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ABSTRACT

Background: Health literacy refers to the skills and resources needed to find, understand and use information and services to maintain good health. Health-related quality of life refers to a person's perception of his or her health status, i.e., physical, social and mental well-being. The objective was to describe health literacy and analyze the relationships with quality of life and the socio-demographic and clinical characteristics of people with type 2 diabetes in Ouagadougou, Burkina Faso.

Methods: This cross-sectional study involved 175 patients with type 2 diabetes recruited from the specialized departments of 5 hospitals. Health literacy was assessed by the multidimensional *Health Literacy Questionnaire* (HLQ) and quality of life by the EQ-5D-5 L (EuroQol, 5 dimensions and 5 levels). Standardized differences in means (*effect size*) were used to describe the magnitude of differences between subgroups.

Results: 80.5% of patients in the sample were under 60 years of age. There were more women (70.3%) than men, 77.7% of patients had less than a high school education and 57.7% were employed. The most significant health literacy difficulties were found for the scales "Appraisal of health information" (mean = 2.57 [2.48 - 2.66]), "Navigating the health care system" (mean = 2.95 [2.84 - 3.06]), and "Ability to find good health information" (mean=2.96 [2.84 – 3.09]). In terms of quality of life, the "Pain/discomfort" dimension was the most impaired. Small to large standardized differences were observed for several HLQ scales according to gender, education level, employment status, family history status, length of time with diabetes and blood glucose level. There was a significant correlation between the HL and HRQoL scales (r from 0.31 to 0.49).

Conclusion: This study objectively assessed the diversity of health literacy profiles on all scales of HLQ according to the socio-demographic status and specific characteristics of patients with type 2 diabetes. Building on the diverse health literacy needs can be a strategy to help reduce inequalities and improve quality of life in type 2 diabetes.

1. Introduction

According to the World Health Organization (WHO), health literacy (HL) refers to the cognitive and social skills that determine an individual's motivation and ability to access, understand and use information appropriately to maintain good health [1]. The HL was originally introduced in the 1970s to assess individuals' skills in reading, understanding health terms or expressions, and numeracy, primarily through functional tests. Later, the concept developed and expanded to include many factors that affect an individual's ability to obtain, understand and use health information and health services [2,3]. Health and social policies have shown that HL is a key determinant of an individual's ability to manage health optimally and of the ability of a health system to ensure equitable access to and use of services [4-6]. Previous studies have shown that low HL is associated with high mortality [7], hospitalizations [8,9] decreased use of preventive health care services [10], decreased adherence to prescribed medications [11], communication difficulties with health care professionals [12], and decreased knowledge of disease processes

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and self-management skills in people with diabetes and hypertension [13-15]. In the specific case of type 2 diabetes, a systematic review on the association between health literacy and type 2 diabetes showed that HL contributes to improved diabetes knowledge, physical activity and quality of life. However, this review suggests that the association between HL and glycaemic control, foot care and medication adherence was inconclusive [16]. Finally, low HL is also associated with increased health care costs [17]. HL is an indicator of good quality care for long-term conditions [18] because the management of these conditions requires that patients adhere to patient-centered care [19] and understand health information to actively participate in care [14]. Due to the lack of data on the role of HL in low-resource countries such as Burkina Faso, there was a need to explore the relationship between HL and the socio-demographic and clinical characteristics of patients followed for type 2 diabetes (T2D). In sub-Saharan Africa, the International Diabetes Federation (IDF) estimates the number of T2D patients to be 19.4 million in 2019 with a projection of 47.1 million in 2045 [20]. Because T2D is a chronic disease, patients have to cope with it throughout their lives.

Moreover, in the context of chronic diseases, health-related quality of life (HRQoL) is a major factor in medical decision-making as much as the efficacy and safety of treatments [21]. The WHO defines HRQoL as "an individual's perception of his or her place in life, in the context of the culture and value system in which he or she lives, in relation to his or her goals and expectations, norms and concerns" [22]. A chronic condition such as diabetes interferes with an individual's well-being, and if some of their needs are not met because of the disease, their HRQoL is reduced [23]. Considering the relationship between HL and HRQoL, the results from the literature seem mixed. A cross-sectional study conducted in 2016 in Tehran, Iran [24] showed a positive and significant correlation between HL and HRQoL in patients with hypertension. Similarly, another cross-sectional study showed that low diabetes-specific HL was associated with deterioration of HRQoL in elderly people with pre-diabetes in rural China, particularly in mental health components [25]. Finally, in a longitudinal study conducted in Canada, Al Sayah et al. [26] showed that low HL was associated with poorer HRQoL in adults with T2D, particularly in mental health components.

In sub-Saharan Africa, there is very little evidence on the relationship between HL and HRQoL. In Ghana, the cross-sectional study by Kugbey et al. in 2019 examined the relationship between high levels of HL and improved HRQoL in women with breast cancer by reducing levels of anxiety and depression [27]. Another study conducted in 2018 in Ghana as part of universal health coverage (UHC) showed that poor HRQoL was associated with low HL and lack of health insurance among rural and urban adults [28]. Based on these data, it seems likely that HL has a positive relationship with the HRQoL of patients with a chronic disease such as T2D. The majority of studies, however, rely on a global or functional measure rather than a fine multidimensional analysis of HL, and there is no evidence to date in the context of sub-Saharan Africa, particularly in Burkina Faso.

The main objective of the present study was to describe HL profiles and explore the relationship between HL and the socio-demographic and clinical characteristics of patients followed T2D, using a multidimensional tool for a fine analysis of the relationship between HL and HRQoL in type 2 diabetics followed in hospitals in the city of Ouagadougou. We hypothesized that patients with a low level of HL would report a lower HRQoL.

2. Materials and methods

2.1. Type of study

This is a cross-sectional study conducted over a three-month period between March and May 2019. The study population was composed of type 2 diabetic patients recruited from the diabetology departments of five hospitals in the city of Ouagadougou.

2.2. Study sites

Five sites were selected for this study. These sites were selected because they were the health care referral centers in the city of Ouagadougou likely to have the bulk of diabetic patients treated on an outpatient basis. They are the University Hospital Center-Yalgado, the University Hospital Center-Bogodogo, the University Hospital Center-Tingandogo, the Saint-Camille Hospital and the Protestant Hospital Schiphra.

2.3. Study population and sampling

The source population consisted of type 2 diabetic patients treated on an outpatient basis. The sampling frame included lists of visits to diabetes services. The sample was obtained by simple random sampling from merged diabetes consultation lists using the sampling function of R. The statistical individual was the type 2 diabetic patient aged at least 18 years without upper age limit, residing in the city of Ouagadougou, diagnosed for at least 6 months. The exclusion criteria were as follows: i) hearing or visual impairment; ii) type 1 diabetes or gestational diabetes.

2.4. Sample size

The number of subjects required was calculated using the Bonett function [29] using R software. This function calculates the sample size needed to estimate a selected Pearson correlation coefficient with a given alpha significance and a width of the confidence interval. The values of the arguments of this function were as follows: risk alpha = 0.05; minimum expected correlation coefficient $\rho = 0.3$ (main judgment criterion) and confidence interval CI2w = 0.3. Thus, the number of subjects required was estimated at 143 patients with type 2 diabetes. The minimum correlation coefficient of 0.30 was set with reference to the meta-analysis of Zheng et al. [30] in which a robust correlation coefficient of 0.35 was estimated between HL and HRQoL.

2.5. Data collection tools

The HL was assessed using the HLQ (Health Literacy Questionnaire) [31], a multidimensional questionnaire with robust psychometric properties, composed of 9 independent scales, each with 4 to 6 items. The HLQ has been translated and validated in several languages [32–34]including French [34].

The nine scales are

1) Feeling understood and supported by health care providers.
2) Having sufficient information to manage my health.
3) Actively managing my health.
4) Social support for health.
5) Appraisal of health information.
6) Ability to actively engage with healthcare providers.
7) Navigating the healthcare system.
8) Ability to find good health information.
9) Understand health information enough to know what to do.

For the first 5 scales, responses are rated: 1= Strongly Disagree; 2= Disagree; 3= Agree; 4= Strongly Agree. For the second part of the HLQ (scales 6 to 9), responses are rated: 1 = Impossible or always difficult; 2 = Generally difficult; 3 = Sometimes difficult; 4 = Generally easy; 5 = Always easy. For all scales, a higher score reflects a higher level of HL.

HRQoL was assessed using the French version of the EuroQol questionnaire, with 5 levels of severity for each of the 5 dimensions (EQ-5D-5 L) [35]. The EQ-5D-5 L is a generic European HRQoL

measure developed by the EuroQol group [36]. The EQ-5D-5L consists of two parts. The first part assesses five dimensions of health: Mobility, Self-care, Usual activities, Pain /Discomfort and Anxiety/Depression. The responses in this section are in five points according to the severity of the problems (1 absent; 2 mild; 3 moderate; 4 severe and 5 extreme). The second section is a visual analogue scale "EQ-VAS" that gives a subjective individual assessment of health status using a thermometer-like scale from 0 to 100. 0 being the worst health status and 100 being the best possible health status. The patient is required to indicate their health status of the day by placing a cross (x) in a box at the corresponding level on the scale. As the HLQ and EQ-5D-5L questionnaires are protected by copyright, we had requested and obtained licenses from the authors. (HLQ license number: L18106IS; EQ-5D registration number: 27,589). Socio-demographic, clinical and biological data were systematically collected from all subjects participating in this study using an open-ended questionnaire.

2.6. Data collection

Before collecting data in real-life situations, we checked the comprehension of the HLQ and EQ-5D questionnaire items on a few patients who could neither read nor write French. There was no explicit local cross-cultural adaptation of the data collection tools (HLQ and EQ-5D-5L). On the other hand, we checked the comprehension of the questionnaire items by our target audience by means of an apparent validity pre-test (cognitive interview test). All the questionnaires were administered face-to-face, essentially in French and Mooré (the majority languages in Ouagadougou). We wanted to use this summary test to ensure that the patients understood the questions asked and were able to answer without difficulty.

For the apparent validity pre-test, we administered the questionnaire to a convenience sample of diabetic patients who came for consultation (11 patients for HLQ and 10 for EQ-5D-5L). This sample included 8 French speaking patients and 3 patients who did not understand French. The 44 HLQ items were randomly selected and distributed among the patients, i.e. 4 items per patient. Each of the 10 patients answered 5 items from the 5 domains of the EQ-5D-5L. The "think aloud" method was used to have the participant answer the questions aloud (Knafl et al., 2007). For each item on the questionnaires, the participant was asked to say verbally what they think, and their comments were noted. "What do you understand about this statement? Is it clear to you? Are there any words that are difficult for you to understand? These are the questions that were essentially asked.

The results of the pre-test showed that the patients had a fairly good level of understanding of the questionnaires. They did not have major difficulties in answering the questions. Furthermore, the proportion of patients who were likely to not understand the items on the questionnaires was marginal in our final study sample.

Data collection took place between March and May 2019. Data collection was carried out with the help of the doctors who consulted the patients. After the routine consultation, the doctors (informed about the study during meetings organised in each department) also administered the HLQ and EQ-5D-5L questionnaires. Patient medical records were then consulted for the collection of clinical and biological characteristics of the patients.

2.7. Ethical considerations

The study received ethical approval from the Health Research Ethics Committee (CERS) of Burkina Faso on March 06, 2019 (Deliberation No. 2019−3−041). Participation in the study was entirely voluntary. However, all study participants gave their written consent. Confidentiality and anonymity of patient data were guaranteed.

2.8. Statistical analysis of data

For patients' HL and HRQoL levels, automated Excel spreadsheets were used to calculate scores for the nine HL scales as well as HRQoL scores from patients' responses to the two administered questionnaires (HLQ and EQ-5D-5L respectively). The HRQoL score was determined using five-digit health profiles (or health states) for the five EQ-5D-5L domains described above. These scores were calculated using an algorithm developed from local population preferences for different health states [37]. This score, called the EQ-5D score, ranges from 0 to 1 (1 being the best possible health state, 0 being the worst possible health state). To our knowledge, no study has yet evaluated the local preferences of the Burkinabe population for different health states with respect to the EQ-5D questionnaire. For this reason, we used an existing data set developed by another African country, Zimbabwe [38].

Descriptive statistics were calculated for the sociodemographic and bio-clinical characteristics of the patients in the sample. Quantitative variables are presented by their mean (standard deviation) [95% confidence interval]. For all HLQ scales, the assumptions of normal distribution and variance homogeneity were not met. We therefore used a robust analysis of variance (ANOVA) for the analysis of HL scores using Welch's method [39]. Post hoc tests were performed using the Games-Howell method of multiple comparisons of means [40]. Effect sizes (ES), i.e. standardized differences in the means between the compared groups were calculated using Cohen's d (calculated as the difference between the two means, divided by the common standard deviation of the two means) [40] with the following interpretation: ES = 0.20 corresponds to a "small effect", ES = 0.50 corresponds to a "medium effect", and ES = 0.80 corresponds to a "large effect" [41]. A Pearson correlation analysis was performed to estimate the bivariate associations between each of the HL and HRQoL scales. All analyses of HL scores and socio-demographic characteristics as well as correlation analyses were carried out using version 4.0.2 of R software and the *rstatix* and *effectsize* packages [42,43]. A value of $p < 0.05$ was considered statistically significant for all bilateral tests used.

3. Results

3.1. Socio-demographic characteristics of patients

A total of 203 diabetic patients were included in the sample, 11 refused to participate in the study and 8 did not complete the questionnaires due to time constraints. Nine patients were withdrawn from the study due to missing data on more than 50% of the questionnaire items. In the end, 175 patients actually completed the questionnaires. Table 1 presents the sociodemographic and bio-clinical characteristics of the participants. The majority (80.5%) of the patients in the sample were under 60 years of age. There were more women (70.3%) than men, 77.7% of the patients did not have a high school education (junior high or high school) and 57.7% were employed.

3.2. Health literacy scores

Table 2 summarizes patients' HL scores. For the first five HLQ scales, the highest mean score was observed on Scale 3 "Actively managing my health" (mean = 3.07; 95% confidence interval [3.00 - 3.13]) and the lowest mean score was observed on Scale 5 "Appraisal of health information" (mean = 2.57 [2.48 - 2.66]). For the other four HLQ scales, the mean scores were quite low overall, but with a wide range of profiles. The highest score was obtained on scale 6 "Ability to actively engage with healthcare providers" (mean = 3.08 [2.96 - 3.20]), while the lowest mean score was obtained on scale 7 "Navigating the health care system" (mean = 2.95 [2.84 - 3.06]).

Table 1
Socio-demographic characteristics of patients (n = 175).

	n	(%)
Female Sex	123	(70.3)
Age < 60 years old	141	(80.5)
No secondary education	136	(77.7)
Employee	101	(57.7)
> 3 years with diabetes	130	(74.2)
Have a family history of diabetes	104	(59.4)
Under antidiabetic treatment	158	(90.2)
Overweight (BMI ≥ 25)	152	(86.8)
Hyperglycemia (fasting blood glucose ≥ 7 mmol/L)	171	(97.7)

Abbreviation: BMI = Body Mass Index.

3.3. Health-Related quality of life

The average HRQoL scores on both scales are high: 0.80 (0.1) and 79.68 (7.1) for the EQ-5D and the EQ-VAS scores, respectively. For each dimension, the five modalities have been recoded into two: "No problem" if the patient indicated 1 for the dimension value and "Mild to Extreme Degradation" for all other values, i.e. 2 to 5 (indicating a level of mild, moderate, severe or extreme problem). Descriptive statistics calculated on the EQ-5D dimensions recoded into two modalities showed that the proportion of patients who reported a health problem was always less than 50% except for the "Pain/Discomfort" dimension where 53.1% of patients indicated a deterioration (Table 3).

3.4. Correlation between health literacy and quality of life

Table 4 shows the associations between HL scales and socio-demographic, bio-clinical and HRQoL dimensions. HL was moderately correlated with HRQoL. The correlation between the 9 HLQ scales and the 2 EQ-5D-5 L scales ranged from 0.31 to 0.49 Table 5.

3.5. Association between health literacy, socio-demographic and clinical characteristics

Table 5 shows the analysis of differences between subgroup means based on effect sizes (ES). . The smallest significant difference was observed between employees and non-employees for scale 4 "Social support for health" (ES = −0.33 [−0.64, −0.03]). Employees were more likely to score higher than non-employees. The largest of the significant differences is observed for patients' glycaemic level for scale 1 "Feeling understood and supported by healthcare providers" (ES = −0.89 [−1.88, 0.11]). Patients with blood glucose levels below 7 mmol/L were more likely to have high scores on the "Feeling understood and supported by health care providers" scale 1 than patients with blood glucose levels above the 7 mmol/L threshold. On all HLQ scales, men had higher scores than women (effect sizes ranged from small: (−0.37 [−0.69, −0.04]) to medium: (−0, 65 [−0, 98, −0, 32]). Small" to "large" differences were observed across all HLQ scales depending on employment status. Employed patients scored higher than their non-employed counterparts in all HLQ domains (effect sizes ranged from (−0.33 [−0.64, −0.03]) to (−0.88 [−1.20, −0.57])). Similarly, "small" to "large" differences were found for all scales of HLQ by family history of diabetes. Patients who reported a family history of diabetes were likely to have lower scores on all scales of HLQ (effect sizes ranged from (0.42 [0.11, 0.72]) to (0.80 [0.49, 1.12])). No significant differences were found in the HLQ scores for the age and body mass index variables.

Table 2
Patient health literacy scores (n = 175).

	Average (SD)	95% CI
Health Literacy Scales (HLQ)		
	Score from 1 (lowest) to 4 (highest)*.	
Scale 1: Feeling understood and supported by health care providers	2.65 (0.69)	[2.55 – 2.75]
Scale 2: Having sufficient information to manage my health	2.71 (0.62)	[2.61 – 2.80]
Scale 3: Actively managing my health	3.07 (0.42)	[3.00 – 3.13]
Scale 4: Social support for health	2.94 (0.55)	[2.86 – 3.02]
Scale 5: Appraisal of health information	2.57 (0.60)	[2.48 – 2.66]
	Score from 1 (lowest) to 5 (highest)*.	
Scale 6: Ability to actively engage with healthcare providers	3.08 (0.81)	[2.96 – 3.20]
Scale 7: Navigating the healthcare system	2.95 (0.73)	[2.84 – 3.06]
Scale 8: Ability to find good health information	2.96 (0.86)	[2.84 – 3.09]
Scale 9: Understand health information enough to know what to do	3.03 (0.90)	[2.89 – 3.16]

* Higher scores indicate higher levels of health literacy.
Abbreviations: SD = Standard Deviation; CI = Confidence Interval; HLQ= *Health Literacy Questionnaire*.

Table 3
Patients' health-related quality of life (n = 175).

	N	(%)
Quality of life dimensions		
Mobility		
No problem	128	(73.1)
Slight to extreme degradation	47	(26.9)
Self-Care		
No problem	112	(64.0)
Slight to extreme degradation	63	(36.0)
Usual Activities		
No problem	91	(52.0)
Slight to extreme degradation	84	(48,0)
Pain/Discomfort		
No problem	82	(46.9)
Slight to extreme degradation	93	(53.1)
Anxiety/Depression		
No problem	100	(57.1)
Slight to extreme degradation	75	(42.9)
EQ-5D score: mean(SD)	175	0.80 (0.1)
EQ-VAS Score : mean (SD)	175	79.7 (7.1)

EQ-VAS = EQ-5D Visual Analogical Scale; SD= Standard deviation.

4. Discussion

Difficulties in accessing relevant and useful health information and services for a chronic disease such as type 2 diabetes are often major barriers to preventing complications and maintaining good HRQoL [26,30]. Research has shown that inadequate HL is independently associated with lower utilization of preventive health services [10] and is a barrier to education for patients with chronic diseases [13,44]. This study identified the diversity of HL profiles in a sample of patients with T2D in Burkina Faso, a country with limited resources. There was a significant correlation between the HL and HRQoL scales. Overall, the results of the study show that T2D patients have difficulties in managing health information but have the capacity to actively manage their health and to engage with health professionals. These results suggest that health practices or policies in T2D rely on this diversity of HL profiles to provide an appropriate response to inequalities and improve patients' HRQoL.

The analysis of HL profiles showed notable difficulties in the population studied, particularly in the management of health information (scales 2, 5, 8 and 9), but also in the relationship with health personnel (Feeling understood and supported by HCP, scale 1) and in the ability to navigate the health system (scale 7). On the other hand, assets were identified in terms of social support (scale 4), active health management (scale 3), and the ability to engage with health professionals (scale 6). Beyond this "average" profile of our

Table 4
Correlation between quality of life and health literacy (n = 175).

Health Literacy Scales	Quality of Life Scales			
	EQ-5D score(r Pearson)	*95% CI*	EQ-VAS Score(r Pearson)	*95% CI*
Scale 1: Feeling understood and supported by health care providers	**0.46**	[0.34 – 0.57]	**0.46**	[0.33 – 0.57]
Scale 2: Having sufficient information to manage my health	**0.41**	[0.28 – 0.52]	**0.46**	[0.34 – 0.57]
Scale 3: Actively managing my health	**0.42**	[0.29 – 0.56]	**0.48**	[0.36 – 0.59]
Scale 4: Social support for health	**0.42**	[0.29 – 0.54]	**0.31**	[0.17 – 0.44]
Scale 5: Appraisal of health information	**0.35**	[0.22 – 0.48]	**0.37**	[0.23 – 0.49]
Scale 6: Ability to actively engage with healthcare providers	**0.46**	[0.34 – 0.57]	**0.47**	[0.35 – 0.58]
Scale 7: Navigating the healthcare system	**0.41**	[0.28 – 0.53]	**0.44**	[0.32 – 0.56]
Scale 8: Ability to find good health information	**0.47**	[0.35 – 0.58]	**0.49**	[0.36 – 0.59]
Scale 9: Understand health information enough to know what to do	**0.43**	[0.30 – 0.55]	**0.45**	[0.32 – 0.56]

population, however, individual diversity must be emphasized. The low score on scale 5 was expected [45], given that the evaluation of health information falls within the critical area of HL and, in general, individuals have more difficulties on this scale. These results reveal the readiness of T2D patients to actively manage their health and cooperate with health care providers, but on the other hand, they experience difficulties in evaluating the information received from health care professionals. Similarly, they have difficulty navigating the health care system for the proper management of their diabetes.

This study is important in the context of Burkina Faso with limited resources, as regard to a chronic disease such as T2D. Health literacy needs assessment is an important prerequisite to foster appropriate self-management of T2D and treatment adherence [19] and to respond to these needs in adopting more resilient and effective health policies. in a country such as Burkina Faso, communicable diseases such as malaria, tuberculosis, and HIV/AIDS account for a significant proportion of morbidity, but increasingly, non-communicable diseases such as diabetes are now an additional burden on the health system [20].

This study was needed to identify HL profiles and to analyze relationships with HRQoL and the socio-demographic and clinical characteristics of T2D patients in order to help lay the foundation for therapeutic strategies focused on the T2D patient.

4.1. Association between health literacy and quality of life

Our main hypothesis was that patients with low levels of HL would report lower HRQoL. We found that there was a significant correlation between the HL and HRQoL scales. In our study, high HL scores in each of the 9 scales of the multidimensional HLQ was associated with better HRQoL in patients with type 2 diabetes, indicating that HL may explain a significant part of the HRQoL level in these chronically ill patients. Zheng et al. [30] found by meta-analysis that HL assessed via heterogenous measures, mainly functional HL or brief screening, was moderately correlated with HRQoL ($r = 0.35$; $p < 0.05$). This is also the case in the study by Al Sayah et al. who showed that brief HL screening with 3 questions assessing understanding written information, filling out medical forms by yourself, and needing help for reading health-related materials was moderately associated with changes in HRQoL in patients with type 2 diabetes [26].

4.2. Association between health literacy and socio-demographic and clinical characteristics

The objective of this study was also to describe HL in different subgroups. Small to large differences in HL were identified. The specific groups with lower HL scores were women, patients with no schooling or primary education, non-employees, patients with a duration of diabetes greater than or equal to 3 years, patients with a family history of diabetes, patients on antidiabetic therapy and patients with high fasting blood glucose (≥ 7 mmol/L).

The socio-demographic variables associated with significant differences in HL were gender, education, and employment status. On all scales, males were more likely than females to have high scores. This finding was consistent with the work of Beauchamp et al. in Australia [46] who also found lower HL scores for women on scale 4 "Social support for health" and scale 6 "Ability to actively engage with healthcare providers", but the effect sizes were very small. In our study, the effect sizes associated with gender differences in HL ranged from "small" to "medium".

We found a positive association between education level and HL scores, as in other studies [47–49]. It is commonly accepted that educated people would have an easier time finding quality health care and understanding health information.

In our study, employees were likely to score higher on all HL scales. The effects of the differences were "small" to "large". This result is also consistent with previous studies [50,51]that have found a positive relationship between an individual income level and HL.

With respect to the specific characteristics of T2D, we found significant differences in HL by the duration of diabetes. Patients with less than 3 years duration of diabetes were likely to have better scores on all HL scales except scale 4 "Social support for Health". This finding reveals HL difficulties in the oldest T2D patients. This result is probably to be nuanced by the fact that patients with a duration of diabetes longer than 3 years were mostly women (74%), had not completed high school (78%) and were not employed (52%); these specific subgroups have lower HL scores.

Reporting a family history of diabetes also appeared to be a factor associated with low HL scores on all HLQ scales. Interestingly, when we extract from our sample the T2D patients who reported a family history of diabetes, similar characteristics are found with those with a duration of diabetes greater than 3 years. Indeed, patients relating a family history of diabetes were mostly women (76%), had not completed high school (83%) and were not employed (55%).

Patients using diet alone as a treatment strategy were likely to score higher on the HLQ Scale 3: "Actively managing my health" than their counterparts on diabetes therapy. This finding is interesting given that in T2D follow-up, active health management through diet and physical activity is an important factor in better diabetes control. Furthermore, it has been shown that among people with T2D, diet and physical activity were the aspects of disease management that much more likely to be actively invested in than those related to treatment and follow-up [45,52].

In our study, high fasting blood glucose (≥7 mmol/L) was associated with low scores on the HLQ Scale 1 alone: "Feeling understood and supported by healthcare providers". This difference had the largest effect size in our sample (−0.89 [−1.88, 0.11]). The same trend is found for the highest duration of diabetes. These data underscore the importance of relationship with and trust of health care providers in the management and control of disease.

No significant differences were found between age and HL scales. This result is consistent with the work of Larsen et al. [51]. Unlike our

Table 5
Association between health literacy. socio-demographic and bio-clinical characteristics.

	(1) Feeling understood and supported by health care providers				(2) Having sufficient information to manage my health				(3) Actively managing my health			
	n	Mean (SD)	*P-value*	Effect size (95% CI)	n	Mean (SD)	*P-value*	Effect size (95% CI)	n	Mean (SD)	*P-value*	Effect size (95% CI)
Sex												
Male	52	2.96 (0.58)	***<0.001***	−0.65 (−0.98. −0.32)	52	2.94 (0.57)	***0.001***	−0.54 (−0.87. −0.21)	52	3.20 (0.36)	***0.004***	−0.44 (−0.77. −0.11)
Female	123	2.53 (0.69)			123	2.62 (0.62)			123	3.02 (0.44)		
Age												
< 60 years old	141	2.67 (0.67)	*0.558*	0.12 (−0.25. 0.50)	141	2.74 (0.61)	*0.202*	0.26 (−0.12. 0.63)	141	3.07 (0.41)	*0.840*	0.04 (−0.33. 0.42)
≥ 60 years old	34	2.59 (0.76)			34	2.58 (0.66)			34	3.06 (0.48)		
Completed secondary education												
Yes	39	2.95 (0.64)	***0.002***	−0.56 (−0.92. −0.20)	39	2.92 (0.57)	***0.013***	−0.44 (−0.80. −0.08)	39	3.27 (0.28)	***<0.001***	−0.61 (−0.97. −0.25)
No	136	2.57 (0.68)			136	2.65 (0.63)			136	3.01 (0.44)		
Professional situation												
Non-salaried employee	74	2.35 (0.67)	***<0.001***	−0.85 (−1.16. −0.53)	74	2.42 (0.57)	***<0.001***	−0.88 (−1.20. −0.57)	74	2.92 (0.48)	***<0.001***	−0.64 (−0.95. −0.33)
Employee	101	2.88 (0.61)			101	2.93 (0.57)			101	3.18 (0.35)		
Diabetic seniority												
< 3 years	45	2.91 (0.62)	***0.003***	0.51 (0.17. 0.85)	45	2.98 (0.51)	***<0.001***	0.59 (0.25. 0.94)	45	3.19 (0.36)	***0.017***	0.39 (0.05. 0.73)
≥ 3 years	130	2.57 (0.69)			130	2.62 (0.63)			130	3.03 (0.44)		
Family history of diabetes												
Yes	104	2.47 (0.70)	***<0.001***	0.72 (0.41. 1.03)	104	2.57 (0.62)	***<0.001***	0.57 (0.26. 0.88)	104	2.98 (0.46)	***<0.001***	0.56 (0.25. 0.86)
No	71	2.93 (0.56)			71	2.92 (0.58)			71	3.21 (0.33)		
Type of treatment												
Anti-diabetic treatment	158	2.63 (0.69)	*0.136*	0.37 (−0.14. 0.87)	158	2.69 (0.62)	*0.145*	0.41 (−0.09. 0.91)	158	3.05 (0.43)	***0.020***	0.50 (−0.01. 1.00)
Diet alone	17	2.88 (0.63)			17	2.94 (0.66)			17	3.26 (0.31)		
Body Mass Index												
Normal Body Build (18.50 - 24.99)	23	2.73 (0.73)	*0.613*	0.12 (−0.32. 0.56)	23	2.80 (0.70)	*0.493*	0.17 (−0.27. 0.61)	23	3.18 (0.42)	*0.188*	0.30 (−0.14. 0.74)
Overweight (≥ 25.00)	152	2.64 (0.68)			152	2.70 (0.61)			152	3.05 (0.42)		
Blood glucose												
Normal blood glucose (< 7 mmol/L)	4	3.25 (0.35)	***0.036***	−0.89 (−1.88. 0.11)	4	2.94 (0.72)	*0.568*	−0.37 (−1.36. 0.62)	4	3.44 (0.33)	*0.102*	−0.89 (−1.89. 0.11)
Hyperglycemia (≥ 7 mmol/L)	171	2.64 (0.69)			171	2.71 (0.62)			171	3.06 (0.42)		

	(4) Social support for health				(5) Appraisal of health information				(6) Ability to actively engage with healthcare providers			
	n	Mean (SD)	*P- value*	Effect size (95% CI)	n	Mean (SD)	*P-value*	Effect size (95% CI)	n	Mean (SD)	*P- value*	Effect size (95% CI)
Sex												
Male	52	3.08 (0.42)	***0.011***	−0.37 (−0.70. −0.04)	52	2.81 (0.54)	***<0.001***	−0.58 (−0.90. −0.24)	52	3.34 (0.81)	***0.006***	−0.47 (−0.80. −0.14)
Female	123	2.88 (0.59)			123	2.47 (0.60)			123	2.97 (0.79)		
Age												
< 60 years old	141	2.93 (0.55)	*0.505*	−0.13 (−0.50. 0.25)	141	2.57 (0.59)	*0.826*	−0.04 (−0.42. 0.33)	141	3.07 (0.81)	*0.759*	−0.06 (−0.43. 0.31)
≥ 60 years old	34	3.00 (0.55)			34	2.59 (0.65)			34	3.12 (0.84)		
Completed secondary education												
Yes	39	3.07 (0.46)	*0.065*	−0.30 (−0.66. 0.06)	39	2.76 (0.61)	***0.034***	−0.40 (−0.76. −0.05)	39	3.31 (0.78)	***0.050***	−0.36 (−0.71. 0.00)
No	136	2.91 (0.57)			136	2.52 (0.59)			136	3.02 (0.81)		
Professional situation												
Non-salaried employee	74	2.84 (0.66)	***0.042***	−0.33 (−0.64. −0.03)	74	2.33 (0.59)	***<0.001***	−0.74 (−1.05. −0.43)	74	2.86 (0.83)	***0.002***	−0.50 (−0.80. −0.19)
Employee	101	3.02 (0.44)			101	2.75 (0.55)			101	3.25 (0.76)		
Diabetic seniority												
< 3 years	45	3.02 (0.43)	*0.196*	0.19 (−0.15. 0.53)	45	2.79 (0.57)	***0.005***	0.49 (0.15. 0.83)	45	3.29 (0.69)	***0.029***	0.35 (0.01. 0.69)
≥ 3 years	130	2.92 (0.59)			130	2.50 (0.59)			130	3.01 (0.84)		
Family history of diabetes												
Yes	104	2.85 (0.61)	***0.004***	0.42 (0.12. 0.73)	104	2.47 (0.57)	***0.008***	0.42 (0.11. 0.72)	104	2.87 (0.81)	***<0.001***	0.69 (0.38. 1.00)
No	71	3.08 (0.43)			71	2.72 (0.61)			71	3.40 (0.71)		
Type of treatment												
Anti-diabetic treatment	158	2.93 (0.56)	*0.277*	0.26 (−0.24. 0.76)	158	2.56 (0.59)	*0.446*	0.22 (−0.28. 0.72)	158	3.04 (0.80)	*0.064*	0.52 (0.01. 1.02)
Diet alone	17	3.07 (0.49)			17	2.69 (0.69)			17	3.46 (0.83)		

(*continued on next page*)

Table 5 (*Continued*)

	(4) Social support for health				(5) Appraisal of health information				(6) Ability to actively engage with healthcare providers			
	n	Mean (SD)	*P- value*	Effect size (95% CI)	n	Mean (SD)	*P-value*	Effect size (95% CI)	n	Mean (SD)	*P- value*	Effect size (95% CI)
Body Mass Index												
Normal Body Build (18.50 - 24.99)	23	3.06 (0.43)	*0.185*	0.25 (−0.19. 0.69)	23	2.64 (0.72)	*0.606*	0.14 (−0.30. 0.57)	23	3.12 (0.84)	*0.819*	0.05 (−0.39. 0.49)
Overweight (≥ 25.00)	152	2.92 (0.57)			152	2.56 (0.58)			152	3.08 (0.81)		
Blood glucose												
Normal blood glucose (< 7 mmol/L)	4	3.30 (0.26)	*0.060*	−0.66 (−1.66. 0.33)	4	3.15 (0.66)	*0.171*	−0.99 (−1.99. 0.00)	4	3.65 (1.11)	*0.375*	−0.72 (−1.71. 0.28)
Hyperglycemia (≥ 7 mmol/L)	171	2.94 (0.55)			171	2.56 (0.59)			171	3.07 (0.80)		

	(7) Navigating the healthcare system				(8) Ability to find good health information				(9) Understand health information enough to know what to do			
	n	Mean (SD)	*P-value*	Effect size (95% CI)	n	Mean (SD)	*P-value*	Effect size (95% CI)	n	Mean (SD)	*P-value*	Effect size (95% CI)
Sex												
Male	52	3.22 (0.68)	***0.001***	−0.54 (−0.87. −0.21)	52	3.34 (0.76)	***<0.001***	−0.64 (−0.97. −0.31)	52	3.26 (0.83)	***0.023***	−0.37 (−0.69. −0.04)
Female	123	2.84 (0.73)			123	2.81 (0.86)			123	2.93 (0.92)		
Age												
< 60 years old	141	2.98 (0.73)	*0.330*	0.19 (−0.18. 0.57)	141	3.01 (0.85)	*0.250*	0.23 (−0.15. 0.60)	141	*3.07 (0.90)*	*0.269*	0.21 (−0.16. 0.59)
≥ 60 years old	34	2.84 (0.75)			34	2.81 (0.89)			34	2.88 (0.90)		
Completed secondary education												
Yes	39	3.21 (0.68)	***0.009***	−0.47 (−0.83. −0.11)	39	3.32 (0.77)	***0.003***	−0.53 (−0.89. −017)	39	3.39 (0.85)	***0.004***	−0.53 (−0.89. −0.17)
No	136	2.88 (0.73)			136	2.87 (0.86)			136	2.93 (0.89)		
Professional situation												
Non-salaried employee	74	2.70 (0.72)	***<0.001***	−0.62 (−0.93. −0.31)	74	2.62 (0.82)	***<0.001***	−0.75 (−1.06. −0.44)	74	2.70 (0.89)	***<0.001***	−0.68 (−0.98. −0.37)
Employee	101	3.14 (0.69)			101	3.23 (0.80)			101	3.28 (0.83)		
Diabetic seniority												
< 3 years	45	3.21 (0.59)	***0.002***	0.48 (0.14. 0.83)	45	3.32 (0.74)	***0.001***	0.56 (0.22. 0.91)	45	3.36 (0.78)	***0.002***	0.51 (0.17. 0.85)
≥ 3 years	130	2.86 (0.76)			130	2.85 (0.85)			130	2.92 (0.91)		
Family history of diabetes												
Yes	104	2.81 (0.75)	***0.001***	0.50 (0.19. 0.80)	104	2.71 (0.89)	***<0.001***	0.80 (0.49. 1.12)	104	2.79 (0.90)	***<0.001***	0.71 (0.40. 1.02)
No	71	3.16 (0.65)			71	3.35 (0.65)			71	3.39 (0.77)		
Type of treatment												
Anti-diabetic treatment	158	2.93 (0.73)	*0.184*	0.33 (−0.17. 0.83)	158	2.93 (0.86)	*0.070*	0.48 (−0.02. 0.98)	158	3.01 (0.90)	*0.289*	0.28 (−0.22. 0.78)
Diet alone	17	3.17 (0.69)			17	3.34 (0.84)			17	3.26 (0.91)		
Body Mass Index												
Normal Body Build (18.50 - 24.99)	23	2.98 (0.82)	*0.842*	0.05 (−0.39. 0.49)	23	3.15 (0.89)	*0.307*	0.24 (−0.20. 0.68)	23	3.12 (0.89)	*0.604*	0.12 (−0.32. 0.55)
Overweight (≥ 25.00)	152	2.95 (0.72)			152	2.94 (0.86)			152	3.02 (0.90)		
Blood glucose												
Normal blood glucose (< 7 mmol/L)	4	3.55 (0.64)	*0.150*	−0.84 (−1.84. 0.15)	4	3.55 (0.64)	*0.159*	−0.69 (−1.68. 0.30)	4	3.85 (0.60)	0.064	−0.94 (−1.93. 0.06)
Hyperglycemia (≥ 7 mmol/L)	171	2.94 (0.73)			171	2.96 (0.86)			171	3.01 (0.90)		

Comparison of the difference in means using a robust ANOVA; effect size (ES) is calculated using Cohen's d for the standardized difference in means. Interpretation of ES: "small" if ES between 0.20 and 0.50. "medium" if ES between 0.50 and 0.80. and "large" ES >0.80; Pearson's r calculated for the quality of life scales; differences statistically (p-value<0.05) are shown in bold.

study, the study by Larsen et al. was based on a population of psoriasis patients in Norway. Similarly, there was no significant difference between body mass index and HL scales in our sample. Conversely, Asian and European studies [53,54]found a significant association between body mass index and LS. This difference in results with our study could be explained by the fact that these studies were conducted in different contexts from ours and, moreover, the tools used were also different.

4.3. Limitations

Our study is limited by the cross-sectional design, the validation of tools only in the French context, and in the recruitment of T2D patients from hospital settings. The cross-sectional design is not appropriate for establishing a causal link between HL and HRQoL. A longitudinal study design would be more appropriate since following patients over the long term engenders conclusions that are more robust. To date, we did not have tools (HLQ and EQ-5D) validated in the context of Burkina Faso, but these tools are still adapted in various contexts [31,55,56] and were entered without identifying any particular problem in our study. Moreover, HLQ validity studies are underway in African countries such as Mali [57], Ghana [58] and Egypt [59], or in populations with a migration background [46,60]. Given that previous studies similar to our study are rare in the African context, our findings should be further supported by evidence from other studies conducted at the national level.

5. Conclusion

This study is the first in Burkina Faso and sub-Saharan Africa to describe HL and HRQoL on T2D. HL in its multidimensional acception was moderately correlated with HRQoL. This study suggests differences in HL on all scales of HLQ according to the socio-demographic status and specific characteristics of T2D patients. Building on HL needs is a potential strategy that should be closely examined to reduce differences in self-management skills and improve HRQoL in T2D patients.

Authors contributions

RN designed the study. MR and PK participated in the data collection. RN, XD, JM and SK participated in the analysis. RN prepared the first draft. RN, XD, MR, PK, JM and SK reviewed the different versions of the manuscript. RN, XD, MR, PK, JM and SK read and approved the final manuscript.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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