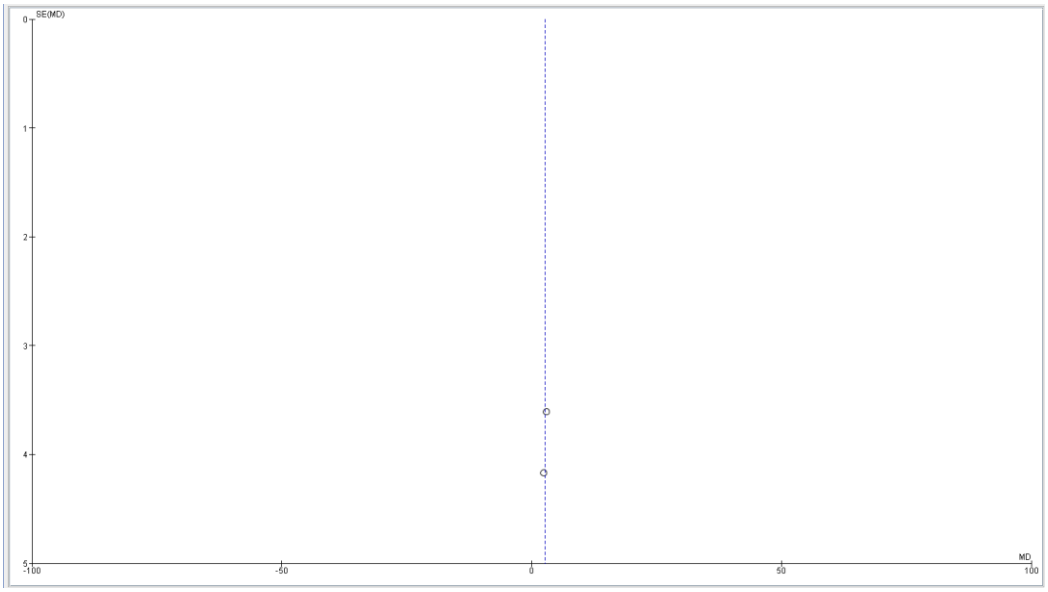

Figure 8. Funnel plot quality of life.

DISCUSSION

The eight studies identified for this review report on the QoL of adults with DM with or without PA, showing that PA has a positive effect on an indicator such as glycated hemoglobin, in addition to promoting a good QoL, bearing in mind that ability, functional and motor ability are determinants of independence and therefore lead to higher scores in this wearable; however, the results highlight the difficulty of detecting changes in QoL with PA, since conventional care, in its general indications, includes prescriptions

of this type. DM is a chronic metabolic disease that affects carbohydrate, protein, and fat metabolism due to insulin deficiency or insufficient effect. It is one of the most critical cardiovascular risk factors, which has led to the creation of exercise and physical activity programs aimed at reducing the complications and symptoms of DM (40) to improve quality of life, functionality, autonomic modulation, metabolic control, physical condition, and insulin sensitivity (41), in addition to reducing inflammatory markers and preventing the progression of neuropathies (42).

Considering the results of this study, there is little or no effect of PA programs on quality of life, considering that usual treatment or care includes comprehensive processes to manage the disease and reduce its effects (43-46), which is in line with Tricalinous et al. (46), who emphasize the importance of interventions aimed at quality of life but with a focus on improvement, considering that it is a pathology that is generally associated with comorbidities such as coronary heart disease, hypertension, renal failure, blindness, micro and macrovascular complications, and even sexual dysfunction, not to mention obesity and dyslipidemia, events that act as risk factors for quality of life, making it difficult to evaluate the effect on this variable with a single study. This statement is consistent with what was expressed by Tekir et al. (47, 48).

In addition, Morris et al. recommend research on physical activity interventions that achieve maximum impact, the promotion of physical activity across the lifespan, and physical activity plans for groups with multiple long-term comorbidities (49), which is consistent with the recommendations of Kennerly et al., who notes that people with type 2 diabetes are more likely to be sedentary and therefore require large-scale interventions focused on healthy lifestyles (50). These programs should focus on improving levels of physical activity by increasing frequency and intensity to improve physical activity levels and thus improve diabetes-related conditions (51, 52).

Furthermore, Donal et al. confirm the importance of considering the impact of the implications and comorbidities of people with DM since these affect all spheres of quality of life, and in addition to complications in the physical dimension, effects related to the psychological and social dimension lead to the presence of complications such as depression, anxiety, and schizophrenia, which would redirect intervention plans and self-management indications regarding mental health, since the burden of morbidity of DM can vary with the addition of depression (53-55), which in turn will cause patients to lose adherence to treatment and thus glycemic control, considering that adherence may be affected by the psychosocial stability of the patient (56). This is in agreement with Yildirim et al., who believe that to guide these programs, in addition to comorbidities, the burden of diabetes should be considered because the higher the burden, the lower the quality of life (57).

Finally, the changes in glycated hemoglobin cannot be determined with the intervention programs and the usual care group, which may result from the different laboratory analysis techniques used and the non-reporting of other techniques used in the different texts. Changes in PA cannot be determined, which may result from the different tests used in the studies, such as the IPAQ, the bicycle ergometer, self-report, and the 6-minute walk. In terms of QoL, an effect is evident towards the control group, so these groups are oriented toward activities that tend to improve well-being and QoL by having comprehensive interventions that address different spheres, so no differences are established compared to the experiment group.

The limitation of this research was that there were articles that considered the changes in QoL with PA, in addition to having texts that did not report the statistical data that would allow them to be considered for the meta-analysis, leading to a publication bias. As a future approach for other research, it is proposed to consider the psychological and environmental factors in this population, considering that most programs focus on adaptations and physical transformations to prevent the progression of pathology from a physiological point of view. The effects of this pathology result from habits acquired throughout life, which are ingrained and difficult to change, confirming the need for programs that emphasize psychological and attitudinal aspects more than physical ones.

CONCLUSION

It has been noted that the studies carried out did not recognize statistically significant differences, and all conclude that the effects of PA can not be differentiated in the experimental

group and the control group because usual care includes a multidisciplinary approach with emphasis on physical and nutritional, which prevents control of bias and establish the effects of the proposed plan for the experimental groups, to which is added the clinical and methodological heterogeneity of the studies, which is another call for standardization and validation of measurement tools that allow access to global information. Therefore, it is considered that the clinical implications of this study are related to an approach that not only focuses on controlling the physical effects of the disease in the patient but also considers mental health. Finally, it is concluded that the effects of PA on QoL for the study groups do not show statistically significant differences compared to the control groups.

APPLICABLE REMARKS

- Intervention programs or plans for the population with DM should not only focus on glycemic control but also consider associated pathologies and their impacts on quality of life and mental health.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Elisa Andrea Cobo-Mejía, Rocio del Pilar Castellanos-Vega. Acquisition of data: Elisa Andrea Cobo-Mejía, Rocio del Pilar Castellanos-Vega. Analysis and interpretation of data: Elisa Andrea Cobo-Mejía, Rocio del Pilar Castellanos-Vega. Drafting the manuscript: Elisa Andrea Cobo-Mejía, Rocio del Pilar Castellanos-Vega. Critical revision of the manuscript for important intellectual content: Elisa Andrea Cobo-Mejía, Rocio del Pilar Castellanos-Vega. Statistical analysis: Elisa Andrea Cobo-Mejía, Rocio del Pilar Castellanos-Vega. Administrative, technical, and material support: Elisa Andrea Cobo-Mejía, Rocio del Pilar Castellanos-Vega. Study supervision: Elisa Andrea Cobo-Mejía, Rocio del Pilar Castellanos-Vega.

CONFLICT OF INTEREST

No conflicts of interest are declared.

FINANCIAL DISCLOSURE

This article results from research funded by the Universidad de Boyacá; however, neither the institution nor the authors have financial interests related to what is presented in the document.

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ETHICAL CONSIDERATION

As this was a systematic literature review and meta-analysis, it was considered that the articles included in this section should report the ethical considerations and the relevant committee assessments and approvals.

ROLE OF THE SPONSOR

The Universidad de Boyacá had no role or interference in any research developments such as planning, execution, data systematization, elaboration, revision, or approval of the manuscript.

ARTIFICIAL INTELLIGENCE (AI) USE

The AI in this manuscript was an aid in translating Spanish to English.

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