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# MAGNITUDE AND FACTORS ASSOCIATED WITH MUSCULOSKELETAL DISORDER AMONG DIABETIC PATIENTS ATTENDING CHRONIC CARE AT ARBAMINCH GENERAL HOSPITAL, ARBAMINCH, SOUTHERN ETHIOPIA, 2021



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# MAGNITUDE AND FACTORS ASSOCIATED WITH MUSCULOSKELETAL DISORDER AMONG DIABETIC PATIENTS ATTENDING CHRONIC CARE AT ARBAMINCH GENERAL HOSPITAL, ARBAMINCH, SOUTHERN ETHIOPIA, 2021

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## ABSTRACT

**Objective:** The aim of this study was to assess the prevalence and determinants of musculoskeletal disorders among diabetic patients in South Ethiopia.

**Design:** Facility based cross-sectional study

**Setting:** data collected from 1st march 2021 to 30th August 2021 at Arba Minch general hospital

**Participants:** diabetic patients at attending care at at Arba Minch general hospital

**Main outcome measures:** the magnitude and determinates of the musculoskeletal disorders

**Results: -** The prevalence of musculoskeletal disorders among diabetic patients was 23.29% (95% CI (19.00 - 27.76). The likely hood of developing musculoskeletal disorders was 6.8 times higher among female than male (AOR = 6.787, 95% CI (2.08, 22.19). Rural participants were about 2.4 times (AOR = 2.38, 95% CI (1.06, 5.33) more likely develop musculoskeletal disorders as compared to urban. Participants with age greater than 50 years were 5.9 times more likely develop musculoskeletal disorders as compared to those age less or equal to 50 years (AOR= 5.864, 95% CI (2.663, 12.914). The odd of developing musculoskeletal disorders was 6.2 times (AOR = 6.247, 95% CI (1.158, 33.702) and 5.5 times (AOR= 5.451 95% CI (1.174, 25.312) higher among participants attend primary and secondary education as compared to who attend college and above respectively. Participants with cardiovascular disease were 3.9 times more likely develop musculoskeletal disorders compared with their counterpart (AOR= 3.854, 95% CI ((1.843, 8.063).

**Conclusions: -** This study showed that age, sex, educational status, place of residence and had cardiovascular disease were found to be determinants of musculoskeletal disorders. Thus, clinical and public health intervention working on diabetic mellitus should consider these determinants.


Key words: musculoskeletal disorders, diabetic mellitus, Arba Minch, South Ethiopia

## STRENGTH AND LIMITATION OF THE STUDY

- The strength of our study were we explore musculoskeletal disorders in our diabetic patients which is an ignored and underestimated problem with sound methodology.
- The limitation of the study were

1. We use FBS as glycemic control method because of resource limitation and HbA1c investigation is not easily accessible in our setting-up.
2. Vascular complications are another important predisposing factor, but we did not include them in our study because there are only limited number of vascular evaluations and investigations that can be performed in our hospital.

## INTRODUCTION

Diabetic mellitus is a metabolic condition that predispose for musculoskeletal complications in the joints, bones, soft tissues, and periarticular structures, resulting in morbidity and disability (1-3). Since the incidence and the life expectancy of the diabetic patients have both increased, leading in the increased prevalence and clinical importance of musculoskeletal abnormalities in diabetic patients (4).

The pathophysiology of most of these musculoskeletal alterations remains unclear (4). Glycosylation of proteins, microvascular abnormalities, and accumulation of collagen in skin and periarticular structures result in changes in the connective tissue. These complications are commonly seen in patients with type 1 diabetes, but they are also present in patients with type 2 diabetes. Some of the complications have a known direct association with diabetes, whereas others have a suggested but unproven association (5).

Many skeletal and muscular system problems arise in Diabetes Mellitus (2). Musculoskeletal complications of diabetes mellitus have been generally under-recognized and poorly treated compared with other complications and leads to functional disability (6). Prevalence and incidence of diabetic mellitus was increasing and percentage of diabetic patients with functional disability will increase as the number of diabetic patient's increases, and hence constitute a major public health problem.

Musculoskeletal disease is common among DM than healthy individual (7) and predominantly affects hand and shoulder (1, 5, 6, 8). Its magnitude varies widely. India 42 - 62 % (3, 4, 9), in Saudi Arabia 17.9% (6), in Jordan 69.5% (1), in Moroccan 14.4% (10)and in Nigeria 56% (11)diabetic individual sufferer from one or more of musculoskeletal Diseases. Also studies conducted in central and north Ethiopia the prevalence were 16.6 to 41.5% and female were more affected than male (5, 12).

Despite the high prevalence of musculoskeletal conditions amongst diabetic patients and its associated impact on health-related quality of life, and economic costs, there are limited local studies on this subject done in Ethiopia. Even though there is a scarcity of data in Ethiopia overall prevalence of one or more of musculoskeletal Diseases is 41.5 % with Hands were the most affected (18.5 %)(5). The study done in Gondar prevalence of shoulder and hand musculoskeletal complications reported 16.6% and the majority of them in females that accounts 20.1% (12).

In addition to the diabetic consequences, MSD causes finger contracture, pain, and loss of function that interfere with finger pricks, insulin injections, and other diabetes management. Also, in most cases, MSD requires surgery that had influence on wound healing. All of this can worsen the quality of life of people with diabetes (13, 14).

MSDs are treatable and easily preventable but manifestations are unrecognized or overlooked. Thus, clinicians should be aware of the possible MSDs in diabetes and asses all individual with DM for the manifestation of MSD that helps for timely diagnosis and early treatment. Despite

having some studies conducted in central and north Ethiopia, there are limited studies in south Ethiopia.

Therefore, this study was aimed to identify:

- The prevalence of musculoskeletal disorders among patients following diabetic clinic in Arba Minch hospital, southern Ethiopias
- Determinants of musculoskeletal disorders among patients following diabetic clinic in Arba Minch hospital, southern Ethiopia

## Materials and methods

### Study design, setting and sampling

An institution based cross-sectional study was conducted from March to August 2021 in Arba Minch hospital. Arba Minch town is located 434 kms far south of Addis Ababa, the capital city of Ethiopia. The hospital provides curative, preventive and rehabilitative service for the population of Gamo, Konso and South Omo zones. A total of 800 type one and two diabetic patient follow in the chronic care unit of the hospital.

### Population of the study

All DM patients following chronic care unit of Arba Minch hospital but individuals with age less than 18 years, secondary diabetes like Cushing's syndrome, history of hand trauma, epilepsy, chronic liver disease, inflammatory arthritis, family history of Dupuytren's contracture, nervous disorders, congenital musculoskeletal abnormalities, recent fracture or injuries, and surgery of shoulder and hand were excluded from the study.

***Dependent variable***

Musculoskeletal disorders.

***Independent Variables***

- Socio demographic: Age, sex, occupation, residence, religion, education
- Diabetic related factors: Type of diabetes, duration of DM, glycemic control, type of therapy
- Individual related factors: Chronic illness, body mass index (BMI), exercise, drugs (insulin)

### Patient and Public Involvement

Our patients were involved in the recruitment to and conduct of the study as astudy paticipants after appropriate consent was taken. The results of the study were disseminated to study participants in their diabetic clinic follow up time.

## Sampling

The sample size was calculated using a one population proportion formula. Assuming 95% confidence interval, 5% degree of precision and a 41.5% expected proportion of MSD among DM patients. Based on the above assumptions, the sample size calculated was 373 [7]. Study participants were selected by employing a systematic random sampling technique.

## Data collection procedures

The data were collected using a pre-tested, interviewer-administered, and structured questionnaire and medical record review which addressed socio-demographic, diabetic, and individual-related factors.

## Measurement

A standard Short Musculoskeletal Function Assessment Questionnaire (SMFA) (11, 29-33) was used to assess the musculoskeletal disorders.

Summing items 1-34 create short Musculoskeletal Function Assessment Questionnaire Raw scores for the Function Index and items 35-46 for the Bothersome Index, after corrections and omissions for missing values (15). The raw score was changed to standardized score In addition, Body height and mass was measured using esca scale and (BMI) calculated using the body formula mass/height $^2$. The collected data double entered into Epi data software version 3.1.with two data clerks independently and the investigator checked consistency between the two data sets. Pretest was done in 5% sample size at Arbaminch general hospital for validation of checklist.

The following definitions used.

- **Musculoskeletal disorder:** the presence of one or more of the following Carpal tunnel syndrome, Dupuytren's contracture, Limited joint mobility, Stenosing tenosynovitis, adhesive capsulitis, Reflex sympathetic dystrophy, Diabetic amyotrophic, Diffuse idiopathic skeletal hyperostosis syndrome, Charcot joint or a score greater than and above in short musculoskeletal assessment form**.**
- **Body Mass Index** –will be assessed according to the standards that describe insufficient body weight (when BMI is <18 kg/m$^2$), normal body weight (when BMI is 18–24.9 kg/m2 ), excess weight (when BMI of 25–30 kg/m 2), and obesity (when BMI ≥30 kg/m $^2$.

**Cardio vascular disease:** the presence of one or more of the following; Heart failure , History of Stroke/TIA, History of MI/IHD, History of Peripheral arterial disease

## Data processing

Intensive on-site training organized for data collectors including their performance evaluation to ensure data consistency. Data were checked for completeness, edited, coded and entered into Epi data version 3.1 and exported to STATA 16.00 statistical software for analysis. After cleaning the data for inconsistencies and missing values, descriptive statistics such as mean, frequency, and percentage were calculated and the data presented as text and tables. A bivariate analysis was performed and all explanatory variables that were associated with the outcome variable at P-

value less than 0.25 in the bivariate analysis and biologically plausible were included in the multivariable analysis model. Then, a multivariable analysis was conducted using backward LR to determine associated factors. Odds ratio with its 95% CI was used to decide whether those independent variables included in the multivariable analysis were statistically significant or not.

**Ethical consideration**

Formal ethical approval letter was taken from Institutional Review Board of college of medicine and health science, Arba Minch University with letter number of IRB/1040/20. Letter of cooperation was received from the hospital and written informed consent was obtained from the study participants after informing the aim of the study.

## RESULTS

### Socio-demographic characteristics of study participants

A total of 365 participants were included in the study, with a response rate of 97.9%. The mean age was 51.42 (±14.06). The majority respondents were female (55.34%), under 50 years old (52.33%), living in urban area (64.66%), and married (92.88%) (Table 1)

Table 1: Socio-demographic characteristics of diabetic patients attending chronic care at ArbaMinch Hospital, Southern Ethiopia, 2021

| Variables | Freq. | Percent |
|---|---|---|
| **Sex of the respondent** | | |
| Female | 202 | 55.34 |
| Male | 163 | 44.66 |
| **Age of the respondent in years** | | |
| < 50 | 191 | 52.33 |
| >50 | 174 | 47.67 |
| **Place of residence** | | |
| Rural | 129 | 35.34 |
| Urban | 236 | 64.66 |
| **Education status** | | |
| College graduate or above | 80 | 21.92 |
| Able to read and write | 14 | 3.84 |
| Unable to read and write | 105 | 28.77 |
| Primary education (1-8) | 98 | 26.85 |
| Secondary school (9-12) | 68 | 18.63 |
| **Occupation** | | |
| Farmer | 43 | 11.78 |
| Government employed | 105 | 28.77 |
| House wife | 151 | 41.37 |
| Self employed | 44 | 12.05 |
| Unemployed | 22 | 6.03 |

| | | |
|---|---|---|
| **Marital status** | | |
| Unmarried | 26 | 7.12 |
| Married | 339 | 92.88 |

**Clinical and individual related characteristics**

23.29% (95% CI (19.00 - 27.76) of the study participant had musculoskeletal disorders. Almost all participants were non-smoker and non-drunker. One third of the participants were with chronic disease including CVD but ¼ of them had CVD. Majority of the participants were with type two DM (91.51), on Oral hypoglycemic drug (76.03%), did not develop diabetic complication (92.05%), did not involve in physical activities (87.09%) and over weight (53%) (Table 2)

Table 2: Clinical and individual related characteristics of diabetic patients attending chronic careat Arba Minch Hospital, Southern Ethiopia, 2021

| Variables | Freq. | Percent |
|---|---|---|
| **Type of diabetic mellitus** | | |
| Type two | 334 | 91.51 |
| Type one | 31 | 8.49 |
| **Type of medication** | | |
| Insulin | 61 | 16.8 |
| Oral hypoglycemic drug | 276 | 76.03 |
| Both | 26 | 7.16 |
| **DM complication** | | |
| No | 336 | 92.05 |
| Yes | 29 | 7.95 |
| **Chronic disease** | | |
| No | 257 | 70.41 |
| Yes | 108 | 29.59 |
| **Cardiovascular disease** | | |
| No | 244 | 74.62 |
| Yes | 83 | 25.38 |
| **Physical activity** | | |
| No | 317 | 87.09 |
| Yes | 47 | 12.91 |
| **Body mass index** | | |
| Under | 11 | 3.01 |
| Normal | 160 | 43.84 |
| Over | 194 | 53.15 |
| **Musculoskeletal disorder** | | |
| No | 280 | 76.71 |
| Yes | 85 | 23.29 |



The glycemic control of the study participant was poor (157.33 mg/dl ±35.73) and only 20.7%

(87) of the study participants have good glycemic control (fasting blood sugar <126mg/dl). Average duration of diabetic mellitus was 5.62 years ±5.08 which was low. The mean total cholesterol, high-density lipoprotein and triglyceride level of the participants was 179.91(± 4.59), 42.77(± .023) and 209.05(± 4.35) respectively. Also the mean duration of patient with DM and level of average fasting blood glucose was 5.62years (± 0.27) and 157.33 (± 1.87) (Table 3).

Table 3: Clinical and individual related characteristics of diabetic patients attending chronic careat Arba Minch Hospital, Southern Ethiopia, 2021

| Variable | Min | Max | Mean | Std. Err. | Std. Dev. | 95% confidence interval Lower | Upper |
|---|---|---|---|---|---|---|---|
| Total cholesterol | 53 | 531 | 179.91 | 4.59 | 86.17 | 170.89 | 188.93 |
| High-density lipoprotein | 30 | 58 | 42.77 | 0.23 | 4.35 | 42.32 | 43.23 |
| Triglyceride level | 11 | 546 | 209.05 | 4.35 | 81.75 | 200.49 | 217.61 |
| Age | 18 | 99 | 51.42 | 0.74 | 14.06 | 49.98 | 52.87 |
| DM duration | 0.2 | 23.0 | 5.62 | 0.27 | 5.08 | 5.10 | 6.14 |
| Weight | 7.0 | 123.0 | 68.43 | 0.64 | 12.18 | 67.18 | 69.69 |
| Height | 1.4 | 101.0 | 2.29 | 0.34 | 6.43 | 1.63 | 2.96 |
| Waist circumference | 53 | 126 | 87.30 | 0.45 | 8.42 | 86.41 | 88.19 |
| Hip circumference | 63 | 120 | 93.21 | 0.39 | 7.28 | 92.44 | 93.97 |
| Fasting blood glucose | 84.67 | 275.00 | 157.33 | 1.87 | 35.73 | 153.65 | 161.01 |

**Factors associated with musculoskeletal disorders**

The likely hood of developing musculoskeletal disorders was 6.8 times higher among female than male (AOR = 6.787, 95% CI (2.08, 22.19). Rural participants were about 2.4 times (AOR = 2.38, 95% CI (1.06, 5.33) more likely develop musculoskeletal disorders as compared to urban. Participants with age greater than 50 years were 5.9 times more likely develop musculoskeletal disorders as compared to those age less or equal to 50 years (AOR= 5.864, 95% CI (2.663, 12.914). The odd of developing musculoskeletal disorders was 6.2 times (AOR = 6.247, 95% CI (1.158, 33.702) and 5.5 times (AOR= 5.451 95% CI (1.174, 25.312) higher among participants attend primary and secondary education as compared to who attend college and above respectively. Participants with cardiovascular disease were 3.9 times more likely develop musculoskeletal disorders compared with their counterpart (AOR= 3.854, 95% CI ((1.843, 8.063) (Table 4).

Table 4: Factors associated with musculoskeletal disorder among diabetic patients attending chronic care at Arba Minch Hospital, Southern Ethiopia, 2021

| Variables | Musculoskeletal disorders NO nº (%) | **Yes** nº (%) | COR (95%CI) | AOR (95%CI) |
|---|---|---|---|---|
| **Sex** | | | | |
| Female | 139(68.81) | 63(31.19) | 2.905(1.69, | 7.08, 22.19) |

| | | | | |
|---|---|---|---|---|
| | | | 4.98) | |
| Male | 141(86.50) | 22(13.50) | **1** | 1 |
| **Age in years** | | | | |
| < 50 | 163(85.34) | 28(14.66) | 1 | 1 |
| > 50 | 117(67.24) | 57(32.76) | 2.84 (1.70, 4.73) | 5.86(2.66, 12.91) |
| **Residency** | | | | |
| Rural | 93(72.09) | 36(27.91) | 1.48 (0.89, 2.43) | 2.38(1.06, 5.33) |
| Urban | 187(79.24) | 49(20.76) | **1** | 1 |
| **Education** | | | | |
| unable to read and right | 11(78.57) | 3(21.43) | 2.46(.56, 10.68) | 0.47(.022, 10.09) |
| able to read and write | 70(66.67) | 35(33.33) | 4.5(1.95, 10.38) | 4.21 (0.71, 24.87) |
| Primary education | 73(74.49) | 25(25.51) | 3.08(1.30, 7.28) | 6.25(1.16, 3.70) |
| Secondary school | 54(79.41) | 14(20.59) | 2.33(0.91, 5.96) | 5.45(1.17, 5.31) |
| College and above | 72(90.00) | 8(10.00) | 1 | 1 |
| **Cardio vascular disease** | | | | |
| No | 198(81.15) | 46(18.85) | 1 | 1 |
| Yes | 52(62.65) | 31(37.35) | 2.57(1.48, 4.44) | 3.85 (1.84, 8.06) |

## DISCUSSION

Musculoskeletal disorders in diabetic mellitus have been ignored and poorly treated as compared to acute and microscopic complications of diabetic mellitus (19).

Our study reveals the following important findings:

1. Hypertension being the commonest concomitant disease (24.38%) which is in line with study done in Tikur Anbesa hospital (5)
2. Overall average FBS value was 157.38 mg/dl, which is high and showed poor glycemic control.
3. Prevalence of musculoskeletal disorders was 23.29%,
4. There was a statistically significant association observed between clinically manifesting musculoskeletal disorders and having a female sex, incrseing of age, residency and cardiovascular disorders.

Diabetes mellitus affects connective tissues in many ways, which leads to different alterations in skeletal and articular systems. It is associated with many of musculoskeletal manifestations, most of which are not clinical and correlated with disease duration and its inadequate control (16). These complications are often found, and, although less valued than the vascular ones, they significantly compromise the patients' quality of life (17). Epidemiologic studies have identified several personal, occupational and psychosocial factors related to the musculoskeletal disorders (16). The exact pathophysiology of most of these musculoskeletal disorders remains unclear, however, connective tissue disorders, neuropathy or vasculopathy may have a synergistic effect on the increased incidence of musculoskeletal disorders in diabetic(18).

Diabetes mellitus affects connective tissues which alters the skeletal and articular systems and associated with many of musculoskeletal manifestations. Musculoskeletal disorders in diabetics have been neglected and under-treated compared to acute and microscopic complications. Therefore, this study attempted to assess the extent and factors associated with musculoskeletal disorders in diabetic patients at the follow-up clinic. The results can help to develop prevention and intervention strategies to reduce morbidity at local and national levels

Many studies have evaluated musculoskeletal manifestations in diabetic patients, but most assessed only an individual component, especially musculoskeletal involvement of the upper extremity while few studies have evaluated the entire musculoskeletal system, including the limbs and back. In this study the magnitude of MSD in DM people was 23.29%.this is higher than the studies done in Saudi Arabia (6), but lower than studies conducted in India, Jordan, Nigeria, Morocco, and central Ethiopia (1, 3, 5, 10, 11, 19).this difference probably due to difference in mean diabetic duration, glycemic control and geographic difference. (7, 19, 26). Lower prevalence of musculoskeletal disorders in our study can be explained by better glycemic control and patients care and decreased manual works in developing countries over time.

MSK conditions were more common in type 2 DM subjects than in type 1 subjects 23.35 vs 22.58 which is in line with studies in Morocco, Egypt, and Ethiopia (10, 12, 20). It is thought that it may be explained by the propensity for type 2 subjects to develop MSKD as a result of obesity, reduced physical activity, older age, dyslipidemia, and hyperuricemia (11)

Participants with age greater than 50 years were 5.9 times more likely develop musculoskeletal disorders as compared to those age less or equal to 50 years which is in line with studies conducted India and Iran (4, 10). The fact that as age increases number of tendon cells is decreased, reduced protein synthesis in the organelles, connective tissue elasticity decreases and joints and tendon sheaths become stiff this predispose older people for MSDs (3). Women were involved in long time, heave manual work at home. This is supported by our findings that the likely hood of developing musculoskeletal disorders was 6.8 times higher among female than male. This is similar with studies conducted in India, Iran and central Ethiopia (4, 5, 21)

Rural participants were about 2.4 times more likely develop musculoskeletal disorders as compared to urban. This may be attributed to more manual labor work for rural residents than urban residents since occupations that involved manual labor increased the risk of hand complications in our patients (17, 22).

The odd of developing musculoskeletal disorders was 6.2 and 5.5 times higher among participants attend primary and secondary education as compared to who attend college and above respectively. This is due to that literacy affects the health seeking behavior and better management of diabetic mellitus so that prevents the developments of complications.

Participants with cardiovascular disease were 3.9 times more likely develop musculoskeletal disorders compared with their counterpart. This is similar with other studies that showed that musculoskeletal disorders have associated with cardiovascular disease. This may be attributable to the micro complication and macro complication diabetic mellitus which are associated with musculoskeletal disorders (14, 23).

The most important predictor of MSK complications in people living with diabetes is blood glucose control (24). In this study, there was no association between blood glucose control and musculoskeletal disorders. It may be because of we only the mean fating blood glucose and not HbA1c level. This may be also explained by the fact that cumulative hyperglycaemia is required to produce changes, while a single cross-sectional fasting blood glucose estimate only represents the glycaemic control over the previous 3 months. This is in line with the findings of studies in Tikur Anbesa Addis Ababa and Iran (7, 26) but contradicts the results obtained in northern India (19,38) and British which showed a strong association between musculoskeletal disorders and poor blood glucose control (24).

## CONCLUSION

The prevalence of musculoskeletal disorders among diabetic patients was 23.29% and it showed that age, sex, educational status, place of residence and had cardiovascular disease were found to be determinants of musculoskeletal disorders. Thus, clinical and public health intervention working on diabetic mellitus should consider these determinants.

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## Data sharing

No additional data available

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## Conflict of interest

The authors declare that there is no conflict of interest.

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**Annex- protocol for scoring and missing value of SMFA**

I-SCORE VALUES

A. Questions 1-25:

| | |
|---|---|
| Not at all difficult | 1 |
| A little difficult | 2 |
| Moderately difficult | 3 |
| Very difficult | 4 |
| Unable to do | 5 |

B. Questions 26-34

| | |
|---|---|
| None of the time | 1 |
| A little of the time | 2 |
| Some of the time | 3 |
| Most of the time | 4 |
| All of the time | 5 |

C. Questions 35-46

| | |
|---|---|
| Not at all bothered | 1 |
| A little bothered | 2 |
| Moderately bothered | 3 |
| Very bothered | 4 |
| Extremely bothered | 5 |

II. HANDLING OF MISSING RESPONSES

A. Questions 1-34:

If patients have fewer than 50% of the answers missing in any one category, substitute the mean value of that category for the missing item(s). Please see the attached form identifying items and categories for this portion of the analysis.

B. Questions 35-46 (Bothersome Index):

Patients with missing answers are omitted from the analyses of the Bother

III. CALCULATION OF SCORES

**A. Raw scores** are created by summing items 1-34 for the Function Index and items 35-46 for the Bothersome Index, after corrections and omissions for missing values (see above); raw scores for categories are created by summing the items within each category.

**B. Scores are standardized**, with high scores indicating poor function and low scores indicating good function. The formula for standardization is:

(Actual raw score - lowest possible raw score/possible raw score range) *100

C. Below are listed the values to be used for standardization:

1. Daily Activities Category:
((raw summed score for daily activities items-10) /40) * 100 2. Emotional Status Category:

((raw summed score for emotional status items -7) /28) * 100 3. Arm and Hand Function Category:

((raw summed score for arm and hand function items - 8) /32) * 100 4. Mobility Category:

((raw summed score for mobility items - 9)/36 * 100.

5. Function Index:

((raw summed score for items 1-34 - 34) /136) * 100

6. Bothersome Index:

((raw summed score for items 35-46 -12)/48 * 100

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

| | Item No | Recommendation | page |
|---|---|---|---|
| **Title and abstract** | 1 | (*a*) Indicate the study's design with a commonly used term in the title or the abstract | 2 |
| | | (*b*) Provide in the abstract an informative and balanced summary of what was done and what was found | 2 |
| **Introduction** | | | |
| Background/rationale | 2 | Explain the scientific background and rationale for the investigation being reported | 3 |
| Objectives | 3 | State specific objectives, including any prespecified hypotheses | 4 |
| **Methods** | | | |
| Study design | 4 | Present key elements of study design early in the paper | 4 |
| Setting | 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | 4 |
| Participants | 6 | (*a*) Give the eligibility criteria, and the sources and methods of selection of participants | 4 |
| Variables | 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | 4 |
| Data sources/ measurement | 8* | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | *4, 5* |
| Bias | 9 | Describe any efforts to address potential sources of bias | 5 |
| Study size | 10 | Explain how the study size was arrived at | 5 |
| Quantitative variables | 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | 5 |
| Statistical methods | 12 | (*a*) Describe all statistical methods, including those used to control for confounding | 5,6 |
| | | (*b*) Describe any methods used to examine subgroups and interactions | |
| | | (*c*) Explain how missing data were addressed | 5 |
| | | (*d*) If applicable, describe analytical methods taking account of sampling strategy | |
| | | (*e*) Describe any sensitivity analyses | |
| **Results** | | | |
| Participants | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed | 6 |
| | | (b) Give reasons for non-participation at each stage | 6 |
| | | (c) Consider use of a flow diagram | |
| Descriptive data | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders | 6 |
| | | (b) Indicate number of participants with missing data for each variable of interest | |
| Outcome data | 15* | Report numbers of outcome events or summary measures | 6 |
| Main results | 16 | (*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included | 7 |

| | | | |
|---|---|---|---|
| | | (*b*) Report category boundaries when continuous variables were categorized | 7,8 |
| | | (*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period | 7,8 |
| Other analyses | 17 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses | |
| **Discussion** | | | |
| Key results | 18 | Summarise key results with reference to study objectives | 9 |
| Limitations | 19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias | 2 |
| Interpretation | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | 9,10 |
| Generalisability | 21 | Discuss the generalisability (external validity) of the study results | 11 |
| **Other information** | | | |
| Funding | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based | 11 |

*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

# Magnitude and Factors Associated with Musculoskeletal Disorder Among Diabetic Patients Attending Chronic Care at Arba Minch General Hospital, Arba Minch, Southern Ethiopia, 2021: A Cross-Sectional Study



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| | |

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# Magnitude and Factors Associated with Musculoskeletal Disorder Among Diabetic Patients Attending Chronic Care at Arba Minch General Hospital, Arba Minch, Southern Ethiopia, 2021: A Cross-Sectional Study

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PO.BOX. 21

## ABSTRACT

**Objective:** This study aimed to assess the prevalence and determinants of musculoskeletal disorders among diabetic patients in Southern Ethiopia.

**Design:** Facility-based cross-sectional study

**Setting:** Data collected from 1st March 2021 to 30th August 2021 at Arba Minch general hospital

**Participants:** Three hundred sixty-five diabetic patients attending care at Arba Minch general hospital

**Main outcome measures:** The magnitude and determinants of the musculoskeletal disorders

**Results: -** The prevalence of musculoskeletal disorders among diabetic patients was 23.29% (95% CI (19.00 - 27.76)). The likelihood of developing musculoskeletal disorders was 6.8 times higher among females than males (AOR = 6.787, 95% CI (2.08, 22.19)). Rural participants were about 2.4 times (AOR = 2.38, 95% CI (1.06, 5.33)) more likely to develop musculoskeletal disorders as compared to those urban participants. Participants with an age greater than 50 years were 5.9 times more likely to develop musculoskeletal disorders as compared to those aged less or equal to 50 years (AOR= 5.864, 95% CI (2.663, 12.914)). The odd of developing musculoskeletal disorders was 6.2 times (AOR = 6.247, 95% CI (1.158, 33.702)) and 5.5 times (AOR= 5.451 95% CI (1.174, 25.312)) higher among participants who attended primary and secondary education as compared to who attended college and above respectively. Participants with cardiovascular disease were 3.9 times more likely to develop musculoskeletal disorders compared with their counterparts (AOR= 3.854, 95% CI (1.843, 8.063)).

**Conclusions: -** This study showed that age, sex, educational status, place of residence, and cardiovascular disease were found to be determinants of musculoskeletal disorders. Thus, clinical and public health interventions working on Diabetes Mellitus should consider these determinants.


Keywords: musculoskeletal disorders, Diabetes Mellitus, Arba Minch, Southern Ethiopia

## STRENGTH AND LIMITATIONS OF THE STUDY

- The strength of our study: we explored musculoskeletal disorders in our diabetic patients, which are an ignored and underestimated problem with sound methodology.
- The limitation of the study:
  1. HbA1c is a better indicator of glycemic control in diabetic patients than fasting blood sugar. But we used fasting blood sugar (FBS) to determine glycemic control because HbA1c is not easily accessible in our setting and resource limitations.
  2. Vascular complications are another important predisposing factor, but we did not include them in our study because there is only a limited number of vascular evaluations and investigations that can be performed in our hospital. Musculoskeletal diseases had a clear association with microvascular complications. Both

Musculoskeletal diseases and microvascular complications usually occur in patients with poorly controlled and long-term diabetes.

## INTRODUCTION

Diabetes Mellitus is a metabolic condition that predisposes to musculoskeletal complications in the joints, bones, soft tissues, and periarticular structures, resulting in morbidity and disability (1-3). The incidence and the life expectancy of diabetic patients have both increased, leading to the increased prevalence and clinical importance of musculoskeletal abnormalities in diabetic patients (4).

The pathophysiology of most of these musculoskeletal alterations remains unclear (4). Glycosylation of proteins, microvascular abnormalities, and accumulation of collagen in the skin and periarticular structures result in changes in the connective tissue. These complications are commonly seen in patients with type 1 diabetes, but they are also present in patients with type 2 diabetes. Some of the complications have a known direct association with diabetes, whereas others have a suggested but unproven association (5).

Many skeletal and muscular system problems arise in diabetes mellitus (2). Musculoskeletal complications of diabetes mellitus have been generally under-recognized and poorly treated compared with other complications and lead to functional disability (6). The prevalence and incidence of diabetes mellitus are increasing, and the percentage of diabetic patients with a functional disability will increase as the number of diabetic patients increases, thereby constituting a major public health problem.

Musculoskeletal disease is more common among individuals with diabetes mellitus (DM) than in healthy individuals (7) and predominantly affects the hand and shoulder (1, 5, 6, 8). Its magnitude varies widely. India's 42 - 62 % (3, 4), Saudi Arabia's 17.9% (6), Jordan's 69.5% (1), Moroccan 14.4% (9), and Nigeria's 56% (10) diabetic individuals suffer from one or more musculoskeletal diseases. Also, in studies conducted in central and northern Ethiopia, the prevalence was 16.6 to 41.5% and females were more affected than males (5, 11).

Despite the high prevalence of musculoskeletal conditions amongst diabetic patients and their associated impact on health-related quality of life and economic costs, there are limited local studies on this subject done in Ethiopia. Even though there is a scarcity of data in Ethiopia, overall prevalence of one or more musculoskeletal diseases is 41.5 % with hands being the most affected (18.5 %)(5). The study done in Gondar reported that the prevalence of shoulder and hand musculoskeletal complications was 16.6% and the majority of them were females, which accounts for 20.1% (11).

In addition to the diabetic consequences, musculoskeletal disorders (MSD) cause finger contracture, pain, and loss of function that interfere with finger pricks, insulin injections, and other diabetes management. Also, in most cases, MSD requires surgery that influences wound healing. All of this can worsen the quality of life of people with diabetes (12, 13).

Musculoskeletal disorders are treatable and easily preventable, but their manifestations are unrecognized or overlooked. Thus, clinicians should be aware of the possible MSD in diabetes and assess all individuals with DM for the manifestation of MSD, which helps for timely

diagnosis and early treatment. Despite some studies conducted in central and north Ethiopia, there are limited studies in south Ethiopia.

Therefore, this study aimed to identify:

- The prevalence of musculoskeletal disorders among patients attending a diabetic clinic in Arba Minch Hospital, southern Ethiopian
- Determinants of musculoskeletal disorders among patients attending a diabetic clinic in Arba Minch Hospital, southern Ethiopia

## Materials and methods

### Study design, setting, and sampling

A facility-based cross-sectional study was conducted from March to August 2021 in Arba Minch hospital. Arba Minch town is located 434 km south of Addis Ababa, the capital city of Ethiopia. The hospital provides curative, preventive, and rehabilitative services for the population of Gamo, Konso, and South Omo zones. A total of 800 type I and type II diabetic patient are followed in the chronic care unit of the hospital.

### The population of the study

All DM patients attending a chronic care unit of Arba Minch hospital, but individuals with less than 18 years of age, secondary diabetes like Cushing's syndrome, history of hand trauma, epilepsy, chronic liver disease, inflammatory arthritis, family history of Dupuytren's contracture, nervous disorders, congenital musculoskeletal abnormalities, recent fractures or injuries, and surgery of the shoulder and hand were excluded from the study.

***Dependent variable***

Musculoskeletal disorders.

***Independent Variables***

- Sociodemographic: Age, sex, occupation, residence, religion, education
- Diabetes-related factors: Type of diabetes, duration of DM, glycemic control, type of therapy
- Individual related factors: Chronic illness, body mass index (BMI), exercise, drugs (insulin)

### Patient and Public Involvement

Our patients were involved in the recruitment to conduct the study as study participants after written consent was taken. The results of the study were disseminated to study participants during their diabetic clinic follow-up time.

### Sampling

The sample size was calculated using a single population proportion formula. Assuming 95% confidence interval, a 5% degree of precision, and a 41.5% expected proportion of musculoskeletal disorders among DM patients (5). Based on the above assumptions, the sample size calculated was 373. Study participants were selected by employing a systematic random sampling technique.

**Data collection procedures**

A pre-tested, interviewer-administered, structured questionnaire and a medical record review were used to collect data on sociodemographic, diabetic, and individual-related factors.

**Measurement**

A standard Short Musculoskeletal Function Assessment (SMFA) questionnaire (5, 14, 15) was used to assess musculoskeletal disorders. Summing items 1-34 creates a short musculoskeletal function assessment questionnaire, raw scores for the function index, and items 35-46 raw scores for the bothersome index, after corrections and omissions for missing values (16). The raw score was changed to a standardized score, that ranges from 0 to 100 points using the following formula: ([actual raw score – the lowest possible raw score]/possible range of raw score) *100 (annex 1,2). Higher scores indicate poorer function. In addition, body height and mass were measured using the esca scale, and BMI was calculated using the body formula mass/height $^{2}$. Two data clerks independently entered the collected data into Epidata software version 3.1, and the investigator checked consistency between the two data sets. The pretest was done in a 5% sample size at Arba Minch general hospital for validation of the checklist.

The following definitions were used.

- **Musculoskeletal disorder:** The presence of one or more of the following Carpal tunnel syndromes, Dupuytren's contracture, Limited joint mobility, Stenosing tenosynovitis, adhesive capsulitis, Reflex sympathetic dystrophy, Diabetic amyotrophic, Diffuse idiopathic skeletal hyperostosis syndrome, Charcot joint or a score greater than and above in short musculoskeletal assessment form**.**
- **Body Mass Index** –was assessed according to the standards that describe insufficient body weight (when BMI is <18 kg/m$^{2}$), normal body weight (when BMI is 18–24.9 kg/m2), excess weight (when BMI of 25–30 kg/m 2), and obesity (when BMI ≥30 kg/m $^{2}$).
- **Cardiovascular disease:** the presence of one or more of the following; heart failure, history of stroke/ transient ischemic attack (TIA), history of myocardial infarction /ischemic heart disease (MI/IHD), history of peripheral arterial disease.

**Data processing**

Intensive on-site training was organized for data collectors, including their performance evaluation to ensure data consistency. Before being exported to STATA 16.00 for analysis, the data were checked for completeness, edited, coded, and entered into Epi Data Version 3.1. After cleaning the data for inconsistencies and missing values, descriptive statistics such as mean, frequency, and percentage were calculated, and the data was presented as text and tables. Assumptions for chi-square were checked and there was no violated assumption. A bivariate analysis was performed and all explanatory variables that were associated with the outcome

variable at a P- value less than 0.25 in the bivariate analysis and biologically plausible were included in the multivariable analysis model. Then, a multivariable analysis was conducted using backward LR to determine associated factors. The odds ratio, with its 95% CI, was used to decide whether those independent variables included in the multivariable analysis were statistically significant or not.

## RESULTS

### Sociodemographic characteristics of study participants

A total of 365 participants were included in the study, with a response rate of 97.9%. The mean age was 51.42 (±14.06). The majority of respondents were females (55.34%), aged under 50 years old (52.33%), living in an urban area (64.66%), and married (92.88%) (Table 1)

Table 1: Sociodemographic characteristics of diabetic patients attending chronic care at Arba Minch Hospital, Southern Ethiopia, 2021

| Variables | Freq. | Percent |
|---|---|---|
| **Sex of the respondent** | | |
| Female | 202 | 55.34 |
| Male | 163 | 44.66 |
| **Age of the respondent in years** | | |
| < 50 years | 191 | 52.33 |
| ≥50 years | 174 | 47.67 |
| **Place of residence** | | |
| Rural | 129 | 35.34 |
| Urban | 236 | 64.66 |
| **Education status** | | |
| College graduate or above | 80 | 21.92 |
| Able to read and write | 14 | 3.84 |
| Unable to read and write | 105 | 28.77 |
| Primary education (1-8) | 98 | 26.85 |
| Secondary school (9-12) | 68 | 18.63 |
| **Occupation** | | |
| Farmer | 43 | 11.78 |
| Government employed | 105 | 28.77 |
| Housewife | 151 | 41.37 |
| Self-employed | 44 | 12.05 |
| Unemployed | 22 | 6.03 |
| **Marital status** | | |
| Unmarried | 26 | 7.12 |
| Married | 339 | 92.88 |

### Clinical and individual-related characteristics

Of the study participant, 23.29% (95% CI (19.00 - 27.76) of them had musculoskeletal disorders. Almost all the participants were non-smokers and non-drunker. One-third of the participants had chronic diseases, including cardiovascular disease (CVD), but only one-quarter of them had CVD. The majority of the participants were type two diabetic patients (91.51%), on an oral hypoglycemic drug (76.03%), had not developed a diabetic complication (92.05%), were not involved in physical activities (87.09%), and were overweight (53%) (Table 2).

Table 2: Clinical and individual-related characteristics of diabetic patients attending chronic careat Arba Minch Hospital, Southern Ethiopia, 2021

| **Variables** | Freq. | Percent |
|---|---|---|
| **Type of Diabetic Mellitus** | | |
| Type two | 334 | 91.51 |
| Type one | 31 | 8.49 |
| **Type of medication** | | |
| Insulin | 61 | 16.8 |
| Oral hypoglycemic drug | 276 | 76.03 |
| Both | 26 | 7.16 |
| **DM complication** | | |
| No | 336 | 92.05 |
| Yes | 29 | 7.95 |
| **Chronic disease** | | |
| No | 257 | 70.41 |
| Yes | 108 | 29.59 |
| **Cardiovascular disease** | | |
| No | 244 | 74.62 |
| Yes | 83 | 25.38 |
| **Physical activity** | | |
| No | 317 | 87.09 |
| Yes | 47 | 12.91 |
| **Body mass index** | | |
| Under | 11 | 3.01 |
| Normal | 160 | 43.84 |
| Over | 194 | 53.15 |
| **Musculoskeletal disorder** | | |
| No | 280 | 76.71 |
| Yes | 85 | 23.29 |

The glycemic control of the study participants was poor, with a mean ± standard deviation of 157.33 mg/dl ±35.73 and only 20.7% (87) of the study participants had good glycemic control (fasting blood sugar <126mg/dl). The average duration of Diabetes Mellitus was 5.62 years ±5.08, which was low. The mean total cholesterol, high-density lipoprotein, and triglyceride levels of the participants were 179.91(± 4.59), 42.77(± .023), and 209.05(± 4.35) respectively.

Also, the mean duration of a patient with DM and the level of average fasting blood glucose were 5.62 years (± 0.27) and 157.33 (± 1.87) (Table 3).

Table 3: Clinical and individual-related characteristics of diabetic patients attending chronic careat Arba Minch Hospital, Southern Ethiopia, 2021

| Variable | Min | Max | Mean | Std. Err. | Std. Dev. | 95% confidence interval | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower | Upper |
| Total cholesterol | 53 | 531 | 179.91 | 4.59 | 86.17 | 170.89 | 188.93 |
| High-density lipoprotein | 30 | 58 | 42.77 | 0.23 | 4.35 | 42.32 | 43.23 |
| Triglyceride level | 11 | 546 | 209.05 | 4.35 | 81.75 | 200.49 | 217.61 |
| Age | 18 | 99 | 51.42 | 0.74 | 14.06 | 49.98 | 52.87 |
| DM duration | 0.2 | 23.0 | 5.62 | 0.27 | 5.08 | 5.10 | 6.14 |
| Weight | 7.0 | 123.0 | 68.43 | 0.64 | 12.18 | 67.18 | 69.69 |
| Height | 1.4 | 101.0 | 2.29 | 0.34 | 6.43 | 1.63 | 2.96 |
| Waist circumference | 53 | 126 | 87.30 | 0.45 | 8.42 | 86.41 | 88.19 |
| Hip circumference | 63 | 120 | 93.21 | 0.39 | 7.28 | 92.44 | 93.97 |
| Fasting blood glucose | 84.67 | 275.00 | 157.33 | 1.87 | 35.73 | 153.65 | 161.01 |

**Factors associated with musculoskeletal disorders**

Binary logistic regression was done to identify which variables are associated with musculoskeletal disorders in diabetic patients. The variables sex, residency, occupation, levels of education, age, and waist to hip circumferences were significantly associated with musculoskeletal disorders in Diabetes Mellitus patients. Independent variables with a p-value of ≤ 0.25, significant in previous studies, and based on the context, were included in the multivariable analysis. The variables sex, age, residence, educational status, and cardiovascular disorders (CVD) were significantly associated in multivariable regression analysis (p-value 0.05) (Table 4).

The likelihood of developing musculoskeletal disorders was 6.8 times higher among females than males (AOR = 6.787, 95% CI (2.08, 22.19). Rural participants were about 2.4 times (AOR = 2.38, 95% CI (1.06, 5.33) more likely to develop musculoskeletal disorders as compared to urban ones. Participants with an age greater than 50 years were 5.9 times more likely to develop musculoskeletal disorders as compared to those aged less than or equal to 50 years (AOR= 5.864, 95% CI (2.663, 12.914)). The odds of developing musculoskeletal disorders were 6.2 times (AOR = 6.247, 95% CI (1.158, 33.702) and 5.5 times (AOR = 5.451, 95% CI (1.174, 25.312) higher among participants who attended primary and secondary school, respectively, than among those who attended college and above. Participants with cardiovascular disease were 3.9 times more likely to develop musculoskeletal disorders compared with their counterparts (AOR= 3.854, 95% CI ((1.843, 8.063)) (Table 4).

Table 4: Factors associated with musculoskeletal disorder among diabetic patients attending chronic care at Arba Minch Hospital, Southern Ethiopia, 2021

| Variables | Musculoskeletal disorders NO nº (%) | Yes nº (%) | COR (95%CI) | AOR (95%CI) |
|---|---|---|---|---|
| **Sex** | | | | |
| Female | 139(68.81) | 63(31.19) | 2.905(1.69, 4.98) | 7.08, 22.19) |
| Male | 141(86.50) | 22(13.50) | **1** | 1 |
| **Age in years** | | | | |
| < 50 years | 163(85.34) | 28(14.66) | 1 | 1 |
| ≥50 years | 117(67.24) | 57(32.76) | 2.84 (1.70, 4.73) | 5.86(2.66, 12.91) |
| **Residency** | | | | |
| Rural | 93(72.09) | 36(27.91) | 1.48 (0.89, 2.43) | 2.38(1.06, 5.33) |
| Urban | 187(79.24) | 49(20.76) | **1** | 1 |
| **Education** | | | | |
| unable to read and Right | 11(78.57) | 3(21.43) | 2.46(.56, 10.68) | 0.47(.022, 10.09) |
| able to read and write | 70(66.67) | 35(33.33) | 4.5(1.95, 10.38) | 4.21 (0.71, 24.87) |
| Primary education | 73(74.49) | 25(25.51) | 3.08(1.30, 7.28) | 6.25(1.16, 3.70) |
| Secondary school | 54(79.41) | 14(20.59) | 2.33(0.91, 5.96) | 5.45(1.17, 5.31) |
| College and above | 72(90.00) | 8(10.00) | 1 | 1 |
| **Cardiovascular disease** | | | | |
| No | 198(81.15) | 46(18.85) | 1 | 1 |
| Yes | 52(62.65) | 31(37.35) | 2.57(1.48, 4.44) | 3.85 (1.84, 8.06) |

COR (95% CI); crude odds ratio at 95% confidence interval, AOR (95% CI); adjusted odds ratio at 95% confidence interval

## DISCUSSION

Musculoskeletal disorders in Diabetes Mellitus have been ignored and poorly treated as compared to acute and microscopic complications of Diabetes Mellitus (11).

Our study reveals the following important findings:

1. Hypertension is the commonest concomitant disease (24.38%), which is in line with a study done in Tikur Anbesa hospital (5)
2. The overall average FBS value was 157.38 mg/dl, which is high and shows poor glycemic control.
3. The prevalence of musculoskeletal disorders was 23.29%,
4. A statistically significant association was observed between clinically manifesting musculoskeletal disorders and having a female sex, increasing age, residency, education, and cardiovascular disorders.

Diabetes mellitus affects connective tissues in many ways, which leads to different alterations in skeletal and articular systems. It is associated with many musculoskeletal manifestations, most of which are not clinical and correlated with disease duration and inadequate control (17). These complications are often found, and, although less valued than the vascular ones, they

significantly compromise the patients' quality of life (18). Epidemiologic studies have identified several personal, occupational, and psychosocial factors related to musculoskeletal disorders (17).The exact pathophysiology of most of these musculoskeletal disorders remains unclear. However, connective tissue disorders, neuropathy, or vasculopathy may have a synergistic effect on the increased incidence of musculoskeletal disorders in diabetics (17).

Many studies have evaluated musculoskeletal manifestations in diabetic patients, but most assessed only an individual component, especially musculoskeletal involvement of the upper extremity while few studies have evaluated the entire musculoskeletal system, including the limbs and back. In this study, the magnitude of MSD in DM people was 23.29%. This is higher than the studies done in Saudi Arabia (6) but lower than studies conducted in Jordan, Nigeria, Morocco, and central Ethiopia (1, 3, 5, 9, 10). This difference is probably due to differences in mean diabetic duration, glycemic control, and geographic difference (4, 5, 19). The lower prevalence of musculoskeletal disorders in our study can be explained by better glycemic control and patient care and decreased manual work in developing countries over time.

Musculoskeletal disorder conditions were more common in type 2 DM subjects than in type 1 subjects (23.35 vs 22.58) which is in line with studies in Morocco, Egypt, and Ethiopia (9, 11, 20). It is thought that it may be explained by the propensity for type 2 subjects to develop MSD as a result of obesity, reduced physical activity, older age, dyslipidemia, and hyperuricemia (10).

Participants with an age greater than 50 years were 5.9 times more likely to develop musculoskeletal disorders as compared to those aged less or equal to 50 years, which is in line with studies conducted in India and Iran (4, 9). The fact that as age increases, the number of tendon cells is decreases, protein synthesis in the organelles, connective tissue elasticity decreases, and joints and tendon sheaths become stiffer, which predisposes older people to MSDs (3). Women were involved for a long time, doing heavy manual work at home. This is supported by our findings that the likelihood of developing musculoskeletal disorders was 6.8 times higher among females than males. This is similar to studies conducted in India, Iran, and central Ethiopia (4, 5, 19).

Rural participants were about 2.4 times more likely to develop musculoskeletal disorders as compared to urban ones. This may be attributed to more manual labor work for rural residents than urban residents since occupations that involved manual labor increased the risk of hand complications in our patients (21, 22).

The odds of developing musculoskeletal disorders were 6.2 and 5.5 times higher among participants who attended primary and secondary education as compared to those who attended college and above, respectively. This may be because literacy affects health-seeking behavior (23, 24) since healthcare-seeking behavior affects glycemic control and adherence to diabetic management modalities, which are important in planning diabetes care and management that minimizes complications. Poor and delayed healthcare-seeking behavior leads to delayed diagnosis and treatment, and poor health outcomes (25, 26). A study also indicated that education and income are factors for diabetic knowledge, which is important in health service utilization, diabetic management, and avoiding complications (27). Participants with cardiovascular disease were 3.9 times more likely to develop musculoskeletal disorders

compared with their counterparts. This is similar to other studies that showed that musculoskeletal disorders are associated with cardiovascular disease. This may be attributable to the micro complications and macro complications of diabetes Mellitus which are associated with musculoskeletal disorders (13, 28).

The most important predictor of MSD complications in people living with diabetes is blood glucose control (29). In this study, there was no association between blood glucose control and musculoskeletal disorders. It may be because we only measured the mean fasting blood glucose and not the HbA1c level. This may also be explained by the fact that cumulative hyperglycemia is required to produce changes, while a single cross-sectional fasting blood glucose estimate only represents the glycemic control over the previous 3 months. This is consistent with the findings of studies in Tikur Anbesa, Addis Abeba, and Iran (5, 19) but it contradicts the findings of studies in northern India (4, 30), and the United Kingdom, which found a strong association between musculoskeletal disorders and poor blood glucose control (29).

## CONCLUSION

The prevalence of musculoskeletal disorders among diabetic patients was 23.29%, and it showed that age, sex, educational status, place of residence, and cardiovascular disease were found to be determinants of musculoskeletal disorders. Thus, clinical and public health interventions working on diabetes mellitus should consider these determinants.

### Ethics statements

### Patient consent for publication

Not applicabl.

### Ethics approval

The Institutional Review Board of the College of Medicine and Health Science, Arba Minch University, approved the study and granted consent to take place in its letter with a reference number of IRB/1040/20. A letter of cooperation was received from the hospital, and written informed consent was obtained from the study participants after being informed of the aim of the study.

## ACKNOWLEDGMENT

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### Data sharing

All relevant data are within the manuscript

### Funding

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## Conflict of interest

The authors declare that there is no conflict of interest.

## Contributorship statement

GA: contributed to the design and implementation of the research, acquisition, analysis, and interpretation of data for the study and to the writing of the manuscript
TH- contributed to the implementation and supervision of the research, critically revise the manuscript
TF: contributed to the design and implementation of the research, to the analysis of the results and to the revision of the manuscript
AG: contributed to the implementation of the research, to the analysis of the results and to the revision of the manuscript.
RT: contributed to the implementation of the research, to the analysis of the results and to the revision of the manuscript.
TS: contributed to the implementation of the research, to the analysis of the results and to the revision of the manuscript.
EK: contributed to the implementation of the research, to the analysis of the results and to the revision of the manuscript.
FD: contributed to the implementation of the research, to the analysis of the results and to the revision of the manuscript.
KA: contributed to the implementation of the research, to the analysis of the results and to the revision of the manuscript.
WW: contributed to the implementation of the research, to the analysis of the results and to the revision of the manuscript.
AB: contributed to the implementation of the research, to the analysis of the results and to the revision of the manuscript.
All authors read and approved the final manuscript.

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NAME: _____DOB:_____

DATE: _____

# *Short Musculoskeletal Function Assessment*

**To be completed by the PATIENT**

SCORE: DYSFUNCTION INDEX: _____ % Previous: _____% Date: _____

BOTHER INDEX: _____ % Previous: _____% Date: _____

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**These questions are about how much difficulty you may be having this week with your daily activities because of your injury or arthritis.**

| | | Not at all difficult | A little difficult | Moderately difficult | Very difficult | Unable to do |
|---|---|---|---|---|---|---|
| **01.** | **How difficult is it for you to get in or out of a low chair?** | ○ | ○ | ○ | ○ | ○ |
| **02.** | **How difficult is it for you to open medicine bottles or jars?** | ○ | ○ | ○ | ○ | ○ |
| **03.** | **How difficult is it for you to shop for groceries or other things?** | ○ | ○ | ○ | ○ | ○ |
| **04.** | **How difficult is it for you to climb stairs?** | ○ | ○ | ○ | ○ | ○ |
| **05.** | **How difficult is it for you to make a tight fist?** | ○ | ○ | ○ | ○ | ○ |
| **06.** | **How difficult is it for you to get in or out of the bathtub or shower?** | ○ | ○ | ○ | ○ | ○ |
| **07.** | **How difficult is it for you to get comfortable to sleep?** | ○ | ○ | ○ | ○ | ○ |
| **08.** | **How difficult is it for you to bend or kneel down?** | ○ | ○ | ○ | ○ | ○ |
| **09.** | **How difficult is it for you to use buttons, snaps, hooks, or zippers?** | ○ | ○ | ○ | ○ | ○ |
| **10.** | **How difficult is it for you to cut your own fingernails?** | ○ | ○ | ○ | ○ | ○ |
| **11.** | **How difficult is it for you to dress yourself?** | ○ | ○ | ○ | ○ | ○ |
| **12.** | **How difficult is it for you to walk?** | ○ | ○ | ○ | ○ | ○ |
| **13.** | **How difficult is it for you to get moving after you have been sitting or lying down?** | ○ | ○ | ○ | ○ | ○ |
| **14.** | **How difficult is it for you to go out by yourself?** | ○ | ○ | ○ | ○ | ○ |
| **15.** | **How difficult is it for you to drive?** | ○ | ○ | ○ | ○ | ○ |
| **16.** | **How difficult is it for you to clean yourself after going to the bathroom?** | ○ | ○ | ○ | ○ | ○ |
| **17.** | **How difficult is it for you turn knobs or levers, for example, open doors, roll down car windows?** | ○ | ○ | ○ | ○ | ○ |
| **18.** | **How difficult is it for you to write or type?** | ○ | ○ | ○ | ○ | ○ |
| **19.** | **How difficult is it for you to pivot?** | ○ | ○ | ○ | ○ | ○ |
| **20.** | **How difficult is it for you to do your usual physical recreational activities, such as bicycling, jogging, or walking?** | ○ | ○ | ○ | ○ | ○ |
| **21.** | **How difficult is it for you to do your usual leisure activities, such as hobbies, crafts, gardening, card playing, going out with friends?** | ○ | ○ | ○ | ○ | ○ |
| **22.** | **How much difficulty are you having with sexual activity?** | ○ | ○ | ○ | ○ | ○ |
| **23.** | **How difficult is it for you to do light housework or yardwork, such as dusting, washing dishes, or watering plants?** | ○ | ○ | ○ | ○ | ○ |
| **24.** | **How difficult is it for you to do heavy housework or yardwork, such as washing floors, vacuuming, or mowing lawns?** | ○ | ○ | ○ | ○ | ○ |
| **25.** | **How difficult is it for you to do your usual work, such as a paid job, housework, volunteer activities?** | ○ | ○ | ○ | ○ | ○ |

***Please continue on next page***


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NAME: _____ DOB:_____

DATE: _____

# *Short Musculoskeletal Function Assessment*

**To be completed by the PATIENT**

**These next questions ask how often you are experiencing problems this week because of your injury or arthritis**

| | | None of the time | A little of the time | Some of the time | Most of the time | All of the time |
|---|---|---|---|---|---|---|
| **26.** | **How often do you walk with a limp?** | ○ | ○ | ○ | ○ | ○ |
| **27.** | **How often do you avoid using your painful limb(s) or back?** | ○ | ○ | ○ | ○ | ○ |
| **28.** | **How often does your leg lock or give-way?** | ○ | ○ | ○ | ○ | ○ |
| **29.** | **How often do you have problems with concentration?** | ○ | ○ | ○ | ○ | ○ |
| **30.** | **How often does doing too much in one day affect what you do the next day?** | ○ | ○ | ○ | ○ | ○ |
| **31.** | **How often do you act irritable toward those around you, for example, snap at people, give sharp answers, or criticize easily?** | ○ | ○ | ○ | ○ | ○ |
| **32.** | **How often are you tired?** | ○ | ○ | ○ | ○ | ○ |
| **33.** | **How often do you feel disabled?** | ○ | ○ | ○ | ○ | ○ |
| **34.** | **How often do you feel angry or frustrated that you have this injury or arthritis?** | ○ | ○ | ○ | ○ | ○ |

**These next questions are about how much you are bothered by problems you are having this week due to your injury or arthritis**

| **How much are you bothered by:** | | Not bothered at all | A little bothered | Moderately bothered | Very bothered | Extremely bothered |
|---|---|---|---|---|---|---|
| **35.** | **Problems using your hands?** | ○ | ○ | ○ | ○ | ○ |
| **36.** | **Problems using your back?** | ○ | ○ | ○ | ○ | ○ |
| **37.** | **Problems doing work around your home?** | ○ | ○ | ○ | ○ | ○ |
| **38.** | **Problems with bathing, dressing, toileting or other personal care?** | ○ | ○ | ○ | ○ | ○ |
| **39.** | **Problems with sleep and rest?** | ○ | ○ | ○ | ○ | ○ |
| **40.** | **Problems with leisure or recreational activities?** | ○ | ○ | ○ | ○ | ○ |
| **41.** | **Problems with your friends, family or other important people in your life?** | ○ | ○ | ○ | ○ | ○ |
| **42.** | **Problems with thinking, concentrating or remembering?** | ○ | ○ | ○ | ○ | ○ |
| **43.** | **Problems adjusting or coping with your injury or arthritis?** | ○ | ○ | ○ | ○ | ○ |
| **44.** | **Problems doing your usual work?** | ○ | ○ | ○ | ○ | ○ |
| **45.** | **Problems with feeling dependent on others?** | ○ | ○ | ○ | ○ | ○ |
| **46.** | **Problems with stiffness and pain?** | ○ | ○ | ○ | ○ | ○ |

*Reproduced from: Marc F. Swiontkowski, M.D.; Ruth Engelberg, Ph.D.; Diane P. Martin, Ph.D.; and Julie Agel, M.A. Short Musculoskeletal Function Assessment Questionnaire: Validity, Reliability, Responsiveness. J Bone Joint Surg AM 81:1245-60, 1999.*





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I. SCORE VALUES

| | | |
|---|---|---|
| A. Questions 1-25: | Not at all difficult | 1 |
| | A little difficult | 2 |
| | Moderately difficult | 3 |
| | Very difficult | 4 |
| | Unable to do | 5 |
| B. Questions 26-34 | None of the time | 1 |
| | A little of the time | 2 |
| | Some of the time | 3 |
| | Most of the time | 4 |
| | All of the time | 5 |
| C. Questions 35-46 | Not at all bothered | 1 |
| | A little bothered | 2 |
| | Moderately bothered | 3 |
| | Very bothered | 4 |
| | Extremely bothered | 5 |

II. HANDLING OF MISSING RESPONSES

A. Questions 1-34:

If patients have fewer than 50% of the answers missing in any one category, substitute the mean value of that category for the missing item(s). Please see the attached form identifying items and categories for this portion of the analysis.

B. Questions 35-46 (Bothersome Index):

Patients with missing answers are omitted from the analyses of the Bother

III. CALCULATION OF SCORES

A. Raw scores are created by summing items 1-34 for the Function Index and items 35-46 for the Bothersome Index, after corrections and omissions for missing values (see above); raw scores for categories are created by summing the items within each category.

B. Scores are standardized, with high scores indicating poor function and low scores indicating good function. The formula for standardization is:
(Actual raw score - lowest possible raw score/possible raw score range) *100

C. Below are listed the values to be used for standardization:

1. Daily Activities Category:
((raw summed score for daily activities items-10) /40) * 100
2. Emotional Status Category:
((raw summed score for emotional status items -7) /28) * 100
3. Arm and Hand Function Category:
((raw summed score for arm and hand function items -8) /32) * 100
4. Mobility Category:
((raw summed score for mobility items - 9)/36 * 100.
5. Function Index:
((raw summed score for items 1-34 - 34) /136) * 100
6. Bothersome Index:
((raw summed score for items 35-46 -12)/48 * 100

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

| | Item No | Recommendation | page |
|---|---|---|---|
| **Title and abstract** | 1 | (*a*) Indicate the study's design with a commonly used term in the title or the abstract | 2 |
| | | (*b*) Provide in the abstract an informative and balanced summary of what was done and what was found | 2 |
| **Introduction** | | | |
| Background/rationale | 2 | Explain the scientific background and rationale for the investigation being reported | 3 |
| Objectives | 3 | State specific objectives, including any prespecified hypotheses | 4 |
| **Methods** | | | |
| Study design | 4 | Present key elements of study design early in the paper | 4 |
| Setting | 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | 4 |
| Participants | 6 | (*a*) Give the eligibility criteria, and the sources and methods of selection of participants | 4 |
| Variables | 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | 4 |
| Data sources/ measurement | 8* | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | *4, 5* |
| Bias | 9 | Describe any efforts to address potential sources of bias | 5 |
| Study size | 10 | Explain how the study size was arrived at | 5 |
| Quantitative variables | 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | 5 |
| Statistical methods | 12 | (*a*) Describe all statistical methods, including those used to control for confounding | 5,6 |
| | | (*b*) Describe any methods used to examine subgroups and interactions | |
| | | (*c*) Explain how missing data were addressed | 5 |
| | | (*d*) If applicable, describe analytical methods taking account of sampling strategy | |
| | | (*e*) Describe any sensitivity analyses | |
| **Results** | | | |
| Participants | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed | 6 |
| | | (b) Give reasons for non-participation at each stage | 6 |
| | | (c) Consider use of a flow diagram | |
| Descriptive data | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders | 6 |
| | | (b) Indicate number of participants with missing data for each variable of interest | |
| Outcome data | 15* | Report numbers of outcome events or summary measures | 6 |
| Main results | 16 | (*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included | 7 |

| | | | |
|---|---|---|---|
| | | (*b*) Report category boundaries when continuous variables were categorized | 7,8 |
| | | (*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period | 7,8 |
| Other analyses | 17 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses | |
| **Discussion** | | | |
| Key results | 18 | Summarise key results with reference to study objectives | 9 |
| Limitations | 19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias | 2 |
| Interpretation | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | 9,10 |
| Generalisability | 21 | Discuss the generalisability (external validity) of the study results | 11 |
| **Other information** | | | |
| Funding | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based | 11 |

*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

# Magnitude and Factors Associated with Musculoskeletal Disorder Among Diabetic Patients Attending Chronic Care at Arba Minch General Hospital, Arba Minch, Southern Ethiopia, 2021: A Cross-Sectional Study



| | |
|---|---|
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# Magnitude and Factors Associated with Musculoskeletal Disorder Among Diabetic Patients Attending Chronic Care at Arba Minch General Hospital, Arba Minch, Southern Ethiopia, 2021: A Cross-Sectional Study

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## ABSTRACT

**Objective:** This study aimed to assess the prevalence and determinants of musculoskeletal disorders among diabetic patients in Southern Ethiopia.

**Design:** Facility-based cross-sectional study

**Setting:** Data collected from 1st March 2021 to 30th August 2021 at Arba Minch general hospital

**Participants:** Three hundred sixty-five diabetic patients attending care at Arba Minch general hospital

**Main outcome measures:** The magnitude and determinants of the musculoskeletal disorders

**Results: -** The prevalence of musculoskeletal disorders among diabetic patients was 23.29% (95% CI (19.00 - 27.76)). The likelihood of developing musculoskeletal disorders was 6.8 times higher among females than males (AOR = 6.787, 95% CI (2.08, 22.19)). Rural participants were about 2.4 times (AOR = 2.38, 95% CI (1.06, 5.33)) more likely to develop musculoskeletal disorders as compared to those urban participants. Participants with an age greater than 50 years were 5.9 times more likely to develop musculoskeletal disorders as compared to those aged less or equal to 50 years (AOR= 5.864, 95% CI (2.663, 12.914)). The odd of developing musculoskeletal disorders was 6.2 times (AOR = 6.247, 95% CI (1.158, 33.702)) and 5.5 times (AOR= 5.451 95% CI (1.174, 25.312)) higher among participants who attended primary and secondary education as compared to who attended college and above respectively. Participants with cardiovascular disease were 3.9 times more likely to develop musculoskeletal disorders compared with their counterparts (AOR= 3.854, 95% CI (1.843, 8.063)).

**Conclusions: -** This study showed that age, sex, educational status, place of residence, and cardiovascular disease were found to be determinants of musculoskeletal disorders. Thus, clinical and public health interventions working on Diabetes Mellitus should consider these determinants.


Keywords: musculoskeletal disorders, Diabetes Mellitus, Arba Minch, Southern Ethiopia

## STRENGTH AND LIMITATIONS OF THE STUDY

- We explored musculoskeletal disorders in our diabetic patients, which are an ignored and underestimated problem with sound methodology.
- The presence of musculoskeletal disorders was based on medical records and self-reports.
- We used fasting blood sugar (FBS) to determine glycemic control because HbA1c is not easily accessible in our setting and resource limitations.
- Vascular complications are not assessed and included in our study due to limited number of vascular evaluations and investigations that can be performed in our hospital.

## INTRODUCTION

Diabetes mellitus is a metabolic condition that predisposes to musculoskeletal complications in the joints, bones, soft tissues, and periarticular structures, resulting in morbidity and disability (1-3). The incidence and the life expectancy of diabetic patients have both increased, leading to the increased prevalence and clinical importance of musculoskeletal abnormalities in diabetic patients (4).

The pathophysiology of most of these musculoskeletal alterations remains unclear (4). Glycosylation of proteins, microvascular abnormalities, and accumulation of collagen in the skin and periarticular structures result in changes in the connective tissue. These complications are commonly seen in patients with type 1 diabetes, but they are also present in patients with type 2 diabetes. Some of the complications have a known direct association with diabetes, whereas others have a suggested but unproven association (5).

Many skeletal and muscular system problems arise in diabetes mellitus (2). Musculoskeletal complications of diabetes mellitus have been generally under-recognized and poorly treated compared with other complications and lead to functional disability (6). The prevalence and incidence of diabetes mellitus are increasing, and the percentage of diabetic patients with a functional disability will increase as the number of diabetic patients increases, thereby constituting a major public health problem.

Musculoskeletal disease is more common among individuals with diabetes mellitus (DM) than in healthy individuals (7) and predominantly affects the hand and shoulder (1, 5, 6, 8). Its magnitude varies widely. India's 42 - 62 % (3, 4), Saudi Arabia's 17.9% (6), Jordan's 69.5% (1), Moroccan 14.4% (9), and Nigeria's 56% (10) diabetic individuals suffer from one or more musculoskeletal diseases. Also, in studies conducted in central and northern Ethiopia, the prevalence was 16.6 to 41.5% and females were more affected than males (5, 11).

Despite the high prevalence of musculoskeletal conditions amongst diabetic patients and their associated impact on health-related quality of life and economic costs, there are limited local studies on this subject done in Ethiopia. Even though there is a scarcity of data in Ethiopia, overall prevalence of one or more musculoskeletal diseases is 41.5 % with hands being the most affected (18.5 %)(5). The study done in Gondar reported that the prevalence of shoulder and hand musculoskeletal complications was 16.6% and the majority of them were females, which accounts for 20.1% (11).

In addition to the diabetic consequences, musculoskeletal disorders (MSD) cause finger contracture, pain, and loss of function that interfere with finger pricks, insulin injections, and other diabetes management. Also, in most cases, MSD requires surgery that influences wound healing. All of this can worsen the quality of life of people with diabetes (12, 13).

Musculoskeletal disorders are treatable and easily preventable, but their manifestations are unrecognized or overlooked. Thus, clinicians should be aware of the possible MSD in diabetes and assess all individuals with DM for the manifestation of MSD, which helps for timely diagnosis and early treatment. Despite some studies conducted in central and north Ethiopia, there are limited studies in south Ethiopia.



Therefore, this study aimed to identify:

- The prevalence of musculoskeletal disorders among patients attending a diabetic clinic in Arba Minch Hospital, southern Ethiopian
- Determinants of musculoskeletal disorders among patients attending a diabetic clinic in Arba Minch Hospital, southern Ethiopia

## Materials and methods

### Study design, setting, and sampling

A facility-based cross-sectional study was conducted from March to August 2021 in Arba Minch hospital. Arba Minch town is located 434 km south of Addis Ababa, the capital city of Ethiopia. The hospital provides curative, preventive, and rehabilitative services for the population of Gamo, Konso, and South Omo zones. A total of 800 type I and type II diabetic patient are followed in the chronic care unit of the hospital.

### The population of the study

All DM patients attending a chronic care unit of Arba Minch hospital, but individuals with less than 18 years of age, secondary diabetes like Cushing's syndrome, history of hand trauma, epilepsy, chronic liver disease, inflammatory arthritis, family history of Dupuytren's contracture, nervous disorders, congenital musculoskeletal abnormalities, recent fractures or injuries, and surgery of the shoulder and hand were excluded from the study.

***Dependent variable***

Musculoskeletal disorders.

***Independent Variables***

- Sociodemographic: Age, sex, occupation, residence, religion, education
- Diabetes-related factors: Type of diabetes, duration of DM, glycemic control, type of therapy
- Individual related factors: Chronic illness, body mass index (BMI), exercise, drugs (insulin)

### Patient and Public Involvement

The patients were not involved in the formulation of research question, in the design of the study, interpretation and write up of the results. The patients were involved in the plans for the results to be disseminated to the diabetic patient community. We plan disseminate the result to inform participants about the results during their diabetic clinic follow-up time individually and the published article will be disseminated to the hospital and the diabetic association.

## Sampling

The sample size was calculated using a single population proportion formula. Assuming 95% confidence interval, a 5% degree of precision, and a 41.5% expected proportion of musculoskeletal disorders among DM patients (5). Based on the above assumptions, the sample size calculated was 373. Study participants were selected by employing a systematic random sampling technique.

## Data collection procedures

A pre-tested, interviewer-administered, structured questionnaire and a medical record review were used to collect data on sociodemographic, diabetic, and individual-related factors.

## Measurement

A standard Short Musculoskeletal Function Assessment (SMFA) questionnaire (5, 14, 15) was used to assess musculoskeletal disorders. Summing items 1-34 creates a short musculoskeletal function assessment questionnaire, raw scores for the function index, and items 35-46 raw scores for the bothersome index, after corrections and omissions for missing values (16). The raw score was changed to a standardized score, that ranges from 0 to 100 points using the following formula: ([actual raw score – the lowest possible raw score]/possible range of raw score) *100 (annex 1,2). Higher scores indicate poorer function. In addition, body height and mass were measured using the esca scale, and BMI was calculated using the body formula mass/height $^2$. Two data clerks independently entered the collected data into Epidata software version 3.1, and the investigator checked consistency between the two data sets. The pretest was done in a 5% sample size at Arba Minch general hospital for validation of the checklist.

The following definitions were used.

- **Musculoskeletal disorder:** The presence of one or more of the following Carpal tunnel syndromes, Dupuytren's contracture, Limited joint mobility, Stenosing tenosynovitis, adhesive capsulitis, Reflex sympathetic dystrophy, Diabetic amyotrophic, Diffuse idiopathic skeletal hyperostosis syndrome, Charcot joint or a score greater than and above in short musculoskeletal assessment form**.**
- **Body Mass Index** –was assessed according to the standards that describe insufficient body weight (when BMI is <18 kg/m$^2$), normal body weight (when BMI is 18–24.9 kg/m2), excess weight (when BMI of 25–30 kg/m 2), and obesity (when BMI ≥30 kg/m $^2$).
- **Cardiovascular disease:** the presence of one or more of the following; heart failure, history of stroke/ transient ischemic attack (TIA), history of myocardial infarction /ischemic heart disease (MI/IHD), history of peripheral arterial disease.

## Data processing

Intensive on-site training was organized for data collectors, including their performance evaluation to ensure data consistency. Before being exported to STATA 16.00 for analysis, the data were checked for completeness, edited, coded, and entered into Epi Data Version 3.1. After cleaning the data for inconsistencies and missing values, descriptive statistics such as mean, frequency, and percentage were calculated, and the data was presented as text and tables. Assumptions for chi-square were checked and there was no violated assumption. A bivariate analysis was performed and all explanatory variables that were associated with the outcome variable at a P- value less than

0.25 in the bivariate analysis and biologically plausible were included in the multivariable analysis model. Then, a multivariable analysis was conducted using backward LR to determine associated factors. The odds ratio, with its 95% CI, was used to decide whether those independent variables included in the multivariable analysis were statistically significant or not.

## RESULTS

### Sociodemographic characteristics of study participants

A total of 365 participants were included in the study, with a response rate of 97.9%. The mean age was 51.42 (±14.06). The majority of respondents were females (55.34%), aged under 50 years old (52.33%), living in an urban area (64.66%), and married (92.88%) (Table 1)

Table 1: Sociodemographic characteristics of diabetic patients attending chronic care at Arba Minch Hospital, Southern Ethiopia, 2021

| Variables | Freq. | Percent |
|---|---|---|
| **Sex of the respondent** | | |
| Female | 202 | 55.34 |
| Male | 163 | 44.66 |
| **Age of the respondent in years** | | |
| < 50 years | 191 | 52.33 |
| ≥50 years | 174 | 47.67 |
| **Place of residence** | | |
| Rural | 129 | 35.34 |
| Urban | 236 | 64.66 |
| **Education status** | | |
| College graduate or above | 80 | 21.92 |
| Able to read and write | 14 | 3.84 |
| Unable to read and write | 105 | 28.77 |
| Primary education (1-8) | 98 | 26.85 |
| Secondary school (9-12) | 68 | 18.63 |
| **Occupation** | | |
| Farmer | 43 | 11.78 |
| Government employed | 105 | 28.77 |
| Housewife | 151 | 41.37 |
| Self-employed | 44 | 12.05 |
| Unemployed | 22 | 6.03 |
| **Marital status** | | |
| Unmarried | 26 | 7.12 |
| Married | 339 | 92.88 |

### Clinical and individual-related characteristics

Of the study participant, 23.29% (95% CI (19.00 - 27.76) of them had musculoskeletal disorders. Almost all the participants were non-smokers and non-drunker. One-third of the participants had chronic diseases, including cardiovascular disease (CVD), but only one-quarter of them had CVD. The majority of the participants were type two diabetic patients (91.51%), on an oral hypoglycemic drug (76.03%), had not developed a diabetic complication (92.05%), were not involved in physical activities (87.09%), and were overweight (53%) (Table 2).

Table 2: Clinical and individual-related characteristics of diabetic patients attending chronic careat Arba Minch Hospital, Southern Ethiopia, 2021

| **Variables** | Freq. | Percent |
|---|---|---|
| **Type of Diabetic Mellitus** | | |
| Type two | 334 | 91.51 |
| Type one | 31 | 8.49 |
| **Type of medication** | | |
| Insulin | 61 | 16.8 |
| Oral hypoglycemic drug | 276 | 76.03 |
| Both | 26 | 7.16 |
| **DM complication** | | |
| No | 336 | 92.05 |
| Yes | 29 | 7.95 |
| **Chronic disease** | | |
| No | 257 | 70.41 |
| Yes | 108 | 29.59 |
| **Cardiovascular disease** | | |
| No | 244 | 74.62 |
| Yes | 83 | 25.38 |
| **Physical activity** | | |
| No | 317 | 87.09 |
| Yes | 47 | 12.91 |
| **Body mass index** | | |
| Under | 11 | 3.01 |
| Normal | 160 | 43.84 |
| Over | 194 | 53.15 |
| **Musculoskeletal disorder** | | |
| No | 280 | 76.71 |
| Yes | 85 | 23.29 |

The glycemic control of the study participants was poor, with a mean ± standard deviation of 157.33 mg/dl ±35.73 and only 20.7% (87) of the study participants had good glycemic control (fasting blood sugar <126mg/dl). The average duration of Diabetes Mellitus was 5.62 years ±5.08, which was low. The mean total cholesterol, high-density lipoprotein, and triglyceride levels of the participants were 179.91(± 4.59), 42.77(± .023), and 209.05(± 4.35) respectively.

Also, the mean duration of a patient with DM and the level of average fasting blood glucose were 5.62 years (± 0.27) and 157.33 (± 1.87) (Table 3).

Table 3: Clinical and individual-related characteristics of diabetic patients attending chronic careat Arba Minch Hospital, Southern Ethiopia, 2021

| Variable | Min | Max | Mean | Std. Err. | Std. Dev. | 95% confidence interval | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower | Upper |
| Total cholesterol | 53 | 531 | 179.91 | 4.59 | 86.17 | 170.89 | 188.93 |
| High-density lipoprotein | 30 | 58 | 42.77 | 0.23 | 4.35 | 42.32 | 43.23 |
| Triglyceride level | 11 | 546 | 209.05 | 4.35 | 81.75 | 200.49 | 217.61 |
| Age | 18 | 99 | 51.42 | 0.74 | 14.06 | 49.98 | 52.87 |
| DM duration | 0.2 | 23.0 | 5.62 | 0.27 | 5.08 | 5.10 | 6.14 |
| Weight | 7.0 | 123.0 | 68.43 | 0.64 | 12.18 | 67.18 | 69.69 |
| Height | 1.4 | 101.0 | 2.29 | 0.34 | 6.43 | 1.63 | 2.96 |
| Waist circumference | 53 | 126 | 87.30 | 0.45 | 8.42 | 86.41 | 88.19 |
| Hip circumference | 63 | 120 | 93.21 | 0.39 | 7.28 | 92.44 | 93.97 |
| Fasting blood glucose | 84.67 | 275.00 | 157.33 | 1.87 | 35.73 | 153.65 | 161.01 |

**Factors associated with musculoskeletal disorders**

Binary logistic regression was done to identify which variables are associated with musculoskeletal disorders in diabetic patients. The variables sex, residency, occupation, levels of education, age, and waist to hip circumferences were significantly associated with musculoskeletal disorders in Diabetes Mellitus patients. Independent variables with a p-value of ≤ 0.25, significant in previous studies, and based on the context, were included in the multivariable analysis. The variables sex, age, residence, educational status, and cardiovascular disorders (CVD) were significantly associated in multivariable regression analysis (p-value 0.05) (Table 4).

The likelihood of developing musculoskeletal disorders was 6.8 times higher among females than males (AOR = 6.787, 95% CI (2.08, 22.19). Rural participants were about 2.4 times (AOR = 2.38, 95% CI (1.06, 5.33) more likely to develop musculoskeletal disorders as compared to urban ones. Participants with an age greater than 50 years were 5.9 times more likely to develop musculoskeletal disorders as compared to those aged less than or equal to 50 years (AOR= 5.864, 95% CI (2.663, 12.914)). The odds of developing musculoskeletal disorders were 6.2 times (AOR = 6.247, 95% CI (1.158, 33.702) and 5.5 times (AOR = 5.451, 95% CI (1.174, 25.312) higher among participants who attended primary and secondary school, respectively, than among those who attended college and above. Participants with cardiovascular disease were 3.9 times more likely to develop musculoskeletal disorders compared with their counterparts (AOR= 3.854, 95% CI ((1.843, 8.063)) (Table 4).

Table 4: Factors associated with musculoskeletal disorder among diabetic patients attending chronic care at Arba Minch Hospital, Southern Ethiopia, 2021

| Variables | Musculoskeletal disorders NO nº (%) | Yes nº (%) | COR (95%CI) | AOR (95%CI) |
|---|---|---|---|---|
| **Sex** | | | | |
| Female | 139(68.81) | 63(31.19) | 2.905(1.69, 4.98) | 7.08, 22.19) |
| Male | 141(86.50) | 22(13.50) | **1** | 1 |
| **Age in years** | | | | |
| < 50 years | 163(85.34) | 28(14.66) | 1 | 1 |
| ≥50 years | 117(67.24) | 57(32.76) | 2.84 (1.70, 4.73) | 5.86(2.66, 12.91) |
| **Residency** | | | | |
| Rural | 93(72.09) | 36(27.91) | 1.48 (0.89, 2.43) | 2.38(1.06, 5.33) |
| Urban | 187(79.24) | 49(20.76) | **1** | 1 |
| **Education** | | | | |
| unable to read and Right | 11(78.57) | 3(21.43) | 2.46(.56, 10.68) | 0.47(.022, 10.09) |
| able to read and write | 70(66.67) | 35(33.33) | 4.5(1.95, 10.38) | 4.21 (0.71, 24.87) |
| Primary education | 73(74.49) | 25(25.51) | 3.08(1.30, 7.28) | 6.25(1.16, 3.70) |
| Secondary school | 54(79.41) | 14(20.59) | 2.33(0.91, 5.96) | 5.45(1.17, 5.31) |
| College and above | 72(90.00) | 8(10.00) | 1 | 1 |
| **Cardiovascular disease** | | | | |
| No | 198(81.15) | 46(18.85) | 1 | 1 |
| Yes | 52(62.65) | 31(37.35) | 2.57(1.48, 4.44) | 3.85 (1.84, 8.06) |

COR (95% CI); crude odds ratio at 95% confidence interval, AOR (95% CI); adjusted odds ratio at 95% confidence interval

## DISCUSSION

Musculoskeletal disorders in Diabetes Mellitus have been ignored and poorly treated as compared to acute and microscopic complications of Diabetes Mellitus (11).

Our study reveals the following important findings:

1. Hypertension is the commonest concomitant disease (24.38%), which is in line with a study done in Tikur Anbesa hospital (5)
2. The overall average FBS value was 157.38 mg/dl, which is high and shows poor glycemic control.
3. The prevalence of musculoskeletal disorders was 23.29%,
4. A statistically significant association was observed between clinically manifesting musculoskeletal disorders and having a female sex, increasing age, residency, education, and cardiovascular disorders.

Diabetes mellitus affects connective tissues in many ways, which leads to different alterations in skeletal and articular systems. It is associated with many musculoskeletal manifestations, most of which are not clinical and correlated with disease duration and inadequate control (17). These complications are often found, and, although less valued than the vascular ones, they significantly

compromise the patients' quality of life (18). Epidemiologic studies have identified several personal, occupational, and psychosocial factors related to musculoskeletal disorders (17).The exact pathophysiology of most of these musculoskeletal disorders remains unclear. However, connective tissue disorders, neuropathy, or vasculopathy may have a synergistic effect on the increased incidence of musculoskeletal disorders in diabetics (17).

Many studies have evaluated musculoskeletal manifestations in diabetic patients, but most assessed only an individual component, especially musculoskeletal involvement of the upper extremity while few studies have evaluated the entire musculoskeletal system, including the limbs and back. In this study, the magnitude of MSD in DM people was 23.29%. This is higher than the studies done in Saudi Arabia (6) but lower than studies conducted in Jordan, Nigeria, Morocco, and central Ethiopia (1, 3, 5, 9, 10). This difference is probably due to differences in mean diabetic duration, glycemic control, and geographic difference (4, 5, 19). The lower prevalence of musculoskeletal disorders in our study can be explained by better glycemic control and patient care and decreased manual work in developing countries over time.

Musculoskeletal disorder conditions were more common in type 2 DM subjects than in type 1 subjects (23.35 vs 22.58) which is in line with studies in Morocco, Egypt, and Ethiopia (9, 11, 20). It is thought that it may be explained by the propensity for type 2 subjects to develop MSD as a result of obesity, reduced physical activity, older age, dyslipidemia, and hyperuricemia (10).

Participants with an age greater than 50 years were 5.9 times more likely to develop musculoskeletal disorders as compared to those aged less or equal to 50 years, which is in line with studies conducted in India and Iran (4, 9). The fact that as age increases, the number of tendon cells is decreases, protein synthesis in the organelles, connective tissue elasticity decreases, and joints and tendon sheaths become stiffer, which predisposes older people to MSDs (3). Women were involved for a long time, doing heavy manual work at home. This is supported by our findings that the likelihood of developing musculoskeletal disorders was 6.8 times higher among females than males. This is similar to studies conducted in India, Iran, and central Ethiopia (4, 5, 19).

Rural participants were about 2.4 times more likely to develop musculoskeletal disorders as compared to urban ones. This may be attributed to more manual labor work for rural residents than urban residents since occupations that involved manual labor increased the risk of hand complications in our patients (21, 22).

The odds of developing musculoskeletal disorders were 6.2 and 5.5 times higher among participants who attended primary and secondary education as compared to those who attended college and above, respectively. This may be because literacy affects health-seeking behavior (23, 24) since healthcare-seeking behavior affects glycemic control and adherence to diabetic management modalities, which are important in planning diabetes care and management that minimizes complications. Poor and delayed healthcare-seeking behavior leads to delayed diagnosis and treatment, and poor health outcomes (25, 26). A study also indicated that education and income are factors for diabetic knowledge, which is important in health service utilization, diabetic management, and avoiding complications (27). Participants with cardiovascular disease were 3.9 times more likely to develop musculoskeletal disorders compared with their counterparts. This is similar to other studies that showed that musculoskeletal disorders are associated with

cardiovascular disease. This may be attributable to the micro complications and macro complications of diabetes Mellitus which are associated with musculoskeletal disorders (13, 28).

The most important predictor of MSD complications in people living with diabetes is blood glucose control (29). In this study, there was no association between blood glucose control and musculoskeletal disorders. It may be because we only measured the mean fasting blood glucose and not the HbA1c level. This may also be explained by the fact that cumulative hyperglycemia is required to produce changes, while a single cross-sectional fasting blood glucose estimate only represents the glycemic control over the previous 3 months. This is consistent with the findings of studies in Tikur Anbesa, Addis Abeba, and Iran (5, 19) but it contradicts the findings of studies in northern India (4, 30), and the United Kingdom, which found a strong association between musculoskeletal disorders and poor blood glucose control (29).

**Limitation of the study**

We used fasting blood sugar for determination of glycemic control because of HbA1c is not easily accessible in our setting and resource limitations. HbA1c is a better indicator of glycemic control in diabetic patients than fasting blood sugar. Cumulative hyperglycemia is required to produce musculoskeletal and soft tissue changes. Even a single HbA1c level does not correlate with tissue levels of advanced glycosylation end products which are important pathologic change for the development of musculoskeletal disease. Vascular complications are another important predisposing factor for musculoskeletal disorders, but we did not include them in our study because there is only a limited number of vascular evaluations and investigations that can be performed in our hospital. Musculoskeletal diseases had a clear association with microvascular complications. Both Musculoskeletal diseases and microvascular complications usually occur in patients with poorly controlled and long-term diabetes. The assessment of musculoskeletal disorders was based on medical records and self-reports. We failed to do some confirmatory work ups.

## CONCLUSION

The prevalence of musculoskeletal disorders among diabetic patients was 23.29%, and it showed that age, sex, educational status, place of residence, and cardiovascular disease were found to be determinants of musculoskeletal disorders. Thus, clinical and public health interventions working on diabetes mellitus should consider these determinants.

**Ethics statements**

**Patient consent for publication**

Not applicabl.

**Ethics approval**

The Institutional Review Board of the College of Medicine and Health Science, Arba Minch University, approved the study and granted consent to take place in its letter with a reference number of IRB/1040/20. A letter of cooperation was received from the hospital, and written

informed consent was obtained from the study participants after being informed of the aim of the study.

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**Data sharing**

All relevant data are within the manuscript

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**Conflict of interest**

The authors declare that there is no conflict of interest.

**Contributorship statement**

GA: contributed to the design and implementation of the research, acquisition, analysis, and interpretation of data for the study and to the writing of the manuscript
TH- contributed to the implementation and supervision of the research, critically revise the manuscript
TF: contributed to the design and implementation of the research, to the analysis of the results and to the revision of the manuscript
AG: contributed to the implementation of the research, to the analysis of the results and to the revision of the manuscript.
RT: contributed to the implementation of the research, to the analysis of the results and to the revision of the manuscript.
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All authors read and approved the final manuscript.

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NAME: _____DOB:_____

DATE: _____

# *Short Musculoskeletal Function Assessment*

**To be completed by the PATIENT**

SCORE: DYSFUNCTION INDEX: _____ % Previous: _____% Date: _____

BOTHER INDEX: _____ % Previous: _____% Date: _____

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**These questions are about how much difficulty you may be having this week with your daily activities because of your injury or arthritis.**

| | | Not at all difficult | A little difficult | Moderately difficult | Very difficult | Unable to do |
|---|---|---|---|---|---|---|
| **01.** | **How difficult is it for you to get in or out of a low chair?** | ○ | ○ | ○ | ○ | ○ |
| **02.** | **How difficult is it for you to open medicine bottles or jars?** | ○ | ○ | ○ | ○ | ○ |
| **03.** | **How difficult is it for you to shop for groceries or other things?** | ○ | ○ | ○ | ○ | ○ |
| **04.** | **How difficult is it for you to climb stairs?** | ○ | ○ | ○ | ○ | ○ |
| **05.** | **How difficult is it for you to make a tight fist?** | ○ | ○ | ○ | ○ | ○ |
| **06.** | **How difficult is it for you to get in or out of the bathtub or shower?** | ○ | ○ | ○ | ○ | ○ |
| **07.** | **How difficult is it for you to get comfortable to sleep?** | ○ | ○ | ○ | ○ | ○ |
| **08.** | **How difficult is it for you to bend or kneel down?** | ○ | ○ | ○ | ○ | ○ |
| **09.** | **How difficult is it for you to use buttons, snaps, hooks, or zippers?** | ○ | ○ | ○ | ○ | ○ |
| **10.** | **How difficult is it for you to cut your own fingernails?** | ○ | ○ | ○ | ○ | ○ |
| **11.** | **How difficult is it for you to dress yourself?** | ○ | ○ | ○ | ○ | ○ |
| **12.** | **How difficult is it for you to walk?** | ○ | ○ | ○ | ○ | ○ |
| **13.** | **How difficult is it for you to get moving after you have been sitting or lying down?** | ○ | ○ | ○ | ○ | ○ |
| **14.** | **How difficult is it for you to go out by yourself?** | ○ | ○ | ○ | ○ | ○ |
| **15.** | **How difficult is it for you to drive?** | ○ | ○ | ○ | ○ | ○ |
| **16.** | **How difficult is it for you to clean yourself after going to the bathroom?** | ○ | ○ | ○ | ○ | ○ |
| **17.** | **How difficult is it for you turn knobs or levers, for example, open doors, roll down car windows?** | ○ | ○ | ○ | ○ | ○ |
| **18.** | **How difficult is it for you to write or type?** | ○ | ○ | ○ | ○ | ○ |
| **19.** | **How difficult is it for you to pivot?** | ○ | ○ | ○ | ○ | ○ |
| **20.** | **How difficult is it for you to do your usual physical recreational activities, such as bicycling, jogging, or walking?** | ○ | ○ | ○ | ○ | ○ |
| **21.** | **How difficult is it for you to do your usual leisure activities, such as hobbies, crafts, gardening, card playing, going out with friends?** | ○ | ○ | ○ | ○ | ○ |
| **22.** | **How much difficulty are you having with sexual activity?** | ○ | ○ | ○ | ○ | ○ |
| **23.** | **How difficult is it for you to do light housework or yardwork, such as dusting, washing dishes, or watering plants?** | ○ | ○ | ○ | ○ | ○ |
| **24.** | **How difficult is it for you to do heavy housework or yardwork, such as washing floors, vacuuming, or mowing lawns?** | ○ | ○ | ○ | ○ | ○ |
| **25.** | **How difficult is it for you to do your usual work, such as a paid job, housework, volunteer activities?** | ○ | ○ | ○ | ○ | ○ |

***Please continue on next page***


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NAME: _____ DOB:_____

DATE: _____

# *Short Musculoskeletal Function Assessment*

**To be completed by the PATIENT**

**These next questions ask how often you are experiencing problems this week because of your injury or arthritis**

| | | None of the time | A little of the time | Some of the time | Most of the time | All of the time |
|---|---|---|---|---|---|---|
| **26.** | **How often do you walk with a limp?** | ○ | ○ | ○ | ○ | ○ |
| **27.** | **How often do you avoid using your painful limb(s) or back?** | ○ | ○ | ○ | ○ | ○ |
| **28.** | **How often does your leg lock or give-way?** | ○ | ○ | ○ | ○ | ○ |
| **29.** | **How often do you have problems with concentration?** | ○ | ○ | ○ | ○ | ○ |
| **30.** | **How often does doing too much in one day affect what you do the next day?** | ○ | ○ | ○ | ○ | ○ |
| **31.** | **How often do you act irritable toward those around you, for example, snap at people, give sharp answers, or criticize easily?** | ○ | ○ | ○ | ○ | ○ |
| **32.** | **How often are you tired?** | ○ | ○ | ○ | ○ | ○ |
| **33.** | **How often do you feel disabled?** | ○ | ○ | ○ | ○ | ○ |
| **34.** | **How often do you feel angry or frustrated that you have this injury or arthritis?** | ○ | ○ | ○ | ○ | ○ |

**These next questions are about how much you are bothered by problems you are having this week due to your injury or arthritis**

| **How much are you bothered by:** | | Not bothered at all | A little bothered | Moderately bothered | Very bothered | Extremely bothered |
|---|---|---|---|---|---|---|
| **35.** | **Problems using your hands?** | ○ | ○ | ○ | ○ | ○ |
| **36.** | **Problems using your back?** | ○ | ○ | ○ | ○ | ○ |
| **37.** | **Problems doing work around your home?** | ○ | ○ | ○ | ○ | ○ |
| **38.** | **Problems with bathing, dressing, toileting or other personal care?** | ○ | ○ | ○ | ○ | ○ |
| **39.** | **Problems with sleep and rest?** | ○ | ○ | ○ | ○ | ○ |
| **40.** | **Problems with leisure or recreational activities?** | ○ | ○ | ○ | ○ | ○ |
| **41.** | **Problems with your friends, family or other important people in your life?** | ○ | ○ | ○ | ○ | ○ |
| **42.** | **Problems with thinking, concentrating or remembering?** | ○ | ○ | ○ | ○ | ○ |
| **43.** | **Problems adjusting or coping with your injury or arthritis?** | ○ | ○ | ○ | ○ | ○ |
| **44.** | **Problems doing your usual work?** | ○ | ○ | ○ | ○ | ○ |
| **45.** | **Problems with feeling dependent on others?** | ○ | ○ | ○ | ○ | ○ |
| **46.** | **Problems with stiffness and pain?** | ○ | ○ | ○ | ○ | ○ |

*Reproduced from: Marc F. Swiontkowski, M.D.; Ruth Engelberg, Ph.D.; Diane P. Martin, Ph.D.; and Julie Agel, M.A. Short Musculoskeletal Function Assessment Questionnaire: Validity, Reliability, Responsiveness. J Bone Joint Surg AM 81:1245-60, 1999.*





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I. SCORE VALUES

| | | |
|---|---|---|
| A. Questions 1-25: | Not at all difficult | 1 |
| | A little difficult | 2 |
| | Moderately difficult | 3 |
| | Very difficult | 4 |
| | Unable to do | 5 |
| B. Questions 26-34 | None of the time | 1 |
| | A little of the time | 2 |
| | Some of the time | 3 |
| | Most of the time | 4 |
| | All of the time | 5 |
| C. Questions 35-46 | Not at all bothered | 1 |
| | A little bothered | 2 |
| | Moderately bothered | 3 |
| | Very bothered | 4 |
| | Extremely bothered | 5 |

II. HANDLING OF MISSING RESPONSES

A. Questions 1-34:

If patients have fewer than 50% of the answers missing in any one category, substitute the mean value of that category for the missing item(s). Please see the attached form identifying items and categories for this portion of the analysis.

B. Questions 35-46 (Bothersome Index):

Patients with missing answers are omitted from the analyses of the Bother

III. CALCULATION OF SCORES

A. Raw scores are created by summing items 1-34 for the Function Index and items 35-46 for the Bothersome Index, after corrections and omissions for missing values (see above); raw scores for categories are created by summing the items within each category.

B. Scores are standardized, with high scores indicating poor function and low scores indicating good function. The formula for standardization is:
(Actual raw score - lowest possible raw score/possible raw score range) *100

C. Below are listed the values to be used for standardization:

1. Daily Activities Category:
((raw summed score for daily activities items-10) /40) * 100
2. Emotional Status Category:
((raw summed score for emotional status items -7) /28) * 100
3. Arm and Hand Function Category:
((raw summed score for arm and hand function items -8) /32) * 100
4. Mobility Category:
((raw summed score for mobility items - 9)/36 * 100.
5. Function Index:
((raw summed score for items 1-34 - 34) /136) * 100
6. Bothersome Index:
((raw summed score for items 35-46 -12)/48 * 100

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

| | Item No | Recommendation | Page No |
|---|---|---|---|
| **Title and abstract** | 1 | (*a*) Indicate the study's design with a commonly used term in the title or the abstract | 1(included in the title) |
| | | (*b*) Provide in the abstract an informative and balanced summary of what was done and what was found | 2 |
| **Introduction** | | | |
| Background/rationale | 2 | Explain the scientific background and rationale for the investigation being reported | 3 |
| Objectives | 3 | State specific objectives, including any prespecified hypotheses | 4 |
| **Methods** | | | |
| Study design | 4 | Present key elements of study design early in the paper | 4 |
| Setting | 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | 4 and 5 |
| Participants | 6 | (*a*) Give the eligibility criteria, and the sources and methods of selection of participants | 4 |
| Variables | 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | 4 and 5 |
| Data sources/ measurement | 8* | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | 5 |
| Bias | 9 | Describe any efforts to address potential sources of bias | 4 |
| Study size | 10 | Explain how the study size was arrived at | 4 |
| Quantitative variables | 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | |
| Statistical methods | 12 | (*a*) Describe all statistical methods, including those used to control for confounding | 5 |
| | | (*b*) Describe any methods used to examine subgroups and interactions | 5 |
| | | (*c*) Explain how missing data were addressed | 5 |
| | | (*d*) If applicable, describe analytical methods taking account of sampling strategy | Not applicable |
| | | (*e*) Describe any sensitivity analyses | Not applicable |
| **Results** | | | |
| Participants | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed | 6 |
| | | (b) Give reasons for non-participation at each stage | 6 |
| | | (c) Consider use of a flow diagram | Not applicable |
| Descriptive data | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders | 6 |

| | | | |
|---|---|---|---|
| | | (b) Indicate number of participants with missing data for each variable of interest | |
| Outcome data | 15* | Report numbers of outcome events or summary measures | |
| Main results | 16 | (*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included | 9 |
| | | (*b*) Report category boundaries when continuous variables were categorized | 9 |
| | | (*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period | Not Applicable |
| Other analyses | 17 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses | |
| **Discussion** | | | |
| Key results | 18 | Summarise key results with reference to study objectives | 9 |
| Limitations | 19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias | 11 |
| Interpretation | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | 9-11 |
| Generalisability | 21 | Discuss the generalisability (external validity) of the study results | 11 |
| **Other information** | | | |
| Funding | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based | 12 |

*Give information separately for exposed and unexposed groups.