


## RESEARCH ARTICLE

# Foot self-care behaviour in type 2 diabetes adults with and without comorbid heart failure

Fekadu Aga<sup>1</sup>  | Sandra B. Dunbar<sup>2</sup> | Tedla Kebede<sup>3</sup> | Senbeta Guteta<sup>3</sup> |  
Melinda Kay Higgins<sup>2</sup> | Rebecca A. Gary<sup>2</sup>

<sup>1</sup>School of Nursing & Midwifery, College of Health Sciences, Addis Ababa University, Addis Ababa, Ethiopia

<sup>2</sup>Nell Hodgson Woodruff School of Nursing, Emory University, Atlanta, Georgia, USA

<sup>3</sup>Department of Internal Medicine, School of Medicine, College of Health Sciences, Addis Ababa University, Addis Ababa, Ethiopia

## Correspondence

Fekadu Aga, School of Nursing & Midwifery, College of Health Sciences, Addis Ababa University, P.O. Box 9083, Addis Ababa, Ethiopia.  
Email: [fiqaaduuagaa@yahoo.com](mailto:fiqaaduuagaa@yahoo.com)

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## Abstract

**Aims:** To compare the correlates of foot self-care behaviours among type 2 diabetes mellitus (T2D) adults with and without comorbid heart failure (HF).

**Design:** Cross-sectional, correlational, comparative design.

**Methods:** A 210 T2D adults (105 with HF and 105 without HF) participated from August–December 2020. Foot self-care behaviour was measured using the foot care subscale of the Summary of Diabetes Self-Care Activities (SDSCA) instrument. A stepwise logistic regression analysis was used to explore variables predicting foot self-care behaviour.

**Results:** The participants' mean age was  $58.7 \pm 10.9$  years. Poor foot self-care behaviour was reported in T2D adults both with (53.3%) and without (54.3%) HF. Participants with HF-comorbidity were statistically significantly older and had higher total daily medication intake. Household income and the total number of daily medications statistically significantly predicted foot self-care behaviour in HF-comorbid T2D adults. Marital status, social support and body mass index predicted foot self-care behaviour in the non-HF group.

## KEYWORDS

foot self-care behaviour, heart failure, multimorbidity, nursing, type 2 diabetes

## 1 | INTRODUCTION

Type 2 diabetes mellitus (T2D), which accounts for 90% of total diabetes mellitus (DM) cases, has emerged as an epidemic in the 21st century, posing serious global health threats largely due to the associated complications (Jaacks et al., 2016; Zheng et al., 2018). Aging of the population, rapid increases in urbanization, environmental and lifestyle factors have escalated the burden of T2D worldwide (Khan et al., 2020). The International Diabetes Federation's (IDF) projects that the global prevalence of DM in adults (20–79 years) will increase by 25% in 2030 and by 51% in

2045 a dramatic increase from 9.3% (463 million people) in 2019 (IDF, 2019; Saeedi et al., 2019). In Africa, this rise in DM is expected to exceed a 143% increase by 2045 from 19 million in 2019. The IDF estimated 3.2% DM prevalence among adult population in Ethiopia in 2019, which is expected to follow a similar upward trend as other countries in Africa. Persons with T2D are at increased risk of developing serious comorbid conditions such as heart failure (HF). Globally, HF is prevalent in 3.2% to 27.7% of person with T2D (Bertoni et al., 2004; Einarson et al., 2018; Nichols et al., 2001; Thrainsdottir et al., 2005; Winter et al., 2012) and there is a 2- to 4-fold increased risk of developing HF in persons with DM than those

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without DM (Dunlay et al., 2019). Studies in Ethiopia indicate 6.83% prevalence of HF in persons with T2D (Regassa et al., 2021), and there DM is associated with 2.04 times increased incidence of HF (Abdissa, Deressa, & Shah, 2020). Incident HF in T2D is associated with worse prognosis (Abdissa, Deressa, & Shah, 2020; Bertoni et al., 2004). Worsening the burden of T2D are complications such as diabetic foot disease (DFD) that negatively affects the persons physical functioning and quality of life. A study described that both HF and DFD are the main reasons for hospital admission among DM patients in Ethiopia (Gizaw et al., 2015). Reducing these debilitating conditions requires proper application of the recommended self-care behaviours.

## 2 | BACKGROUND

Diabetic foot disease (DFD) or syndrome, which includes primarily peripheral neuropathy and arterial disease, is a progressive pathway to diabetic foot ulceration that may eventually lead to amputation (Amin & Doupis, 2016; Netten et al., 2020). The prevalence of diabetic foot ulcer (DFU) among persons with T2D is 6.4% worldwide (Zhang et al., 2017) and ranges from 12.98%–21.1% in Ethiopia (Abdissa, Adugna, et al., 2020; Mariam et al., 2017; Tola et al., 2021; Tolossa et al., 2020). The annual incidence of DFU is estimated to be 6.3% worldwide, with a lifetime incidence ranging between 19%–34% (Armstrong et al., 2017). In Ethiopia, Adem et al. (2020) reported an incidence rate of 4 DFU cases per 100 person-years of observation. The risk for DFU recurrence is also high even after successful healing of the ulcer. The reported rate shows 40% of recurrence in 1 year, 60% in 3 years and 65% in 5 years after ulcer healing (Armstrong et al., 2017).

Comorbidities including HF have negative impact on foot health outcomes (Hendry et al., 2019). A study reported that comorbidities are related to delayed wound healing and amputation in persons with DFU (Gershater et al., 2009). Studies have demonstrated that comorbid HF increases the risk of ulcer recurrence, delayed wound healing, amputation and mortality in persons with DFU (Melni et al., 2018; Rhou et al., 2015; Xu et al., 2013). Other multimorbidities such anaemia (Gezawa et al., 2019) and chronic kidney disease, cardiovascular events, respiratory failure, malignancy and multi-organ failure (Jeyaraman et al., 2019) are also related to delayed wound healing, amputation, mortality in persons with DFU. It is important, therefore, to assess patients for multimorbidity and their ability to perform effective self-care. Serious comorbid conditions such as HF are complex for patients to manage. It is essential that nurses communicate with providers to better ensure that therapies for multiple conditions can be streamlined as much as possible to better ensure patients are not overwhelmed.

Studies have shown that over half of persons with DFU develop infections (Prompers et al., 2007), and the risk of death at 5 years is 2.5 times higher for those with DFU than DM patients without it (Walsh et al., 2016). Infection and greater severity of DFU are associated with increased risk of amputation and mortality (Brennan

et al., 2017; Ndosi et al., 2018). Studies have reported the rate of lower extremity amputation as high as 30.43% among DM patients with DFU in Ethiopia (Bekele et al., 2020; Bekele & Chelkeba, 2020). Both DFU and its ensuing infections increase the risk of emergency department visits and hospital admissions (Skrepnek et al., 2017). Diabetic patients with DFU experience poor health-related quality of life, mainly in the physical and emotional functions, than DM patients without DFU (Polikandrioti et al., 2020; Siersma et al., 2013). Studies have also described DFU posing a higher economic burden at the individual, family and the healthcare system levels (Guest et al., 2018; Hopkins et al., 2015).

There are a number of risk factors associated with the development of DFU. Studies have reported that peripheral neuropathy (Abdissa, Adugna, et al., 2020; Adem et al., 2020; Mariam et al., 2017; Woldemariam et al., 2020), poor foot self-care behaviours (Mariam et al., 2017; Tola et al., 2021; Tolossa et al., 2020; Woldemariam et al., 2020) overweight and obesity (Adem et al., 2020; Mariam et al., 2017; Tola et al., 2021; Tolossa et al., 2020), taking insulin alone (Tola et al., 2021; Woldemariam et al., 2020), rural residence (Mariam et al., 2017; Tolossa et al., 2020), delayed DM follow-up, history of infection and hypertension (Tola et al., 2021), and presence of foot callus, longer duration of DM and advancing age (Tolossa et al., 2020) are positively associated with DFU. In addition, a studies have shown that retinopathy, nephropathy, poor glycaemic control, smoking and height are positively associated with DFU (Banik et al., 2020; Rossoboth et al., 2021). Early identification and treatment of the at-risk foot and implementing and adhering to effective self-care behaviours are essential for the prevention of DFU (ADA, 2021; Schaper et al., 2020).

Encouraging T2D patients to implement the recommended daily foot self-care behaviours is an important self-management goal for the primary prevention of DFU (ADA, 2021; Schaper et al., 2020). Diabetic foot self-care behaviour involves daily inspection of feet and inside of shoes, adequate daily foot hygiene, avoiding walking barefoot, wearing proper footwear, trimming toenails, avoiding the use of anything abrasive on the feet, and seeking professional examination and care for any lesion and open wound early (Bonner et al., 2016; Jordan & Jordan, 2011; Matricciani & Jones, 2015). A systematic review described that the implementation of foot self-care behaviour reduces the risk of injury, infection and amputation in persons with T2D (Bonner et al., 2016). Interventional studies have also reported the effectiveness of foot self-care education for improving self-care ability and reducing the development or worsening of DFU in persons with T2D (Ali & Ghonem, 2019; Yakota et al., 2019). Studies have shown, however, that race or ethnicity (Johnson et al., 2014); gender (Choi et al., 2015); lower educational level, household income and higher age (Chourdakis et al., 2014; Gurmu et al., 2018); low self-efficacy (Abubakari et al., 2016; Gurmu et al., 2018); poor diabetes-related knowledge (Kueh et al., 2015); depressive symptoms (Maneze et al., 2016); lack of social support (Gurmu et al., 2018; Watkins et al., 2013); and higher body mass index (Dixon et al., 2014) also influence specific diabetes self-care behaviours in T2D, including foot self-care.

Similarly, studies have shown that comorbid chronic conditions negatively affect the performance of diabetes self-care behaviours (Aga et al., 2019; Seides, 2014; Timar et al., 2016) and the achievement of diabetes care goals (Magnan et al., 2015) in adults with T2D. As the most distressful comorbid condition, HF may distract from self-care and confound the person's ability to assess and manage T2D-related symptoms (Dunbar et al., 2014). However, there is lack of evidence related to foot self-care behaviours in T2D adults with comorbid conditions such as heart failure (HF).

### 3 | THE STUDY

#### 3.1 | Aims

This study investigated foot self-care behaviour in T2D adults with and without comorbid HF. The objectives were to describe foot self-care behaviour in T2D adults with and without comorbid HF and compare the demographic, clinical and psychosocial correlates of foot self-care behaviour in Tikur Anbessa Specialized Referral Hospital (TASRH), a tertiary healthcare setting in Addis Ababa, Ethiopia.

#### 3.2 | Design

A cross-sectional, correlational, comparative design was used.

#### 3.3 | Participants

This study enrolled 210 T2D adults (105 with HF and 105 without HF) using a systematic sampling method based on a list of patient's attending the diabetes outpatient clinic at TASRH. The sample size was determined following the steps recommended for clinical research (Hulley et al., 2013) to detect the effect size of 0.5 at a power of 0.95 and statistical significance ( $\alpha$ ) set at 0.05. The inclusion criteria were being 18 years of age or above, confirmed diagnosis of T2D with or without comorbid HF as documented in the medical record, and ambulatory and able to respond to questions. Participants with uncorrected hearing problem were excluded from the study. Every second T2D adults on the eligible list from the daily clinic attendees were enrolled in the study. All the eligible persons requested to participate agreed to enrol, probably the availability of glycated haemoglobin (HbA1c) test in our study serving as an incentive for participation.

#### 3.4 | Data collection

Data were collected from August–December 2020 using a study-developed clinical data extraction form and an interviewer administered questionnaire. The interviewer-administered questionnaire

consisted of a battery of instruments used to collect self-report demographic and psychosocial data. These instruments were forward translated from English to Amharic and then back translated from Amharic to English using different bilingual translators to ensure accuracy. Blood samples were also collected for measuring glycated haemoglobin (HbA1c) and fasting blood glucose (FBG).

### 3.5 | Variables and measurement

#### 3.5.1 | Sociodemographic and clinical characteristics

Sociodemographic and clinical data were collected from medical records and through self-report. The sociodemographic characteristics included age, sex, marital status, education, occupation, monthly income, religion, residence place and family income. The clinical characteristics measured were body mass index (BMI), year since diagnosis of T2D, diabetes treatment regimen, diabetes medication type, year since diagnosis of HF, total daily medication, total number of comorbidities excluding T2D and HF using Charlson comorbidity index (CCI), perceived general (self-reported) health, family history of DM, HbA1c and FBG. The single item self-reported health (SRH) was used to measure the persons perceived general health status (Bombak, 2013). HbA1c was measured using an assay and haemolysing reagent on Beckman Coulter® AU chemistry analyser. FBG was measured using the On-Call® Extra Blood Glucose Monitoring System.

#### 3.5.2 | Foot self-care behaviour

The foot care subscale of the summary of diabetes self-care activities (SDSCA) was used to measure diabetes foot self-care behaviour (Toobert et al., 2000). The foot care subscale of SDSCA consists of 2 items and participants report how many days in the last week they have performed the recommended foot self-care. The performance of foot care 7 days considered as good foot self-care behaviour and performance <7 days as poor foot self-care behaviour. A previous study reported a Cronbach's alpha of 0.77 for the Arabic version of the foot care subscale of SDSCA (Aljohani et al., 2016). The Cronbach's alpha in the current study is 0.93.

#### 3.5.3 | Diabetes self-efficacy

The 8-item Perceived Diabetes Self-Management Scale (PDSMS) was used to measure diabetes self-efficacy (Wallston et al., 2007). Each PDSMS item has 5 response option ranging from 1 (strongly disagree)–5 (strongly agree). A total scale score ranges from 8–40. A higher score shows more confidence in self-managing diabetes. The Cronbach's alpha was 0.83 in a previous study (Wallston et al., 2007) and 0.68 in the current study.

### 3.5.4 | Diabetes knowledge

The general knowledge segment of the Revised Diabetes Knowledge Test (DKT2) was used to measure diabetes knowledge (Fitzgerald et al., 2016). The general knowledge segment of DKT2 consists of 14 items and scored based on the percent of correctly answered questions. The reported Cronbach's alpha was 0.77 in a previous study (Fitzgerald et al., 2016) and 0.62 in the current study.

### 3.5.5 | Depression

The Patient Health Questionnaire (PHQ-9) was used to assess participants for depressive symptoms (Kroenke et al., 2001). The PHQ-9 is a self-reported 4-point Likert-type scale, ranging from 0 (not at all)–3 (nearly every day). The total score of PHQ-9 ranges from 0–27 with a score of 5–9 indicating mild depressive symptoms and  $\geq 10$  moderate to severe depressive symptoms. The Cronbach's alpha was 0.85 in a previous study among adult population in Ethiopia (Gelaye et al., 2013) and 0.81 in the current study.

### 3.5.6 | Social support

The Enhancing Recovery in Coronary Heart Disease (ENRICH) Social Support Instrument (ESSI) was used to measure the participants' perceived social support in this study (ENRICH, 2000). The ESSI is a 7-item self-report survey instrument. The first 6 items are 5-point Likert scale ranging from 1 (none of the time)–5 (all the time) and item 7 is a yes/no question, scored 4 for yes and 2 for no response (Mitchell et al., 2003). Total score ranges from 8–34, a higher score indicating greater perceived social support. A Cronbach's alpha was 0.88 in an earlier study (Vaglio et al., 2004) and 0.78 in the current study.

## 3.6 | Data analysis

Before the analysis, the data were assessed for accuracy, completeness, any outliers and missing values. Bivariate statistical analysis was conducted employing chi-squared test and biserial correlation to identify the demographic, psychosocial and clinical variables associated with foot self-care behaviour. To facilitate the analysis, the outcome variable—foot self-care behaviour—was binary coded as 1 if undertaken 7 days per week and 0 if undertaken for less than 7 days per week. A stepwise multiple logistic regression analysis was conducted to explore the demographic, psychosocial and clinical variables predicting foot self-care behaviour of T2D adults with and without comorbid HF. All variables with  $p$  value of 0.25 or below were entered into the regression model (Bursac et al., 2008) after checking for multicollinearity. Variables with statistically significant multicollinearity were excluded from entry into the regression model. The overall model's goodness of fit was assessed using the

Omnibus Tests of Model Coefficients. The Cox and Snell R Square and Nagelkerke R Square were used to evaluate the variation in exercise self-care behaviour. An odds ratio ( $e^B$ ) was used to test and assess the fit of individual variable in the model with the application of Wald's chi-squared test for the regression parameter estimation. A  $p$  value below 0.05 and 95% confidence interval were used to decide the statistical significance. The IBM SPSS for Windows version 24 was used to manage and analyse the data.

## 4 | RESULTS

### 4.1 | Sociodemographic characteristics

The mean age of the participants was  $58.7 \pm 10.9$  years (Table 1), and those with comorbid HF were statistically significantly older (Table 3). The majority of participants (Table 1) were women (53.3%), married (72.9%), had a secondary school or above educational level (61.4%), and most were Orthodox Christian (73.8%) and urban dwellers (88.6%).

### 4.2 | Foot self-care behaviour

Figure 1 displays that 54.3% T2D adults without comorbid HF and 53.3% of those with comorbid HF had poor foot self-care behaviour (were not inspecting their feet 7 days a week) though the difference was not statistically significant,  $\chi^2 = 0.019$ ,  $df = 1$ ,  $p = 0.890$ .

### 4.3 | Demographic and psychosocial factors associated with foot self-care behaviour

Table 1 indicates household income was statistically significantly associated with foot self-care behaviours in T2D adults with comorbid HF ( $p = 0.039$ ) but not in those without HF. Social support was statistically significantly and positively associated with foot self-care behaviour in T2D adults without comorbid HF ( $p = 0.006$ ) but not in those with HF (Table 1) regardless of the latter group reporting statistically significantly higher ( $MD = 2.1$ ,  $p = 0.003$ ) social support score (Table 3). No other demographic and psychosocial factors statistically significantly associated with foot self-care behaviour in both groups.

### 4.4 | Clinical factors associated with foot self-care behaviour

Table 2 depicts that BMI was statistically significantly and negatively associated with foot self-care behaviour in T2D adults without HF ( $p = 0.028$ ) but not in those with HF. Total number of daily medications statistically significantly and negatively associated with foot self-care behaviour in those with comorbid HF ( $p = 0.032$ ) but not in

TABLE 1 Demographic and psychosocial factors associated with foot self-care behaviour in type 2 diabetes adults with and without comorbid heart failure (N = 210)

Characteristics	Overall no. (%)	Comorbid HF				Test of association	
		No		Yes		Comorbid HF	
		Poor FSCB (no., %)	Good FSCB (no., %)	Poor FSCB (%)	Good FSCB (no., %)	No	Yes
Age in year, mean ± SD	58.7 (10.9)					$r_{bis} = -0.017, p = 0.860$	$r_{bis} = -0.078, p = 0.430$
Sex							
Female	112 (53.3)	33 (57.9)	29 (60.4)	22 (39.3)	28 (57.1)	$X^2 = 0.069, df = 1, p = 0.793$	$X^2 = 3.341, df = 1, p = 0.068$
Male	98 (46.7)	24 (42.1)	19 (39.6)	34 (60.7)	21 (42.9)		
Marital status							
In marriage	153 (72.9)	47 (82.5)	35 (72.9)	42 (75.0)	29 (59.2)	$X^2 = 0.239, df = 1, p = 0.239$	$X^2 = 0.084, df = 1, p = 0.084$
Not in marriage	57 (27.1)	10 (17.5)	13 (27.1)	14 (25.0)	20 (40.8)		
Educational status							
Primary school and below	80 (38.1)	21 (36.8)	21 (43.8)	20 (36.4)	18 (36.7)	$X^2 = 0.518, df = 1, p = 0.472$	$X^2 = 0.002, df = 1, p = 0.969$
Secondary school and above	129 (61.4)	36 (63.2)	27 (56.3)	35 (63.6)	31 (63.3)		
Occupation							
Skilled worker	116 (55.2)	37 (64.9)	36 (75.0)	22 (39.3)	21 (42.9)	$X^2 = 1.251, df = 1, p = 0.263$	$X^2 = 0.138, df = 1, p = 0.710$
Unskilled worker	94 (44.8)	20 (35.1)	12 (25.0)	34 (60.7)	28 (57.1)		
Monthly income							
Earn < ETB 5251	182 (86.7)	49 (89.1)	38 (82.6)	51 (91.1)	44 (89.8)	$X^2 = 0.882, df = 1, p = 0.348$	$X^2 = 0.049, df = 1, p = 0.824$
Earn ≥ ETB 5251	24 (11.4)	6 (10.9)	8 (17.4)	5 (8.9)	5 (10.2)		
Religion							
Orthodox Christian	155 (73.8)	39 (73.6)	36 (76.6)	40 (71.4)	40 (83.3)	$X^2 = 0.120, df = 1, p = 0.729$	$X^2 = 2.063, df = 1, p = 0.151$
Others <sup>a</sup>	49 (23.3)	14 (26.4)	11 (23.4)	16 (28.6)	8 (16.7)		
Residence place							
Rural	24 (11.4)	9 (15.8)	6 (12.5)	6 (10.7)	3 (5.1)	$X^2 = 0.230, df = 1, p = 0.631$	$X^2 = 0.703, df = 1, p = 0.402$
Urban	186 (88.6)	48 (84.2)	42 (87.5)	50 (89.3)	46 (93.9)		
Household income							
Hand-to-mouth <sup>b</sup>	67 (31.9)	14 (25.5)	16 (33.3)	16 (28.6)	21 (42.9)	$X^2 = 1.987, df = 2, p = 0.370$	$X^2 = 6.505, df = 2, p = 0.039$
Modest <sup>c</sup>	123 (58.6)	37 (67.3)	26 (54.2)	38 (67.9)	22 (44.9)		
Sufficient <sup>d</sup>	18 (8.6)	4 (7.3)	6 (12.5)	2 (3.6)	6 (12.2)		
Diabetes self-efficacy (PDSMS) score, mean ± SD	20.1 (3.3)					$r_{bis} = 0.104, p = 0.294$	$r_{bis} = 0.036, p = 0.719$

(Continues)

TABLE 1 (Continued)

Characteristics	Comorbid HF		Test of association	
	No		Comorbid HF	
	Poor FSCB (no., %)	Good FSCB (no., %)	No	Yes
Overall no. (%)				
Diabetes Knowledge (DKT2) score, mean ± SD	75.2 (24.8)		$r_{\text{bis}} = 0.121, p = 0.219$	$r_{\text{bis}} = -0.049, p = 0.616$
Depression (PHQ-9) score, mean ± SD	4.52 (4.7)		$r_{\text{bis}} = -0.024, p = 0.811$	$r_{\text{bis}} = 0.154, p = 0.118$
Social support (ESSI) score, mean ± SD	22.3 (5.3)		$r_{\text{bis}} = 0.267, p = 0.006$	$r_{\text{bis}} = -0.054, p = 0.586$

Abbreviations: DKT2, Revised Brief Diabetes Knowledge Test; ESSI, ENRICHD Social support instrument; ETB, Ethiopian Birr; FSCB, Foot self-care behaviour; PDSMS, Perceived Diabetes Self-Management Scale; PHQ-9, Patient Health Questionnaire-9;  $r_{\text{bis}}$ , biserial correlation.

<sup>a</sup>Others include Muslim, Catholic, Protestant, and Waqaefataa.

<sup>b</sup>Have hardly enough money or food to live on.

<sup>c</sup>Have some money or food enough to live on.

<sup>d</sup>Have adequate amount of money and other resources for comfortable livzzzzing.

those without HF. Self-reported health status was statistically significantly and positively associated with foot self-care behaviour in those with comorbid HF ( $p = 0.038$ ) but not in those without HF. Participants with comorbid HF also had a statistically significantly higher number of total daily medications ( $MD = 4, p < 0.001$ ), Charlson comorbidity index ( $MD = 3, p < 0.001$ ), total number of comorbidities ( $MD = 1.7, p < 0.001$ ) and diabetes self-efficacy ( $MD = 1.4, p = 0.002$ ) than those without this comorbidity (Table 3). No other clinical factors were statistically significantly associated with foot self-care behaviour in both groups.

#### 4.5 | Predictors of foot self-care behaviour

Stepwise logistic regression analysis was conducted to explore the demographic, psychosocial and clinical factors predicting foot self-care behaviour for adults with T2D with and without comorbid HF (Table 4). The two final models containing all predictors for T2D adult with and without comorbid HF were statistically significant,  $\chi^2 (4, N = 98) = 23.999, p < 0.001$  and  $\chi^2 (5, N = 104) = 19.00, p = 0.002$ , respectively, indicating that the models were able to distinguish between respondents who were taking care of their feet 7 days per week or less than 7 days. The model for those without comorbid HF as a whole explained between 21.7% (Cox and Snell R Square)–29.0% (Nagelkerke R Square) of the variance in foot self-care behaviour, and correctly classified 67.3% of foot self-care events. Similarly, the model for those with comorbid HF explained between 16.7% (Cox and Snell R Square)–22.3% (Nagelkerke R Square) of the variance in foot self-care behaviour, and correctly classified 67.3% of the foot self-care events. As shown in Table 4, three variables (not being married, social support and BMI) add a statistically significant contribution to the model for those without comorbid HF. This indicates that compared to married participants those not married were about 3.8 times more likely to take care of their feet 7 days a week. The odds of participating in foot self-care behaviours were about 18.9% higher for each 1 unit increase in social support score. The odds of taking foot self-care 7 days a week was 26.4% less likely for each 1 kg/m<sup>2</sup> increase of BMI. Two variables (household income and total daily medication intake) also added statistically significant contribution to the model among those with comorbid HF. Compared to participants who live on hand-to-mouth household income (have hardly enough money or food to live on) those who live on modest income are 60.6% less likely to take care of their feet 7 days a week. The odds of taking foot self-care 7 days a week are 26.6% less likely for a 1 drug increase on the total daily medication intake.

## 5 | DISCUSSION

This study investigated diabetes foot self-care behaviour and its demographic, clinical and psychosocial correlates in T2D adults with and without comorbid HF. T2D adults who have and do not have comorbid HF both reported poor foot self-care behaviours.



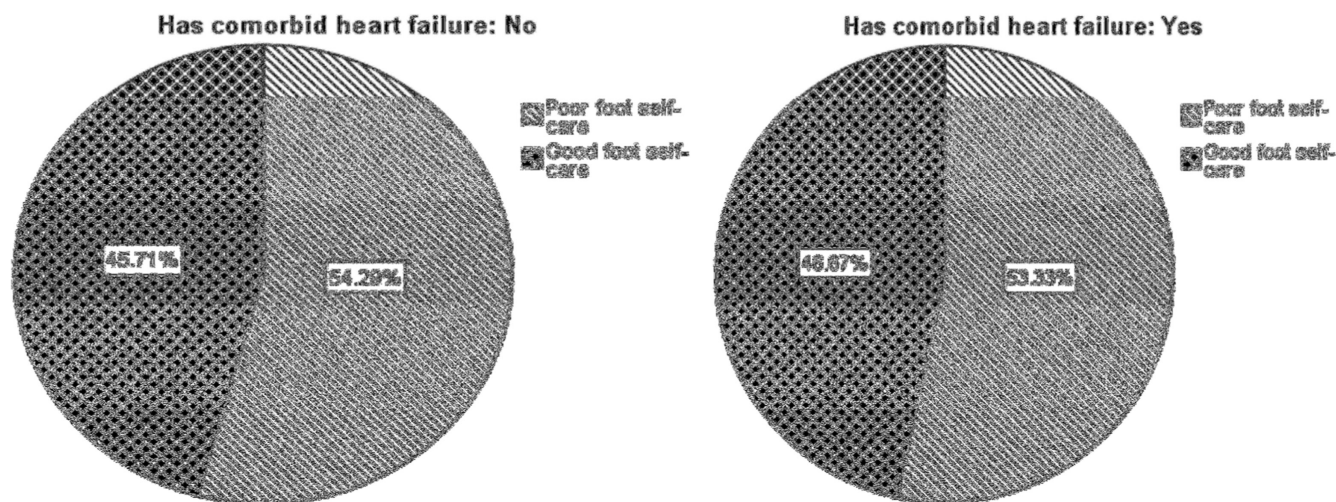


FIGURE 1 Foot self-care behaviour in type 2 diabetes adults with and without comorbid heart failure

There is variation in factors correlated with foot self-care behaviour between T2D adults who have and do not have comorbid HF in this study. Household income was one of the important predictors of poor foot self-care behaviours in T2D adults with comorbid HF but not in those without comorbidity. In this patient group, those with modest and hand-to-mouth household income (have hardly enough money or food to live on) were less likely to perform the recommended foot self-care behaviours. Previous studies have also demonstrated that low household income is associated with poor self-care behaviours in persons with T2D (Boakye et al., 2018; Luo et al., 2015) although they did not consider the influence of comorbid conditions in their analysis. From this perspective, our finding implies that the influence of household income on foot self-care behaviour is more prominent among T2D adults with comorbid HF. HF poses greater disruption to daily routines and ability to work, which may negatively impact the household income required to successfully implement the recommended foot self-care behaviour (Fry et al., 2016). For example, poor household income can affect the ability to afford diabetic footwear and devices used for daily monitoring of foot temperature that already have proven effectiveness of preventing DFU. Obviously, it is difficult to afford the expenses for diabetic footwear and devices through out-of-pocket expenditure, which is the traditional method of covering household's healthcare cost in Ethiopia. Thus, it is necessary to find ways to increase access to the recently began health insurance scheme (EHIA, 2015) for patients with comorbid T2D and HF who are from poor socioeconomic status (SES) households. Healthcare team should also identify patients with poor SES and try to link them with health insurance agency that may enable them overcome resource constraints to implement the recommended foot self-care behaviours.

The total number of daily medications intake was another important predictor of foot self-care behaviour in T2D adults with comorbid HF. Persons with HF take on average 6 medications daily which greatly increases the complexity of self-care and reduces

the likelihood of performing the recommended foot self-care behaviour. The high number of medication intake indicates increasing multimorbidity among HF comorbid groups as previous studies described the existence of such a relationship (Patel et al., 2017; Sancho-Mestre et al., 2016). The present study also identified that HF comorbid T2D adults take higher number of daily medication and more multimorbidities than those without HF comorbidity. Both the burden of medication and multimorbidity may derail the physical and cognitive capacity to execute foot self-care behaviours (Rosbach & Andersen, 2017). Multimorbidity is often linked to functional challenges that can limit the person's ability to self-care (Liddy et al., 2014). Therefore, future research must focus on finding strategies to reduce the burden of both medication and multimorbidity and to enhance the self-care ability of persons with T2D and comorbid HF. An integrated self-care approach (Dunbar et al., 2014; Dunbar et al., 2015) is one of the important areas to test in HF-comorbid T2D adults with multimorbidities.

Unlike a previous study (Domingos et al., 2021), our study showed that marital status is one of the important predictors of foot self-care behaviour among T2D adults without comorbid HF. The current study suggests that adults with T2D are married were less likely to perform the recommended foot self-care behaviours. This difference may be related to the family, social and financial responsibilities associated with marriage. Arguably, those who are married have more of these responsibilities which could compromise the resources they can invest on self-care. Therefore, further investigation of factors contributing to marital status difference in foot self-care behaviour of adults with T2D is necessary for designing appropriate intervention.

Corroborating with previous studies (Gurmu et al., 2018; Watkins et al., 2013), our study showed that social support is positively associated with better performance of foot self-care behaviour among T2D adults without HF. There is recognition in the body of literature concerning the value of greater social support for better diabetes self-care among persons with T2D

TABLE 2 Clinical factors associated with foot self-care behaviour in type 2 diabetes adults with and without comorbid heart failure (N = 210)

Characteristics	Comorbid HF				Test of association				
	Overall no. (%)	No		Yes		Comorbid HF		Yes	No
		Poor FSCB (no., %)	Good FSCB (no., %)	Poor FSCB (no., %)	Good FSCB (no., %)	No	Yes		
BMI, mean $\pm$ SD	27.6 (4.8)						$r_{\text{bis}} = -0.215, p = 0.028$	$r_{\text{bis}} = 0.033, p = 0.735$	
Year since diagnosis of T2D, mean $\pm$ SD	13.4 (9.5)						$r_{\text{bis}} = -0.002, p = 0.982$	$r_{\text{bis}} = -0.119, p = 0.225$	
Diabetes treatment regimen									
Diet and exercise alone	5 (2.4)	1 (1.9)	0 (0.0)	3 (5.4)	1 (2.0)		$X^2 = 0.860, df = 1, p = 0.354$	$X^2 = 0.784, df = 1, p = 0.376$	
Diet and exercise plus drugs	200 (95.2)	53 (98.1)	46 (100)	53 (94.6)	48 (98.0)				
Diabetes medication									
Insulin only	45 (21.4)	12 (21.8)	10 (20.8)	11 (19.5)	12 (24.5)		$X^2 = 1.449, df = 3, p = 0.694$	$X^2 = 1.121, df = 3, p = 0.772$	
Oral antihyperglycaemics only	77 (36.7)	20 (36.4)	15 (31.3)	22 (39.3)	20 (40.8)				
Both insulin and oral antihyperglycaemics	81 (36.6)	22 (40.0)	23 (47.9)	20 (35.7)	16 (32.7)				
None	5 (2.4)	1 (1.8)	0 (0.0)	3 (5.4)	1 (2.0)				
Years since diagnosis of HF, mean $\pm$ SD	6.4 (5.8)						$r_{\text{bis}} = -0.010, p = 0.917$		
Total daily medication, mean $\pm$ SD	3.9 (2.4)						$r_{\text{bis}} = 0.054, p = 0.583$	$r_{\text{bis}} = -0.210, p = 0.032$	
Charlson comorbidity index (CCI), mean $\pm$ SD	3.07 (2.5)						$r_{\text{bis}} = 0.171, p = 0.080$	$r_{\text{bis}} = -0.086, p = 0.384$	
Total number of comorbidities <sup>a</sup> , mean $\pm$ SD	2.9 (1.6)						$r_{\text{bis}} = 0.181, p = 0.065$	$r_{\text{bis}} = 0.055, p = 0.576$	
Self-reported health									
Poor	22 (10.5)	3 (5.3)	2 (4.2)	8 (14.3)	9 (18.4)		$X^2 = 0.707, df = 2, p = 0.702$	$X^2 = 6.555, df = 2, p = 0.038$	
Fair	87 (41.4)	23 (40.4)	16 (33.3)	32 (57.1)	16 (32.7)				
Good	101 (48.1)	31 (54.4)	30 (62.5)	16 (28.6)	24 (49.0)				
Family history of diabetes									
No	132 (62.9)	32 (56.1)	32 (66.7)	37 (66.1)	30 (61.2)		$X^2 = 1.213, df = 1, p = 0.271$	$X^2 = 0.266, df = 1, p = 0.606$	
Yes	78 (37.1)	25 (43.9)	16 (33.3)	19 (33.9)	19 (38.8)				

Abbreviations: BMI, body mass index; FSCB, Foot self-care behaviour; HF, heart failure;  $r_{\text{bis}}$ , biserial correlation.<sup>a</sup>Total number of comorbidities excluding T2D and HF.



TABLE 3 Subgroup analysis of selected demographic, clinical and psychosocial variables (N = 210)

Variable	Overall, mean ± SD	Comorbid heart failure (HF)		Mean difference (MD)
		No, mean ± SD	Yes, mean ± SD	
Age in year	58.7 ± 10.9	55.7 ± 10.6	61.6 ± 10.5	MD = 5.9, <i>p</i> = 0.000
Body mass index	27.6 ± 4.8	27.2 ± 4.2	28.0 ± 5.4	MD = 0.8, <i>p</i> = 0.228
Years since diagnosis of T2D	13.4 ± 9.5	13.2 ± 8.9	13.7 ± 10.1	MD = 0.48, <i>p</i> = 0.712
Total daily medication	3.9 ± 2.4	1.9 ± 0.9	5.9 ± 1.7	MD = 4.0, <i>p</i> = 0.000
Charlson comorbidity index	3.1 ± 2.5	1.6 ± 2.1	4.6 ± 1.8	MD = 3.0, <i>p</i> = 0.000
Total number of comorbidities <sup>a</sup>	2.9 ± 1.6	2.1 ± 1.4	3.8 ± 1.3	MD = 1.7, <i>p</i> = 0.000
Glycated haemoglobin (HbA1c)		9.5 ± 2.5	9.5 ± 2.6	MD = 0, <i>p</i> = 1.000
Fasting blood glucose		173.7 ± 75.4	153.2 ± 50.4	MD = 20.4, <i>p</i> = 0.021
Diabetes self-efficacy (PDSMS score)	20.1 ± 3.3	19.4 ± 3.6	20.8 ± 3.1	MD = 1.4, <i>p</i> = 0.002
Diabetes knowledge (DKT2 score)	75.2 ± 24.8	74.7 ± 24.5	75.6 ± 12.2	MD = 0.9, <i>p</i> = 0.808
Depression symptoms (PHQ-9 score)	4.5 ± 4.7	4.3 ± 4.5	4.7 ± 4.9	MD = 0.4, <i>p</i> = 0.547
Social support (ESSI score)	22.3 ± 5.3	21.2 ± 4.9	23.4 ± 5.4	MD = 2.1, <i>p</i> = 0.003

Abbreviation: T2D, Type 2 diabetes mellitus.

<sup>a</sup>Excluding T2D and HF, PDSMS, Perceived Diabetes Self-Management Scale; DKT2, Revised Diabetes Knowledge Test; PHQ-9, Patient Health Questionnaire-9; ESSI, ENRICH Social Support Instrument.

TABLE 4 The final stepwise logistic regression predicting the likelihood of foot self-care behaviour

Predictor	B	S.E	Wald	Df	<i>p</i> -value	Odds ratio (e <sup>B</sup> )	95% confidence interval	
							Lower	Upper
No comorbid heart failure								
Marital status—not in marriage (1)	1.348	0.610	4.881	1	0.027	3.849	1.164	12.727
Diabetes knowledge (DKT2) score	0.014	0.009	2.240	1	0.135	1.014	0.996	1.032
Social support (ESSI) score	0.173	0.055	9.959	1	0.002	1.189	1.068	1.323
Body mass index in kg/m <sup>2</sup>	-0.181	0.064	7.848	1	0.005	0.835	0.736	0.947
Constant	-0.178	1.903	0.009	1	0.926	0.837		
With comorbid heart failure								
<i>Household income:</i>								
Hand-to-mouth (0)			7.913	2	0.019	10.372		
Modest (1)	-0.932	0.465	4.023	1	0.045	0.394	0.158	0.979
Sufficient (2)	1.386	0.990	1.961	1	0.161	4.001	0.575	27.856
Total daily medication	-0.309	0.140	4.845	1	0.028	0.734	0.557	0.967
Constant	2.339	1.009	5.371	1	0.020	10.372		

(Song et al., 2017). Healthcare team should assess the social support available to adults with T2D in for improving foot self-care behaviours.

The current study also identified that increasing BMI is associated with poor foot self-care behaviour in T2D adults without HF. Earlier studies have also shown the positive relationship between obesity and foot morbidity (Pinzur et al., 2005; Tanamas et al., 2012) and poor metabolic control in T2D (Sonmez et al., 2019). Controlling body weight through self-care intervention including healthy eating and regular physical activity could help to improve foot self-care behaviour and reduce morbidity (Franz et al., 2015).

## 5.1 | Limitations

Though this study brings a fresh look at the difference in foot self-care behaviour between T2D adults with and without comorbid HF, the findings should be seen in the context of the following limitations. The study was conducted in a single tertiary healthcare setting in Ethiopia. Future studies that recruit T2D adults with and without comorbid HF from different regions of the country are needed to enhance the generalizability of the findings. This study attempted to control for covariates and reduce threat of bias using a stepwise logistic regression models, but the impact of unforeseen potential

confounder should not be ignored. The cross-sectional nature of the design did not permit to ascertain causality between the factors and foot self-care behaviour. Thus, interventional or longitudinal studies are recommended for future studies.

## 6 | CONCLUSION

Findings from this study show poor foot self-care behaviour in T2D adults with and without comorbid HF. It also indicates that the correlations of foot self-care behaviour differ between T2D adults with and without comorbid HF. The findings of this study support the development of foot self-care interventions that may improve outcomes for T2D adults with and without comorbid HF. Nurses and other clinicians should consider household income and total number of daily medication intake when caring for T2D adults with comorbid HF. They should also consider marital status, social support and BMI when caring for those without comorbid HF. There is a need to find ways to make the recently implemented health insurance scheme more accessible to persons with comorbid T2D and HF in Ethiopia. Doing these would help them enhance the patient's ability for foot self-care.

### AUTHOR CONTRIBUTIONS

FA, RAG, SBD, TK and SG involved in conceptualization of the study. FA recruited the participants, and collected and analysed the data. FA and MKH validated the data analysis. All authors contributed to, and reviewed the writing of the manuscript and approved its submission.

All authors have agreed on the final version and meet at least one of the following criteria [recommended by the ICMJE (<http://www.icmje.org/recommendations/>)]:

- substantial contributions to conception and design, acquisition of data or analysis and interpretation of data;
- drafting the article or revising it critically for important intellectual content.

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### CONFLICT OF INTEREST

The authors declared that they have no conflict of interest.

### DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on reasonable request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

### ETHICS STATEMENT

The Institutional Review Board of the College of Health Sciences at Addis Ababa University approved the study protocol. All participants provided signed informed consent.

### ORCID

Fekadu Aga  <https://orcid.org/0000-0003-2230-7153>

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