Original Article

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Anatomy Section

Evaluation of Limited Joint Mobility of the Hand and Associated Factors among Diabetic and Non Diabetic Patients in a Tertiary Care Hospital in Southern Ethiopia: A Case-control Study

KEREBIH HAREGEWOYIN[1], MERGU PRASAD[2], NIGUSSIE HAYMANOT[3], GEBREMICKAEL ABINET[4], GETACHEW TAMIRU[5]

ABSTRACT

Introduction: Limited Joint Mobility (LJM) is one of the long-term complications of Diabetes Mellitus (DM). It is a widespread problem among patients with DM, affecting more than two-thirds of diabetic patients. It is known that LJM predominantly affects the mobility of upper limb joints, especially those of the hand, and is often neglected until hand deformity is severe enough to interfere with daily life. Even though various studies in developed countries have revealed a significantly higher rate of LJM among diabetic patients, there is limited evidence in developing countries, specifically in Ethiopia.

Aim: To assess LJM of the hand and associated factors among diabetic and non diabetic patients.

Materials and Methods: A hospital-based, case-control study was conducted on 240 participants in Arba Minch General Hospital, Southern Ethiopia from November 2018 to May 2019. The range of flexion and extension motions of individual hand joints {wrist, Metacarpophalangeal (MCP), first Interphalangeal (IP), Proximal Interphalangeal (PIP), and Distal Interphalangeal (DIP)} were measured by using a Goniometer. The collected data was entered into Epi (Epidemiological) Info version 3.2 and transferred to Statistical Package for Social Sciences (SPSS) version 20.0 for analysis. An independent t-test was conducted to compare the mean and standard deviations of hand joint motions among diabetic and non diabetic groups. Logistic regression was used to assess the association between the dependent and independent factors. The p-value <0.05 was considered as statistically significant.

Results: A total of 234 participants (response rate of 97.5% ,117 diabetic cases and 117 non diabetic controls) were included in the study. The magnitude of LJM among diabetic cases was 17.1%, whereas in non diabetic controls, it accounted for 4.3%. The composite score mean (±SD) of hand flexion in diabetic patients was 1088.75±860, which is significantly lower (p<0.05) than in non diabetic patients, 1117.75±82.880, and hand extension in diabetic patients was 227.98±87.220, which was significantly lower than in non diabetic patients, 276.96±78.180. Age >50 years {AOR: 3.9 (1.14-13.36) with p=0.03} and co-morbidity with hypertension {AOR: 3.26 (1.02-10.41) with p=0.04} were identified as significant associated factors for LJM in diabetic patients.

Conclusion: In diabetic patients, flexion and extension movements of hand joints were significantly reduced compared to those of non diabetic patients. Advanced age and co-morbidity with hypertension were significantly associated with LJM in the current study.

Keywords: Diabetic cheiroarthropathy, Diabetes mellitus, Finger joints, Hand joints, Range of motion

INTRODUCTION

The LJM is also known as diabetic cheiroarthropathy, or stiff hand syndrome, and is one of the long-term complications of DM [1]. It is defined as a painless non inflammatory reduction in the mobility of hands, feet, and large joints [2]. LJM develops in people with long-term type 1 diabetes and was first identified to describe a stiffening effect in the hand joints [3]. LJM is a widespread problem, affecting more than two-thirds of diabetic patients [4]. An increased magnitude of musculoskeletal disease is recognised in DM and is a common source of disability. It is known that LJM predominantly affects the mobility of upper limb joints, especially joints of the hand, and is often neglected until hand deformity is severe enough to interfere with daily life [5]. So, this might result in economic losses and social isolation, loss of independence, and reduced quality of life [6].

When the limitation of joint mobility becomes worse, small joints in the hands may develop fixed flexion contractures. It can be best appreciated by asking the patient to approximate the palms while keeping the wrists extended fully (prayer sign) or by asking the patient to flatten the palm of his/her hand against the surface of the table (table-top sign) [7]. Different studies have used prayer or table-top signs to detect LJM in the hands of diabetic patients [8-10]. These tests are useful for detecting a clinically apparent form of limitation. Still, it is not sufficient to identify a more discrete subclinical form of LJM in the hands, which can be detected only by using goniometric measurement [11]. Early recognition of LJM is essential for two reasons; one is that it can be reversed by treatment if diagnosed early, and the other is that it can be used as a marker for diabetic microvascular complications [12].

Even though various studies in developed countries have revealed a significantly higher rate of LJM among diabetic patients, there is limited evidence in developing countries, specifically in Ethiopia [10,11,13-17]. Moreover, there is also a lack of evidence relating to the factors associated with LJM. This study aimed to assess the magnitude of limited joint mobility of the hand among diabetic patients and non diabetic controls, and the factors associated with LJM of the hand in diabetic patients.

MATERIALS AND METHODS

The hospital-based, case-control study was conducted in Arba Minch General Hospital, Southern Ethiopia from November 2018 to May 2019. This hospital provides preventive, curative, and rehabilitative services, including diabetic and other chronic non

communicable diseases. A total of 240 patients were enrolled for the study (120 diabetic cases and 120 non diabetic controls). DM was diagnosed as patients having plasma glucose ≥7.0 mmol/L (126 mg/dL) or 2 hour plasma glucose ≥11.1 mmol/L (200 mg/dL). Before the data collection commencement, ethical clearance (IEC No: CMHS/12031837/54/11) was obtained from the Institutional Review Committee of the College of Medicine and Health Sciences (CMHS), Arba Minch University, and consent was obtained from the patients included in the study.

Inclusion criteria: The 120 known diabetic patients aged 18 years and above, of both type 1 and 2 diabetic patients who had at least three months of follow-up visits at Arba Minch general hospital were included as cases. The 120 non diabetic controls who came to the adult Outpatient Department (OPD) of the hospital were included as controls in the present study.

Exclusion criteria: Those diabetic and non diabetic patients with a history of hand injury, burn, or surgery, a Body Mass Index (BMI) greater than 35 kg/m^2 [18], severe illness, or speech impairment were excluded from the study.

Sample size calculation: The sample size was calculated using the double population to mean formula and the online open Epi version 3 open sources calculator, taking into account the average of mean and standard deviations of dominant and non dominant 5th MCP joint extension in diabetics (52.35±18.75) and non diabetics (59.3±17.85) [10], 95% confidence interval, power 80%, and a diabetic-to-non diabetic ratio of 1:1. Based on this assumption and by adding a 10% non response rate, the final sample size was 120 for each group.

For the diabetic group, on an average, 25 diabetic patients visit chronic disease OPD per day. Therefore, during the two weeks data collection period, 250 diabetic patients were expected to be available. By calculating the "K" value which is two, study participants were selected every second interval until the required sample size was obtained.

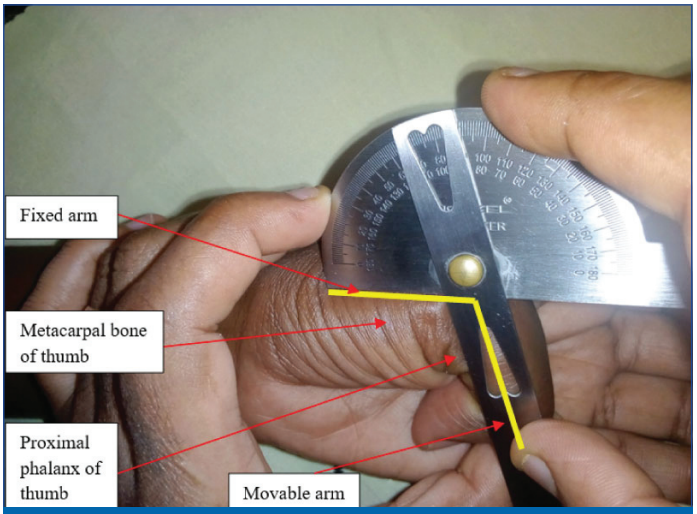
For the non diabetic group, there are two adult OPDs in the hospital and, on average, 60 patients visit this OPD per day. Therefore, during the two-week data collection period, around 600 patients were forecasted to be available. So, after calculating the sampling interval, k=5, study participants were selected every fifth interval until obtaining the required sample size. The total response rate was 97.5% thus 234 participants (117 diabetic cases and 117 non diabetic controls) were finally included in the study and analysed.

Questionnaire

A pretested questionnaire was developed by reviewing different literature and it was modified according to the setting [11,15]. To assess the validity of the instrument, pretest was done before the commencement of the data collection using 5% of the sample size. Then the questionnaire was used for the collection of socio-demographic (age, sex, residence, distance from the hospital, marital status, educational status, occupation, and religion) and diabetic-related data (type, age of onset and duration of DM, co-morbidity with hypertension, control of Fasting Blood Sugar (FBS) and others like those with a history of burns or fractures. The questionnaire was prepared in English and was interviewed in the Amharic language (local language). It was translated by language experts who were proficient both in English and the Amharic language. Study participants height and weight were measured before proceeding to other data collection by using a height and weight measuring scale.

Procedure

A standardised 1800 metal goniometer (Kristeel) was used to measure the passive Range of Motion (RoM) of dominant hand joints. The fixed arm of the Goniometer was aligned to the proximal bone (proximal phalange for the IP joint, metacarpal for the MCP joint, and distal radius for the wrist joint), and the moveable arm was aligned to the distal bone [Table/Fig-1]. The extension motions of the 2nd, 3rd, and 4th MCP joints were not taken due to the non flexibility of the instrument.



[Table/Fig-1]: The photograph showing goniometric measurement of flexion motion of 1st MCP joint in diabetic patient.

The axis of the Goniometer was positioned laterally on the joint axis. Then maximal flexion and extension motions of a joint were measured by bending the distal part of the respective joint as fully as possible and expressed in degrees [15]. All the goniometric measurements were taken by a single person (principal investigator).

Operational Definitions

Limited Joint Mobility (LJM): If the composite score of hand joints motion is below the fifth percentile of the respective joints' motion in the control group, it is considered LJM [14].

Composite score: The result of adding similar hand joint motions. For hand flexion, the composite score is the summation of all the joints' degrees of flexion, and for hand extension, the composite score is the summation of all the joints' degrees of extension [14].

Passive Range of Motion (RoM): flexion or extension motion of hand joints without effort from the patient itself.

Controlled blood sugar: by reviewing the patient's card (hospital record), FBS results for the last three consecutive hospital visits, including at the time of data collection, lie within the normal range (76-126 mg/dL).

FBS: taking a blood test after eight hours of fasting.

Co-morbidity with HTN Hypertension (HTN) detected by reviewing the reports of the patients, Systolic Blood Pressure (SBP) >140 mmHg or Diastolic Blood Pressure (DBP) >90 mmHg in either of the last three consecutive hospital visits, including at the time of data collection and documented evidence of HTN.

STATISTICAL ANALYSIS

The collected data was entered into Epi Info version 3.2 and transferred to SPSS version 20.0 for analysis. An independent t-test was conducted to compare the mean and standard deviations of hand joint motions among diabetic and non diabetic groups. Also, bivariable and multivariable logistic regression analysis were computed to assess the association between dependent and independent variables among diabetic patients. The adjusted odds ratio was calculated with its 95% confidence interval and p-value to assess the strength of association and the statistical significance. Statistical significance was declared at a p-value less than 0.05.

RESULTS

Among 240 samples, a total of 234 study participants were involved in the present case-control study with a response rate of 97.5%

and 2.5% were non respondents. Among the participants, with a response rate of 97.5 percent, 117 were diabetics and the rest were non diabetics, the mean (±SD) of the age of diabetics was 50.92 ±12.99 years, whereas in non diabetics, 48.32±14.44 years. There was no significant difference in the age of study participants between the diabetic and non diabetic groups, which were assessed by running a t-test (p>0.05) [Table/Fig-2].

Groups	Mean	LL	UL	t-test	p-value
Diabetic	50.92	48.3906	53.0697	0.79	0.374
Non diabetics	48.32	46.5078	52.5474		

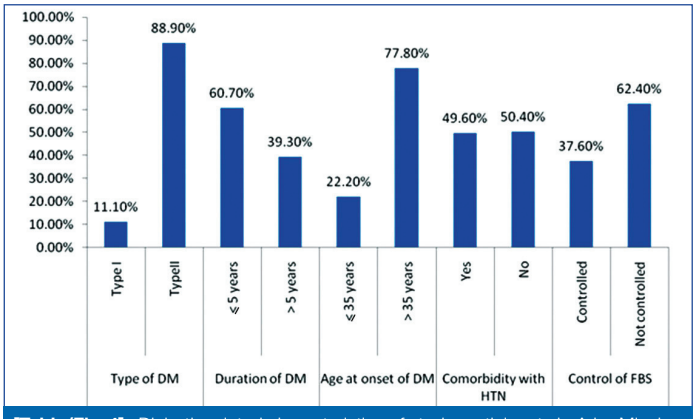
[Table/Fig-2]: Mean age of study participants in both diabetics and non diabetics groups.
LL: Lower Level; UL: Upper Level

Among the study participants, 51 (43.6%) and 62 (53.0%) were males in the diabetic and non diabetic groups of patients, respectively. The majority of the study participants in both groups were manual workers [Table/Fig-3].

Variable	Variable category	Groups	
		Diabetics (Cases)	Non diabetics (Controls)
Age	≤50 years	58 (49.6%)	65 (55.6%)
	>50 years	59 (50.4%)	52 (44.4%)
Sex	Male	51 (43.6%)	62 (53.0%)
	Female	66 (56.4%)	55 (47.0%)
Residence	Rural	40 (34.2%)	57 (48.7%)
	Urban	77 (65.8%)	60 (51.3%)
Educational status	No formal education	29 (24.8%)	33 (28.2%)
	Primary	30 (25.6%)	38 (32.5%)
	Secondary and above	58 (49.6%)	46 (39.3%)
Occupation	Manual worker	83 (70.9%)	96 (82.1%)
	Intellectual (government) worker	34 (29.1%)	21 (17.9%)
BMI	≤25 kg/m^2	40 (34.2%)	67 (57.3%)
	>25 kg/m^2 to 35 kg/m^2	77 (65.8%)	50 (42.7%)
Smoking cigarette	Yes	5 (4.3%)	6 (5.1%)
	No	112 (95.4%)	111 (94.9%)

[Table/Fig-3]: Socio-demographic characteristics of study participants.
BMI: Body mass index

The majority of diabetic patients, 104 (88.9%), were type 2. The mean (±SD) of the duration of diabetes was 4.8±3.8 years. In addition, 58 (49.6%) of them had high blood pressure (SBP >140 mmHg or DBP >90 mmHg), and 62.4% were unable to control their FBS within the normal range (76-126 mg/dL) for the last three consecutive hospital visits [Table/Fig-4].



[Table/Fig-4]: Diabetic related characteristics of study participants in Arba Minch General Hospital.
DM: Diabetes mellitus; FBS: Fasting blood sugar; HTN: Hypertension

The overall magnitude of LJM in diabetic patients was 17.1% with 95% CI (10.3, 23.1), whereas, in non diabetic patients, it accounted for 4.3% with 95% CI (0.8, 7.7). The magnitude of LJM was also determined separately in different joints such as limitation of flexion motions at the wrist, MCP and IP joints were 6%, 8.5%, and 3.4% respectively in diabetics as compared to 4.3%, 3.4%, and 4.3% in the non diabetic group of patients. In addition, limitation of extension motions accounted for 6.8%, 8.5% and 17.1% at the wrist, MCP and IP joints, respectively, in diabetics, as compared to 4.3%, 3.4% and 4.3 % in non diabetics [Table/Fig-5].

Hand joint motion	Type of joint	Group	The magnitude of LJM with 95% CI	p-value
Flexion	Wrist	Diabetics	6% (1.75%, 10.25%)	0.23
		Non diabetics	4.3 % (0.8 %, 7.7 %)	
	MCP	Diabetics	8.5% (3.6%, 13.4%)	**0.03***
		Non diabetics	3.4% (0.16%, 6.6%)	
	IP	Diabetics	3.4% (0.16%, 6.6%)	0.32
		Non diabetics	4.3 % (0.8 %, 7.7 %)	
Extension	Wrist	Diabetics	6.8% (2.3%, 11.3%)	0.4
		Non diabetics	4.3% (0.8%, 7.7%)	
	MCP	Diabetics	8.5% (3.6%, 13.4%)	0.21
		Non diabetics	3.4% (0.16%, 6.6%)	
	IP	Diabetics	17.1% (10.3%, 23.1%)	**p<0.001****
		Non diabetics	4.3% (0.8%, 7.7%)	
Total LJM	Hand	Diabetics	17.1% (10.3%, 23.1%)	**p<0.001****
		Non diabetics	4.3% (0.8%, 7.7%)	

[Table/Fig-5]: The Magnitude of LJM of hand joints in the diabetic and non diabetic group of patients.
IP: Interphalangeal; MCP: Metacarpophalangeal; PIP: Proximal interphalangeal; p<0.05*: statistically significant; p<0.001**: statistically highly significant

The limitation affected more the DIP joints (19.7 %), followed by MCP (13.7 %) and PIP joints (12 %). The mean (±SD) of the age of diabetic patients with LJM was 55.75±12.03 years, whereas diabetic patients without LJM were 49.93±13.02 years. The duration of DM was 5.8±4.13 years in diabetic patients with LJM compared to diabetic patients without LJM 4.6±3.7 years.

The composite score of hand flexion in diabetic patients was 1088.75±86°, significantly lower than in non diabetic patients, 1117.75±82.88°. The composite score of hand extension was also significantly lower in people with diabetes, 227.98±87.22° as compared to non diabetic patients 276.96±78.18° [Table/Fig-6].

Composite joint motion	Groups		t-test	p-value
	Diabetics (mean±SD)	Non diabetics (mean±SD)		
Hand flexion	1088.75±86°	1117.75±82.88°	-2.62	**0.009***
Hand extension	227.98±87.22°	276.96±78.18°	-4.52	**<0.001****
Hand	1316.73±154.26°	1394.71±135.65°	-4.11	**<0.001****

[Table/Fig-6]: Comparison of flexion and extension motions of composite hand joints among the diabetic and non diabetic groups of patients.
All the data is expressed in degrees as a mean (SD); Hand flexion: Wrist flexion+1st through 5th MCP flexion+1st IP flexion+2nd through 5th PIP and DIP flexion; Hand extension: Wrist extension+1st through 5th MCP extension+1st IP extension+2nd through 5th PIP and DIP extension; Hand: hand flexion+hand extension; p<0.05*: statistically significant, p<0.001**: statistically highly significant

Almost all individual extension motions of hand joints except the wrist, 1st MCP, and IP and 5th PIP joints were significantly lower in diabetic patients than in the non diabetic group of patients (p<0.05). Diabetics have significantly lower flexion motions of hand joints in the 2nd and 3rd MCP, 3rd through 5th PIP, and 3rd DIP joints when compared to non diabetic patients (p<0.05) [Table/Fig-7].

In the multivariable logistic regression analysis, age >50 years {AOR with 95% CI {3.9 (1.14, 13.36)} and co-morbidity with HTN {AOR with 95% CI {3.26 (1.02, 10.41)} were identified significantly as associated factors with LJM of the hand in diabetic patients [Table/Fig-8].

Hand joint motion	Group	Goniometric measurement in degree (Mean±(SD))	t-test	p-value
Wrist flexion	Diabetics	60.62±8.28	1.02	0.308
	Non diabetics	59.57±7.43		
Wrist extension	Diabetics	59.02±12.3	0.01	0.991
	Non diabetics	59±9.753		
1st MCP flexion	Diabetics	45.53±12.8	-0.11	0.912
	Non diabetics	45.7±10.87		
1st MCP extension	Diabetics	24.06±13.07	0.75	0.456
	Non diabetics	22.79±12.84		
1st IP flexion	Diabetics	56.33±10.95	-1.07	0.287
	Non diabetics	57.89±11.35		
1st IP extension	Diabetics	38.6±16.75	0.71	0.478
	Non diabetics	37.17±13.83		
2nd MCP flexion	Diabetics	67.8±12.25	-2.82	**0.005***
	Non diabetics	72.05±10.72		
2nd PIP flexion	Diabetics	94.54±7.47	-1.38	0.17
	Non diabetics	95.99±8.63		
2nd PIP extension	Diabetics	10.13±11.34	-3.9	**<0.001****
	Non diabetics	15.73±10.62		
2nd DIP flexion	Diabetics	54.37±9.9	-1.28	0.201
	Non diabetics	56.09±10.69		
2nd DIP extension	Diabetics	16.97±13.58	-4.17	**<0.001****
	Non diabetics	23.47±10.04		
2nd MCP flexion	Diabetics	77.88±9.97	-1.97	0.05
	Non diabetics	80.46±10.08		
2nd PIP flexion	Diabetics	94.38±8.11	-3.53	**0.001***
	Non diabetics	98.21±8.51		
2nd PIP extension	Diabetics	9.26±11.83	-2.82	**0.005***
	Non diabetics	13.26±9.82		
3rd DIP flexion	Diabetics	56.44±10.44	-2.47	**0.014***
	Non diabetics	59.84±10.58		
3rd DIP extension	Diabetics	12.91±12.09	-4.02	**<0.001****
	Non diabetics	18.86±10.49		
4th MCP flexion	Diabetics	81.76±9.73	-1.75	0.082
	Non diabetics	83.92±9.22		
4th PIP flexion	Diabetics	97.95±9.04	-3.23	**0.001***
	Non diabetics	101.45±7.5		
4th PIP extension	Diabetics	7.44±10.16	-4.25	**<0.001****
	Non diabetics	13.1±10.23		
4th DIP flexion	Diabetics	57.64±11.08	-0.3	0.76
	Non diabetics	58.08±10.76		
4th DIP extension	Diabetics	9.42±11.1	-4.08	**<0.001****
	Non diabetics	14.98±9.72		
5th MCP flexion	Diabetics	85.21±10.04	-1.91	0.058
	Non diabetics	87.56±8.71		
5th MCP extension	Diabetics	29.22±13.34	-7.02	**<0.001****
	Non diabetics	41.29±12.96		
5th PIP flexion	Diabetics	94.36±8.2	-2.64	**0.009***
	Non diabetics	96.97±6.92		
5th PIP extension	Diabetics	3.73±8	-1.88	0.061
	Non diabetics	5.68±7.9		
5th DIP flexion	Diabetics	63.93±10.05	-0.02	0.984
	Non diabetics	63.96±9.97		
5th DIP extension	Diabetics	7.24±10.9	-2.88	**0.004***
	Non diabetics	11.62±12.31		

[Table/Fig-7]: Comparisons of flexion and extension motions of individual hand joints amongdiabetic and non diabetic groups of patients.
SD: Standard deviation; p<0.05*: Statistically significant; p<0.001**: statistically highly significant

Variable	Variable category	Joint Movement		COR (95% CI)	AOR (95% CI)	p-value
		Limited	Normal			
Age	≤50 years	4 (20%)	54 (55.7%)	1	1	**0.03***
	>50 years	16 (80%)	43 (44.3%)	5.02 (1.56, 16.13)	3.9 (1.14, 13.36)	
Sex	Male	7 (35%)	44 (45.4%)	0.65 (0.24, 1.77)	0.43 (0.12, 1.52)	0.19
	Female	13 (65%)	53 (54.6%)	1	1	
Educational status	No formal education	4 (20%)	25 (25.8%)	0.64 (0.16, 2.55)	0.32 (0.06, 1.78)	0.19
	Elementary	6 (30%)	24 (24.7%)	0.77 (0.22, 2.7)	0.52 (0.11, 2.45)	0.4
	Secondary and above	10 (50%)	48 (49.5%)	1	1	
Occupation	Manual	18 (90%)	65 (67.0%)	4.43 (0.97, 20.28)	4.35 (0.75,25.3)	0.1
	Intellectual	2 (10%)	32 (33%)	1	1	
Residence	Rural	5 (25%)	35 (36.1%)	0.59 (0.2, 1.76)	0.15 (0.01, 3.05)	0.2
	Urban	15 (75%)	62 (63.9%)	1	1	
Distance from the hospital	≤5 km	13 (65%)	61 (62.9%)	1	1	
	>5 km	7 (35%)	36 (37.1%)	0.91 (0.33, 2.5)	0.14 (0.01, 2.75)	0.2
Physical activity	Yes	7 (35%)	23 (23.7%)	1	1	
	No	13 (65%)	74 (76.3%)	0.58 (0.21, 1.62)	0.42 (0.12, 1.48)	0.18
BMI	≤25 kg/m^2	5 (25%)	35 (36.1%)	1	1	0.3
	>25 kg/m^2	15 (75%)	62 (63.9%)	1.7 (0.57, 5.06)	1.5 (0.49, 4.14)	
Duration of DM	≤5 years	9 (45%)	62 (63.9%)	1	1	0.46
	>5 years	11 (55%)	35 (36.1%)	2.17 (0.82, 5.73)	1.52 (0.5, 4.64)	
Age at onset	≤35 years	3 (15%)	23 (23.7%)	0.57 (0.15, 2.11)	0.49 (0.14, 1.6)	0.67
	>35 years	17 (85%)	74 (76.3%)	1	1	
Co-morbidity with HTN	Yes	15 (75%)	43 (44.3%)	3.77 (1.27, 11.19)	3.26 (1.02, 10.41)	**0.04***
	No	5 (25%)	54 (55.7%)	1	1	
Control of FBS	Controlled (76-176 mg/dL)	8 (40%)	36 (37.1%)	1	1	0.45
	Not controlled	12 (60%)	61 (62.9%)	0.89 (0.33, 2.37)	0.63 (0.19, 2.1)	

[Table/Fig-8]: Factors affecting hand joint mobility among diabetic patients (n=117).
All the data expressed as mean (SD); BMI: Body mass index; DM: Diabetes mellitus; HTN: Hypertension; FBS: Fasting blood sugar; kg: kilogram; m^2: Meter square; dL: Deciliter; p<0.05*: statistically significant

DISCUSSION

In the current study, the magnitude of LJM was 17.1% with 95% CI (10.3, 23.1) and 4.3% with 95% CI (0.8, 7.7) in the diabetic and non diabetic group of patients, respectively. These findings were consistent with those of Schulte L in Atlanta [14], Fernando DJ and Vernidharan J in Sri Lanka [11], and Bhat TA in India [19], who found 12.3%, 18.5%, and 17.8%, respectively, in diabetic patients. However, it is lower than studies conducted in Iraq (55.5%) [20], India (41%) [10], Germany (33.7%) [21], Nigeria (26.3%) [15] and at Tikur Anbessa Teaching Hospital (44.5%) and 25.35% in Insulin Dependant Diabetes Mellitus (IDDM) and Non-insulin Dependant Diabetes Mellitus (NIDDM), respectively [22]. These discrepancies may be because unlike the other studies in India [10,19], Iraqi [20], Germany [21] and Ethiopia [22] this study used goniometric measurement which has high inter-rater and intra rater reliability [23-26]. Most studies documenting higher magnitudes used qualitative assessment techniques (table-top and prayer sign), which are subjective to classify joint mobility of the hand as limited or normal [23-25].

The present study revealed that the composite score of hand flexion and extension motions in diabetic patients was significantly lower than non diabetic patients (p<0.001). This difference in goniometric measurement of hand joints between groups was in line with the study conducted by Schute L in Atlanta, which shows that composite joint motions of dominant joints in diabetic subjects had a mean of 4.7% less mobility than the non diabetic control subjects [14]. It is also in line with a study conducted in Spain which showed that joint mobility deteriorated with time in diabetic patients (reduced flexion of 5th MCP joint and wrist) but there was no significant deterioration in healthy subjects [26]. This significant difference between diabetics and non diabetics could be attributed to the hyperglycaemic and high oxidative stress environment, which will result in the production of several cytokines and, eventually, the development of LJM [1].

The current study also showed that the limitation of joint mobility affects more DIP joints (19.7%), followed by MCP (13.7%) and PIP joints (12%). These results were in line with the study conducted by Schulte L in Atlanta [14]. The mean extension motions of the 2nd through 4th PIP and DIP joints and the 5th MCP and DIP joints were significantly lower (p<0.001) in people with diabetes as compared to non diabetic patients. This discrepancy in mean differences between diabetic and non diabetic patients was also consistent with the study in Atlanta.

Flexion motions of the 2nd and 3rd MCP, 3rd through 5th PIP, and 3rd DIP joints were also significantly decreased in diabetic patients (p<0.05). These findings were consistent with the study in Nigeria, which mentioned that flexion motions of 1st through 3rd MCP, and 3rd PIP and DIP joints in people with diabetes were significantly decreased as compared to non diabetic patients (p<0.001) [27]. Advanced age (age >50 years) was more likely to develop LJM than its counterparts. This finding was consistent with the findings of studies conducted by Schulte L in Atlanta [14], Fernando DJ and Vernidharan J in Sri Lanka [11], and Al-Matubsi in Arab [28]. It may be because as age increases, the functioning of the hand and the RoM decreases [29].

The current study also revealed that co-morbidities with hypertension were more likely to develop LJM than non hypertensive diabetic subjects. This finding was consistent with Frost's study in Germany, which found a statistically significant association between hypertension and LJM in male diabetic patients (p=0.05) [21], as well as an Iranian study, which found that the mean systolic blood pressure is significantly higher in DM patients with LJM than in those without LJM (p=0.001) [30]. This association may be because hypertensive subjects are prone to develop microvascular complications, which are the markers of LJM in diabetic patients [12]. In contrast to several studies, this study showed that DM duration was not significantly associated with LJM [11,14,20,28,31]. This may be because the mean duration of diabetic patients in the current study was shorter (4.8 years) in contrast with ten years and above in the other studies.

Limitation(s)

The limitations of the current study were that the goniometric measurements of hand joints were restricted to the dominant hand due to time constraints, and extension motions of the 2nd, 3rd, and 4th MCP joints were not taken due to the fact that the instrument used was not flexible.

CONCLUSION(S)

The magnitude of LJM of the hand in people with diabetes was higher than in non diabetic patients. The limitation affects more of the DIP joints followed by MCP and PIP joints. Almost all individual extension motions of hand joints except the wrist, 1st MCP, and IP and 5th PIP joints are significantly lower in diabetic cases than in the non diabetic controls. Diabetics had significantly lower flexion motions of hand joints in the 2nd and 3rd MCP, 3rd through 5th PIP, and 3rd DIP joints when compared to non diabetic patients. Among the factors which affect hand joints, RoM, advanced age, and co-morbidity with HTN were significantly associated with LJM of the hand.

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PARTICULARS OF CONTRIBUTORS:
1. Lecturer, Department of Anatomy, Arba Minch University, Arba Minch, Ethiopia.
2. Associate Professor, Department of Anatomy, MNR Medical College and Hospital, Hyderabad, Telangana, India.
3. Lecturer, Department of Public Health, Arba Minch University, Arba Minch, Ethiopia.
4. Assistant Professor, Department of Anatomy, Arba Minch University, Arba Minch, Ethiopia.
5. Lecturer, Department of Anatomy, Arba Minch University, Arba Minch, Ethiopia.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Mergu Prasad,
Associate Professor, Department of Anatomy, MNR Medical College and Hospital, Sangareddy, Hyderabad, Telangana, India.
E-mail: m.omprasad@gmail.com

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