Exercise type and frequency, diet conformity, and medication adherence are captured in patients with type 2 DM.

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Abstract: This cross-sectional study investigated the interrelation between exercise behaviour, dietary adherence, and medication use in 69 patients with type 2 diabetes mellitus (T2DM) who were recruited in Iraqi hospitals. The sample was mostly middle-aged adults (40-49), with 42.0% and were patients distributed according to sex with (male 43.5%, women 56.5%). The information about the exercise modality and the frequency of exercising per week, adherence to the diet, and use of anti-diabetic medications were collected through the use of structured interviews and questionnaires. Findings showed a heterogeneous exercise activity engagement; aerobic exercises were also related with a more frequent use, which argued the importance of exercise in glucose levels. Moreover, the compliance with the diet was positively correlated with oral hypoglycaemic agents prescribed, which is an indication of a synergistic interaction between the lifestyle changes and the pharmacotherapy where in our study Lastly, poorer self-rated general health was associated with polypharmacy, which makes the maintenance of a balance between therapeutic complexity and patient-reported outcomes important also These findings support the necessity to embrace individualised lifestyle change interventions in combination with optimised drug regimens to enhance adherence and customer outcomes in T2DM management.

Keywords: *exercise type, medication adherence, type 2 dm, patients, polypharmacy*

Introduction

Non-communicable diseases refer to chronic ones, which are generally characterized by progressive development; diabetes mellitus (DM) is one of those previously named by the World Health Organization (WHO) as the focus of the preventive measures. DM is used to refer to an expression of multi-factorial metabolic dysregulation, which is typified by sustained hyper-glycaemia, impairments in carbohydrate, lipid, and protein metabolism, and is a result of insulin secretion deficiencies, or insulin action, or both [1,2,3,4].

Diabetes Mellitus (DM) is a chronic illness which is not only costly but also has become virtually incurable, and its occurrence has risen significantly in the last several years [5]. The disease causes about 5 million adult deaths aged 20 and 79. Diabetes Mellitus also has a tendency to develop chronic complications, which cause disability, and this poses a menacing task to the delivery of healthcare systems in the global context [6,7,8]. Physical activity is also commonly discussed as one of the elements of an extensive therapeutic program of the

disorder; many authors [1216] support its implementation in the treatment of patients with type 2 diabetes mellitus [91011]. The rationale behind this suggestion is the overwhelming importance of physical activity that patients tend to ignore or do not consider essential in their therapy regimen [12,13]. The therapeutic role of exercising among patients with type 2 diabetes mellitus is beyond doubt [14]. A significant proportion of these patients are also affected by obesity, are of a sedentary lifestyle with clinical characteristics [15]. The more sedentary people are likely to have a high body mass index (BMI), a larger waist circumference, and significantly increased systolic blood pressures [16].

Physical inactivity (PA) contributes to a worse lipid profile, high C-reactive protein levels, and high HOMA-IR insulin resistance index. Physical inactivity also contributes to the production of an augmented triglyceride/cholesterol ratio, and high-density lipoprotein cholesterol and insulin. [17,18]

This reality requires our healthcare professionals to understand the usefulness of physical activity in these patients, which will increase their motivation to prescribe it [19] Undoubtedly, the accelerated growth of sedentary lifestyles, T2DM, and obesity (Ob) has a socioeconomic and human impact on the National Health System, justifying the development of health policies based on population-based interventions where PE plays an important role [20]

From these considerations, the subsequent paper offers an account of the beneficial effects of PE on individuals with T2DM.

Material and method

The cross-sectional study design was used in the current study to examine exercise type and exercise frequency, adherence to diet, and medication adherence of type 2 diabetes mellitus (T2DM) patients where in our Participants were enrolled according to diagnosis criteria that were confirmed mainly by the glucose tolerance test (GTT) and HbA1c, as recorded on clinical notes , according table 1 recorded Demographic information such as age, gender, and marital status were also obtained to describe the study population where The sample size comprised 69 patients who were mainly between the ages of 40 and 69 years recruited from various hospitals from Iraq with study duration between 2024 and 2025 with a greater number of females (56.5%) and the majority being married (78.3%) as well as It was addressed Duration of diabetes data also ranged substantially, from very recent diagnosis (as few as 7 days) to long-standing disease presence (up to 26 years), allowing examination of different disease stages even that Diagnoses based on age were also documented, revealing the majority of the patients were between 30 and 59 years old at the time of diagnosis in addition to Medication histories were also collected with emphasis on the history of anti-diabetic therapy, which showed that the majority of the patients (60.9%) were not on present medication, but the others were taking oral hypoglycemic drugs like glibenclamide and metformin, combinations like insulin analogs and sitagliptin, respectively.

According to Physical activity behaviours were categorized by type and number of times per week to analyse exercise behaviours, which are central to successful management of diabetes while also Adherence to dietary changes was also assessed and analyzed against the number of oral hypoglycemic agents (OHD) taken by the participant, to examine lifestyle adherence in relation to medication pill burden while in study examined the association between the number of chronic drugs taken and the general health of the patients to determine if treatment complexity has a link to self-registered health status furthermore The medication history emphasized history of past and present anti-diabetic therapy. Patients volunteered information on the use/non-use of medicines such as oral hypoglycaemic drugs and insulin treatment.

Exercise data were obtained.

- Either by interviewing patients or by questionnaire, which categorized both the exercise type (e.g., aerobic, resistance training) and the weekly exercise session frequency.
- This measure was important to quantify activity levels relevant to glycemic control.
- Figure 1 illustrates the association between exercise type and exercise frequency.

Dietary adherence was assessed by self-report of adherence to prescribed/recommended dietary modifications, i.e., adherence to "being a conformist" to dietary recommendations while that measure of dietary adherence was then mapped against the number of items of oral hypoglycemic drug product consumed, shown in Figure 2, to explore compensatory activity between lifestyle and pharmacotherapy so as The patients' self-assessment scales were utilized to gauge the general health perception, which were then cross-matched with the

utilization of chronic drugs prescribed (including those that were not diabetes medication) to establish how the treatment burden may impact overall health feel Data were analyzed utilizing descriptive statistics to summarize the demographics of the patients, disease attributes, and therapy regimens as well as Correlation tests were conducted to determine meaningful relationships between exercise regularity, dietary adherence, medication use, and overall health furthermore These variables were accurately recorded and structured within tables that provide demographic data (Table 1), diabetic history duration (Table 2), age of diagnosis and mode of diagnosis (Table 3), and pre-existing diabetes drugs (Table 4).

Results

Table 1- General demographic of the study

Age Group	Count	Percentage
40-49	29	42.0%
50-59	17	24.6%
60-69	21	30.4%
≥70	2	2.9%
Gender	**Count**	**Percentage**
Female	39	56.5%
Male	30	43.5%
Marital Status	**Count**	**Percentage**
Married	54	78.3%
Widowed	13	18.8%
Divorced	1	1.4%
Single	1	1.4%

Table 2- Distribution by Duration of Diabetes Mellitus

Duration	Count	Percentage
5 years	15	21.7%
13 years	6	8.7%
6 years	6	8.7%
2 years	5	7.2%
1 year	3	4.3%
11 years	3	4.3%
7 years	3	4.3%
4 years	3	4.3%
12 years	3	4.3%
9 years	2	2.9%
17 years	2	2.9%
16 years	2	2.9%
8 years	2	2.9%
3 month	2	2.9%
18 years	2	2.9%
First visit	2	2.9%
6 month	2	2.9%
9 months	1	1.4%
7 days	1	1.4%

3 years	1	1.4%
3 weeks	1	1.4%
26 years	1	1.4%
15 years	1	1.4%

Table 3- Distribution by Age at Diagnosis and Diagnosis Method

Age at Diagnosis Group	Count	Percentage
<30	4	5.8%
30-39	20	29.0%
40-49	19	27.5%
50-59	16	23.2%
≥60	10	14.5%
Diagnosis Method	**Count**	**Percentage**
GTT	64	92.8%
HbA1c	5	7.2%

Table 4- Distribution by Previous Anti-Diabetes Medications

Medication	Count	Percentage
0	42	60.9%
Glibenclamide	17	24.6%
Glibenclamide, Metformin	3	4.3%
Unknown	2	2.9%
Glimepiride	2	2.9%
Metformin	1	1.4%
Insulin Glargine, Sitagliptin	1	1.4%
Glimepiride, Sitagliptin	1	1.4%

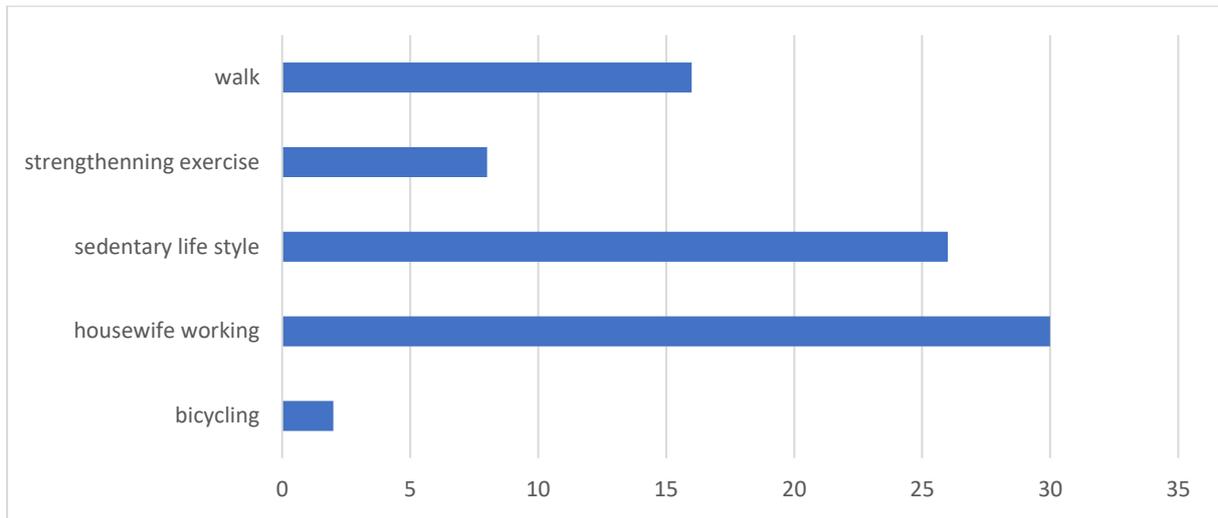### Figure 1- The relationship between the type of exercise and with frequency of exercise per week

Figure 2- Correlation Between Diet Modification (Conformist) With NUMBER OF OHD ITEMS (Totally)
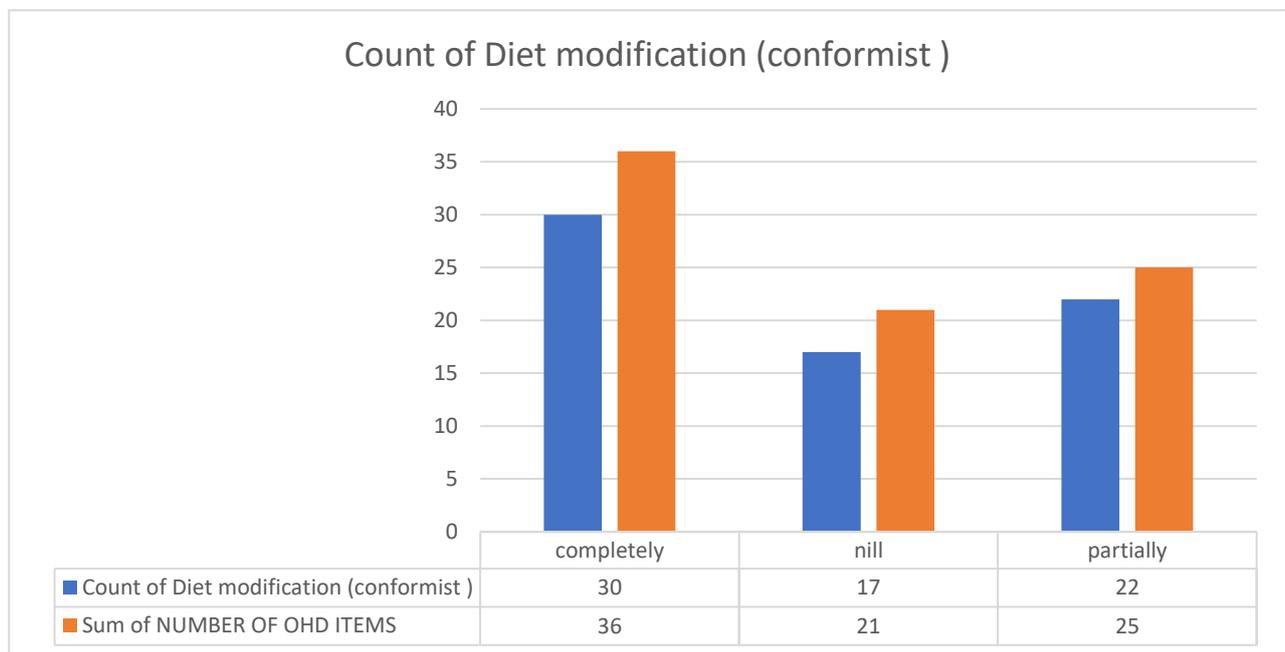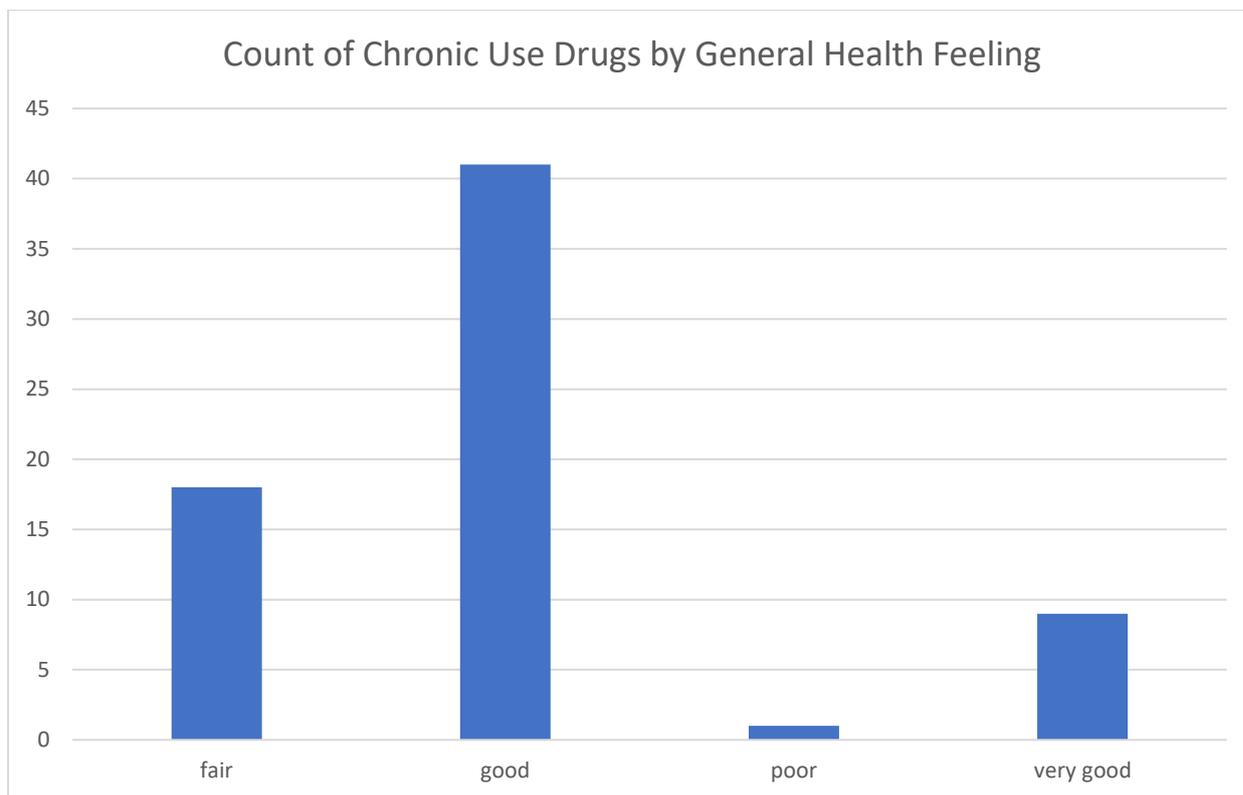

	completely	nill	partially
Count of Diet modification (conformist)	30	17	22
Sum of NUMBER OF OHD ITEMS	36	21	25

Figure 3- Correlation between the count of use chronic drug use drugs with general health feelinf

Count of Chronic Use Drugs by General Health Feeling

Discussion

as shown in table 1 refer to The demographic features described in Table 1 show a study population mainly between ages 40-69 years, of whom 42.0% were between 40-49 years of age, 24.6% were between 50-59 years of age, and 30.4% were between 60-69 years of age, based on This distribution is compatible with the typical presentation and prevalence of type 2 diabetes mellitus (T2DM), which presents typically in middle-aged and elderly adults due to the development of insulin resistance and metabolic changes that accompany aging wParticipants were predominantly female (56.5%) compared to males (43.5%), which may be due to gender-specific health-seeking practices or regional demographical patterns addition to Marital status distribution indicates the majority of the patients were married (78.3%), indicating the absence of a social support system that could have a positive influence on disease management since it has been established that social support has a bearing on lifestyle adherence across chronic conditions , according to Table 2 also shows high variability in the duration of diabetes among the study participants, with cases ranging between recent diagnoses (as short as 7 days or the first visit) to diabetes lasting as long as 26 years furthermore in our study The most common duration encountered was 5 years (21.7%), reflecting the high proportion of persons with medium-term disease exposure while also The high variability provides the basis for studying the influence of the duration of disease on adherence practices, glycemic control, and risk of complications, since long disease duration has been typically accompanied by increasing beta-cell dysfunction and increased risk of complications , although Additionally, the presence of recent onset allows one to study the very initial management practices.

As finding Age at diagnosis reported in Table 3 emphasizes that the large proportion were between ages 30-59, with 29.0% between ages 30-39 and 27.5% between ages 40-49, supporting the middle-age onset distribution typical of T2DM also reported The mode of diagnosis was significantly by glucose tolerance test (92.8%), the gold-standard test for diagnosis, securing soundness of diagnosis and reliability, in addition to More patients were identified by HbA1c (7.2%), which, despite being on the increase, may fluctuate due to hemoglobinopathies or anemia where These data on diagnosis validate the clinical characterization of the identified cohort and emphasize the need for standardized criteria of diagnosis in studies to uphold validity . as depend on Table 4 gives important information on prior anti-diabetes therapy, so found Of interest, 60.9% of patients had no anti-diabetic medication use, which may reflect early disease, lifestyle-dominant diabetes, or potential access/treatment adherence issues even that In the medication group, the predominant therapy was glibenclamide at 24.6%, with combinations of glibenclamide and metformin at 4.3%, It was addressed in our study The prevalence of multiple therapy regimens

including insulin analogues indicates differential disease severities and personalised management strategies , found This heterogeneity mirrors the challenge of managing T2DM and the imperative of personalised therapy according to patient response, side effects, and comorbidity.

According to figure 1 shows the association between exercise modality and weekly exercise, which suggests that some exercise types might be associated with greater physical activity levels. Moreover, as an example, aerobic exercise, which has been identified to improve insulin sensitivity and glycemic control, might be more popular for regular participation than resistance exercise or walking. Regular exercise is necessary for the best glucose metabolism, and the association gives information that can be used to design targeted intervention to enhance physical activity levels in persons, based on The correlation between dietary change adherence (diet adherence) and the overall number of oral hypoglycemic drug (OHD) products taken is shown in Figure 2, however found A positive correlation could reflect patients taking more drugs as being also more likely to follow dietary advice, reflecting greater disease severity awareness and greater blood glucose control motivation overall as well as poor diet adherence in the face of polypharmacy could be an indicator of treatment difficulty. Determining the relative roles of the pharmacologic intervention and lifestyle management is still paramount to the total treatment of diabetes. Figure 3 illustrates that the number of chronic drugs used has a negative relationship with the overall perception of health of patients, which is an indication that polypharmacy (a common marker of many comorbidities) may be linked with a lower self-evaluation of health status.

The nature and mode of the exercise have a strong effect on the glycaemic control in patients with type 2 diabetes mellitus (T2DM). Recent evidence shows that organized exercise, particularly taken multiple times a week, has significant positive effects on such indicators as HbA1c and fasting glucose. In a recent literature review, the participants who exercised three times a week had a 0.38 percent reduction in HbA1c and fasting glucose reduction of 0.25, which is a sharp contrast to the weekly exercising participants or those under the usual care. Overall, it can be concluded that exercise 3-4 times per week, 30-60 minutes, is the most effective way to manage glycaemic control. In terms of modality, aerobic and resistance training are equally beneficial as well as combined training is the most beneficial. Low-intensity exercises, such as yoga and walking, also have beneficial outcomes, which provides an idea that even light activity is beneficial. However, personal likes and feasibility usually act as obstacles to compliance, emphasising the importance of tailored intervention programs to ensure the most enhanced participation in physical exercise. [21]

The factors of physical activity, diet control, and attendance at medical appointments, identified by the World Health Organization (2003) as essential aspects for improving treatment adherence, are highlighted when considering that among the studies analyzed in this work, only one does not take any of them into account [22] a study with one of the lowest weights in the meta-analysis (5.14%) Therefore, the inclusion of sessions aimed at providing information on diet control, physical activity, and medication intake is considered appropriate when the situation allows, both to improve treatment adherence and to promote multidisciplinary work by integrating physical trainers, nutritionists, and at least physicians into this work Although psychological interventions for disease control are not considered a substitute for medical treatment, they provide appropriate support.

Conclusion

Finally, according to our research, the most remarkable is that the identified associations of exercise type and frequency, adherence to dietary advice and medication burden, and prevalence of polypharmacy and the general health perception of patients indicate the interdependence of lifestyle practices, pharmacologic treatment, and overall health, among other things.

These findings therefore provide support to the necessity of a holistic, patient-centred approach to Type 2 diabetes mellitus treatment, involving the combination of behavioural counselling and closely-adjusted medication regimes to promote better adherence and clinical results.

Reference

1. Centers for Disease Control and Prevention, author. National diabetes statistics report estimates of diabetes and its burden in the United States, 2014. Atlanta, GA US Dep Health Hum Serv. 2014. p. 2014.
2. Alotaibi A, Perry L, Gholizadeh L, Al-Ganmi A. Incidence and prevalence rates of diabetes mellitus in Saudi Arabia: An overview. J Epidemiol Glob Health. 2017;7:211–218. doi: 10.1016/j.jegh.2017.10.001. [DOI] [PMC free article] [PubMed] [Google Scholar]

3. Cho NH, Shaw JE, Karuranga S, Huang Y, da Rocha Fernandes JD, Ohlrogge AW, et al. IDF Diabetes Atlas: Global estimates of diabetes prevalence for 2017 and projections for 2045. Diabetes Res Clin Pract. 2018;138:271–281. doi: 10.1016/j.diabres.2018.02.023. [DOI] [PubMed] [Google Scholar]

4. WDA. World Data Atlas (WDA), author Rwanda - Diabetes prevalence as a share of population aged 20-79 years. knoema; 2019. Accessed from https://knoema.com/atlas/Rwanda/topics/Health/Nutrition/Diabetes-prevalence . [Google Scholar]

5. Alhariri A, Daud F, Almaiman A, Saghir S. Factors associated with adherence to diet and exercise among type 2 diabetes patients in Hodeidah city, Yemen. Life. 2017;7:264–271. [Google Scholar]

6. Ganiyu AB, Mabuza LH, Malete NH, Govender I, Ogunbanjo GA. Non-adherence to diet and exercise recommendations amongst patients with type 2 diabetes mellitus attending Extension II Clinic in Botswana. Afr J Prim Health Care Fam Med. 2013;5:1–6. AOSIS. [Google Scholar]

7. Kirwan, J. P., Sacks, J., & Nieuwoudt, S. (2017). The essential role of exercise in the management of type 2 diabetes. *Cleveland Clinic journal of medicine*, *84* (7 Suppl 1), S15.

8. Goldstein, B. J. (2002). Insulin resistance as the core defect in type 2 diabetes mellitus. *The American journal of cardiology*, *90* (5), 3-10.

9. Mphasha, M., & Mothiba, T. (2025). Personalised nutrition approaches in the prevention and management of type 2 diabetes: A narrative review of evidence and practice. *International Journal of Environmental Research and Public Health*, *22* (7), 1047.

10. Yuan, S., Li, X., Liu, Q., Wang, Z., Jiang, X., Burgess, S., & Larsson, S. C. (2023). Physical activity, sedentary behavior, and type 2 diabetes: mendelian randomization analysis. *Journal of the Endocrine Society*, *7* (8), bvad090.

11. Balooch Hasankhani, M., Mirzaei, H., & Karamoozian, A. (2023). Global trend analysis of diabetes mellitus incidence, mortality, and mortality-to-incidence ratio from 1990 to 2019. *Scientific Reports*, *13* (1), 21908.

12. Zimmet, P., Alberti, K. G., Magliano, D. J., & Bennett, P. H. (2016). Diabetes mellitus statistics on prevalence and mortality: facts and fallacies. *Nature Reviews Endocrinology*, *12* (10), 616-622.

13. Harding, J. L., Weber, M. B., & Shaw, J. E. (2024). The global burden of diabetes. *Textbook of diabetes*, 28-40.

14. Colberg, Sheri R., Ronald J. Sigal, Jane E. Yardley, Michael C. Riddell, David W. Dunstan, Paddy C. Dempsey, Edward S. Horton, Kristin Castorino, and Deborah F. Tate. "Physical activity/exercise and diabetes: a position statement of the American Diabetes Association." Diabetes care 39, no. 11 (2016): 2065.

15. Kirwan, J. P., Sacks, J., & Nieuwoudt, S. (2017). The essential role of exercise in the management of type 2 diabetes. *Cleveland Clinic journal of medicine*, *84* (7 Suppl 1), S15.

16. Ribeiro, A. K. P. D. L., Carvalho, J. P. R., & Bento-Torres, N. V. O. (2023). Physical exercise as treatment for adults with type 2 diabetes: a rapid review. Frontiers in Endocrinology, 14, 1233906.

17. Kennerly, A. M., & Kirk, A. (2018). Physical activity and sedentary behaviour of adults with type 2 diabetes: a systematic review. Practical Diabetes, 35 (3), 86-89g.

18. Gérvas, J., & Pérez-Fernández, M. In medicine, more is not always better. The case of prevention (and prediabetes).

19. Rosenfeld, R. M., Grega, M. L., Karlsen, M. C., Abu Dabrh, A. M., Aurora, R. N., Bonnet, J. P., ... & Gulati, M. (2025). Lifestyle interventions for treatment and remission of type 2 diabetes and prediabetes in adults: a clinical practice guideline from the American College of Lifestyle Medicine. American Journal of Lifestyle Medicine, 19 (2_suppl), 10S-131S.

20. Rosenfeld, R. M., Grega, M. L., Karlsen, M. C., Abu Dabrh, A. M., Aurora, R. N., Bonnet, J. P., ... & Gulati, M. (2025). Executive summary of lifestyle interventions for treatment and remission of type 2 diabetes and prediabetes in adults: a clinical practice guideline from the American College of Lifestyle Medicine. American Journal of Lifestyle Medicine, 19 (2_suppl), 132S-154S.

21. Nascimento, T., Andrade, A., Pinto, E., Cabrita, C., Pais, S., & Puerta, R. D. L. (2025). Medication Adherence and Glycemic Control in Older Adults with Type 2 Diabetes: A Cross-Sectional Study in a Community Setting. *Diabetology*, *6* (5), 33.

22. Nascimento, T., Andrade, A., Pinto, E., Cabrita, C., Pais, S., & Puerta, R. D. L. (2025). Medication Adherence and Glycemic Control in Older Adults with Type 2 Diabetes: A Cross-Sectional Study in a Community Setting. *Diabetology*, *6* (5), 33