Original Research Article

HEALTH-RELATED QUALITY OF LIFE AMONG ADULTS WITH TYPE 2 DIABETES ON TREATMENT WITH HERBAL AND CONVENTIONAL GLUCOSE-LOWERING AGENTS IN NAIROBI, KENYA.

ABSTRACT

Background: Patients with type 2 diabetes often seek care from herbal clinics for glycemic control. The impact of herbal glucose-lowering therapies in this patient population has not been studied adequately.

Aim: To determine and compare health-related quality of life in patients with type 2 diabetes on treatment with herbal and conventional antidiabetic therapies.

Methods: A cross-sectional study was conducted among 80 patients with type 2 diabetes attending a conventional clinic at Kenyatta National Hospital and 37 patients receiving care at New Life Herbal Clinic in Nairobi City County, Kenya. A general questionnaire was used to collect sociodemographic and clinical information from the study participants. The World Health Organization Quality of Life Brief Version was used to assess the health-related quality of life in both groups. Descriptive data analysis was performed on all variables. The health-related quality of life scores were compared using the non-parametric Mann-Whitney test. Multiple linear regression analyses were used to identify the sociodemographic and clinical factors affecting the various domains of health-related quality of life. P-values equal to or less than 0.05 were considered to be statistically significant.

Results: Health-related quality of life scores in all the domains were significantly higher among the patients treated with conventional drugs compared to those treated at the herbal clinic (p<0.001). Patients in both groups had the highest scores in the social domain (median score: 66.67 [33.33-75] for herbal and 75 [75-97.92] for the conventional group). Among patients on herbal therapies, the lowest scores were on psychological aspect of HRQoL (45.83 [33.33-45.17]). Regarding overall quality of life, patients at Kenyatta National Hospital had significantly higher median scores (75 [75-100]) compared to those at the herbal clinic (75 [75-100], p< 0.001). Treatment at Kenyatta National Hospital was associated with significant improvements in HRQoL scores on all the domains (p< 0.001). Other factors associated with improved health-related quality of life scores were higher levels of education (p=0.010) and engagement in physical activity (p=0.001) for the physical domain; microvascular complications for psychological health scores (p=0.010) and male gender for the social domain (p=0.037). Factors associated with improvement in the environmental domain scores were male gender (p=0.033), older age (p=0.004), urban residence (p=0.026) and alcohol intake (p=0.048).

Conclusions: Patients on treatment with conventional therapies for type 2 diabetes had higher health-related quality of life scores compared to those on herbal treatments. We identified modifiable factors that can be enhanced to improve the quality of life of individuals with type 2 diabetes in both conventional and herbal treatment settings.

Keywords: health-related quality of life; Type 2 Diabetes; Herbal; Conventional.

INTRODUCTION

Diabetes is a chronic disease affecting an estimated 537 million adults aged 20-79 years worldwide. According to the international Diabetes Federation (IDF), this number is projected to increase to 783 million by 2045. The most rapid increase is expected to occur in low and middle-income where 80% of patients with diabetes live (Sun et al., 2022). The prevalence of diabetes in Kenya has been reported to be 4%. In 2021, diabetes-related complications accounted for 5% of deaths occurring in people under 60 years of age in Kenya (Sun et al., 2022)

Management of diabetes involves both lifestyle modifications and pharmacotherapy. In addition, self-management practices such as exercise, healthy diet and self-monitoring of blood glucose (SBMG) are recommended to improve diabetes treatment outcomes. The goals of diabetes treatment are to achieve optimal glycemic control, relieve the signs and symptoms of hyperglycemia, prevent the occurrence and progression of microvascular and macrovascular complications and improve the patient's quality of life. The impact of these interventions is routinely assessed

using objective measures of health such as blood glucose levels and lipid profiles along with morbidity and mortality attributable to diabetes (Elsayed et al., 2023).

Diabetes and its treatment have the potential to affect the patient's quality of life in several ways. Diabetes-related complications may lead to decreased mobility, pain and inability to carry out their daily activities. Other comorbid conditions may require additional treatment which further increases the treatment burden. For example, medical therapy, dialysis and renal transplant may be required to treat end-stage renal failure in patients with type 2 diabetes (Jing et al., 2018). Other factors that may worsen quality of life in patients with type 2 diabetes include the complexities of diabetes treatment regimens, cost of medications, and adverse effects of drugs.

The World Health Organization (WHO) defines health as "a state of complete physical, mental, and social well-being—not merely the absence of disease, or infirmity" (World Health Organization, 2011). This definition implies that measurement of health and the effect of health interventions must not only include biomedical markers of health but also an estimation of the patients' well-being. While the laboratory tests and clinical examinations provide objective information on the effectiveness of health interventions, they do not measure how patients feel or are satisfied with their treatments. The effectiveness of health interventions and their effects on the patients' well-being are assessed by combining objective measures of health with patient reported outcomes such as health-related quality of life (HRQoL). Evaluation of HRQoL is important in chronic diseases such as type 2 diabetes low HRQoL may have an impact on adherence to treatment and deterioration of clinical outcomes (Hand, 2016). HRQoL provides insights to the patients' perception regarding the impact of a disease and its treatment on their physical, psychological and social well-being. However, unlike the standard treatment outcomes, HRQoL and other patient-reported outcomes are not routinely monitored in care of patients with type 2 diabetes.

In Kenya, some patients with type 2 diabetes turn to herbal therapy for their diabetes control (Elsa et al., 2017). This is driven by factors such as the belief that herbal medicines are totally safe , are more effective than conventional medicines and can cure diabetes. Herbal medicines are also easier to access since they do not require a prescription and are also more culturally acceptable (Elsa et al., 2017). Although several herbs have been reported to have glucose-lowering effects, there are no local guidelines for their use. Despite the widespread use of herbal medicines by type 2 diabetic patients in Kenya, studies on diabetes-related quality of life have focused on patients treated in conventional settings (Genga et al., 2014). Therefore, there exists a gap on how this patient-reported outcome among patients with type 2 diabetes treated at the herbal clinics. In this study, we estimated and compared the quality of life in patients treated for type 2 diabetes at Kenyatta National Hospital (KNH) and New Life Herbal Clinic (NLHC) in Nairobi City County, Kenya. The findings from this study will enable healthcare providers in both the conventional and

herbal care settings to better understand the impact of conventional and herbal therapies on the patients' quality of life. Additionally, the study will identify factors that can be addressed to enhance quality of life in patients receiving care in herbal and conventional diabetes care settings.

MATERIALS & METHODS

The methodology for recruitment and data collection on the sociodemographic and clinical characteristics of the patients who participated in this study has been described elsewhere (Karara et al., 2022)

Study design and setting

A facility-based cross-sectional study was conducted at Kenyatta National Hospital (KNH) and New Life Herbal Clinic (NLHC), a private herbal clinic in Nairobi County, Kenya between March 2019 and December 2021.

Study population and sampling procedures

The population for this study were all adult outpatients with type 2 diabetes at the two study sites. Patients were included in the study if they had received treatment and were on follow-up at the study sites for at least 6 months prior to this study. Patients with Type 1 and gestational diabetes were excluded from the study. The minimum sample size required at each study site was calculated as 66 patients. We increased this number to 73 patients per group to cater for a 10% non-response rate. Since there were few patients at the herbal clinic, we used an allocation ratio of one patient in the herbal clinic for every two patients recruited at KNH. This ratio was within the recommendations for research with unequal study arms (Torgerson & Torgerson, 2008). Consequently, we recruited 80 patients at Kenyatta National Hospital and 37 patients at the herbal clinic. Diabetic patients who met the study criteria were recruited consecutively during the clinic visits until the required sample size was achieved.

Data collection on HRQoL

Patients who met the criteria and consented to the study were recruited during their clinic visits. The abbreviated World Health Organization Quality of Life (WHOQOL-BREF) questionnaire was used to collect HRQoL data. The questionnaire has a total of 26 questions. Twenty-four questions (items) belong to 4 different domains (dimensions) of health namely; environmental (8 questions), physical (7 questions), psychological (6 questions) and social (3 questions). The remaining two questions assess the patient's general QOL and health. One question asks about the individual's overall perception of HRQoL while the other evaluates the individual's general perception of his or her health. Each question has 5 Likert-type response options with scores ranging 1-5. Higher scores represent higher QOL (Harper et al., 1998). Data on the sociodemographic

characteristics, diabetes duration, complications and comorbidities as well as types of antidiabetic treatments was obtained through face to face interviews and from patients files and recorded on a general questionnaire.

Statistical Analysis

The scores for the physical, psychological, social relationships and environmental domains were derived from the completed questionnaires. The other two items (questions 1 and 2) which assess the overall quality of life and overall satisfaction with health were examined separately. The mean score of items within each domain were used to calculate the domain score. Mean scores were then multiplied by 4 in order to make domain scores comparable with the scores used in the WHOQOL-100. Where more than 20% of data was missing from an assessment, the assessment was discarded. Where an item was missing, the mean of other items in the domain was substituted. Where more than two items were missing from the domain, the domain score was not calculated (with the exception of domain 3, where the domain was only calculated if < 1 item is missing).

An SPSS syntax file that automatically checks, recodes data and computes domain scores has been provided by the WHO and was used in the computation of the HRQoL scores. The derived scores were then be entered and analyzed using IBM SPSS package (SPSS 26.0, Chicago, IL). Summary statistics calculated included median scores and interquartile range for the various domains of health. P-values were obtained using the two-sample Mann-Whitney U test. Linear regression analysis was performed to identify the determinants of HRQoL in the two study groups. P-values less or equal to 0.05 were considered to be statistically significant.

RESULTS

A total of 80 patients were recruited at the KNH Endocrinology and Diabetes Outpatient Centre while 37 patients were enrolled at the herbal clinic. A greater proportion of the patients treated for type 2 diabetes at KNH were females (52, 65%) compared to those at the herbal clinic (13, 35.1%). Patients on conventional therapies were also older (62.31$\pm$13.91 years) than their counterparts on herbal medicines (55.95$\pm$13.99 years) . participants recruited at KNH had longer duration of diabetes (10 [4-18] years) than those at the herbal clinic (3[1-7] years). Only two patients (5.4%) of the patients treated at the herbal clinic owned a glucometer and none of them had a HbA1c check six months prior to this study. Comorbidities were more prevalent among patients on conventional therapies with 65 (82.1%) of the patients reporting more than one comorbidity (Table 1).

Table 1: Sociodemographic and clinical characteristics of study participants on treatment for type 2 diabetes at KNH and NLHC

Characteristic	Category	KNH (n=80) n (%)	NLHC (n=37) n(%)
Gender	Female	52 (65)	13 (35.1)
Age (years) (mean±SD)		62.31±13.91	55.95±13.99
Married	Yes	61 (76.3)	31 (83.8)
Highest education level	No formal education	16 (20)	1 (2.7)
	Primary	28 (35)	17 45.9)
	Secondary	30 (37.5)	13(35.1)
	Tertiary(college/university)	6 (7.5)	6 (16.2)
Body mass index (BMI)	<18.5 (underweight)	1 (1.3)	1 (2.7)
	18.6-24.9 (normal)	24 (30.0)	11 (29.7)
	>25(overweight/obese)	55 (68.7)	25 (67.6)
Alcohol history	Yes	25 (31.3)	28 (75.7)
Smoking history	Yes	11 (13.8)	21 (56.8)
Years with DM (median (IQR))		10[4-18]	3 [1-7]
Own glucometer	Yes	52 (65)	2 (5.4)
Previous (last 6 months) HbA1c	Yes	36 (45.0)	0 (0.0)
Complications	Microvascular	55 (68.8)	23 (62.2)
	Macrovascular	27 (33.8)	2 (5.4)
No. of comorbidities	None	0 (0.0)	3 (8.1)
	1	15 (18.8)	10 (27)
	>1	65 (82.1)	24 (64.9)

HRQoL SCORES

Patients on conventional therapies for type 2 DM at KNH had significantly better HRQoL scores in all domains compared to their counterparts on herbal therapies ($p< 0.001$). Patients in both groups had the highest scores in the social domain (Table 2). Among patients on herbal therapies,

the lowest scores were on the psychological aspect of HRQoL (45.83 [33.33-54.17]). Regarding overall quality of life, patients at KNH had significantly higher scores 75[75- 100] compared to those at the herbal clinic5(0[25- 75]) , (p< 0.001). Both patient groups had equal median scores on general health 75 [25-75].

Table 2:HRQoL domain scores in patients with type 2 diabetes on conventional therapies at KNH and herbal therapies at NLHC

HRQoL DOMAIN	NLHC (n=37) Median [IQR]	KNH (n=80) Median [IQR]	p-value
Physical	50 [37.50- 57.14]	67.86 [60.71- 78.57]	**<0.001**
Psychological	45.83 [33.33- 54.17]	66.67 [62.50- 75]	**<0.001**
Social	66.67 [33.33- 75]	75.00 [75.00- 97.92]	**<0.001**
Environmental	53.13 [46.88- 59.38]	71.88 [65.63- 80.47]	**<0.001**
Overall QOL	50[25- 75]	75[75- 100]	**<0.001**
General Health	75 [25- 75]	75 [75- 75]	**<0.001**

DETERMINANTS OF HRQoL

The results of bivariable and multivariable linear regression analysis are presented in Table 3. Treatment at Kenyatta National Hospital improved physical health by 1.48 scores (p<0.001). Higher levels of education significantly improved physical health by 1.07 scores (p=0.010) while physical activity improved this aspect of HRQoL by 1.32 scores (p=0.001). Treatment with conventional agents improved psychological health by 1.55 units (p<0.001). The presence of microvascular complications resulted in a 0.89 increase in psychological health scores (p=0.010). Treatment with conventional agents significantly increased scores in the social domain by 1.56 units (p<0.001). Male gender was significantly associated with a 1.52 increase in the social domain scores on bivariate analysis. However, although the effect of male gender on this domain remained significant on multivariate analysis, the improvement in the scores was lower (1.12 , p=0.037). Factors associated with improvement in the environmental domain were treatment with conventional agents (1.45 scores, p<0.001), male gender (1.08 scores, p=0.033) and urban residence (1.05 scores, p=0.026). Older age improved environment HRQoL by 0.96 scores (p=0.004) while alcohol intake was associated with a 0.93 increase in the scores in this domain

Table 3: Bivariable and multivariable linear regression analysis of determinants of physical and psychological HRQoL among the study participants

Variables	WHOQOL DOMAINS							
	Physical				Psychological			
	Crude β(95% C.I)	P-value	Adj. β (95% C.I)	P-value	Crude β (95% C.I)	P-value	Adj.β (95% C.I)	P-value
Study site	1.17 (0.78-1.76)	0.271	1.48 (1.36-1.62)	**<0.001**	1.44 (0.88-2.35)	0.105	1.55 (1.41-1.70)	**<0.001**
Gender (male)	1.11 (0.88-1.41)	0.469	-	**-**	1.02 (0.77-1.36)	0.979	-	**-**
Older Age	0.99 (0.92-1.06)	0.698	-	-	0.96 (0.88-1.04)	0.370	-	**-**
Marital status	0.99 (0.84-1.16)	0.836	-	-	1.03 (0.84-1.25)	0.985	-	**-**
Highest education level	1.10 (1.00-1.20)	0.081	1.07 (1.02-1.12)	**0.010**	1.03 (0.92-1.15)	0.416	-	**-**
Employment	0.97 (0.81-1.16)	0.713	-	-	1.08 (0.87-1.33)	0.496	-	**-**
Residence (urban)	1.03 (0.85-1.25)	0.823	-	-	1.04 (0.83-1.31)	0.795	-	**-**
Physical activity	1.13 (0.84-1.53)	0.441	1.32 (1.12-1.56)	**0.001**	0.93 (0.65-1.34)	0.911	-	**-**
Cigarette smoking	1.12 (0.89-1.41)	0.240	-	-	1.18 (0.89-1.56)	0.202	-	**-**
Alcohol intake	0.89 (0.75-1.06)	0.178	-	-	0.89 (0.72-1.09)	0.332	-	**-**
BMI	1.10 (0.96-1.25)	0.152	-	-	0.96 (0.82-1.12)	0.626	-	**-**
Duration with diabetes	0.99 (0.85-1.15)	0.818	-	-	0.99 (0.83-1.19)	0.818	-	**-**
Own glucometer	1.06 (0.86-1.30)	0.445	-	-	1.12 (0.87-1.43)	0.480	-	**-**
Previous hba1c level	1.10 (0.86-1.41)	0.455	-	-	1.01 (0.75-1.35)	0.920	-	**-**
study hba1c level	0.88 (0.74-1.04)	0.142	-	-	0.94 (0.77-1.15)	0.432	-	**-**

Macrovascular complications	0.95 (0.78-1.15)	0.531	-	-	0.96 (0.76-1.21)	0.746	-	**-**
Microvascular complications	0.87 (0.75-1.02)	0.066	-	-	0.86 (0.72-1.03)	0.112	0.89 (0.81-1.03)	**0.010**
No. of comorbidities	1.02 (0.91-1.14)	0.683	-	-	1.01 (0.88-1.16)	0.865	-	**-**

Table 4: Bivariable and multivariable linear regression analysis of determinants of social and environment HRQoL among the study participants

Variable	**WHOQOL-BREF Domains**							
	Social				**Environment**			
	Crude β (95% C.I)	**P-value**	**Adj. β (95% C.I)**	**P-value**	**Crude β (95% C.I)**	**P-value**	**Adj. β (95% C.I)**	**P-value**
Study site (KNH)	1.27 (0.71-2.25)	0.409	1.56 (1.39-1.75)	<0.001	1.46 (1.11-1.92)	0.007	1.45 (1.34-1.57)	<0.001
Gender (male)	1.52 (1.06-2.18)	0.023	1.12 (1.01-1.24)	0.037	0.95 (0.81-1.10)	0.480	1.08 (1.01-1.15)	0.033
Older Age	0.92 (0.83-1.01)	0.091	-	-	0.95 (0.91-0.99)	0.022	0.96 (0.93-1.01)	0.004
Marital status	1.01 (0.80-1.27)	0.944	-	-	0.98 (0.88-1.09)	0.696	-	-
Highest education level	0.95 (0.83-1.08)	0.416	-	-	1.06 (1.00-1.13)	0.042	-	-
Employment	1.13 (0.88-1.45)	0.317	-	-	1.04 (0.93-1.17)	0.490		
Residence (urban)	1.24 (0.95-1.63)	0.116	-	-	1.06 (0.98-1.15)	0.126	1.05 (1.01-1.10)	0.026
Physical activity	0.80 (0.52-1.22)	0.289	-	-	1.01 (0.83-1.23)	0.918	-	-
Cigarette smoking	0.88 (0.62-1.24)	0.465	-	-	1.15 (0.99-1.34)	0.071	-	-
Alcohol intake	0.81	0.099	-	-	0.96	0.506	0.93	0.048

	(0.63-1.04)				(0.86-1.08)		(0.86-1.00)	
BMI	1.02 (0.85-1.22)	0.861	-	-	1.05 (0.96-1.14)	0.269	-	-
Duration with diabetes	1.09 (0.88-1.35)	0.443	-	-	1.02 (0.92-1.13)	0.652	-	-
Own glucometer	1.29 (0.97-1.73)	0.080	-	-	1.05 (0.92-1.21)	0.446	-	-
Previous hba1c level	0.91 (0.65-1.28)	0.570	-	-	0.99 (0.85-1.17)	0.941	-	-
study hba1c level	1.05 (0.83-1.33)	0.673	-	-	0.99 (0.88-1.10)	0.789	-	-
Macrovascular complications	1.00 (0.76-1.32)	0.997	-	-	0.96 (0.84-1.09)	0.515	-	-
Microvascular complications	0.92 (0.74-1.13)	0.403	-	-	0.97 (0.88-1.07)	0.567	-	-
No. of comorbidities	**0.95 (0.81-1.12)**	**0.558**	**-**	**-**	**1.00 (0.93-1.08)**	**0.983**	**-**	**-**

DISCUSSION

The main objective of this study was to compare health-related quality of life among patients treated for type 2 diabetes in a conventional setting with those receiving care in a herbal clinic. Patients on conventional treatment had significantly higher HRQoL scores in all the domains compared to those recruited at the herbal clinic. Similar findings have been reported in previous studies comparing HRQoL in patients on conventional versus those on complementary and alternative medicine (CAM). In Japan, patients with type 2 diabetes on CAM were found (Lu et al., 2017) to have lower HRQoL compared to those who did not use these forms of therapy (Mori et al., 2023)). This trend has also been reported among CAM users with bronchial asthma (Huo et al., 2015) and inflammatory bowel disease (Opheim et al., 2016). Patients using complementary and alternative therapies including herbal drugs are likely to have disease complications and other comorbid conditions which may further compromise their health-related quality of life (Bayoumy et al., 2021a; Ruiz-Noa et al., 2021) .

In this study, higher levels of education had significant positive effects on physical health scores. A study in Vietnam revealed that level of education has significant effects on HRQoL with higher scores among the educated and poorer scores among the illiterates (Kien et al., 2021) . Individuals with diabetes who attain higher levels of education may benefit from improved social support, enhanced self-esteem, and have a better understanding of their condition (Kien et al., 2021). These factors may collectively contribute to better treatment adherence and improved health

outcomes, including quality of life. Regular physical activity was also associated with improved scores in the physical HRQoL domain. Similar findings were reported in an Iranian study in which physical activity among patients with type 2 DM was associated with better overall QOL with the greatest improvements observed in the physical domain (Sadeghi et al., 2024). Physical activity on prescription (PAP) was also reported to improve physical functioning among Swedish patients (Brorsson Lundqvist et al., 2024). Physical activity plays a critical role in the management of type 2 diabetes. Regular exercise is helpful in controlling weight, blood sugars, blood pressure as well as in reducing the incidence of cardiovascular diseases. Moderate exercise can improve the body's immunity and insulin resistance resulting in better glycemic control, reduced risk of diabetes-related complications, and improved QOL (Shah et al., 2021)

Contrary to prior findings, participants with microvascular complications in this study showed moderate improvements in psychological domain scores. In Taiwan, moderately low HRQoL scores on mental health perspectives were reported among patients with diabetic complications (Pham et al., 2020). Development of neuropathy is associated with reduction in the physical and mental aspects of life (Arnold et al., 2022). The presence of microvascular complications also increases the risk of depression (Le et al., 2022). This finding therefore warrants further investigation to identify potential contributing variables.

Male participants in our study were more likely to experience better HRQoL compared to their female counterparts. Generally, women play the role of care providers in their families and therefore may not receive the necessary support from other family members in managing and coping with diabetes (Moeineslam et al., 2019). Similarly, the male participants had better scores on the environment domain. This may reflect better means of transportation, security and access to health information among the male participants compared to the female participants.

In this study, older age improved scores in the environmental domain of HRQoL among the study participants. Advancing age is often linked to a decline in HRQoL due to the increased risk of onset and progression of diabetes-related complications and comorbidities (Nguyen et al., 2018). However, some studies suggest that older adults may report higher satisfaction in certain HRQoL domains, potentially due to adaptive coping mechanisms and fewer responsibilities such as those related to work and family (Ibrahim et al., 2016). Alcohol intake was associated with improved scores in the environmental domain. Previous studies have reported mixed findings regarding the relationship between alcohol consumption and HRQoL in T2DM patients. Moderate alcohol intake may confer cardiovascular benefits, potentially enhancing HRQoL. On the other hand, alcohol consumption increases the risk of comorbidities and may have negative economic consequences leading to poor HRQoL (Wonde et al., 2022).

Urban residence was associated with improvements in the environment domain. This is supported by similar findings among type 2 diabetes patients in Ethiopia (Aschalew et al., 2020). Although there are limited studies comparing diabetes HRQoL in rural versus urban residents, findings from studies in healthy populations have reported better HRQoL scores from urban dwellers compared to rural residents (Zhang et al., 2022) . Urban residents are likely to have better access to transport, health services and health information leading to better HRQoL compared to rural residents (Pope et al., 2022).

CONCLUSION

Treatment at Kenyatta National Hospital was associated with better scores on all the HRQoL domains evaluated in this study. Other determinants of physical QOL were levels of education and engaging in physical activity. The presence of microvascular complications improved psychological health. Urban residence and male gender were associated with better scores on environment domain Alcohol intake and older age significantly improved this aspect of HRQoL. Treatment at Kenyatta National Hospital and male gender were the significant determinants of social health.

CONSENT

All authors declare that written informed consent was obtained from the participants. A copy of the written consent is available for review by the Editorial office/Chief Editor/Editorial Board members of this journal.

ETHICAL APPROVAL

The KNH/UON Ethics and Research Committee granted ethical approval for this research (Approval number KNH/ERC/R/91). Participants were asked for voluntary consent to be recruited into the study.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

REFERENCES

Arnold, S. V., Khunti, K., Tang, F., Chen, H., Nicolucci, A., Gomes, M. B., Ji, L., Shestakova, M. V., Watada, H., Cooper, A., Fenici, P., Hammar, N., Medina, J., & Kosiborod, M. (2022). Impact of micro- and macrovascular complications of type 2 diabetes on quality of life: Insights from the DISCOVER prospective cohort study. *Endocrinology, Diabetes & Metabolism*, *5*(2), 14. https://doi.org/10.1002/EDM2.321

Aschalew, A. Y., Yitayal, M., & Minyihun, A. (2020). Health-related quality of life and associated factors among patients with diabetes mellitus at the University of Gondar referral hospital. *Health and Quality of Life Outcomes*, *18*(1), 1–8. https://doi.org/10.1186/S12955-020-01311-5/TABLES/5

Bayoumy, I. El, Dawod, W., Bayoumy, I. El, & Dawod, W. (2021). Herbal Use and Perceptions among Patients with Type 2 Diabetes Mellitus in Kuwait. *Journal of Diabetes Mellitus*, *12*(1), 50–62. https://doi.org/10.4236/JDM.2022.121006

Brorsson Lundqvist, E., Praetorius Björk, M., & Bernhardsson, S. (2024). Physical activity on prescription in Swedish primary care: a survey on use, views, and implementation determinants amongst general practitioners. *Scandinavian Journal of Primary Health Care*, *42*(1), 61–71. https://doi.org/10.1080/02813432.2023.2288126

Constitution of the World Health Organization. (2011). *American Journal of Public Health*, *36*(11), 1315–1323. https://doi.org/10.2105/AJPH.36.11.1315

E.K, Genga., C.F, Otieno., E.N, O., & M.C, M. (2014). Assessment of the Perceived Quality of Life of Non insulin Dependent Diabetic patients attending the Diabetes Clinic in Kenyatta National Hospital. *IOSR Journal of Pharmacy (IOSRPHR)*, *04*(03), 15–21. https://doi.org/10.9790/3013-040315-21

Elsa, O., Kuria, K., Nyamu, D., & Mwangangi, E. (2017). Utilization of Herbal Medicines among Diabetic Patients Attending Kenyatta National Hospital Outpatient Clinic. *Journal of Complementary and Alternative Medical Research*, *3*(1), 1--18. https://doi.org/10.9734/jocamr/2017/33962

Elsayed, N. A., Aleppo, G., Aroda, V. R., Bannuru, R. R., Brown, F. M., Bruemmer, D., Collins, B. S., Hilliard, M. E., Isaacs, D., Johnson, E. L., Kahan, S., Khunti, K., Leon, J., Lyons, S. K., Perry, M. Lou, Prahalad, P., Pratley, R. E., Seley, J. J., Stanton, R. C., & Gabbay, R. A. (2023). 6. Glycemic Targets: Standards of Care in Diabetes—2023. *Diabetes Care*, *46*(Supplement_1), S97–S110. https://doi.org/10.2337/DC23-S006

Harper, A., Power, M., Orley, J., Herrman, H., Schofield, H., Murphy, B., Metelko, Z., Szabo, S., Pibernik-Okanovic, M., Quemada, N., Caria, A., Rajkumar, S., Kumar, S., Saxena, S., Chandiramani, K., Amir, M., Bar-On, D., Tazaki, M., Noji, A., … Sartorius, N. (1998). Development of the World Health Organization WHOQOL-BREF quality of life assessment. The WHOQOL Group. *Psychological Medicine*, *28*(3), 551–558. https://doi.org/10.1017/S0033291798006667

Huo, N., Ray, G. E., Mehta, S., & Lobello, S. G. (2015). Complementary and alternative medicine use among people with asthma and health-related quality of life. *The Journal of Asthma : Official Journal of the Association for the Care of Asthma*, *52*(3), 308–313. https://doi.org/10.3109/02770903.2014.963867

Ibrahim Abdel-Latif Megahed, F., Ibrahim Abd El Latif, F., Ali Abd El Wahid, H., Ahmed Mohamed, A., & Kassem Farg, H. (2016). *Physical and psychological health domains of quality of life in type 2 diabetic patients in relation to clinical factors of diabetes mellitus in Egypt*. https://www.netjournals.org/z_IRJMMS_16_015.html

Jing, X., Chen, J., Dong, Y., Han, D., Zhao, H., Wang, X., Gao, F., Li, C., Cui, Z., Liu, Y., & Ma, J. (2018). Related factors of quality of life of type 2 diabetes patients: A systematic review and meta-analysis. *Health and Quality of Life Outcomes*, *16*(1). https://doi.org/10.1186/S12955-018-1021-9

Karara, M. W., Okalebo, F. A., Ndirangu, P. K., & Opanga, S. A. (2022). Comparative Glycemic Control in Adult Patients with Type 2 Diabetes on Herbal and Conventional Glucose-Lowering Agents in Nairobi County, Kenya. *Journal of Complementary and Alternative Medical Research*, 25–34. https://doi.org/10.9734/JOCAMR/2022/V19I2385

Le, T. D., Duong, H. H., Nguyen, L. T., Nguyen, N. P. T., Nguyen, S. T., & Van Ngo, M. (2022). The Relationship Between Depression and Multifactorial Control and Microvascular Complications in Vietnamese with Type 2 Diabetes Mellitus Aged 30–60 Years. *Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy*, *15*, 1185–1195. https://doi.org/10.2147/DMSO.S354443

Lu, Y., Wang, N., Chen, Y., Nie, X., Li, Q., Han, B., Chen, Y., Xia, F., Cang, Z., Lu, M., Meng, Y., & Lu, Y. (2017). Health-related quality of life in type-2 diabetes patients: A cross-sectional study in East China. *BMC Endocrine Disorders*, *17*(1), 1–7. https://doi.org/10.1186/S12902-017-0187-1/TABLES/5

Moeineslam, M., Amiri, P., Karimi, M., Jalali-Farahani, S., Shiva, N., & Azizi, F. (2019). Diabetes in women and health-related quality of life in the whole family: a structural equation modeling. *Health and Quality of Life Outcomes*, *17*(1). https://doi.org/10.1186/S12955-019-1252-4

Mori, Y., Daikuhara, H., Oshima, T., Suzuki, H., Okada, S., & Miyatake, N. (2023). Use of Complementary and Alternative Medicine and Its Relationship with Health-Related Quality of Life (HRQOL) in Patients with Type 2 Diabetes Mellitus. *Epidemiologia 2023, Vol. 4, Pages 53-59*, *4*(1), 53–59. https://doi.org/10.3390/EPIDEMIOLOGIA4010005

Nguyen, H. T. T., Moir, M. P. I., Nguyen, T. X., Vu, A. P., Luong, L. H., Nguyen, T. N., Nguyen, L. H., Tran, B. X., Tran, T. T., Latkin, C. A., Zhang, M. W. B., Ho, R. C. M., & Vu, H. T. T. (2018). Health-related quality of life in elderly diabetic outpatients in Vietnam. *Patient Preference and Adherence*, *12*, 1347. https://doi.org/10.2147/PPA.S162892

Opheim, R., Lie Høivik, M., Bernklev, T., Jelsness-Jørgensen, L. P., & Moum, B. (2016). The Use of Complementary and Alternative Medicine among Patients with Inflammatory Bowel Disease Is Associated with Reduced Health-Related Quality of Life. *Gastroenterology Research and Practice*, *2016*. https://doi.org/10.1155/2016/6453657

Pham, T. B., Nguyen, T. T., Truong, H. T., Trinh, C. H., Du, H. N. T., Ngo, T. T., & Nguyen, L. H. (2020). Effects of Diabetic Complications on Health-Related Quality of Life Impairment in Vietnamese Patients with Type 2 Diabetes. *Journal of Diabetes Research*, *2020*. https://doi.org/10.1155/2020/4360804

Pope, C. N., Stavrinos, D., Fazeli, P. L., & Vance, D. E. (2022). Transportation Barriers and Health-Related Quality of Life in a Sample of Middle-Aged and Older Adults Living with HIV in the Deep South. *AIDS and Behavior*, *26*(7), 2148–2158. https://doi.org/10.1007/s10461-021-03560-x

Ruiz-Noa, Y., Ibarra-Reynoso, L. D. R., Ruiz-Padilla, A. J., Alonso-Castro, A. J., Ramírez-Morales, M. A., Zapata-Morales, J. R., Orozco-Castellanos, L. M., Solorio-Alvardo, C. R., & Lara-Morales, A. (2021). Use of herbal medicine for diabetes mellitus in adults from the central-western region of Mexico. *Primary Care Diabetes*, *15*(6), 1095–1099. https://doi.org/10.1016/j.pcd.2021.08.010

Sadeghi, D., Motlagh, M. K., Darvish, A., Daryaafzoon, M., Mohamadnejad, E., Molaei, A., Montazerlotf, P., & Hosseini, R. S. S. (2024). Comparative effect of physical health training and psychological training of the theory of reasoned action (TRA) model on the life quality of patients with diabetes in Tehran, Iran: utilization of message texting. *BMC Endocrine Disorders*, *24*(1), 1–12. https://doi.org/10.1186/s12902-024-01598-1

Shah, S. Z. A., Karam, J. A., Zeb, A., Ullah, R., Shah, A., Haq, I. U., Ali, I., Darain, H., & Chen, H. (2021). Movement is Improvement: The Therapeutic Effects of Exercise and General Physical Activity on Glycemic Control in Patients with Type 2 Diabetes Mellitus: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *Diabetes Therapy*, *12*(3), 707–732. https://doi.org/10.1007/s13300-021-01005-1

Sun, H., Saeedi, P., Karuranga, S., Pinkepank, M., Ogurtsova, K., Duncan, B. B., Stein, C., Basit, A., Chan, J. C. N., Mbanya, J. C., Pavkov, M. E., Ramachandaran, A., Wild, S. H., James, S., Herman, W. H., Zhang, P., Bommer, C., Kuo, S., Boyko, E. J., & Magliano, D. J. (2022). IDF Diabetes Atlas: Global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. *Diabetes Research and Clinical Practice*, *183*. https://doi.org/10.1016/J.DIABRES.2021.109119

Torgerson, D. J., & Torgerson, C. J. (2008). Designing randomised trials in health, education and the social sciences: An introduction. In *Designing Randomised Trials in Health, Education and the Social Sciences: An Introduction*. Palgrave Macmillan. https://doi.org/10.1057/9780230583993

Tran Kien, N., Phuong Hoa, N., Minh Duc, D., & Wens, J. (2021). Health-related quality of life and associated factors among patients with type II diabetes mellitus: A study in the family medicine center (FMC) of Agricultural General Hospital in Hanoi, Vietnam. *Health Psychology Open*, *8*(1). https://doi.org/10.1177/2055102921996172

Wonde, T. E., Ayene, T. R., Moges, N. A., & Bazezew, Y. (2022). Health-related quality of life and associated factors among type 2 diabetic adult patients in Debre Markos Referral Hospital, Northwest Ethiopia. *Heliyon*, *8*(8). https://doi.org/10.1016/J.HELIYON.2022.E10182

Zhang, J., Xiao, S., Shi, L., Xue, Y., Zheng, X., Dong, F., Xue, B., & Zhang, C. (2022). Differences in Health-Related Quality of Life and Its Associated Factors Among Older Adults in Urban and Rural Areas. *Risk Management and Healthcare Policy*, *15*(July), 1447–1457. https://doi.org/10.2147/RMHP.S373077