

ORIGINAL ARTICLE

Health-related quality of life and chronic wound characteristics among patients with chronic wounds treated in primary care: A cross-sectional study in Singapore

Xiaoli Zhu^{1,2}  | Maja Magdalena Olsson^{3,4} | Ram Bajpai^{3,5}  |
 Krister Järbrink³ | Wern Ee Tang⁶ | Josip Car^{3,7}

¹Nursing Services, National Healthcare Group Polyclinics, Singapore, Singapore

²Lee Kong Chian School of Medicine, Nanyang Technological University Singapore, Singapore

³Centre for Population Health Sciences, Lee Kong Chian School of Medicine, Nanyang Technological University, Singapore, Singapore

⁴Centre for Healthcare Transformation, School of Nursing, Queensland University of Technology, Brisbane, Queensland, Australia

⁵School of Medicine, Keele University, Staffordshire, UK

⁶Clinical Research Unit, National Healthcare Group Polyclinics, Singapore, Singapore

⁷Department of Primary Care and Public Health, School of Public Health, Imperial College London, London, UK

Correspondence

Xiaoli Zhu, Nursing Services, National Healthcare Group Polyclinics Singapore, 3 Fusionopolis Link, Nexus@one-north (South Lobby), #05-10, Singapore, Singapore, 138543.

Email: julia_zhu@nhgp.com.sg

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Abstract

Chronic wounds commonly decrease patients' quality of life. Understanding how chronic wounds impact a patient's health-related quality of life (HRQoL) is important for healthcare service delivery and treatment management. This study explored HRQoL among patients suffering from chronic wounds and investigated associations with patients' socio-demographics and wound characteristics. Two hundred and thirty-three patients across six primary care clinics were assessed and responded to a survey that collected information on socio-demographic, wound characteristics, and HRQoL using the EQ-5D-5L instrument. Data were analysed by descriptive statistics and generalised linear models. The mean age of patients was 61.2 (SD: 14.6) years; 68.2% were males; and 61.8% were of Chinese origin. Arterial ulcers had the greatest negative impact on HRQoL related to mobility, self-care, pain/discomfort and anxiety/depression, and the lowest VAS mean score 62.31 (SD: 28.3; range: 0-100) indicating the worst health. HRQoL related to mobility was significantly associated with age ($\beta = 0.008$, $P < .001$), non-Chinese ethnicity ($\beta = 0.25$, $P = .001$), mixed ulcers ($\beta = -0.41$, $P = .022$), atypical hard-to-heal wounds ($\beta = -0.38$, $P = .021$), wounds with low ($\beta = 0.24$, $P = .044$) to moderate ($\beta = 0.29$, $P = .018$) exudate level, and a wound duration ≥ 6 months ($\beta = 0.19$, $P = .033$). The findings can be used to improve healthcare delivery for patients with chronic wound to optimise their HRQoL.

KEYWORDS

chronic wound, health-related quality of life, primary care, Singapore, socio-demographics

Key Messages

- chronic wounds commonly decrease patients' quality of life. Understanding how chronic wounds impact HRQoL is important for healthcare service delivery and treatment management

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- this study explored HRQoL among primary care patients' suffering from chronic wounds and investigated associations with patients' socio-demographics and wound characteristics
- HRQoL was most impacted for patients suffering from arterial ulcers compared to other wound aetiologies. Chronic wound duration and the level of exudate impacted HRQoL related to mobility
- the findings can be used to improve health care delivery for patients with chronic wounds to optimise their quality of life

1 | INTRODUCTION

Chronic or hard-to-heal wounds are commonly defined as wounds that have not reduced in size by more than 40% to 50%¹ or healed within 1 month.^{2,3} The global prevalence of chronic wounds is estimated at 1.51 to 2.21 per 1000 population,⁴ and the incidence is expected to rise with ageing populations worldwide.⁵ Chronic wounds may have different aetiologies and are commonly classified in the categories of diabetic foot ulcers (DFUs), wounds related to peripheral arterial disease, venous leg ulcers, pressure injuries (PIs),⁶ and atypical hard-to-heal wounds (AHHW).^{7,8} Healing of chronic wounds depends on several complex biological factors and wound care regimens.^{9,10} However, even after a chronic wound heals up to 40% of DFUs¹¹ and 69% of venous leg ulcers¹² may recur within 1 year.

Chronic wounds are associated with significant physical, emotional, and economic burdens,¹³ both at an individual^{14,15} and societal level.¹⁶⁻¹⁸ Health-related quality of life (HRQoL) is a patient-reported outcome that presents the patient's own perception of well-being¹⁹ and reflects the total impact of health and illness on the individual.²⁰ HRQoL is decreased in chronic wound patients since wounds often cause physical problems, impaired mobility, social distress, pain, depression, and restricted lifestyle.^{13,15,21-25} Understanding the factors that contribute to HRQoL in patients with chronic wounds can guide the identification of patients in whom further support may improve their quality of life outcomes.^{15,21} Assessing HRQoL in patients with chronic conditions is increasingly important as it provides valuable knowledge that can be used to highlight and develop interventions to assist patients to achieve the best possible patient outcomes and HRQoL.²¹

HRQoL is a complex multidimensional concept related to physical function, psychological state, psychosocial life and physical symptoms, which enables an understanding of the general health and health status.²⁶ Instruments developed to collect data on HRQoL can either be disease specific or generic. There are several disease-specific instruments developed for wound patients,²⁷ such as the

Cardiff Wound Impact Schedule, Würzburg Wound Score and Freiburg Life Quality Assessment.²⁸⁻³⁰ Generic HRQoL instruments collect data that is not specific to a disease or condition and can be applied to any population,^{19,31} which have the advantage that HRQoL can be compared across different disease groups.³²

In Singapore, the incidence of chronic wound has increased exponentially over the past two decades and is expected to raise further due to a rapidly ageing population and growing prevalence of chronic conditions, such as diabetes.⁵ The increased prevalence of chronic wounds in Singapore has generated a significant clinical and economic burden related to extended wound care services and healthcare costs at both a hospital and primary care level.³³ There is limited knowledge about the factors associated with HRQoL for patients with chronic wound treated in primary care. This study therefore aimed at exploring HRQoL and associations with patients' socio-demographic and wound characteristics in a multi-ethnic primary care population.

2 | MATERIALS AND METHODS

2.1 | Study design and participants

This population-based cross-sectional study explored associations between HRQoL, clinical wound characteristics and socio-demographic in patients with chronic wounds that were treated in primary care in Singapore. Patients were recruited between March and April 2018 from six general primary care clinics. Included patients had to receive wound care at the primary care clinic for a wound that was chronic (not healed within 1 month), be 21 years of age or older or have a Legally Authorised Representative that could give consent for their participation in the study. Patients with malignant and surgical wounds that were healing by primary intention were excluded. All patients with chronic wounds who visited the participating primary care clinics for wound care during the recruitment period were assessed by their attending nurses for eligibility on their treatment day. Eligible

patients were invited to participate in the study and introduced to research assistants who provided information about the study.

2.2 | Instruments and outcome measures

A pre-developed Wound Care Inventory Questionnaire including wound management, healthcare service utilisation and the instrument was used to obtain data on patient socio-demographic, specific clinical wound information, healthcare service use, medical history and patient-reported HRQoL. The questionnaire was inspired by the Client Socio-Demographic and Service Receipt Inventory³⁴ and developed in close collaboration with wound care experts and clinicians to collect data relevant for patients receiving wound care in Singapore. Patients were administered the survey to fill in the non-clinical sections (eg, socio-demographic data and the HRQoL instrument) after they had received their wound care at the clinics. The survey was either self-administered or filled in with the aid of the research assistants. Patients were offered to sit in a designated area at the clinics that offered more privacy while filling in the survey.

2.2.1 | Health-related quality of life

The generic and validated instrument EQ-5D-5L³⁵ is self-reported by patients and consists of two parts: a descriptive system and a visual analogue scale (VAS). The descriptive system contains questions relating to five domains of health, namely, mobility, self-care, usual activities, pain/discomfort and anxiety/depression. There are five levels to each question ranging from 'no problems', 'slight problems', 'moderate problems', 'severe problems' to 'extreme problems' or 'unable to'. The VAS is a 20 cm long vertical line that ranges from 'worst imaginable health state' set at 0 to 'best imaginable health state' set at 100, where respondents rate their current health status. EQ-5D-5L was available in all language versions for which the instrument is validated in Singapore (English, Mandarin, Malay and Tamil).

2.2.2 | Wound characteristics

Wound characteristics and other medical data were extracted from the patients' medical record at the primary care clinics. Wounds were classified as venous ulcers, arterial ulcers, mixed (arterial and venous) ulcers, DFUs and atypical hard-to-heal wounds, which were those chronic wounds that presented atypical clinical features and did

not fall into a typical wound category, that is, venous, arterial, mixed, pressure injury or DFU^{1,7,8} and failed to heal following a normal healing trajectory. Pressure injuries, sinus wounds and wounds with unclear aetiology were categorised as 'others' due to the small number of patients that suffered from those wound types. For patients with more than one wound, only the wound assessed as the most severe, was described.

Trained registered nurses ascertained wound characteristics in accordance with medical records and institutional wound management guidelines. This included wound aetiology, wound size, wound exudate level, wound bed appearance and wound infection. Wound size was recorded in square centimetres (cm²). Appearance of wound bed referred to the percentage of wound bed tissue including necrotic, granulating, sloughy and epithelialising. Wound exudate level was assessed based on wound exudate score and reported as 'none', 'low', 'moderate' and 'heavy'.³⁶ Wound infection referred to wounds that were treated with oral antibiotics. Other wound variables included wound duration, number of wounds, wound location and dressing frequency.

2.3 | Ethical considerations

The study was approved by the Institutional Review Board of Nanyang Technological University (IRB-2017-05-020-02) and the National Healthcare Group Domain Specific Review Board (2017/01159). Written and verbal information about the study was provided to participants, and they were informed that participation was voluntary. Signed informed consent from participants was obtained prior to participation in the survey.

2.4 | Data analysis

Descriptive statistics are reported with mean and standard deviation (SD) for continuous variables, and categorical variables are reported with frequencies with proportions. Kolmogorov–Smirnov and Shapiro–Wilk tests were used to assess the normality of continuous variables. Furthermore, as HRQoL variables were measured on nonlinear, ordinary linear regression with log-transformation is not appropriate due to the 'retransformation bias'.³⁷ Therefore, generalised linear model (GLM) with gamma family log link function was used to explore association between socio-demographic and wound-related factors with HRQoL outcome variables. The modified Park test was used to select the appropriate family within the GLM approach using the most likely appropriate variance function. The

TABLE 1 Socio-demographic and clinical characteristics of study participants

Patient characteristics	n (%) / mean (SD) (n = 233)
Age (years) (mean (SD))	61.2 (14.6)
Gender	
Female	74 (31.8)
Male	159 (68.2)
Ethnicity	
Chinese	144 (61.8)
Malay	34 (14.6)
Indian	51 (21.9)
Others	4 (1.7)
Employment status	
Employed full-time/part-time/self-employed	109 (46.8)
Retired	77 (33.1)
Unemployed/ students/ housewife	47 (20.17)
Accommodation	
1-3 room public housing flats	78 (33.5)
4-5 room public housing flats	137 (58.8)
Others	18 (7.7)
Number of comorbidities	
0	38 (16.3)
1-2	102 (43.8)
≥3	93 (39.9)
Comorbidities	
Autoimmune disease	1 (0.4)
Cerebro-vascular accident	15 (6.4)
COPD	1 (0.4)
Deep venous thrombosis	3 (1.3)
Diabetes mellitus	143 (61.4)
Gout	13 (5.6)
Heart disease	50 (21.5)
Hypertension	106 (45.5)
Kidney disease	69 (29.6)
Osteoarthritis	18 (7.7)
Peripheral vascular disease	59 (24.9)
Rheumatoid arthritis	2 (0.9)

Abbreviations: COPD, chronic obstructive pulmonary disease; SD, standard deviation.

estimated coefficient (λ) from the modified Park test indicated that a gamma family was appropriate (λ value close to 2 indicates Gamma family).³⁷ Regression coefficients with corresponding standard errors (SE) are reported. A

TABLE 2 Wound aetiology and characteristics of chronic wounds

Wound aetiology characteristics (n = 233)	n (%)
Wound aetiology	
Venous ulcer	24 (10.3)
Arterial ulcer	13 (5.6)
Mixed ulcer	18 (7.7)
DFU	78 (33.5)
AHHW	80 (34.3)
Others ^a	20 (8.6)
No of wound(s)	
1	164 (70.4)
2	55 (23.6)
≥3	14 (6.0)
Location of most serious wound	
Head or neck	9 (3.9)
Arms	2 (0.9)
Chest	
Abdomen	14 (6.0)
Back	14 (6.0)
Sacrum	3 (1.3)
Hip	1 (0.4)
Upper leg/groin	8 (3.4)
Lower leg/ankle	77 (33.1)
Foot	94 (40.3)
Others	11 (4.7)
Wound size (cm ²)	
<2	108 (46.4)
2-5	57 (24.5)
6-10	33 (14.2)
11-25	19 (8.2)
>25	8 (3.4)
Not applicable	8 (3.4)
Appearance of wound bed	
Necrotic	8 (3.4)
Granulating	204 (87.6)
Sloughy	85 (36.5)
Epithelialising	58 (24.9)
Fungating	1 (0.4)
Exudate level	
Low	132 (56.7)
Medium	75 (32.2)
High	6 (2.6)
Wound duration	
4-6 weeks	65 (27.9)
6 weeks to <3 months	57 (24.5)

range of goodness-of-fit measures was used to assess the fitting of the model such as deviance distribution, correlation between observed and predicted outcome, and link test for model adequacy. Co-linearity and interactions between predictors and outcomes were controlled for when necessary. All statistical analyses were performed by using Stata software version 16.1 (StataCorp, College

Station, Texas). A two-tailed *P*-value <.05 was considered statistically significant for the analysis.

3 | RESULTS

3.1 | Demographic and clinical characteristics of patients with chronic wounds

A total of 233 patients participated in the study (Table 1). The mean age of patients was 61.2 ± 14.6 years and 68.2% of the sample were males. Chinese (61.8%) was the most common ethnicity, and almost half of the study population were either full-time, part-time or self-employed. Most patients lived in 4 to 5 room (58.5%) and 1 to 3 room (33.5%) HDB (public housing) flats. In the sample, 43.8% had 1 to 2 comorbidities and 39.9% had more than two comorbidities. The majority of patients (61.3%) were diagnosed with diabetes. A little less than half of the sample suffered from hypertension. Almost one-third of participants had kidney disease.

TABLE 2 (Continued)

Wound aetiology characteristics (n = 233)	n (%)
3 months to <6 months	46 (19.7)
6 months to 1 year	29 (12.5)
1-5 years	29 (12.5)
>5 years	7 (3.0)
Recurrent wound	43 (18.5)
Infected wound	112 (48.1)

Abbreviations: AHHW, atypical hard-to-heal wounds; DFU, diabetic foot ulcers.

^aOthers refer to pressure injuries, sinus wounds and wounds with unclear aetiology.

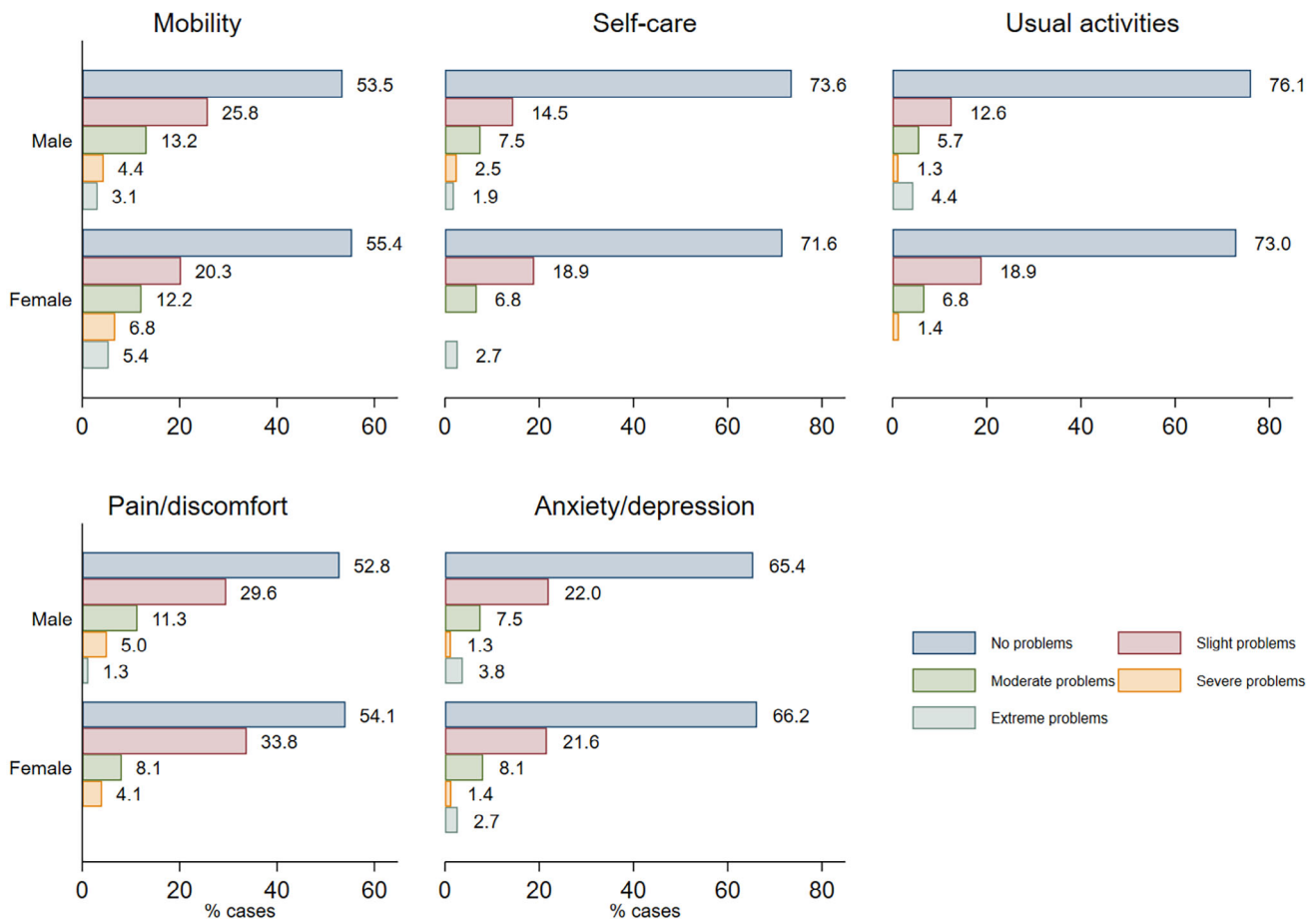


FIGURE 1 Distribution of health-related quality of life responses across genders assessed with EQ-5D-5L questionnaire

TABLE 3 EQ-5D-5L frequencies and proportions reported by domain and level of problem (n = 233)

	Mobility n (%)	Self-care n (%)	Usual activities n (%)	Pain/discomfort n (%)	Anxiety/ depression n (%)
No problems	127 (54.4)	169 (72.6)	174 (74.6)	125 (53.5)	153 (65.8)
Any problems (slight, moderate, severe and extreme problems)	106 (45.6)	64 (27.4)	60 (25.6)	109 (46.5)	80 (34.2)
Total	233 (100)	233 (100)	233 (100)	233 (100)	233 (100)

TABLE 4 HRQoL EQ-5D-5L scores and VAS scores according to wound aetiology, wound exudate level and wound duration (n = 233)

Parameters	HRQoL EQ-5D and VAS					
	Mobility	Self-care	Usual activities	Pain/ discomfort	Anxiety/ depression	VAS score
	Mean (SD)					
Wound aetiology						
Venous ulcer (n = 24)	1.79 (1.14)	1.33 (0.70)	1.25 (0.53)	1.96 (1.00)	1.54 (1.02)	73.96 (20.54)
Arterial ulcer (n = 13)	2.23 (1.17)	1.92 (1.38)	1.46 (0.97)	2.00 (1.22)	1.69 (0.95)	62.31 (28.33)
Mixed ulcer (n = 18)	1.61 (0.85)	1.44 (0.98)	1.33 (0.69)	1.67 (0.91)	1.33 (0.97)	77.50 (11.91)
DFU (n = 78)	2.00 (1.14)	1.50 (0.99)	1.50s (1.03)	1.56 (0.77)	1.60 (0.90)	74.38 (16.93)
AHHW (n = 80)	1.51 (0.83)	1.35 (0.64)	1.40 (0.85)	1.68 (0.92)	1.55 (1.02)	74.60 (18.83)
Others (n = 20)	2.15 (1.60)	1.40 (0.82)	1.50 (1.05)	1.75 (0.91)	1.45 (0.76)	72.00 (13.51)
Wound exudate level						
Low (n = 132)	1.78 (1.11)	1.44 (0.92)	1.44 (0.95)	1.72 (0.86)	1.52 (0.93)	74.66 (19.05)
Medium (n = 75)	1.93 (1.03)	1.48 (0.83)	1.40 (0.84)	1.71 (0.93)	1.63 (0.98)	73.40 (18.45)
High (n = 6)	1.83 (0.75)	1.67 (1.03)	1.33 (0.82)	1.67 (0.82)	1.50 (0.84)	68.33 (17.22)
Wound duration						
4-6 weeks (n = 65)	1.62 (0.90)	1.54 (0.95)	1.51 (1.00)	1.60 (0.81)	1.48 (0.75)	75.77 (13.47)
6 weeks to <3 months (n = 57)	1.82 (1.10)	1.35 (0.79)	1.42 (1.02)	1.68 (1.07)	1.54 (0.98)	67.81 (23.04)
3 months to <6 months (n = 46)	1.74 (1.00)	1.48 (0.89)	1.46 (0.94)	1.70 (0.87)	1.43 (0.86)	75.87 (18.11)
6 months to 1 year (n = 29)	2.24 (1.46)	1.45 (0.91)	1.31 (0.60)	2.07 (0.84)	1.62 (1.08)	73.62 (17.82)
1-5 years (n = 29)	1.90 (1.05)	1.41 (0.87)	1.31 (0.60)	1.55 (0.74)	1.62 (0.94)	77.93 (13.98)
Any others (n = 7)	1.71 (1.50)	1.14 (0.38)	1.43 (0.79)	1.57 (1.13)	2.43 (1.81)	73.57 (25.61)
Overall	1.81 (1.09)	1.44 (0.87)	1.42 (0.90)	1.69 (0.90)	1.55 (0.95)	73.78 (18.27)

Note: HRQoL was assessed with EQ-5D-5L, higher scores indicate greater impact; VAS: lower scores indicate greater impact.

Abbreviations: AHHW, atypical hard-to-heal wounds; DFU, diabetic foot ulcers; HRQoL EQ-5D, health-related quality of life 5 domains; SD, standard deviation; VAS, visual analogue scale.

3.2 | Wound aetiology and characteristics of chronic wounds

Patients with AHHW (34.3%) and DFU (33.5%) made up two-thirds of the study population. Most patients (70.4%) had only one wound. The majority of the wounds were

located to the foot (40.3%) or lower leg (33.0%). Nearly half of the wounds (46.4%) were small (<2 cm²). The main bulk of wounds (87.6%) appeared granulating and approximately one-third had medium (32.2%) or high (2.6%) exudate levels. More than half of the wounds had a duration shorter than 6 months. Less than every fifth

TABLE 5 Generalised linear regression analysis to explore factors associated with HRQoL (n = 233)

Variables	Mobility			Self-care			Usual activities			Pain/discomfort			Anxiety/depression			VAS		
	Coef. (95%CI)	P-value	Coef. (95%CI)	P-value	Coef. (95%CI)	P-value	Coef. (95%CI)	P-value	Coef. (95%CI)	P-value	Coef. (95%CI)	P-value	Coef. (95%CI)	P-value	Coef. (95%CI)	P-value		
Age (years)	0.008 (0.004, 0.012)	P < .001	0.002 (-0.003, 0.007)	.416	-0.009 (-0.014, -0.004)	.001	-0.002 (-0.006, 0.003)	.474	-0.001 (-0.006, 0.004)	.604	-0.002 (-0.004, -0.001)	.081	-0.002 (-0.004, -0.001)	.081	-0.002 (-0.004, -0.001)	.081		
Female (reference = male)	0.07 (-0.08, 0.21)	.361	-0.03 (-0.181, 0.12)	.694	-0.09 (-0.235, 0.064)	.260	-0.12 (-0.246, 0.016)	.086	-0.002 (-0.151, 0.148)	.982	0.005 (-0.013, 0.123)	.110	0.005 (-0.013, 0.123)	.110	0.005 (-0.013, 0.123)	.110		
Other ethnic group (reference = Chinese)	0.25 (0.11, 0.391)	.001	0.15 (0.03, 0.297)	.046	-0.002 (-0.151, 0.147)	.979	0.08 (-0.05, 0.216)	.221	0.18 (0.023, 0.337)	.025	-0.007 (-0.082, 0.067)	.847	-0.007 (-0.082, 0.067)	.847	-0.007 (-0.082, 0.067)	.847		
Wound aetiology (reference = others)																		
Venous ulcer (n = 24)	-0.35 (-0.73, 0.04)	.077	-0.17 (-0.516, 0.17)	.323	-0.16 (-0.538, 0.211)	.393	0.01 (-0.288, 0.316)	.929	-0.09 (-0.445, 0.266)	.623	0.03 (-0.118, 0.167)	.732	0.03 (-0.118, 0.167)	.732	0.03 (-0.118, 0.167)	.732		
Arterial ulcer (n = 13)	-0.17 (-0.57, 0.25)	.431	0.26 (-0.223, 0.714)	.304	0.12 (-0.383, 0.616)	.648	0.15 (-0.275, 0.581)	.484	0.10 (-0.317, 0.526)	.628	-0.12 (-0.39, 0.143)	.363	-0.12 (-0.39, 0.143)	.363	-0.12 (-0.39, 0.143)	.363		
Mixed ulcer (n = 18)	-0.41 (-0.76, -0.06)	.022	-0.08 (-0.46, 0.293)	.662	-0.05 (-0.442, 0.345)	.811	-0.13 (-0.442, 0.189)	.432	-0.21 (-0.525, 0.096)	.175	0.05 (-0.058, 0.166)	.348	0.05 (-0.058, 0.166)	.348	0.05 (-0.058, 0.166)	.348		
DFU (n = 78)	-0.12 (-0.44, 0.21)	.480	0.004 (-0.304, 0.311)	.982	-0.69 (-0.421, 0.283)	.700	-0.20 (-0.445, 0.467)	.112	0.001 (-0.272, 0.274)	.994	0.04 (-0.056, 0.144)	.384	0.04 (-0.056, 0.144)	.384	0.04 (-0.056, 0.144)	.384		
AHHW (n = 80)	-0.38 (-0.69, -0.06)	.021	-0.11 (-0.402, 0.182)	.459	-0.17 (-0.516, 0.167)	.317	-0.12 (-0.379, 0.132)	.344	-0.03 (-0.310, 0.258)	.857	0.04 (-0.061, 0.140)	.441	0.04 (-0.061, 0.140)	.441	0.04 (-0.061, 0.140)	.441		
Wound duration (reference = 4-6 weeks)																		
6 weeks to <3 months (n = 57)	0.15 (-0.02, 0.33)	.085	-0.16 (-0.362, 0.457)	.128	-0.87 (-0.302, 0.129)	.430	0.02 (-0.174, 0.208)	.859	-0.002 (0.206, 0.182)	.906	-0.11 (-0.201, -0.009)	.031	-0.11 (-0.201, -0.009)	.031	-0.11 (-0.201, -0.009)	.031		
3 months to <6 months (n = 46)	0.05 (-0.13, 0.23)	.605	-0.87 (-0.307, 0.133)	.438	-0.05 (-0.281, 0.178)	.661	-0.005 (-0.197, 0.186)	.958	-0.07 (-0.280, 0.137)	.503	0.02 (-0.062, 0.101)	.643	0.02 (-0.062, 0.101)	.643	0.02 (-0.062, 0.101)	.643		
≥6 months (n = 58)	0.19 (0.02, 0.37)	.033	-0.14 (-0.334, 0.503)	.148	-0.15 (-0.337, 0.043)	.130	0.07 (-0.104, 0.234)	.453	0.11 (-0.070, 0.298)	.224	0.004 (-0.735, 0.082)	.913	0.004 (-0.735, 0.082)	.913	0.004 (-0.735, 0.082)	.913		
Wound size (reference = <2 sq.cm)																		
2-5 sq.cm (n = 57)	0.03 (-0.14, 0.20)	.711	-0.004 (-0.188, 0.179)	.964	-0.06 (-0.268, 0.143)	.549	-0.09 (-0.257, 0.085)	.323	0.05 (-0.139, 0.247)	.583	-0.007 (-0.115, 0.100)	.892	-0.007 (-0.115, 0.100)	.892	-0.007 (-0.115, 0.100)	.892		
6-10 sq.cm (n = 33)	0.12 (-0.08, 0.32)	.247	0.06 (-0.191, 0.309)	.641	0.03 (-0.198, 0.261)	.787	-0.10 (-0.295, 0.105)	.351	-0.18 (-0.396, 0.041)	.111	-0.05 (-0.116, 0.084)	.751	-0.05 (-0.116, 0.084)	.751	-0.05 (-0.116, 0.084)	.751		
>10 sq.cm (n = 27)	0.03 (-0.18, 0.24)	.779	0.09 (-0.11, 0.282)	.388	-0.09 (-0.309, 0.134)	.440	0.03 (-0.204, 0.259)	.815	-0.02 (-0.258, 0.210)	.842	0.02 (-0.074, 0.120)	.642	0.02 (-0.074, 0.120)	.642	0.02 (-0.074, 0.120)	.642		
Wound exudate level (reference = none)																		
Low (n = 123)	0.24 (0.01, 0.47)	.044	0.17 (-0.033, 0.366)	.101	-0.04 (-0.292, 0.207)	.737	0.22 (-0.067, 0.503)	.135	0.02 (-0.291, 0.336)	.886	0.03 (-0.067, 0.133)	.515	0.03 (-0.067, 0.133)	.515	0.03 (-0.067, 0.133)	.515		
Medium (n = 75)	0.29 (0.05, 0.53)	.018	0.20 (-0.012, 0.419)	.065	<0.001 (-0.263, 0.263)	.999	0.23 (-0.073, 0.529)	.137	0.13 (-0.191, 0.453)	.424	0.02 (-0.091, 0.130)	.728	0.02 (-0.091, 0.130)	.728	0.02 (-0.091, 0.130)	.728		
Heavy (n = 6)	0.28 (-0.18, 0.73)	.235	0.29 (-0.222, 0.795)	.269	-0.03 (-0.337, 0.434)	.895	0.13 (-0.334, 0.599)	.577	0.07 (-0.445, 0.590)	.784	-0.05 (-0.253, 0.154)	.634	-0.05 (-0.253, 0.154)	.634	-0.05 (-0.253, 0.154)	.634		

Abbreviations: AHHW, atypical hard-to-heal wounds; CI, Confidence interval; DFU, diabetic foot ulcers; HRQoL, health-related quality of life; VAS, visual analogue scale.

wound (18.5%) was a recurrent wound. Nearly half (48.1%) of the wounds were infected. Chronic wound aetiologies and characteristics are presented in Table 2.

3.3 | EQ-5D-5L distribution across genders, frequencies and proportions reported by domains and level of problems

There was no difference in the overall response pattern of HRQoL outcomes between male and female participants (Figure 1). More than half of the patients reported 'no problems' across all five domains. Most patients perceived 'slight/moderate/severe/extreme problems' for HRQoL related to the domains mobility and pain/discomfort compared to the other three domains (Table 3).

3.4 | HRQoL scores according to wound aetiology, wound exudate level and wound duration

Table 4 shows HRQoL EQ-5D-5L and VAS mean scores according to wound aetiology, wound exudate level and wound duration in which the domain mobility had the lowest overall mean score 1.81 (SD: 1.09; range: 0-5) across all domains indicating the greatest impact. There was a variation between different wound aetiologies in which arterial ulcers had the highest mean scores for HRQoL related to mobility 2.23 (SD:1.17; range: 0-5), self-care 1.92 (SD: 1.38; range: 0-5), pain/discomfort 2.00 (SD: 1.22; range: 0-5) and anxiety/depression 1.69 (SD: 0.95; range: 0-5), and the lowest VAS mean score 62.31 (SD: 28.3; range: 0-100), indicating the greatest negative impact on HRQoL compared to other wound aetiologies. Mean HRQoL scores also varied between different exudate levels in which patients with medium to high levels of wound exudate had greater mean scores with mobility and self-care and having lower mean VAS score compared to a low level of wound exudate. A variation between different wound durations and HRQoL was also found in which the lowest mean score of HRQoL related to mobility 2.24 (SD: 1.46; range: 0-5) and pain/discomfort 2.07 (SD: 0.84; range: 0-5) and indicated the lowest perceived HRQoL among patients with a wound duration between 6 months to 1-year, while the lowest VAS mean score 67.81 (SD: 23.04; range: 0-100) was for wound durations of 6 weeks to 3 months, which also was the duration displaying the greatest negative impact on HRQoL.

3.5 | Factors associated with HRQoL outcomes

Factors associated with HRQoL by EQ-5D-5L domain and VAS-score are presented in Table 5 as regression coefficients with 95% CIs. The coefficients quantify the size and the direction of the impact when other variables included in the model are controlled for. Age had a positive impact on HRQoL related to mobility ($\beta = 0.008$, $P = .001$), but a negative impact in relation to usual activities ($\beta = -0.009$, $P = .001$). Non-Chinese ethnicity implied a negative impact on HRQoL in the domains of mobility ($\beta = 0.25$, $P = .001$), self-care ($\beta = 0.15$, $P = .046$) and anxiety/depression ($\beta = 0.18$, $P = .025$) when other factors were controlled for. Mixed ulcers and AHHWs were the aetiologies that impacted HRQoL related to mobility the least, $\beta = -0.41$, $P = .022$ and $\beta = -0.38$, $P = .021$, respectively. A wound duration over 6 months had the greatest negative impact on HRQoL related to mobility ($\beta = 0.19$, $P = .033$), while a duration of 6 weeks to 3 months was most negatively impacted according to the VAS score ($\beta = -0.105$, $P = .031$). Wound size was shown to be non-significant related to HRQoL independently of domain and VAS scores. Wound exudate, particularly low ($\beta = 0.24$, $P = .044$) to medium ($\beta = 0.29$, $P = 0.018$) levels, had a clear negative impact on HRQoL related to mobility.

4 | DISCUSSION

The mean age 61.2 (SD: 4.6) of the patients with chronic wound in this study is similar to previous studies from Germany (65.3 years, SD: 14.8)³⁸ and Brazil (average 61.0 years).³⁹ However, it is lower than the reported age in an earlier study conducted in Singapore (median 74, IQR 63-84), which obtained data from a nationwide administrative claims database including admissions from all levels of care to public and private acute care hospitals.⁵ The lower age of the participants in our study compared to in the above-mentioned Singaporean study may be because our study only recruited patients in primary care. Hence, participants in our study may be in better health states compared to patients with chronic wounds in hospitals and nursing homes.

Age was negatively associated with HRQoL related to usual activities ($\beta = -0.009$, $P = .001$). This finding is in alignment with a hospital setting study from Saudi Arabia, which reported that age affected HRQoL, particularly for physical functions in patients with DFUs.⁴⁰ The finding is also supported by a recent German study of chronic wound patients from three

university hospitals and one foot care centre, which found a significant negative correlation between the total Wound-QoL score and age in patients with arterial leg ulcers.⁴¹ However, findings from a Swedish study from a specialist wound centre on patients with venous leg ulcers did not find a correlation between age and HRQoL⁴² and neither did a mixed aetiologies chronic wound study from three outpatient settings and one hospital setting in Brazil.³⁹ A possible explanation for this could be attributed to variations in patients' mean age between the studies, where the present study has a relatively low mean age that possibly affected HRQoL less compared to a sample with a high mean age over 70 years, as HRQoL generally declines by age. The differences between the findings from the present study and the other studies may also be related to the use of various HRQoL instruments.

We also found that most participants in the present study were employed either full-time, part-time or self-employed. This is rather unusual as patients with chronic wounds most frequently reported lower HRQoL in the domains related to physical functioning¹³ and most patients with chronic wounds are retired.^{44,45} This may indicate that chronic wound patients treated in primary care are younger compared to those in hospitals in Singapore.^{5,33}

The most common wound aetiologies in the present study were atypical hard-to-heal wounds and DFUs. This differs to other chronic wound studies from Singapore^{5,33} and China,⁴⁵ which showed that pressure injuries were most prevalent. A plausible explanation for this could be that those studies reported the prevalence of wounds from inpatient settings, where patients may be bed bound to a higher extent, whereas this primary care setting study included patients that are ambulant and more independent.^{5,33,45}

Our results showed that the overall response pattern of HRQoL outcomes was similar across male and female participants. This finding is different from a recent study, which assessed HRQoL for patients with chronic wounds with Wound-QoL tool and found that the overall QoL scores for male were higher than female.⁴¹ However, the finding is in accordance with a study from China, which assessed HRQoL with SF-36 tool and reported no difference in the overall responses to HRQoL outcomes between male and female participants.⁴⁴ This could possibly be attributed to cultural norms and beliefs which may contribute to differences in self-reported health status, particularly in patients with chronic wound conditions. For the present study, response patterns for women and men were similar to the findings in the Chinese sample⁴⁴ but different from the German sample.⁴¹ Further studies in a Singaporean context are needed to explore relatable aspects more comprehensively.

Arterial ulcers had the greatest impact on HRQoL related to four of five dimensions of health compared to other wound aetiologies. Furthermore, arterial ulcer also had the lowest VAS mean score 62.31 (SD: 28.3; range: 0-100) indicating the greatest negative impact on HRQoL among all wound categories. This finding is consistent with another study where patients with arterial ulcers had the lowest quality of life when compared to other types of leg ulcers.⁴⁶ A study from Poland reported that patients with arterial ulcers had increased risk of sleep disturbances and pain.⁴⁷ A systematic review on quality of life in patients with arterial ulcers and DFU also concluded that patients with arterial ulcers suffered more from pain and restrictions related to their physical and social life compared to other chronic wounds.⁴⁸

The present study did not find that wound size was associated with HRQoL in any domain nor for the VAS score, even though wound size has been associated with HRQoL in previous studies for patients with venous leg ulcers⁴³ and other chronic wound aetiologies.⁴⁹ This could potentially be explained by the fact that most participants in the current study presented with rather small wound sizes (<2 cm²) compared to wounds in other studies.^{43,49} The finding in the current study is consistent with other studies from Sweden⁴² and Spain⁵⁰ including patients with large wound sizes that did not find any association between ulcer size and HRQoL.

This study found that a low to moderate level of wound exudate was negatively associated with HRQoL related to mobility, but not associated with any other domain or the VAS score. A previous study found that the quality (ie, characteristics and odour) of exudate rather than quantity (ie, amount) of exudate was associated with HRQoL in patients with chronic wounds.⁴⁹ A systematic review from year 2018 also reported that odour and exudate characteristics affected HRQoL negatively in patients with venous leg ulcers related to sleep, mobility and mood.⁵¹

A wound duration longer than 6 months was negatively associated with HRQoL for the domain mobility, and the lowest VAS score was associated with a wound duration between 6 weeks and 3 months in the current study. These findings are different from a small Swedish study (n = 50), which did not find any associations between HRQoL and wound duration for primary care patients with venous leg ulcer.⁴² However, wound duration has been associated with HRQoL in other primary care studies that assessed patients with chronic wounds in Brazil (n = 170)⁴⁹ and patients with venous leg ulcer in Canada (n = 424).⁴³ Given that the findings of the large studies^{43,49} show that longer duration yielded lower HRQoL, a possible plausible explanation for the negative association between wound duration and HRQoL in the

current study could be attributed to a positively overrated HRQoL by patients with chronic wounds longer than 6 months.

HRQoL related to mobility was impacted for patients with mixed ulcers and atypical hard-to-heal wounds. The findings from recent studies from primary care in Brazil⁴⁹ and a Spanish study found that the 'physical symptoms and daily living' and 'domestic activities' domain were the least affected domains in patients with chronic wound and venous leg ulcer.⁵⁰ A 2019 systematic review found that patients with chronic wounds most frequently reported lower HRQoL in the domains related to physical functioning.¹³

Limitations for this study include that patients were recruited from non-specialised wound clinics. Hence, some patients with wounds that may be less severe are more likely to be treated there rather than in specialised wound clinics, where more complicated wound patients may be treated. This could possibly reduce the generalisability of our findings. The study findings also showed that the majority of the patients with chronic wound reported 'no problems' indicating a better health state. A positively overrated HRQoL with more 'no problem' could be due to ceiling effects of the EQ-5D-5L instrument. This may influence the precision of calculating the true health state. Also, a generic and wound-specific instrument could have been used for better sensitivity, but that would have disabled us to compare the findings to other patient groups.

This study assessed HRQoL and characteristics of chronic wounds in primary care patients in Singapore. The findings revealed that HRQoL was most impacted for patients suffering from arterial ulcers compared to other wound aetiologies. Patients with non-Chinese ethnicity perceived greater impact on HRQoL compared to other ethnicities. The duration of the chronic wound and the level of exudate impact HRQoL related to mobility. The findings can be used to improve health care delivery for patients with chronic wound to optimise their HRQoL. This could, for example, be done by targeting areas in which patients experience the lowest HRQoL and provide treatments to alleviate problems related to that specific domain of health.

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CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

AUTHOR CONTRIBUTIONS

All authors contributed to and approved the final manuscript.

DATA AVAILABILITY STATEMENT

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

ORCID

Xiaoli Zhu  <https://orcid.org/0000-0003-3406-6203>

Ram Bajpai  <https://orcid.org/0000-0002-1227-2703>

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