Original article

Validation of the French version of the Beliefs about Medicines Questionnaire (BMQ) among diabetes and HIV patients

Validation de la version française du « Beliefs about Medicines Questionnaire » (BMQ) auprès de patients diabétiques et de patients atteints du VIH

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ABSTRACT

Introduction. – Because changing personal beliefs about treatment could help improve adherence, having a validated tool for identifying these beliefs is important.
Objective. – This study sought to validate the French version of the Beliefs about Medicines Questionnaire (BMQ-f©).
Method. – Data were gathered among 253 patients with type 2 diabetes and 123 HIV patients with the help of self-reported questionnaires, including the Beliefs about Medicines Questionnaire, a French adherence assessment, and some demographic variables.
Results. – Confirmatory factor analyses show the French version of the BMQ has the same factorial structure as the English original in both diabetes and HIV samples. All items load on their expected factor, namely specific-necessity, specific-concern, general-harm, and general-overuse. Moreover, each scale revealed good internal consistency and retained the psychometric qualities of the original version. These satisfactory properties were consolidated by predictive validity data that demonstrate the impact of treatment beliefs on adherence levels.
Conclusion. – Findings are discussed in light of previous diabetes and HIV studies. The French BMQ proved to be a good way of quickly identifying inaccurate beliefs about treatment. It could be a useful tool in French clinical practice, such as in patient education.

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RÉSUMÉ

Introduction. – Changer les croyances des patients sur leurs traitements peut aider à améliorer leur adhésion. C'est pourquoi il est important de disposer d'un outil validé pour identifier ces croyances.
Objectifs. – Cette étude visait à valider la version française du « Beliefs about Medicines Questionnaire » (BMQ-f©).
Méthode. – Les données ont été recueillies auprès de 253 patients diabétiques de type 2 et 123 patients atteints du VIH avec des questionnaires auto-reportés incluant la version française du « Beliefs about Medicines Questionnaire », une échelle française mesurant l'adhésion, et des questions concernant les données démographiques.

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Résultats. – Des analyses factorielles confirmatoires ont montré que la version française du BMQ conservait la structure factorielle de la version originale anglaise pour les deux échantillons de patients. Chaque item convergeait sur le facteur attendu (nécessité-spécifique, inquiétudes-spécifiques, dangerosité-générale et sur-utilisation-générale). En outre, ces 4 sous-échelles avaient une bonne cohérence interne et conservaient les qualités psychométriques de la version originale. Ces propriétés psychométriques satisfaisantes sont renforcées par la validité prédictive de l'outil qui atteste du lien entre les croyances sur le traitement et le niveau d'adhésion.

Conclusion. – Les résultats sont discutés à la lumière des études antérieures sur le diabète et le VIH. La version française du BMQ peut être considérée comme un bon outil pour identifier rapidement les croyances erronées sur le traitement. Cet outil pourrait être d'une grande utilité dans la pratique clinique française, comme pour l'éducation thérapeutique.

1. Introduction

Non-adherence continues to be a major barrier to health improvements for patients suffering from chronic diseases (WHO, 2003). Adherence is defined as the extent to which a patient's behavior matches agreed recommendations from the prescriber (Barofsky, 1978). It implies patients have thought about and agreed to their treatment (Horne, Weinman, Barber, Elliot, & Morgan, 2006). There is evidence that low adherence rates in diabetes are problematic (Bailey & Kodack, 2011), leading to complications (Donnelly, Morris, & Evans, 2007) and poor quality of life (Clouet, Excler-Cavailher, Christophe, Masson, & Fasquel, 2001). Even though it is widely recognized that adherence to highly active antiretroviral treatment (HAART) is vital for treatment success, it is often poor in HIV as well (Liu et al., 2001).

With a view to improving patient adherence, several psychosocial models have been proposed to identify the variables that lead patients to take their treatment as prescribed. Leventhal's Common Sense Model of Self-regulation (CSM) conceptualizes adherence as a dynamic phenomenon that is constantly re-assessed by patients (Leventhal, Diefenbach, & Leventhal, 1992). The CSM model identifies four stages. In the first stage, individuals extract information from their social environment, physical sensations and past experience of the illness. In the second stage, they create their own beliefs about their illness. The third stage comprises an action plan and coping procedure (e.g. taking or not taking treatment). During the final stage, patients assess the effectiveness of their actions, and their appraisal serves as feedback for reinforcing or altering their coping procedure and/or their beliefs about their illness.

Beliefs about treatment are relevant when the CSM model is used to understand treatment-related behaviours such as adherence (Leventhal, Brisette, & Leventhal, 2003). Horne has developed a conceptual framework combining specific and general medication beliefs within Leventhal's CSM (Horne, 1999). Beliefs about medication have been linked to adherence in several chronic diseases, including kidney disease and cancer (Horne & Weinman, 1999), asthma (Horne & Weinman, 2002), heart disease (Wray, Waters, Radley-Smith, & Sensky, 2006), hypertension (Ross, Walker, & MacLeod 2004), HIV (Gauchet, Tarquinio, & Fischer, 2007; Horne, Cooper, Gellaitry, Date, & Fisher, 2007) and diabetes (Broadbent, Donkin, & Stroh, 2011). Patients' assessment of specific prescribed medicines is strongly related to adherence, particularly how they rate their need for the treatment (necessity beliefs) versus their concerns about the potential negative effects of taking it (Horne et al., 2007). Furthermore, these specific beliefs are influenced by more general social beliefs about pharmaceutics as a class of treatment (Horne, Parham, Driscoll, & Robinson, 2009). General beliefs may also have a direct impact on adherence (Horne & Weinman, 1999). Since changing beliefs about treatment could help improve adherence, having a

validated tool for identifying these idiosyncratic perceptions is important.

The "Beliefs about Medicines Questionnaire" (BMQ) is a valuable tool for assessing beliefs about treatment. It has good psychometric properties (Horne, Weinman, & Hankins, 1999) and is reliable in terms of adherence (Horne & Weinman, 1999). Created on the basis of the literature and patient interviews, it was validated among 514 patients with chronic illnesses. Its relevance for clinical studies stems from the fact that it assesses both specific and general beliefs. The BMQ-Specific scale measures the perceived need for the prescribed treatment for staying healthy now and in the future, as well as concerns about the potential negative effects of the treatment. The BMQ-General scale assesses the extent to which patients perceive general medicines as harmful substances, and their beliefs about how these are prescribed by physicians.

The BMQ was validated among various samples, such as asthmatic, diabetic, renal, cardiac, psychiatric patients (Horne, Weinman, & Hankins, 1999), as well as patients with a number of mental disorders (Jónsdóttir et al., 2009), rheumatoid arthritis (Kumar et al., 2008), and inflammatory bowel disease (Horne et al., 2009). It was also validated for several languages and cultures: Spanish (Tordera, Moragon, Fuster, Bayo, & Ciscar, 2009), Italian (Tibaldi et al., 2009), German (Mahler et al., 2012), and Japanese (Iihara, Suzuki, Kurosaki, Morita, & Hori, 2010).

The cross-cultural studies confirmed the four-factor measurement model developed by Horne et al. (1999), as well the validity of the questionnaire, but they have their limitations, namely the type of factorial analysis and lack of measurement invariance. All of them used exploratory factorial analysis to measure internal consistency, validity and scale structure, but only the Japanese validation measured the factorial invariance of the questionnaire, and only for specific beliefs (necessity and concerns) without giving any consideration to general beliefs. So one of the strengths of the present study is that it verifies the factor structure of the BMQ with confirmatory factor analysis and examines the measurement invariance in the French population in respect of diabetic and HIV patients.

The aim of our study was first to validate the BMQ in French, with two samples of chronic diseases: diabetes and HIV infection. Our second aim was to test measurement invariance between diabetic and HIV patients to find out whether the BMQ measures constructs with the same meaning across groups and allows for sound quantitative group comparisons. We decided to study those particular two subgroups, because diabetes and HIV are two significant chronic diseases where medication adherence is crucial. Diabetes is commonly used as a representative sample for chronic diseases, including in the original article about BMQ (Horne et al., 1999). Interest in medication adherence with HIV patients has grown exponentially since the beginning of antiretroviral treatment in 1996. Some studies have shown the importance of medication beliefs for medication adherence, especially with HIV

Table 1
Demographic and clinical data for type 2 diabetes and HIV patients.

Measures	Type 2 diabetes patients		HIV patients	
	Mean	SD	Mean	SD
Age (years)	68.7	10.3	39.7	9.2
Educational level (%)				
Primary	22.8		40.9	
Secondary	43.9		37.8	
Higher	33.3		21.3	
Gender (%)				
Male/Female	57/43		78/22	
Marital status (%)				
Single/not single	56/44		62/38	
Time since diagnosis (years)	19	11.93	8	4.41
HbA1c[a] (%)	7.22	1.02		
Viral load (%)				
Detectable/undetectable			51.6/48.4	
Type of treatment (%)				
Oral/injectable	47/53			
Tri/quadri therapy			93.3/6.7	

[a] Glycosylated hemoglobin (HbA1c) was obtained by self-reporting (high level correspond to low glycemic control).

patients (Gauchet et al., 2007). An original feature of this paper is its unprecedented validation of the BMQ among HIV patients. Thirdly, we wanted to investigate whether the BMQ scores were related to medication adherence.

2. Method

2.1. Participants

French-speaking type 2 diabetics were recruited by a trained psychologist from patient associations in Clermont-Ferrand and Paris (France) via postal questionnaires. A total of 651 printed questionnaires were sent, and 253 returned completed. One hundred and forty-four men and 109 women were included in the study. All diabetic patients included in the study were receiving treatment for their diabetes.

French-speaking HIV-positive adults currently prescribed antiretroviral treatment (ART) were recruited from the Regional Hospital in Metz (France). One hundred and seventy-five patients responded initially to recruitment efforts, but 52 of them failed to meet the eligibility criteria. Data from 95 men and 28 women were included in the analyses. All of the participants completed the questionnaire during a face-to-face interview. They were prescribed an average daily dose of 8 (SD = 3.9) antiretroviral pills.

For both samples, patients were included if they had been prescribed some medication to be taken regularly for the treatment of their illness for at least two months prior to the study, and providing they were not psychotic or demented.

The demographic characteristics of the diabetic and HIV participants are set out in Table 1.

2.2. Ethical considerations

The hospital and associations taking part in the study gave their approval for the research project, which was accredited by a French ethics committee (Commission Nationale de l'Informatique et des Libertés). Before being asked to sign the consent form, the patients were informed of the content of the study and assured that they would not be identifiable.

2.3. Procedure

The BMQ was translated into French in accordance with an internationally recommended procedure (Brislin, 1986). First of all, two

French psychologists produced a French translation of the original English version of the BMQ (Horne et al., 1999). The French translation was then translated back into English by a bilingual psychologist blind to the original version. A comparison of the back-translation with the original English BMQ revealed only minor discrepancies. The final version was then submitted to 13 diabetic patients and 10 HIV patients who reported no difficulty understanding and completing the questionnaire.

2.4. Measures

2.4.1. Medication beliefs

The BMQ (Horne et al., 1999) consists of 18 items, each comprising a 5-point Likert scale ranging from 1 "strongly agree" to 5 "strongly disagree". 10 items measure specific beliefs about the prescribed treatment, in terms of its perceived necessity (specific-necessity: e.g., "*My life would be impossible without my medicines*") and concerns about it (specific-concerns e.g., "*Having to take medicines worries me*"). A further 8 items measure general beliefs about medicine, including perceptions of harm (general-harm, e.g., "*Medicines do more harm than good")* and overuse (general-overuse e.g., "*Doctors use too many medicines*"). For each, a total score was computed by adding together items' reverse scores. Each specific belief (specific-necessity and specific-concerns) scored between 5 and 25, and each general belief (general-harm and general-overuse) between 4 and 20. Higher values denote stronger beliefs. For specific beliefs, a differential score was computed by subtracting specific-concerns from specific-necessity (necessity-concerns differential). For this additional score, a value above 0 means the perceived necessity of the treatment exceeded the concerns about taking it.

2.4.2. Adherence

We used a French scale developed with HIV patients to measure specific adherence (Tarquinio, Fischer, & Grégoire, 2000). Respondents indicate to what extent they agree with 6 statements describing how they take their treatment *(e.g., "I comply with all medical prescriptions"*) using a 5-point Likert scale ranging from 1 (never) to 5 (always). A total score was calculated by adding together the scores for each of the 6 items, with a high value denoting high adherence. Cronbach alpha were .63 for diabetes sample and .70 for HIV sample.

2.5. Data analysis

Data for the 123 HIV patients interviewed in the context of this study are complete, and missing data among the study variables in respect of the diabetic sample did not exceed 4.35%. These missing data were analyzed with the Full Information Maximum Likelihood (FIML).

We used the software AMOS 18 to perform the CFA analyses. This method serves to establish whether a given data set is consistent with a model based on prior theoretical or empirical work. In the original validation, two specific factors (necessity and concern) and two general factors (overuse and harm) were found for the BMQ using explanatory factor analyses (Horne et al., 1999). It was then our intention to use these four factors to test a hypothetical model, which would be compared to one model, which divides BMQ items into a specific factor and a general factor and another, which has only one factor.

There is no consensus regarding sample size calculation using CFA. Rules-of-thumb vary from 4 to 10 subjects per variable, with a minimum of 100 subjects to ensure stability of the variance–covariance matrix (Kline, 2011). We decided to set the requirement to 7 subjects per item as in De Vet, Ader, Terwee, and Pouwer (2005). Since the BMQ consists of 18 items, this decision

meant the minimal sample size for the purposes of our study was 126.

The estimation method used to test the three models among both chronic disease groups was the one most frequently used with continuous variables (Jackson, Gillaspy, & Purc-Stephenson, 2009), namely the Maximum Likelihood (ML) method. The models were Fit-assessed on the basis of multiple indicators: (adjusted) Comparative Fit Index (P)CFI, Root Mean Square Error Approximation (RMSEA), Tucker-Lewis coefficient (TLI), (Standardized) Root Mean Square Residual (SRMR), and Akaike's Information Criterion (AIC). These Confirmatory Factor Analyses were performed in accordance with the procedure and criteria described in detail by Kline (2011). Values greater than .90 for CFI and greater than .60 for PCFI (adjusted to take account of the parsimony of the model) are considered indicative of adequate model fit. TLI values close to 1 indicate a very good fit, with acceptable fit for values greater than .90. The RMR values close to 0 indicate an acceptable model fit, with SRMR ≤ .08 the threshold for concluding an acceptable fit. RMSEA values below .08 indicate an acceptable fit, with .05 the optimal critical value (Browne & Cudeck, 1992). We also reported the lower and upper boundaries of the 90% confidence interval for RMSEA, with an upper boundary of more than .10 indicating that the model should be rejected (Browne & Cudeck, 1992). AIC is not scaled on a zero-to-one range and is used for assessment relative to other models. The smaller the AIC values, the better and more parsimoniously the model fits.

In addition, we tested the measurement invariance between the HIV and diabetic samples (Meredith, 1993). We successively tested configural, metric, strong factorial and strict factorial invariance by increasing levels of group equality constraints imposed on factor loadings, item intercepts, and residual variances parameters (Gregorich, 2006). A Chi^2 difference test was used to compare two hierarchical models. As this statistical index is dependent on sample size (Cheung & Rensvold, 2002), we also took account of other, more reliable indices. As recommended by Cheung and Rensvold (2002) and Chen (2007), we consider that a Δ CFI value of less than or equal to −.010 and a Δ RMSEA value of less than or equal to .010 indicate that the null hypothesis of invariance should not be rejected.

Additional analyses were conducted using SPSS 19. The internal reliabilities of each BMQ subscale (specific-necessity, specific-concern, general-overuse and general-harm) were assessed with Cronbach's alphas. Regarding demographical variables, we examined Pearson correlations to identify the link between medication beliefs and age. We also used independent t-tests to compare women and men for each belief. For predictive validity, linear regressions were used to assess the predictive power of each medication belief with respect to adherence. Based on the original validation (Horne et al., 1999), we hypothesized that high adherence levels would be predicted by how individual patients rate their own need for the treatment versus their concerns about potential adverse effects (calculated as the necessity-concerns differential), whereas low adherence would be predicted by general negative beliefs (general-harm and general-overuse).

3. Results

3.1. Confirmatory factor analysis

Three models were tested in both diabetes and HIV samples. As expected, the model with four factors exhibited the most acceptable model fit when compared with the two other models. The fit indices of all three models are given in Table 2. The Chi^2 difference test was significant between the four-factor and the two-factor models ($\chi^2 5 = 526.15$; $p < .001$ for diabetes and $\chi^2 5 = 124.2$;

Table 2
Fit indices for the three measurements models across chronic diseases groups.

	Diabetes group (n = 253)	HIV group (n = 123)
Single factor models		
Chi^2 (d.f.)	1068.18 (135)	415.16 (135)
Chi^2/d.f.	7.91	3.08
RMSEA [90%CI]	.166 [.156; .175]	.13 [.116; .145]
TLI	.38	.4
CFI/PCFI	.51/0.41	.47/.41
AIC	1176.18	487.16
RMR	.165	.211
Specific and general factors models		
Chi^2 (d.f.)	861.99 (134)	321.58 (134)
Chi^2/d.f.	6.43	2.4
RMSEA [90%CI]	.147 [.138; .156]	.107 [.092; .122]
TLI	.52	.59
CFI/PCFI	.62/0.49	.64/.56
AIC	971.99	395.58
SRMR	.19	.14
4 factors models (Horne et al., 1999)		
Chi^2 (d.f.)	335.84 (129)	197.38 (129)
Chi^2/d.f.	2.6	1.53
RMSEA [90%CI]	.08 [.69; .09]	.07 [.047; .084]
TLI	.86	.85
CFI/PCFI	.89/0.67	.87/.73
AIC	455.8	281.38
SRMR	.076	.08

For all models, the Chi^2 is highly significant with $p < .001$.

$p < .001$ for HIV), as well as between the four-factor and one-factor models ($\chi^2 6 = 732.34$; $p < .001$ for diabetes and $\chi^2 6 = 218.24$; $p < .001$ for HIV). In addition, the Chi^2 and AIC were lower for the four-factor model in respect of both the diabetes and HIV samples. As regards the four-factor model, the upper RMSEA boundary did not exceed .10 in either sample. SRMR were below the threshold for concluding an acceptable fit. CFI and TLI were close to .90, even if they failed to meet their conventional cut-off criterion, and Parsimonious CFI indices were above .60. Based on these indicators, it is proposed that the four-factor model adequately describes the data for diabetes and HIV samples. The four-factor measurement model is shown in Fig. 1 with standardized loadings and residual variances of each item on their respective factor. In all cases, the loadings were significant in the expected directions.

As CFI and TLI failed to meet their conventional cut-off criterion, we studied modification indices to see whether the model could be adjusted to fit the data better. For the HIV sample, modification indices indicate that adding a covariance between the residual variance of Item 9 ("I sometimes worry about becoming too dependent to my medicines") and that of Item 13 ("most medicines are addictive") results in a 15.58 reduction in Chi^2. It is interesting to note that both these items are about dependency, in relation to specific medicines in the case of Item 9 and general medicines in the case of Item 13. The adjusted model fits better with the data ($\chi^2 128 = 180.26$; RMSEA = .058 [.036; .077]; CFI = .90; TLI = .88; PCFI = .75; AIC = 266.26). In respect of the diabetes sample, modification indices indicate that adding a covariance between the residual variance of Item 1 ("My health, at present, depends on my medicines") and that of Item 7 ("My health in the future will depend on my medicines") results in a 45.84 reduction in Chi^2. What is interesting to note here is that both these sentences have the same structure, the first regarding the present, the second the future. The adjusted model fits better with the data ($\chi^2 128 = 289.46$; RMSEA = .071 [.060; .082]; CFI = .92; TLI = .90; PCFI = .77; AIC = 375.46). These modifications involve no changes in the scale insofar as they are only concerned with residual variances.

As for the original validation (Horne et al., 1999), specific-necessity was not significantly correlated with specific-concern,
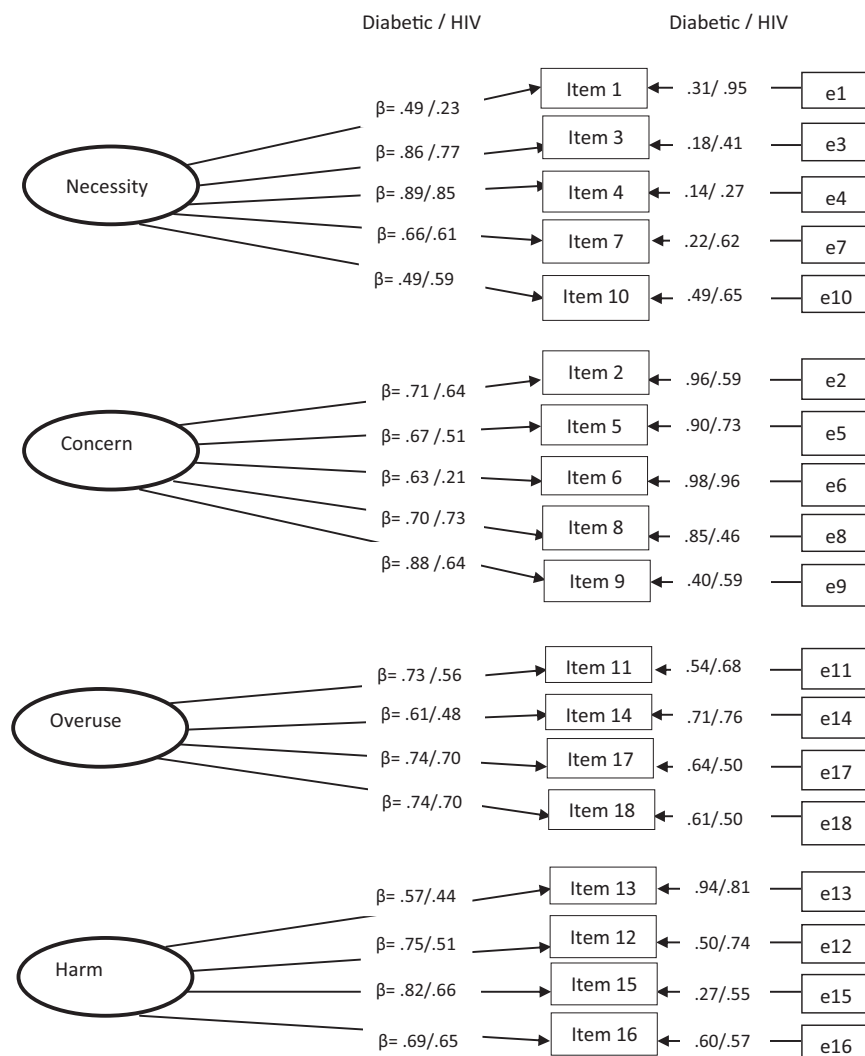
Fig. 1. Confirmatory Factor Analysis of the French BMQ for diabetic and HIV patients (with items' standardized regression weight and uniquenesses). All items load to the corresponding latent factor with a *p*-value of less than .001.

Table 3
Factor correlations for the four-factor BMQ model.

	Necessity		Concern		Harm	
	Diabetes	HIV	Diabetes	HIV	Diabetes	HIV
Concern	.034 ns	−.067 ns				
Harm	−.29***	−.224*	.49***	.395**		
Overuse	−.34***	−.186*	.51***	.256**	.87***	.548**

***p < .001; **p < .01; *p < .05.

whereas general-harm was highly correlated with general-overuse (Table 3). Moreover, specific-concern was significantly correlated with the two general negative perceptions (Table 3).

Each invariance step is summarized in Table 4 with model fit and comparison statistics.

To test configural invariance, an unrestricted baseline model was specified in which both samples had the same structure. The results indicate an adequate model-to-data fit (Table 4), meaning that each common factor is associated with identical item sets for HIV and diabetes samples.

Metric invariance was tested with two hierarchical models, the previous "configural model", with no equality constraints, and another model which imposed cross-group equality constraints on the factor loadings (named "metric invariance model").

The Chi[2] difference between these two models was significant ($\Delta\chi^2 13 = 26.14$, $p < .02$). Given that this statistical index is sensitive to sample size, and that there is no substantial difference in CFI (Δ CFI = −.005) and in RMSEA (Δ RMSEA = .001), we concluded there was no appreciable difference between the HIV sample and the diabetes sample in respect of factor loadings, and that BMQ constructs manifest themselves in the same way in each group.

The strong invariance was tested by comparing "the metric invariance model" with a new model in which intercepts were additionally constrained to be equal between the two samples (named "scalar invariance model"). Results ruled out the invariance hypothesis (Table 4). With this rejection of full invariance, we decided to test partial invariance to determine which intercepts were invariant across groups. We determined an invariant set for each common factor using the "Triangle Heuristic" devised by Cheung and Rensvold (1999), with systematic examination of all combinations for items loading to this factor. Then we tested all the invariant sets in a global "partial strong invariance" model. Results show that the intercepts associated with items 1, 4, 7, 11, 12, 13, 14, 15, 16, 17, and 18 are invariant.

Finally, we tested strict invariance by including cross-group equality constraints on residual variances of items from the previous set in a new model (the "strict invariant model"). Δ CFI and Δ RMSEA failed to meet their conventional cut-off criterion when

Table 4

Measurement invariance steps between HIV and diabetes samples.

Invariance models	Cross-group equality constraints	Chi^2 (d.f.)	CFI	RMSEA (90% CI)	Compared model	Δ Chi^2 (d.f.), p	Δ CFI	Δ RMSEA	Rejection of the null hypothesis of invariance
Configural	No constraint	499.04 (266)	.906	.048 [.042; .055]					No
Metric	Factor loadings	525.18 (279)	.901	.049 [.042; .055]	1	26.14 (13), $p < .02$	−.005	.001	No
Strong	Factor loadings Item intercepts	617.5 (297)	.871	.054 [.048; .060]	2	92.32 (18), $p < .001$	−.03	.005	Yes
Partial strong	Factor loadings Intercepts (excepted items 2,3,5,6,8,9,10)	556.87 (290)	.893	.050 [.043; .056]	2	31.69 (11), $p < .001$	−.008	.001	No
Strict	Factor loadings Intercepts (excepted items 2,3,5,6,8,9,10) Residual variances (excepted items 2,3,5,6,8,9,10)	640.66 (301)	.863	.055 [.049; .061]	4	87.79 (11), $p < .001$	−.03	.005	Yes
Partial strict	Factor loadings Intercepts (excepted items 2,3,5,6,8,9,10) Residual variances (excepted items 1,2,3,5,6,7,8,9,10,12)	588.39 (298)	.883	.051 [.045; .057]	4	23.16 (6), $p < .005$	−.01	.001	No

this model was compared to the "partial strong model" (Table 4). We then tested partial strict invariance with the same method used for partial strong invariance and found that items 1, 7 and 12 were not invariant.

This final subset of items 4, 11, 13, 14, 15, 16, 17, and 18 meets the configural, metric, strong and strict factorial invariance criteria and can be further used to estimate differences between HIV and diabetes samples.

3.2. Psychometric properties

BMQ means and standard deviations are presented in Table 5 for each disease sample, along with those of the original diabetes sample (Horne et al., 1999). Each of the subscales was found to demonstrate good internal consistency with all Cronbach's alphas ranging from .79 to .85 for diabetic patients and from .64 to .72 for HIV patients (Table 5). The factors' internal reliability in respect of the original diabetes sample is also presented in Table 5.

3.2.1. Demographical variables

Age was associated with treatment necessity in both the diabetes ($r = .15$, $p < .05$) and HIV samples ($r = .28$, $p < .01$). In terms of gender, the only difference was with concerns about diabetic treatment, where diabetic women scored significantly higher ($t_{248} = -2.2$, $p < .05$) than diabetic men (respectively $M = 16.4$, $SD = 5$; $M = 15.0$, $SD = 4.97$).

3.2.2. Predictive validity

Means and Standard Deviations of adherence scores of diabetic patients and HIV patients were respectively $M = 27.95$; $SD = 2.03$ and $M = 32.22$; $SD = 3.81$. As expected, the Necessity-Concerns Differential predicted high adherence in both samples ($\beta = .23$; $p < .001$; adjusted $r^2 = .05$ for diabetic sample, and $\beta = .30$; $p = 001$; adjusted $r^2 = .08$ for HIV sample). Moreover, general beliefs predicted low adherence ($\beta_{harm} = -.20$; $p_{harm} = .002$; adjusted $r^2_{harm} = .037$ and $\beta_{overuse} = -.22$; $p_{overuse} = .001$; adjusted $r^2_{overuse} = .043$ for diabetic sample; and $\beta_{harm} = -.27$; $p_{harm} = .004$; adjusted $r^2_{harm} = .058$ and $\beta_{overuse} = -.25$; $p_{overuse} = .006$; adjusted $r^2_{overuse} = .053$ for HIV sample).

4. Discussion

Confirmatory Factor analyses show that the French BMQ has the same factorial structure as the English version in both diabetes and HIV samples. Topics relating to medication prescribed for the patient (specific-necessity and specific-concern), and to general medication (general-harm and general-overuse) were clearly apparent in the factorial structure with each item loading to its expected factor. In addition, the internal consistencies of the BMQ subscales demonstrated that each subscale retained the psychometric qualities of the original version.

Making only minor modifications to the initial CFA model results in a re-specified model that suits the data in both samples. With respect to the HIV model, we added a covariance between the residual variance of item 9 and that of item 13, both of which have to do with dependency, in relation to specific beliefs and general beliefs respectively. With respect to the diabetes model, we added a covariance between the residual variance of item 1 and that of item 7, two items with the same sentence structure regarding the present or future. These modifications do not involve changing the BMQ scale at all because they only concern residual variances.

The BMQ configural and metric invariance was confirmed between the two samples, meaning that constructs manifest themselves in the same way in each disease group. Only a restricted subset of items (4, 11, 13, 14, 15, 16, 17, and 18) meet the criteria of strong and strict invariance between the two samples. (It

is a result that does not bring into question the structure validity of the BMQ). The subtest of invariant items can be used to estimate quantitative differences between HIV and diabetes samples in future studies. It is not surprising that all the items representing general beliefs are invariant. By contrast, all the items loading on concern and some of the items loading on necessity are non-invariant. These items signal qualitative differences between the HIV and diabetes groups. Where they are concerned, mean comparisons between different disease groups should be analyzed with caution, because they can give the false impression that one group scores higher or lower on these specific beliefs. Such differences could be due to a response known as "differential acquiescence styles", signifying that "forces that are unrelated to common factors such as cultural norms may systematically cause higher or lower valued item response on one population group compared with another" (Gregorich, 2006, p. 6).

Even if the possibility that this response bias results from socio-demographic differences between our two samples (e.g., age, ethnicity, gender, etc) cannot be ruled out, it is probably inherent in the specific features associated with each disease. Indeed, this result is hardly surprising given that each disease has its particularity, resulting in different representations regarding disease (Leventhal et al., 1992) and treatment (Horne et al., 1999). For example, type 2 diabetes is an asymptomatic disease, and it is sometimes difficult for patients to perceive the necessity of treatment when their "blood sugar is normal" (Mann et al., 2009). In the case of HIV, treatment has major side effects, which can make patients feel that they are sick because of their treatment (Gauchet et al., 2007) and increase concerns about treatment. Future research studies should focus more precisely on the qualitative differences between chronic diseases for these beliefs about medicines. It could also be interesting to explore measurement invariance between several cultural groups. Nevertheless, this result does not challenge the validity of the BMQ's factorial structure. Even if specific features of the diseases may have injected a differential additive bias, meaning that differences observed for some items may not accurately reflect differences in actual beliefs, the scale is an equally valid instrument for measuring beliefs about medicines with each disease.

In accordance with the Common Sense Model (Leventhal et al., 1992) and Horne's conceptual framework (Horne et al., 1999), the BMQ-f© proved to be predictive of adherence levels in both disease groups. The Necessity-Concerns Differential was the best predictor of adherence, accounting for 8% of the adherence level variance in the HIV sample and 5% of it in the diabetes sample. This result replicated the finding that adherence occurs when specific-concerns about taking treatment exceed the perceived need for treatment (Horne et al., 2007). Our results are consistent with previous studies. For example, significant correlations were found between adherence and both necessity and concern scales among 151 type 2 diabetes patients (Mann et al., 2009). Another study that used the BMQ on 271 patients with chronic diseases concluded that negative beliefs were predictors of low medication adherence (Gatti, Jacobson, Gazmararian, Schmottzer, & Kripalani, 2009).

We also replicated a positive correlation between the necessity scale and age (Horne & Weinman, 1999). Older patients are more likely to perceive a greater need for medication in both diseases maybe because they have a better knowledge of their condition. Concerning the gender effect, women expressed greater concerns about their treatment for diabetes than men, consistent with a previous study finding (Aikens & Piette, 2009).

This study has some limitations. First, the diabetic patients were recruited from patient associations and the HIV patients from a hospital. The two samples therefore correspond to those patients most committed to their care and may not be representative of the entire population affected by these two chronic

Table 5
bBMQ means (standard deviation), reliability for the diabetic and HIV samples, and psychometric properties of the original BMQ for the diabetic sample.

	Necessity-concerns differential	Necessity	Concern	Harm	Overuse
HIV sample					
M (SD)	5.73 (7.18)	21.80 (5.31)	16.07 (4.47)	9.72 (3.09)	10.84 (3.29)
Cronbach alphas		.72	.68	.64	.7
Diabetes sample					
M (SD)	6.49 (5.97)	22.03 (2.85)	15.55 (5.19)	9.70 (3.30)	11,54 (3.51)
Cronbach alphas		.82	.85	.78	.79
Original diabetes sample[a]					
M (SD)		21.26 (2.98)		9.29 (2.43)	1.43 (2.77)
Cronbach alphas		.74	12.91 (3.38)	.66	.8
			.8		

[a] The original diabetes sample consisted of 99 type 1 and type 2 diabetic patients (Horne et al., 1999).

diseases. Despite this shortcoming, the study enabled us to validate the French version of the BMQ in two different samples of chronic disease, thereby improving its generalizability among the French population. Second, adherence was assessed with a self-reported questionnaire, which may have a social desirability bias and result in an overestimation of adherence (Morisky, Green, & Levine, 1986). Nevertheless, a literature review highlighted a good match between self-reported and objective measures of adherence (Garber, Nau, Erickson, Aikens, & Lawrence, 2004). Moreover, even validated in French, this scale was initially developed for use in HIV and it may therefore not be perfectly adapted for diabetic patients. However, its properties were satisfactory in our diabetic sample.

Finally, even if further validation is needed to confirm these results, this French validation is conclusive. Our results confirm the value of the BMQ as a quick tool for assessing beliefs and, accordingly, as a good way of identifying inaccurate beliefs about treatment. Health professionals could use the BMQ in Patient Education to address treatment beliefs and help patients cope more effectively with their disease. The BMQ is also a suitable basis for psychological interventions aimed at changing patients' beliefs, such as Cognitive-Behavioral-Therapies. Beliefs about treatment are clearly predictive of adherence, which is vital in chronic diseases.

Disclosure of interest

Acknowledgements

Appendix A. French version of the Beliefs about Medicines Questionnaire.

Tout à fait d'accord	D'accord	Incertain	En désaccord	Fortement en désaccord
1	2	3	4	5

Croyances spécifiques :

1. Ma santé, aujourd'hui, dépend de mon traitement.
2. Avoir à prendre un traitement m'inquiète.
3. Ma vie serait impossible sans mon traitement.
4. Sans mon traitement, je serais très malade.
5. Je m'inquiète parfois à propos des effets à long terme de mon traitement.
6. Mon traitement est un mystère pour moi.
7. Ma santé future dépend de mon traitement.
8. Mon traitement perturbe ma vie.
9. Je suis parfois inquiet(e) de devenir trop dépendant(e) de mon traitement.
10. Mon traitement empêche mon état d'empirer.

Croyances générales :

11. Les médecins utilisent trop de traitements.
12. Les personnes qui prennent des médicaments devraient arrêter leur traitement de temps en temps.
13. La plupart des traitements provoquent une dépendance.
14. Les remèdes naturels sont plus sûrs que les traitements médicaux.
15. Les traitements font plus de mal que de bien.
16. Tous les traitements sont des poisons.
17. Les médecins accordent trop de confiance aux traitements.
18. Si les médecins passaient plus de temps avec les patients, ils prescriraient moins de traitements.

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