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# Assessment of lifestyle modifications among Sudanese individuals with diabetes: The situation so far and the need to do more

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## Abstract:

**BACKGROUND:** Inadequate lifestyle practices among individuals with diabetes may influence the progression of diabetes and its complications. The aim of this study was to assess the lifestyle practices among individuals with diabetes in Sudan.

**METHODOLOGY:** This was a descriptive, cross-sectional, health facility-based study conducted in 3 diabetes centers treating individuals with diabetes. The data were collected using a standardized pretested metabolic questionnaire about lifestyle and were analyzed by performing descriptive and inferential statistics through SPSS program version 23.

**RESULTS:** A total of 528 patients with diabetes answered the questionnaire. There were 52.1% of female participants and 72.9% of urban residents. 23.9% were obese, regular exercise was reported by 27.7%, and no exercise by 17%. There was a statistically significant association between lifestyle practices and gender ( $P < 0.001$ ), age ( $P < 0.001$ ), educational level ( $P = 0.002$ ), marital status ( $P < 0.001$ ), duration of diabetes ( $P < 0.001$ ), hypertension ( $P < 0.001$ ), high-density lipoprotein ( $P < 0.001$ ), low-density lipoprotein ( $P < 0.001$ ), and HbA1c level ( $P < 0.001$ ). Logistic regression analysis showed male gender and education were significantly associated with lifestyle changes. Men were more likely to engage in favorable lifestyle practices than women ( $P < 0.001$ ), while those with no formal education were less likely to engage in healthy lifestyle ( $P < 0.001$ ).

**CONCLUSIONS:** Health authorities in Sudan will need to put more efforts into education for promoting self-awareness and good lifestyle practices in the population with diabetes.

## Keywords:

Exercise, lifestyles, obesity, Sudan

## Introduction

Diabetes prevalence has been increasing all over the world but more so in Africa and the MENA regions.<sup>[1]</sup> According to the latest estimates from the IDF diabetes atlas of 2019, Sudan is the 3<sup>rd</sup> highest country in the world in terms of the percentage of patients with diabetes as the prevalence in those aged between 20 and 79 years was estimated at 22.1%. This estimate was based

on a number of recent studies including one conducted by our group, which showed that the prevalence of diabetes in the north of Sudan was 19% in urban areas.<sup>[2]</sup>

Lifestyle changes are one of the cost-effective options for health authorities in low-income countries such as Sudan to promote and spread in order to enhance glycemic control and decrease diabetes complications. Importantly, it was shown that individuals

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with diabetes who regularly engaged in self-care practices have achieved better glycemic control.<sup>[3]</sup> This is highly needed in Sudan due to high prevalence of diabetes complications such as retinopathy, nephropathy, ischemic heart disease, and diabetic septic foot.<sup>[4,5]</sup> A study from a rural area in India showed that more than 70% of individuals with diabetes had the correct knowledge about the role of diet, exercise, smoking, and alcohol, while 72% had strict drug compliance but only 29.3% of subjects followed a favorable physical exercise schedule.<sup>[6]</sup> In contrast, in another study from a different area of rural India, Dinesh *et al.* showed that 24% had good knowledge about diabetes. Importantly, checking feet was only achieved by only 0.5%, capillary glucose testing was achieved by 65%, and only 48% of the respondents were regular in taking drugs and 20.5% exercised for at least 5 days in a week for 20–30 min.<sup>[7]</sup>

Management of diabetes mellitus requires setting of a proper treatment plan including medications, healthy diet, weight loss, and regular physical activity. Patient adherence, education, and integration into the health-care team are essential for the successful management of diabetes. For instance, adherence to antidiabetic medications and the associated factors among individuals with type 2 diabetes attending Jabir Abu Eliz Diabetes Centre in Khartoum state, Sudan, only 15.0% were highly adherent to diabetes medications while 44.6% reported medium adherence and 40.4% reported low adherence.<sup>[8]</sup> Knowledge about diabetes and lifestyle has been variable in different studies. In a study from India, majority of respondents (92.2%) had poor knowledge of the benefits of exercise, weight loss, and a healthy diet. The majority (97.7%) demonstrated poor practices in relation to lifestyle modifications, although over four-fifths (84.3%) had a positive attitude toward healthy lifestyle modifications.<sup>[9]</sup> Furthermore, in another study from India, it was found that the self-care capabilities of 69.2% of the participants were poor, moderate capabilities were found in 23.3%, while good/acceptable capabilities were reported in only 7.5% of the participants.<sup>[10]</sup> The aim of this study was to assess lifestyle practices among Sudanese individuals with diabetes and its relationship to various patient factors.

## Methodology

### Study setting

This was a descriptive, cross-sectional, health facility-based study of patients with diabetes followed at three diabetes centers in Sudan (two centers in Khartoum and one in Atbara city).

Adult patients of both sexes who are more than 18 years of age and have confirmed diabetes mellitus were

recruited. All patients with diabetes who agreed to participate in the study were included. We excluded pregnant ladies, those younger than 18 years old, and those who do not want to participate in the study.

## Materials and methods

The data were collected through direct interview using predesigned standardized questionnaire. A combined weight and height scale was used for measuring weight and height and body mass index (BMI) was calculated.<sup>[2]</sup> Glycemic control was determined based on the latest available HbA1c result.

### Data analysis

The data were analyzed using the computerized program, Statistical Package for Social Sciences (SPSS, IBM, Chicago, USA, version 25). Results were presented as tables and figures. Chi-square test was used for cross-tabulation at 0.05 margins of error (*P* value). Descriptive statistics (frequency tables, median, histogram, means, and standard deviation) and inferential statistics (Chi-square test) were performed followed by logistic regression analysis.

### Ethical consideration

Ethical approval was obtained from Sudan Medical and Scientific research institute (SUMASRI)- Institutional Review Board of the faculty of Medicine, University of Medical Sciences and Technology, Khartoum, Sudan (IRB No. 00008867). The information was communicated verbally. Refusal to participate in the study did not deny the patient the appropriate management. The participants did not bear any cost.

## Results

### Sociodemographic characteristics

Five hundred and twenty-eight patients with diabetes completed the questionnaires. Sociodemographic characteristics of the participants are shown in Table 1: The mean age was 57 years (SD 11.5), while the most common age group was 51–60 years in (34.7%) of the participants. Females were 52.1% while 72.9% of the participants were from urban areas. Regarding education level, highest percentage of the participants (29.2%) were illiterate, while 80.1% of all the participants were married.

The median BMI for the participants was 26.7, 40% of the participants were overweight, 23.9% were obese, while 33.3% were of normal weight [Table 1].

### Type of diabetes and duration

(The majority (93.2%) had type 2 diabetes mellitus, while only 6.8% had type 1 [Table 2], while 41.7%

**Table 1: Distribution of the participants according to sociodemographic characteristics (n=528)**

Sociodemographic characteristics	n (%)
Age group (years)	
20-30	15 (2.8)
31-40	28 (5.3)
41-50	107 (20.3)
51-60	183 (34.7)
61-70	157 (29.7)
>70	38 (7.2)
Gender	
Male	253 (47.9)
Female	275 (52.1)
Residence	
Rural	143 (27.1)
Urban	385 (72.9)
Level of education	
Illiterate	154 (29.2)
Primary	128 (24.2)
Secondary	146 (27.7)
University graduate and postgraduate	100 (18.9)
Marital status	
Single	25 (4.7)
Married	423 (80.1)
Divorced	19 (3.6)
Widowed	61 (11.6)
BMI	
Underweight	15 (2.8)
Normal weight	176 (33.3)
Overweight	211 (40.0)
Obese	126 (23.9)

BMI=Body mass index

**Table 2: Distribution of the participants according to diabetes type and duration (n=528)**

DM information	n (%)
Duration of DM (years)	
0-5	220 (41.7)
6-10	82 (15.5)
>10	226 (42.8)
Type of DM	
Type 1	36 (6.8)
Type 2	492 (93.2)

DM=Diabetes mellitus

of the participants had diabetes for <5 years, 15.5% had diabetes for between 6 and 10 years, while 42.8% had diabetes for more than 10 years. 37.5% of the participants had hypertension, while only 4.5% had ischemic heart diseases. 26.5% had uncontrolled total cholesterol levels, while 44.7% had uncontrolled low-density lipoprotein (LDL) levels. According to HbA1c criteria, only 19.8% of the participants had good diabetes control, while uncontrolled diabetes was seen in 80.2%. 87.5% and 86.2% of the participants had normal levels of serum creatinine and blood urea nitrogen, respectively.

## Lifestyle practices

27.7% of the participants exercise regularly, while more than half (55.3%) sometimes practice exercise and only 17% they said that they do not practice exercise at all [Table 3]. Cigarette smoking was reported by 22.2% of the participants, while alcohol consumption was reported by 11.4%.

When cross-tabulation and Chi-square tests were performed to determine the associations between different variables, we found that there were statistically significant relationships between the lifestyle practice and gender, age, educational level, marital status, duration of diabetes, hypertension, high-density lipoprotein (HDL), LDL, and HbA1c levels. For example, favorable lifestyle practices were achieved by 62.3% of males and by only 37.7% of females ( $P < 0.001$ ); 40% of the participants aged 51–60 years were exercising regularly ( $P = 0.001$ ), while 47% of those who do not exercise regularly were illiterate ( $P < 0.001$ ). Furthermore, 84.2% of married participants were exercising regularly ( $P < 0.001$ ). Duration of diabetes also had an influence on lifestyle practices, for instance, 57% of those with diabetes for 0–5 years were exercising regularly while in those with diabetes for more than 10 years, only 32% were doing regular exercise ( $P < 0.001$ ) [Tables 2–4]. Among those who engaged in favorable lifestyle practices regularly, only 22% had hypertension, 64% had normal HDL, and 57% had normal LDL levels ( $P < 0.001$ ,  $< 0.000$ , and  $0.016$ , respectively). Uncontrolled diabetes was seen among two-thirds of those who do not practice exercise regularly ( $P < 0.001$ ).

Gender and education were significantly associated with lifestyle changes. Using logistic regression analysis, the adjusted effect for males was 0.697 ( $P < 0.001$ ), which means that, adjusting for all factors simultaneously, men are more likely to engage in favorable lifestyle practices than women. Similarly, those with no formal education were less likely than the reference group (university graduates) to engage in healthy lifestyle (effect =  $-0.973$ , [ $P < 0.001$ ]) [Table 4].

## Discussion

Physical activity is a general term that includes all movement that increases energy use and is an important part of the diabetes management plan. International guidelines and several studies recommend that all patients with diabetes should engage in at least 150 min/week of moderate intensity exercise such as brisk walking.<sup>[11–15]</sup> Exercise has been shown to improve blood glucose control, reduce cardiovascular risk factors, contribute to weight loss, and improve well-being.<sup>[16–23]</sup>

In this study, we report that regular exercise was reported by only 27.7% of participants while 55.3%

reported performing exercise only sometimes and 17% reported performing no exercise whatsoever. Other studies reported similarly low percentages of patients with diabetes doing regular exercise, Srivastava *et al.* showed that only 29.3% were engaged in regular physical activity<sup>[6]</sup> while Okonta *et al.* reported that only 8.3% of patients exercised regularly and the majority (94.4%) exercises for <30 min/day or <150 min/week.<sup>[9]</sup>

**Table 3: Distribution of the participants according to lifestyle practice (n=528)**

Items	n (%)
Smoking	
Yes	117 (22.2)
No	411 (77.8)
Alcohol	
Yes	60 (11.4)
No	468 (88.6)
Practice regular exercise	
Yes	146 (27.7)
No	90 (17)
Sometimes	292 (55.3)

Physical activity in Sudanese individuals tends to decrease with obesity, higher education levels, hypertension, older age, and doing sedentary jobs. Gender in Sudan is also an absolute risk factor for physical activity as males have more than three times probability of being physically active than women.<sup>[16]</sup> This probably contributed to the reported higher prevalence of obesity in women more than men in Sudan.<sup>[17]</sup> Therefore, it was not surprising in this study to find men were more likely to engage in favorable lifestyle practices than women.

Adherence to lifestyle changes is challenging to individuals with diabetes not only in the Western world but also for those living with diabetes in Africa. For instance, in Ghana, the majority of individuals with diabetes were not adherent to positive lifestyle changes such as exercise, being physically active, and healthy eating despite their knowledge about diabetes.<sup>[11]</sup> Therefore, it is not surprising that another study from same country, recommended the need for education about physical activity and weight loss.<sup>[12]</sup> Performance of exercise by patients with diabetes can

**Table 4: Logistic regression analysis of the variance**

Covariate	Unadjusted effect	SE	P	Adjusted effect	SE	P
Male gender	0.736	0.173	<0.001	0.697	0.277	0.012
Age group						
31-40	1.110	0.660	0.096	0.003	0.003	0.351
41-50	-0.177	0.579	0.759	0.680	0.837	0.417
51-60	0.587	0.564	0.298	-0.722	0.900	0.423
61-70	0.263	0.567	0.643	-0.337	1.120	0.763
70-plus	0.071	0.624	0.908	-0.971	1.386	0.484
Education						
Illiterate	-0.842	0.253	<0.001	-0.973	0.332	0.003
Primary	-0.271	0.258	0.295	-0.407	0.330	0.218
Secondary	-0.006	0.249	0.982	-0.149	0.300	0.620
Urban residence	-0.017	0.188	0.950	-0.108	0.233	0.643
Marital status						
Married	-0.353	0.424	0.405	-0.620	0.488	0.205
Single	-0.146	0.581	0.801	-0.538	0.689	0.436
Widowed	-0.635	0.475	0.182	-0.345	0.560	0.538
DM duration (years)						
6-10	-0.476	0.257	0.064	-0.483	0.319	0.130
10 plus	-0.119	0.184	0.515	-0.320	0.277	0.248
Uncontrolled cholesterol	-0.279	0.192	0.146	-0.124	0.258	0.630
Uncontrolled HDL	0.003	0.168	0.986	0.004	0.223	0.842
Uncontrolled LDL	0.178	0.169	0.293	0.355	0.219	0.105
IHD	-0.209	0.387	0.589	-0.229	0.446	0.608
Alcohol	0.349	0.253	0.168	-0.006	0.359	0.860
Smoking	0.466	0.199	0.020	0.009	0.314	0.768
BMI	-0.016	0.014	0.267	0.00008	0.002	0.996
High PC	-0.143	0.252	0.571	0.227	0.415	0.585
Neuropathy	-0.152	0.174	0.384	0.1772	0.220	0.421
Hypertension	0.066	0.189	0.792	0.115	0.209	0.582
Uncontrolled HbA1C	-0.057	0.230	0.806	0.342	0.313	0.274

BMI=Body mass index, DM=Diabetes mellitus, SE=Standard error, HDL=High density lipoprotein, LDL=Low density lipoprotein, IHD=Ischaemic heart disease, HbA1C=Glycosylated haemoglobin, PC=Plasma creatinine

vary depending on whether they reside in rural or urban areas. In a study from India, Dinesh *et al.* showed that 20.5% of those residing in a rural area exercised for at least 5 days in a week for 20–30 min.<sup>[7]</sup> Less physical activity was also reported in urban areas in comparison with rural areas in a study from Sub-Saharan Africa.<sup>[13]</sup> In this study, we also reported less engagement with physical activity in residents of urban areas compared with those from rural areas. Importantly, several studies have shown that rapid urbanization was associated with an increase in metabolic conditions like type 2 diabetes, hypertension, and obesity.<sup>[14,15]</sup> A study from the United States has shown that race can also have an influence on the practice of exercise as more Hispanics achieved the recommended levels of exercise compared with white or African Americans.<sup>[24]</sup>

The prevalence of smoking in this study was 22.2%, and this was less than the prevalence reported by Awadalla *et al.* who showed a prevalence of 33.9%. Awadalla *et al.* showed that smoking in Sudanese individuals with diabetes was associated with an increase in age, male gender, HbA1c, ischemic heart disease and triglyceride levels.<sup>[18]</sup>

Zhong *et al.* concluded that best performance in self-management is achieved when those with type 2 diabetes have a high degree of knowledge of diabetes, positive attitudes toward diabetes, strong self-efficacy for self-management, and perceptions of good social support.<sup>[19]</sup> These observations were also endorsed by Mehata who showed that strong knowledge about diabetes can enhance lifestyle changes significantly.<sup>[20]</sup> Importantly, adequate support and encouragement provided by the health authorities may have a profound impact on increasing knowledge, attitude, and perception scores and this may lead to better self-care behavior.<sup>[21]</sup> We showed in this study that individuals with diabetes with no formal education were less likely to engage in healthy lifestyle practices. Therefore, health authorities in Sudan should dedicate more time and resources in order to increase the development of knowledge about diabetes and ultimately this may lead to better self-care behavior. We believe that an important issue as different studies from different countries showed that individuals with diabetes normally do not receive adequate knowledge about diabetes. For instances, In Ethiopia, some individuals with diabetes were reported to lack knowledge about diabetes and as result they were not engaged in physical activity, do not check capillary glucose regularly, and not adhering to healthy dietary habits.<sup>[25]</sup> Adil *et al.* also showed low level of knowledge about diabetes in Pakistan and this was negatively associated with low level of healthy lifestyles and adherence to medication.<sup>[26]</sup> Similar observations were also reported in individuals with

diabetes from Bangladesh.<sup>[27]</sup> It is worth mentioning that patient education and self-empowerment can be associated with positive outcome in term of glycemic control in type 2 diabetes.<sup>[28-30]</sup>

This study has several limitations. The cross-sectional design does not allow a precise estimation of the temporal relationship between the potential risk factors and outcomes. Also, the study may not represent all Sudan as recruitment of patients was from limited areas in Sudan. Despite these limitations, the study is novel as this first study about lifestyle and diabetes in Sudan and reflects the need for more health education. This can be achieved by health professionals working in diabetes management. Further studies will be needed to monitor the impact of health education in lifestyles among Sudanese individuals with diabetes.

## Conclusion

Engagement in healthy lifestyle practices in Sudanese patients with diabetes is more likely to be reported in male, young individuals, those with a shorter duration of diabetes and married individuals. Lower education levels can negatively influence engagement with a healthy lifestyle. Therefore, health authorities in Sudan need to invest more in education and promotion of better awareness about healthy lifestyle in those with diabetes.

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## Conflicts of interest

There are no conflicts of interest.

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