



## Quality of life of Moroccan children with celiac disease: Arabic translation and validation of a specific celiac disease instrument



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### ABSTRACT

**Purpose:** Gluten-free diet (GFD) is a lonely lifelong management for patients with celiac disease (CD), which may affect their quality of life (QoL). This can be evaluated by generic or specific instruments. We aimed to translate, validate and cross-culturally adapt a specific-CD instrument to Moroccan-Arabic version (M-CD-DUX), and then apply it to evaluate the QoL of Moroccan celiac children.

**Design and methods:** CD-DUX instrument was translated and culturally adapted, and preliminarily evaluated on 15 children and their proxies. The reproducibility and internal consistency of M-CD-DUX were measured by intra-class coefficient (ICC) and Cronbach  $\alpha$  tests respectively. The statistical analysis of data consisted was conducted using SPSS, and the Goodness-of-Fit test was measured by SPSS AMOS.

**Results:** The reliability of M-CD-DUX instrument showed a good internal consistency and reproducibility. The psychometric properties of M-CD-DUX were acceptable, and the instrument's Model fit was good [(Root Mean Square Error of Approximation = 0.062;  $\chi^2 = 603.08$ ,  $p < 0.001$ ]. M-CD-DUX was completed by 52 celiac children and their proxies. It showed a worse QoL for all items and subscales, and no difference was observed between the QoL of celiac children already under GFD and those recently diagnosed.

**Conclusion:** M-CD-DUX was the first reliable and adapted instrument used to evaluate the QoL of celiac children in an Arab country, emphasizing a negative impact of CD on their QoL.

**Practice implications:** Therefore, improving their QoL requires to make gluten-free products available to them at an appropriate price as well as a good integration into society.

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### Introduction

Celiac disease (CD) is a chronic autoimmune disease triggered by the ingestion of gluten in predisposed individuals which causes a small intestinal villous atrophy (Admou et al., 2009). It manifests as symptomatic or asymptomatic, with frequent systemic manifestations. The diagnosis is usually confirmed by immunological assays and intestinal biopsy (Buzby, 2010; Husby & Murray, 2014). Its overall prevalence is estimated between 0.7 and 1.4%, but varies among regions and ethnic groups (Singh et al., 2018), and may be associated with type 1 diabetes (Erickson et al., 2015).

**Abbreviation:** CD, Celiac Disease; CD-Q, CD-Questionnaire; GFD, Gluten-Free Diet; ICC, coefficient of Intra-Class Correlation; M-CD-DUX, Moroccan version of CD-Dux Questionnaire; QoL, Quality of Life; QoLHR, Quality of Life Health Related.

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A lifetime exclusion of any food containing gluten from the diet remains the only effective treatment (Ludvigsson et al., 2014). Strict adherence to the gluten-free diet (GFD) imposes significant lifestyle changes, which affects the quality of life (QoL) of the celiac patient. According to WHO, QoL is defined 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, and in relation to his or her goals, expectations, norms and concerns” (WHOQOL Group, 1994). Wagner et al. (2008) highlighted the importance of the adherence to the GFD on the QoL of children and adolescents with CD. Many children with CD may feel different or stigmatized when they have to eat gluten-free foods, and the special diet can have negative effects on a social level. Thus, it can affect their QoL (Schroeder & Mowen, 2014; Skjerning et al., 2014). In addition, another factor that may decrease QoL is an ongoing concern regarding cross contamination, especially naturally gluten-free foods (Wolf et al., 2018).

Many instruments have been used to assess the QoL in these categories, such as generic, disease-generic and disease-specific questionnaires

(Yacavone et al., 2001). As generic methods, TACQOL (Loonen et al., 2007) and DUX-25 (Koopman et al., 1998) were used first, while the PedsQL Measurement Model (Varni et al., 2003) and The European KIDSCREEN (Ravens-Sieberer et al., 2014) have recently been taken more into account. Then disease-generic methods were used to assess the QoL regardless of the nature of the disease (Petersen et al., 2005). Recently, disease-specific instruments have been developed and validated for adults, children and adolescents with CD (Guennouni, El Khoudri, Bourrhoutate, & Hilali, 2020). Three of these instruments have been used for adults (CD-Q, CD-QoL and CD-AQ) (Crocker et al., 2018; Dorn et al., 2010; Huuser et al., 2007). For children and adolescents, the CD-DUX method was the first method developed and used in the Netherlands in 2008 (Van Doorn et al., 2008). Five years later, Jordan et al. (2013) developed and validated the CDPQOL method in the USA. The CDQOL method was developed in order to evaluate the QoL of children, adolescents and adults (Skjerning et al., 2017). A cross-cultural translation, adaptation and validation of these methods have been carried out in various countries (Guennouni, El Khoudri, Bourrhoutate, & Hilali, 2020), including CD-DUX in Argentina (Pico et al., 2012), Brazil (Lins et al., 2015), and Spain (Barrio et al., 2016). In the light of our knowledge, no specific instrument aiming to assess the QoL of children and adolescents with CD has been validated to date, neither in Morocco nor in Arab countries.

The objective of this study was first to translate, cross-culturally adapt, and validate a CD-specific instrument, then use it to evaluate the QoL among children and adolescents with CD in Morocco.

## Materials and methods

In order to apply the final Moroccan/Arabic version of CD-DUX to Moroccan children and adolescents with CD, we have carried out the following steps: (i) translation; (ii) cultural adaptation; (iii) calculation of the internal consistency and reproducibility; (iv) validation; (v) calculation of the scores obtained from the items of the final M-CD-DUX and (vi) highlighting the factors influencing QoL improvement. This process was conducted according to IQOLA (International Quality of Life Assessment) project recommendations (Bullinger et al., 1998; Gandek & Ware, 1998; Ware Jr & Sherbourne, 1992).

### Questionnaire

In order to assess the QoL of children (including adolescents) with CD, we used the CD specific questionnaire (CD-DUX) which has been developed and applied by the Netherlands. This instrument is based on 12 items subdivided into three subscales: "Having CD (3 items)", "Communication (3 items)" and "Diet (6 items)", and allows to know how patients feel about the disease (Van Doorn et al., 2008). Responses obtained using this instrument were assessed by the Likert scale, which assigns a score from one to five to each response. Higher scores correspond to a better QoL. This scale is accompanied by facial expressions in pictures, which helps children to respond easily. A version of CD-DUX intended to children and adolescents' caregivers has been developed in order to appreciate their children's feelings towards CD. The overall and subscales scores were transformed into a scale ranging from 0 to 100. The QoL was considered good, neutral, poor and very poor when scores were respectively above 61, between 41 and 60, between 21 and 40, and below 20. The consent from the original author of the CD-DUX was received by email prior to its use. The questionnaire also included socio-demographic and economic aspects (gender, age, living environment, intellectual level, marital status and medical insurance) as well as medical characteristics (height, weight, age at CD diagnosis, adherence to GFD and its duration).

### Subjects

The study focused on children and adolescents with confirmed CD according to Marsh's modified classification (Oberhuber, 2000). They

were members of the Moroccan association of gluten intolerant (AMIAG) and/or the national association of CD and wheat allergies (BASMA). This study targeted children (including adolescents) with CD aged of 8 to 18 years. Seventy-seven patients and their caregivers were targeted by the survey and only 52 of them responded to the questionnaire.

### Translation, cultural adaptation and validation

The validation of the questionnaire to be used in this study was carried out according to the following steps: translation and back-translation of the original version; adaptation to the cultural context of the population; assessment of the comprehension of the questionnaire by a group of participants; and study of the psychometric properties of the translated version.

#### • Translation and back-translation

The translation of the original version of the questionnaire into Arabic was carried out separately by a university professor specializing in translation and a university professor specializing in health sciences. This resulted in a similar version of the questionnaire. The latter was retranslated by two other university professors belonging to similar specialties. The resulting version was then sent to the main author of the original version to verify the conformance of the retranslated version.

#### • Cultural Adaptation and Semantic Evaluation

To adapt the Netherland's original version of the questionnaire to Moroccan culture, some terminological words have been either removed, added or replaced. This process resulted in an easy version for Moroccan children with CD and their proxies to understand, and thus overcoming any difficulties related to intercultural differences.

#### • Pilot Test

The objective of this step was to assess the comprehensibility of all items of the questionnaire. This questionnaire was given to five children with CD and their proxies in order to highlight difficulties in understanding the translated version. The opinions of dieticians and pediatric gastroenterologists have taken into account any changes.

#### • Reproducibility and Internal Validity of the Arabic CD-DUX

To evaluate the consistency of the translated version of the questionnaire, the internal consistency and reproducibility of the items were assessed to 15 children and their proxies. First, reproducibility was assessed by re-administering the questionnaire 7 to 15 days after its first administration to the same participants. This period is considered sufficient to avoid any influence linked to the answers to the first questionnaire. This reproducibility was considered "good" if the ICC was higher than 0.4 (Auquier & Robitail, 2001). The internal consistency between items was assessed by Cronbach  $\alpha$  value, which must be greater than 0.60 to have a "good" internal consistency (Nunnally & Bernstein, 1978). The percentage of responses to all questions was used to measure the feasibility of the instrument (ceiling and floor effects).

### Adherence to gluten-free diet

Children were subdivided into two groups depending on whether or not they were on the GFD. The first group included those newly diagnosed and not yet under GFD, while the second group included those who have already initiated GFD. The influence of adherence to GFD on QoL was assessed by comparing the two groups.

## Moroccan CD-DUX application

The final translated, cross-culturally adapted and validated version was intended for 77 children with CD and their proxies. The number of completed questionnaires was 52 and each questionnaire contained 12 items in Arabic divided into 3 subscales.

### Statistics

The scores obtained in this study were analyzed using SPSS - Statistical Package for Social Logiciel Sciences for Windows (SPSS version 25.0, SPSS Inc., Chicago, IL, USA). The normality of data was assessed using Shapiro-Wilk test, and the homogeneity of the variances was evaluated by Levene test. The normal distribution variables were expressed as means (SD) while the abnormal distribution variables were expressed as medians (IQR). Student's *t*-test was used to assess the independence between quantitative and qualitative variables for two categories and ANOVA test was used to compare variables for three or more categories. The correlation between quantitative variables was measured by Spearman coefficients, and Chi-square test was used to estimate the association between categorical variables. The difference is considered significant when *p*-value is less than 0.05. In addition, the studied psychometric properties of the Moroccan/Arabic version were floor effects (% of patients scoring at the highest score), ceiling effects (% of patients scoring at the lowest score) and reliability (internal consistency and reproducibility). The influence of adherence to the GFD on QoL was assessed by measuring the difference in scores between patients on GFD and those without a diet (at the time of diagnosis). Confirmatory Factor Analysis (CFA) was used to determine construct validity. The Kaiser Meyer Olkin test ( $KMO > 0.5$ ) and the Bartlett Sphericity test ( $p < 0.05$ ) were calculated to verify the possibility of factorizing the data (Galtier, 2003). Each item must represent a communality greater than 0.5 to be included in the CFA. When applying the CFA, factors with an Eigen value greater than or equal to 1 have been maintained. An orthogonal rotation (Varimax) has been applied when the correlation between items is less than 0.3 (Galtier, 2003). The fit of the model has been studied by the calculation of Root Mean Square Residual (RMSR  $< 0.08$ : acceptable fit) and by Chi-squared test ( $p < 0.05$ ) (Schermelleh-Engel et al., 2003).

### Ethics, authorisation and approval

The study focuses on children and their proxies. Therefore, the anonymity of each celiac patient was considered according to recommendations of the Declaration of Helsinki. Permission to use the original version (CD-DUX) has been granted by the developer of the instrument obtained by e-mail from the corresponding author. The study was approved by [removed for blind peer review].

## Results

### Translation, cultural adaptation and semantic evaluation

During the translation and cultural adaptation processes, a discussion was initiated between the members of the translation and cultural adaptation committee on the term "celiac" in Arabic. It was translated as "digestive dysfunction disease". However, the overwhelming majority of patients use the foreign word "coeliaque" in French. Thus, the word "السيلياك", which means CD, has been used in the Arabic version. The original CD-DUX original instrument for children consists of a single version for both girls and boys. However, when translating the original version into Arabic, it was possible to use two versions of the questionnaire, one for girls and another for boys separately; or one common version for both genders. The translation committee judged that the latter version to be most practical and adequate because it contains terms that are suitable for both sexes. Therefore, alphabets have been added in

brackets to certain Arabic verbs to show that the question is also addressed to the female gender. However, no difficulty was found in the translation and culturally adaptation of the versions intended for proxies.

### Reliability (internal consistency & reproducibility), ceiling and floor effect

The results obtained by calculating the values of Cronbach's  $\alpha$  show that the internal consistency of the questionnaire was good either for the children or for their proxies, and Cronbach's  $\alpha$  values obtained were greater than 0.7 (Table 1). The reproducibility was considered as "good" in the proxies through either ICC ( $ICC > 0.4$ ), Spearman's correlation ( $> 0.67$ ) or Wilcoxon's test (non-significant difference). This good reproducibility was noted for all items as well as for each subscale (Table 1). For children, the Wilcoxon's test showed that the reproducibility was considered "poor" only for "Communication" and "having CD" subscales, while it was "good" for "Diet" subscale and for all other items. ICC and Pearson test showed that the reproducibility in children was excellent for all items and for all subscales. It should be noted that this reproducibility was more consistent among the proxies than children (Table 1).

### Socio-economic and demographic characteristics of the participants

The application process of the final version of the instrument was initially intended for 77 children with CD. However, only 52 of them completed the questionnaire, with a response rate of 67.5%. Children living in rural areas were the most represented (86.5%) and the majority were female (65.4%). The average age of the surveyed children was  $13.85 \pm 3.70$  years (range: 8–18 years) and the age group between 13 and 18 years old was the most represented (63.5%). The mean of BMI was  $18.17 \pm 3.64$ , which shows a risk of obesity in only one case. The majority of proxies were married, live in a nuclear family, with an average level of education and have a medical insurance. The disease was diagnosed mainly after atypical manifestations (84.6%), and the majority of them were under GFD (Table 2).

The overall floor and ceiling effects tended to zero for both children and their proxies. The ceiling effect was zero for all subscales, whether for children or proxies. The floor effect was inferior to 4% in all subscales for proxies and children, while only "communication" subscale was high (13%) for proxies (Table 3).

### Confirmatory factor analysis & model fit (construct validity)

Applied to the data collected through the used instrument, the factorizing tests' values of Kaiser Meyer Olkin's and Bartlett's sphericity tests were 0.654 ( $KMO > 0.5$ ) and 187.08 ( $p < 0.001$ ) respectively for children, and 0.693 ( $KMO > 0.5$ ) and 204.06 ( $p < 0.001$ ) respectively for proxies. The Confirmatory Factor Analysis (CFA) showed that all items represented communalities greater than 0.5 and the total variance explained showed that three components represented almost 60% of the total variance. The root mean square error of approximation (RMSEA) was equal to 0.062 ( $< 0.08$ ) and the Chi-square test was equal to 603.08 ( $p < 0.001$ ). This showed that the model fit of this instrument was good. The results of the CFA were illustrated in Table 4, including the factors loadings and the Cronbach's alpha for each scale.

### Application of Moroccan CD-DUX (M-CD-DUX)

The application of the Moroccan version of CD-DUX (M-CD-DUX) showed that the QoL perceived by children with CD and their proxies was respectively equal to  $36.48 \pm 14.98$  and  $29.09 \pm 14.57$ . This led to the conclusion that this QoL was poor for proxies and children. The scores obtained from three subscales (having CD, communication and diet) ranged between 24 and 39 and no subscale reached 40 (neutral QoL). Among all subscales, the scores found for "having CD" subscale remained the most affected (Table 3).

**Table 1**  
a. Reproducibility and Reliability scores of CD-DUX children version (n = 15 participants).

	Score			Spearman's Correlation		Intraclass Correlation Coefficient		Cronbach α
	Test Mean (SD)	Retest Mean (SD)	p+	Correlation	p	ICC	p	
Communication	28.33	46.66	0.001	0.75	0.001	0.72	0.001	0.813
Having CD	38.33	19.47	0.001	0.76	0.001	0.83	0.001	
Diet	33.05	26.11	0.05	0.70	0.003	0.82	0.001	
Total CD-DUX	33.24	30.75	0.36	0.73	0.002	0.87	<0.001	

**Table 1 b.** Reproducibility and Reliability scores of CD-Dux proxy version (n = 15 participants)

	Score			Spearman's Correlation		Intraclass Correlation Coefficient		Cronbach α
	Test Mean (SD)	Retest Mean (SD)	p+	Correlation	p	ICC	p	
Communication	25.55	22.78	0.33	0.67	0.006	0.81	0.002	0.78
Having CD	31.67	27.22	0.18	0.80	<0.001	0.85	0.001	
Diet	35.83	36.94	0.33	0.95	<0.001	0.98	<0.001	
Total CDDUX	31.02	28.98	0.21	0.92	<0.001	0.94	0.001	

ICC: Intraclass Correlation Coefficient; SD: Standard deviation; +: based on the Wilcoxon's test.

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*Child/proxies concordance*

The QoL perceived by parents was poorer compared to that perceived by their children. This difference was globally significant (36.48 ± 14.98 vs. 29.09 ± 14.57; p = 0.012), which was noticeable especially for the “communication” subscale (33.97 ± 19.30 vs. 24.68 ± 17.30, p = 0.011). The difference was not significant for “having CD” and “diet” subscales (p = 0.064 and p = 0.103) respectively (Table 3).

*Influence of socio-economic, demographic and medical characteristics*

The living areas, gender, nutritional status, living condition, and type of CD manifestations had no influence on the total and subscales

**Table 2**  
Socio-economic, demographic and medical characterisation of the study sample (children/proxies) (n = 52).

Characteristics	Category	Number of Respondents (%)
Gender	Female	34(65.4)
	Male	18(34.6)
Place of residence	Urban	45(86.5)
	Rural	7(13.5)
Age(Year)	13.85 ± 3.70	
Age category	[8–13 years]	19(36.5)
	[13–18 years]	33(63.5)
BMI (kg/m2) <sup>2</sup>	18.17 ± 3.64	
BMI category	Underweight	23(44.2)
	Normal	23(44.2)
	Risk of obesity/Obesity	1(1.9)
Educational level	Illiterate	12(23.1)
	Primary	10(19.2)
	Secondary	18(34.6)
	University degree	12(23.1)
Marital status	Married	49(94.2)
	Divorced	3(5.8)
Living condition	Big family	18(34.6)
	Nuclear family	34(65.4)
Medical insurance	Medical assistance regime	7(13.5)
	public	14(26.9)
	Private	14(26.9)
Having CD in family	Without medical insurance	7(32.7)
	No	12(23.1)
Manifestation of CD	Yes	40(76.9)
	Typical form	44(84.6)
GFD adherence	Atypical form	8(15.4)
	Yes	44(84.6)
	No	8(15.4)

scores. However, this QoL was poor in the 8–12 age group compared to the 13–18 age group (30.26 ± 13.59 vs. 40.07 ± 13.60, p = 0.02). QoL was also poor among patients without medical insurance (39.24 ± 15.45 vs. 30.80 ± 12.50, p = 0.041) compared to those with (Table 5).

*Influence of GFD on QoL*

Table 5 shows that no difference was observed in the QoL of patients with CD under gluten-free diet and those who were recently diagnosed. A non-significant difference was also observed regarding the duration of the GFD. Therefore, GFD did not improve the QoL in children with CD.

**Discussion**

Several researchers have used generic methods to assess the QoL of patients with CD, while others have gradually developed specific methods to CD (Guennouni, El Khoudri, Bourrhouat, & Hilali, 2020). These specific instruments allow specialists to better understand the effect of CD on the QoL of their patients in different aspects (Van Doorn et al., 2008). Indeed, the development of such instruments requires the deployment of significant human and financial resources. This is why many authors have adapted and validated already developed instruments. To implement one instrument in another country, a translation, cross-cultural adaptation and validation of the original questionnaire are necessary (Patrick et al., 1994). In this study, we adapted a specific method already developed in Netherlands to assess the QoL of Moroccan children with CD. No difficulties were encountered during the translation and intercultural adaptation process. The psychometric properties of the adapted version including internal consistency, reproducibility, floor and ceiling effects were acceptable. Similar findings were reported by a study previously conducted on both children and adults (Guennouni, El Khoudri, Bourrhouat, & Hilali, 2020). The results obtained from the application of confirmatory factor analysis and model fit allowed to retain the structure of the original version. This structure is composed of 12 items subdivided into three subscales (communication, having CD and diet). Therefore, the application of the final version (M-CD-DUX) to Moroccan children with CD became possible.

Generally, the CD causes a decrease in the QoL of patients with CD (Marchese et al., 2013; Skjerning et al., 2017). Our result is consistent with this conclusion. In fact, the instrument used in our study (M-CD-DUX) showed that the QoL scores were worse than those obtained

**Table 3**  
Data quality and Scores of the Moroccan version of Celiac Questionnaire (M-CD-DUX).

Properties	Measure	Having CD		Communication		Diet		CD-Dux Overall	
		Children	Proxies	Children	Proxies	Children	Proxies	Children	Proxies
Data quality									
Floor effect	% of patients scoring at the lowest score	3.85%	5.77%	1.92%	13.46%	1.92%	0.00%	0.00%	0.00%
Ceiling effect	% of patients scoring at the highest score	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Scores									
	Mean	39.74	32.53	33.97	24.68	35.74	30.05	36.48	29.09
	SD	20.78	18.45	19.30	17.30	17.91	17.31	14.98	14.57
	p	0.064		0.011		0.103		0.012	

SD: Standard deviation.

Model fit is good through SPSS AMOS: Root Mean Square Error of Approximation (RMSEA) = 0.062 and  $\chi^2 = 603.08$ ,  $p < 0.001$ .

**Table 4**  
Factor analysis of the final translated version of M-CD-DUX.

Question	Factor loading			Value of $\alpha$ if it was excluded	Cronbach's $\alpha$
	Communication	Having CD	Diet		
Q3. Talking about my coeliac disease with others my age, I find ...	0.696			0.763	0.798
Q6. When I have to explain to others what coeliac disease is, I feel ...	0.680			0.786	
Q7. Talking about coeliac disease I find ...	0.773			0.796	
Q1. When I think of food containing gluten, I feel ...		0.844		0.774	
Q2. When at school I am given food containing gluten, I find it ...		0.836		0.778	
Q5. When someone offers me food that I can't have, I feel ...		0.733		0.797	
Q4. Not being able to eat just everything, I find ...			0.862	0.817	
Q8. Having to follow a lifelong diet, I find ...			0.717	0.775	
Q9. Having to pay attention to what I eat, I find ...			0.532	0.775	
Q10. Having celiac disease is ...			0.821	0.777	
Q11. Not being able to eat anything I want like other people, I find ...			0.800	0.791	
Q12. Following a diet for my celiac disease is ...			0.590	0.762	

**Table 5**  
Influence of socio-economic, demographic and medical characteristics of sample study on the scores of M-C-DUX.

Characteristic	Having CD		Communication		Diet		CD-Dux Overall	
	Mean (SD)	p	Mean (SD)	p	Mean (SD)	p	Mean (SD)	p
Age category								
[8–13 years]	33.33(21.87)	0.090	25.00(19.24)	0.010	32.45(17.04)	0.321	30.26(13.59)	0.020
[14–14 years]	43.43(19.52)		39.14(17.61)		37.63(18.38)		40.07(13.60)	
Gender								
Female	38.23(21.23)	0.477	37.99(18.02)	0.038	34.19(18.65)	0.398	36.80(15.82)	0.834
Male	42.59(20.19)		26.39(19.85)		38.65(16.51)		35.88(13.66)	
Place of residence								
Urban	40.55(21.29)	0.480	35.55(19.25)	0.136	37.13(15.09)	0.157	37.75(15.09)	0.125
Rural	34.52(17.63)		23.81(17.63)		26.78(20.67)		28.37(12.16)	
Living condition								
Nuclear family	38.97(17.49)	0.376	32.11(19.37)	0.343	34.68(17.64)	0.564	35.25(14.47)	0.420
Big family	41.20(46.52)		37.50(19.23)		37.73(18.77)		38.81(16.06)	
Medical insurance								
No	42.85(22.24)	0.087	36.67(19.30)	0.149	38.21(18.24)	0.144	39.24(15.45)	0.041
Yes	33.33(16.14)		28.43(18.65)		30.63(16.60)		30.80(12.50)	
Nutritional status (BMI category)								
Underweight	37.68(18.44)	0.951	39.88(18.77)	0.856	35.33(17.17)	0.609	35.20(11.92)	0.946
Normal	36.23(19.88)		32.61(19.95)		35.51(19.78)		35.51(16.82)	
Obesity	33.33		41.67		16.67		30.55	
Manifestation of CD								
Typical form	40.72(20.66)	0.432	35.61 (19.52)	0.155	37.12(17.94)	0.194	37.81(14.36)	0.134
Atypical form	34.57(22.02)		25.00(16.06)		28.12(16.78)		29.17(17.17)	
GFD adherence								
Yes	39.39(22.11)	0.779	34.28(19.79)	0.792	35.61(18.18)	0.903	36.43(15.84)	0.948
No	41.67(11.78)		32.29(17.50)		36.46(17.50)		36.81(9.65)	
GFD duration								
[At diagnosis – 2 years]	45.07(20.99)	0.277	32.95(17.15)	0.818	39.58(18.75)	0.237	39.20(12.81)	0.540
[2–5 years]	35.00(19.74)		33.33(20.77)		34.58(17.95)		34.30(16.05)	
Over 5 years	37.50(21.61)		37.50(22.31)		29.58(16.01)		34.86(14.98)	

Statistical analyses were made according to parametric tests: (Student's t-test was used for qualitative variables with two modalities; ANOVA test was used for qualitative variables with three or more modalities).

through the original version of the questionnaire (Van Doorn et al., 2008). However, this QoL was neutral in studies driven in Brazil, Spain and Argentina, using other adapted versions (Barrio et al., 2016; Lins et al., 2015; Pico et al., 2012). In Morocco, the incidence of CD is increasing (El Fakiri et al., 2016), but Moroccan patients with CD suffer from the low availability, high cost and unbalanced nutritional quality of GFP (Guennouni, El Khoudri, Bourrouhouate, & Hilali, 2020; Guennouni, Elkhoudri, Bourrouhouat, & Hilali, 2020). This causes patients with CD to isolate themselves in society with integration difficulties, which has a negative impact on their QoL. The quality of life was negatively impacted by the lack of medical insurance, which confirms the influence of low individual income on QoL, in particular with the exorbitant price of GFP and the low availability of medical centers responsible for monitoring patients with CD in Morocco. Thus, to improve the QoL of patients with a lack of health insurance in our country, several efforts are mandatory to facilitate access to gluten-free products as adopted by several countries. For example, monthly vouchers for patients with CD dedicated to GFPs in Italy (Celiac Disease Foundation, 2018), direct gluten-free food supply in Spain (Asociación de Celiacos de Extremadura, 2015), reduction of taxes on gluten-free foods in Ireland and in USA (Coeliac society of Ireland, 2019; Department of the Treasury Internal Revenue Service of USA, 2019) and reimbursement of GFP consumers in France (Association Française Des Intolérants Au Gluten, 2019). In addition, support for adolescents with lower QoL from their proxies and psychologists is desirable. This will allow them to accept their illness and thus facilitate their integration into society.

GFD plays an important role in improving the QoL of patients with CD, one that has been demonstrated by several studies (Aksan et al., 2015; Barrio et al., 2016; Casellas et al., 2013). Unfortunately, our study did not show a significant difference in the impact of adherence to GFD on QoL between the newly diagnosed group and the group of patients on the gluten-free diet. This could be due to the scarcity of GFPs and their high cost (Guennouni, El Khoudri, Bourrouhouate, & Hilali, 2020). This may also be linked to the lack of compliance with regulations regarding the exact gluten content and/or the labelling of these foods. This can be achieved by overcoming the factors that affect the adherence to GFD (Xhakollari et al., 2019).

The Moroccan celiac proxies find that their children's QoL is low compared to how their children feel ( $p = 0.012$ ). A similar observation was noted during either the development of the original version of the instrument (Van Doorn et al., 2008) or its adaptation in Argentina (Pico et al., 2012) and Brazil (Lins et al., 2015). Conversely, a Spanish study reported a lack of improvement (Barrio et al., 2016) (Table 6). Recently, Abreu Paiva et al. (2019) developed a specific questionnaire (CDPC-QoL) for children with CD proxies in Brazil.

Despite its original character in Arab countries, the present study nevertheless has certain limitations mainly related to the limited number of patients. This would have a particular impact on the evaluation of the psychometric properties of the QoL measuring instrument used and on the possible power of statistical analysis.

**Table 6**

Comparison between total scores of QoL in Children and adolescents/ Parents or guardians by CD-DUX questionnaire.

Country (Reference)	Children and adolescents	Parent or guardian	p
	Total scores: Mean(SD)	Total scores: Mean(SD)	
Netherlands (Van Doorn et al., 2008)	44 (15)	39(15)	<0.05
Brazil (Lins et al., 2015)	57.6 (12.3)	45.4 (10.4)	<0.01
Argentina (Pico et al., 2012)	53.33(17.18)	51.46(14.45)	<0.05
Spain (Barrio et al., 2016)	54.82 (12.30)	5.48 (12.72)	=0.499
Morocco (present study)	36.48 (14.98)	29.09 (14.57)	0.012

## Conclusion

The psychometric properties of the Arabic version (M-CD-DUX) (internal consistency, reproducibility, floor and ceiling effect) and the model fit were good and acceptable, allowing the adapted version to be applied in Morocco. Overall, the QoL of the children with CD in our study was worse, especially in the context of a lack of medical insurance, where even the surveillance of the GFD could not improve their QoL. The Moroccan celiac proxies find that their children's QoL is low when compared to how their children feel. It is therefore important to act on the factors responsible for a failure of GFD compliance, in particular those related to low availability, to the high price and imbalance of nutritional quality of gluten-free foods. Furthermore, public awareness of CD through media and social networks remains a priority for a better understanding of this disease, thus enabling an easy integration of patients with CD in society.

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pedn.2021.06.011>.

## Ethics committee approval

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving research study participants were approved by the the Ethics Committee of the Faculty of Medicine and Pharmacy of Marrakech (Number 029/2020).

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## Conflicts of interest

The authors declare that they have no conflict of interests.

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