

Accessing Patient Views about Medication in Chronic Conditions using the Beliefs about Medicine Questionnaire (BMQ): A Review Study

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Abstract

Aim: This work presents an extensive comparative study for the use of the Belief about Medicine Questionnaire (BMQ), in order to assess the beliefs of patients into their prescribed medication. The multifactorial nature of patient medication adherence as well as, several compliance improvement strategies are initially examined. According to literature review, most commonly used method for measuring the positions of patients for their drug therapy employs self-organized questionnaires. The current review focuses on studies where BMQ is employed, in several chronic conditions, investigating the beliefs of patients about the necessity of drugs and concerns about their use. The current study aims to examine medical fields that BMQ could be useful for the prediction and avoidance of non-compliance effects, which affect the quality of life of the patient.

Methods: Patient medication beliefs play a significant role in chronic diseases, where long time medication is required. A variety of studies have been presented in the literature, either focusing on specific chronic conditions or investigating generally the assessment of patient medication beliefs in mixed datasets. Most of the studies, present statistical analysis in questionnaire results, regarding the validity of BMQ itself or the performance of socioclinical findings about patients' beliefs. Statistical results from several works are extensively presented and discussed, regarding BMQ validity, as well as factors such as the chronic condition, the patient age, the prescribed number of drugs per day etc.

Conclusions: BMQ has been extensively employed to measure the beliefs about medicine in several chronic conditions and has been reported to correlate with objective medication adherence assessment. However, beliefs among different patient populations can significantly vary.

Keywords: Patient medication beliefs; Drug compliance; Belief about Medicine Questionnaire

Introduction

The significant role of the patients' adherence to their prescribed medication is extensively investigated in several research studies, regarding the lack of diseases control and the quality of life (QoL) of patients. In terms of healthcare, medication adherence represents the extent that patients follow the advice of healthcare professionals regarding their medication and disease management [1]. Typically, about 50% of patients present low adherence to the prescribed medication treatment [2,3]. The main aim of the studies is the effect of the non-compliance of patients that follow a specific drug medication for their diseases.

The quantification of patient medication adherence can be performed either directly or indirectly (Figure 1). There are two direct methods to measure the compliance of the patients to their medication [4]:

- Bioassays and Biomarkers:** Direct proof that medication has been taken is attempted via lab test of biologic fluid for evidence of drug. However, there are several disadvantages of this approach, since it cannot be employed for all the cases (there are no markers for all drugs) and it is expensive.

- Direct observation of each dose:** This approach aims to the direct observation of medication taking, however it is impractical for outpatient setting and long-term treatments.

Apart from direct methods, four different indirect methods have been proposed and investigation in the literature:

- Pharmacy refill rates:** Health providers can capture the frequency and the amount of medications via their databases, since they can easily observe the timelines that patients refill their medications.
- Pill counts:** Remaining medication is counted and compared with the amount that should remain at each particular time. This is a simple and inexpensive method, however requires the reliance of the patient, and may over estimate medication adherence due to pill dumping or sharing.
- Electronic medication adherence monitoring:** For this method electronic devices are required, which are attached to the medication container. It provides information on daily intake and analysis of long-term patterns of medication. This method requires extra costs for the device, while there are issues about its reliability.

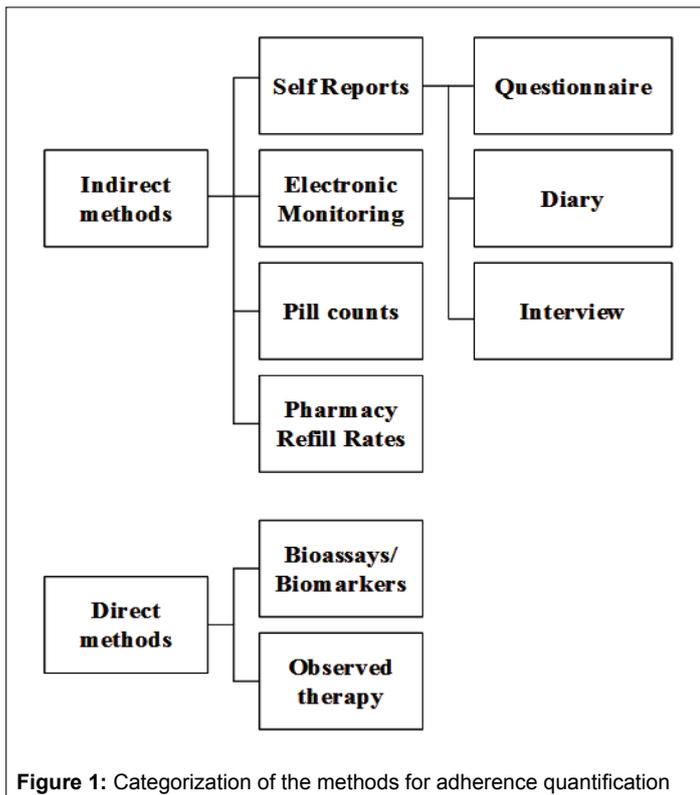


Figure 1: Categorization of the methods for adherence quantification

iv) **Self-report:** This method can be employed either via completion of questionnaire and diaries or via interviews between the patient and the physician. This is also a simple and inexpensive method which can provide the physician with several important data about the patient's situation.

The multifactorial nature of medication adherence in chronic disease patients, could explain a variety of reasons that patients fail to adhere to their maintenance medication [5]. Medication adherence can be influenced by disease (chronic, asymptomatic, requiring different strategies to reach the goal); medicine cost, information about their harm (syndrome of leaflet), dosage scheme and rearing skills with administration; strategy of treatment (polypharmacotherapy, treatment of acute and chronic phase), experience and skills of individuals (motor activity, good vision, understanding of process of minimization of risk, cognitive aspects, etc.); patient-physician (or another health care worker focusing on pharmacotherapy) relationship and understanding each other. The main factors that affect patient compliance include:

- **The disease extent and duration:** In most of the cases, the interest of patients for their disease decreases during a long time medication, due to the constant situation of the disease.
- **The cost of medication:** One of the main reasons which can affect the compliance of the patients, is the cost medication. If the patient can't afford the cost of drug or health providers stop provide medication, there is a high possibility to have an effect to the patient medication adherence.
- **The individual psychosocial variables:** The disease and quality of life (QoL) of patients can cause several mental disorders, which can affect the compliance of the patient to the prescribed medication.
- **The patient-physician relationship:** Physicians have to keep the patient informed and to provide knowledge about the disease, and thus build a successful patient-physician relationship.

- **The beliefs about medicines:** Maybe the most important factor that affects patient compliance is his/her general opinion about drugs, since it can overrun most of the other factors. Generally, people's belief is that drug medication can be harmful for their health, since it is well known that drugs can cause several adverse events.

Especially in chronic diseases, the consequences of non-compliance to the prescribed medication could cause lack of disease control and affect the QoL of patients. Most of remission cases present clinical recurrence after several months, due to non-adherence of patient to the maintenance medication [6].

Several strategies have been proposed to improve the patient medication adherence. In practice, common approaches attempt to improve the dose regimen using reminders, specific pill-boxes or simplifying the dosing. However, these approaches address the cases where low adherence is due to involuntary medication dose skipping and do not address drug disallowance due to other factors (e.g. low opinion about medication). Thus, most of research studies for medication adherence improvement focus on the education of the patient for understanding:

- **The disease process:** It is important for patients to know exactly all the stages of their disease in order to recognize the symptoms and signs. Symptoms and signs can feed patients with interest about their disease and the significance of medication.
- **The treatment plan:** The treatment plan is designed focusing on the problems that the patient brings into treatment. According to the diagnostic summary, the treatment plan provides the guidelines for patient's therapeutic schedule. It is important to take into account all physical, emotional and behavioral problems relevant to the patient's care, as well as the patient's strengths and weaknesses. All these issues have to be drawn with the patient contribution, in order to choose the optimal personalized treatment plan. This fact could help the patient to adhere the prescribed medication.
- **The efficacy of medicines:** Apart from side effects of medicines, patients have to focuses on their beneficial role. Sometimes the fear of adverse effects, as well as the fear of the disease itself, makes it difficult for the patients to emphasize in the positive medicines effect. Physicians can underline the efficacy of the medicine for the treatment of the disease.

Better understating and knowledge about the above factors improves the beliefs of the patient regarding his medication and thus affects the drug compliance. Even demonstration tools, which illustrate photographic documentation about the disease, could be beneficial [7]. In this direction Elkjaer et al. [8-10] developed a web-based educational tool, where patients improve their ability to self-initiate treatment and increase the level of disease-specific knowledge. Also, Nigro et al. [11] investigated the correlation between non-adherence and psychiatric disorders, proposing preventive psychiatric interventions.

Apart from the important role of the compliance to the patient health, increasing the medication adherence could be beneficial for the costs of health providers. Luga AO et al. [12] presented recent developments in the investigation of compliance, emphasizing to the impact of medication adherence or non-adherence on healthcare costs, in the US health system. The study denotes the magnitude of the non-adherence problem and related costs, with an extensive discussion of the underlying mechanisms of non-adherence impact on costs. Employing the Medication Possession Ratio (MPR) and the Proportion of Days Covered (PDC) metrics, the authors estimate the impact of non-adherence on health care costs in several chronic diseases, such as diabetes and asthma. MPR is calculated as the total number of days supplied, divided by the number of days between the first and last refills; while PDC is calculated as the total number of days supplied during an interval, divided by the total number of days during that interval.

Methods - Related Questionnaires

Employing self-administered questionnaires for the clarification of several factors about the disease process, beliefs and preferences of the patients or their QoL, is a common practice for physicians. Statistical findings highlight a number of physical aspects for the treatment progress regarding personal beliefs, concerns or lifestyle. Quantification of patients' compliance to their prescribed medication also employs several self-administered questionnaires [13]. Each questionnaire attempts to measure patient medication adherence from a different point of view. The questioners that are more frequently used focus on a specific disease regarding its symptoms, medication, psychological factors, QoL of the patient and the knowledge of the patient about the disease. Below, a summary of the most well-known questionnaires for compliance quantification is presented. There are several general health scales and questionnaires to measure the medication adherence of patient regardless of the disease, as well as there are several questionnaires for specific diseases.

A general health scale, which could be employed for the quantification of patient medication adherence is the Medication Adherence Report Scale (MARS) [14]. MARS is a combination of two other scales, the Drug Attitude Inventory (DAI) [15] and the Medication Adherence Questionnaire (MAQ) [16], consisting of 10 selected items (Table 1). Although, MARS has been employed mainly in the Psychiatric field, the findings of its analysis could be extremely useful to quantify patient compliance.

Another general scale is the Trust in Physician [17], which focuses on the relation between the patient and the physician. After several versions of the scale a five-point response scale is employed, reducing a large number of items into 11, to exclude any redundant information, and make the questionnaire more comfortable (Table 2). There are three dimensions of trust: a) confidence in physician skills and knowledge b) physician dependability, c) and finally the confidentiality of information given by the physician.

Hospital Anxiety and Depression Scale (HADS) [18] consists of two sets of items, which are related to the anxiety and the depression of the patient (Table 3). Indirectly, HADS could be employed to extract the compliant of patients to their medication.

The Work Productivity and Activity Impairment Questionnaire (WPAI) was created as a patient-reported assessment of the amount of absenteeism, presenteeism and daily activity impairment attributable to general health (WPAI:GH). Since sometimes it is more effective to employ disease-specific questionnaires, WPAI has been modified for specific health problems (WPAI:SHP) [19]. The WPAI:GH and the WPAI:SHP were created simultaneously and are based on the same template, but in the GH version the subject is instructed to respond with reference to general health status while in the SHP version, the subject responds with reference to a specified health problem, disease or condition.

MAQ 1	Do you ever forget to take your medicine?
MAQ 2	Are you careless at times about taking your medicine?
MAQ 3	When you feel better, do you sometimes stop taking your medicine?
MAQ 4	Sometimes if you feel worse when you take your medicine, do you stop taking it?
DAI 6	I take my medication when I am sick
DAI 8	It is unnatural for my mind and body to be controlled by medication
DAI 9	My thoughts are clearer on medication
DAI 10	By staying on medication I can prevent getting sick
DAI 2	I feel weird, like a 'zombie', on medication
DAI 5	Medication makes me feel tired and sluggish

Table 1: Medication Adherence Rating Scale (MARS)
MAQ: Medication Adherence Questionnaire; DAI: Drug Attitude Inventory.

Item	Score
I doubt that my doctor really cares about me as a person. †	1-5
My doctor is usually considerate of my needs and puts them first.	1-5
I trust my doctor so much that I always try to follow his/her advice.	1-5
If my doctor tells me something is so, then it must be true.	1-5
I sometimes distrust my doctor's opinion and would like a second one.†	1-5
I trust my doctor's judgement about my medical care.	1-5
I feel my doctor does not do everything he/she should for my medical care.†	1-5
I trust my doctor to put my medical needs above all other considerations when treating my medical problems.	1-5
My doctor is a real expert in taking care of medical problems like mine.	1-5
I trust my doctor to tell me if a mistake was made about my treatment.	1-5
I sometimes worry that my doctor may not keep the information we discuss totally private	1-5

Table 2: Trust in Physician Scale

Five-point response scale: 1-totally disagree; 2-disagree; 3-neutral; 4-agree; 5-totally agree

†Reverse-scored items

Relate to anxiety	Relate to depression
I feel tense or wound up (0-3)	I still enjoy the things I used to enjoy (0-3)
I get a sort of frightened feeling as if something bad is about to happen (0-3)	I can laugh and see the funny side of things (0-3)
Worrying thoughts go through my mind (0-3)	I feel cheerful (0-3)
I can sit at ease and feel relaxed (0-3)	I feel as if I am slowed down (0-3)
I get a sort of frightened feeling like butterflies in the stomach (0-3)	I have lost interest in my appearance (0-3)
I feel restless and have to be on the move (0-3)	I look forward with enjoyment to things (0-3)
I get sudden feelings of panic (0-3)	I can enjoy a good book or radio or TV program (0-3)

Table 3: Hospital Anxiety and Depression Scale (HADS)

Apart from general scales, questionnaires for specific field have also been presented in the literature. For example, several specific field questionnaires refer to Inflammatory Bowel Diseases (IBD). Such self-organized questionnaire is the Crohn Colitis Knowledge Score (CCKNOW) presented by Eaden et al. [13], the Short Inflammatory Bowel Disease Questionnaire [20] (Short - IBDQ), and the simplified clinical colitis activity index (SCCAI) [21].

Beliefs about Medicine Questionnaire

Beliefs about Medicine Questionnaire (BMQ) [22], in one of the most commonly used self-organized scale to assess the beliefs of chronic patients in their prescribed medication. The main innovation of BMQ is the direct quantification of the beliefs of patients about the drugs and their use, which is a significant factor that affects the compliance of the patients to their prescribed medication.

Description of BMQ

The aim of BMQ [22] is the assessment of the broad range of beliefs about specific and general medication. Thus, the questionnaire is divided into two scales, with each of them being divided into two subscales (Table 4). First scale concerns the belief of patients about their prescribed

BMQ-Specific	The BMQ-General
Without my medicines I would be very ill (1-5)	Medicines do more harm than good (1-5)
My life would be impossible without my medicines (1-5)	All medicines are poisons (1-5)
My health, at present, depends on my medicines (1-5)	Most medicines are addictive (1-5)
My health in the future will depend on my medicines (1-5)	People who take medicines should stop their treatment for a while every now and again (1-5)
My medicines protect me from becoming worse (1-5)	Natural remedies are safer than medicines (1-5)
I sometimes worry about becoming too dependent on my medicines (1-5)	Doctors use too many medicines (1-5)
My medicines disrupt my life (1-5)	If doctors had more time with patients they would prescribe fewer medicines (1-5)
My medicines are a mystery to me (1-5)	Doctors place too much trust on medicines (1-5)
Having to take medicines worries me (1-5)	
I sometimes worry about long-term effects of my medicines (1-5)	
These medicines give me unpleasant side effects (1-5)	

Table 4: Belief about Medicine Questionnaire (BMQ)

medication, while in the second one patients are inquired for their opinion generally about medicines and their use. More specifically the two scales of BMQ are:

- i. BMQ-Specific, that assesses the patients' opinion about their specific medication. It consists of 11 items, which are further categorized as Specific-Necessity and Specific-Concerns. Specific-necessity includes 5 items, such as "My health, at present, depends on my medicine" or "My life would be impossible without my medicine". There are 6 items in the Specific-Concerns subscale, which focuses on the beliefs of the patient about the efficacy of his medication. Specific-Concerns items assess fears of the patient to potential adverse outcomes or side effects of lifelong medication. For example, "My medicines are mystery to me" or "I sometimes worry about long term effects of my medicine" are phrases that patient have to declare his agreement. The degree of agreement for each item is denoted using a 5-point Likert scale, with "1" corresponding to strong disagreement and "5" being strong agreement.
- ii. The BMQ-General that assesses the patients' general beliefs about efficacy, dangers and use of medicines. The 8 items in this scale are further divided into General-Harm and General-Overuse. The General-Harm subscale includes 5 items, such as "Medicine do more harm than good" or "Medicines are poisons", while the remaining 3 items, such as "Doctor prescribe too many medicine" or "if doctors spent more time with patient, they would prescribe less", comprise the General-Overuse subscale.

BMQ studies in chronic conditions

BMQ is a self-administer questionnaire, which focuses directly to the beliefs and concerns of the patients about the use and efficacy of medicines. It can be used to a wide range of diseases, where prescribed medication is required. Several studies have been already presented in the literature that uses BMQ for the patients' medication beliefs assessment. Most of these studies employ mixed datasets, in terms of the diseases. Initial studies by Horne et al. [22,23] use data from several chronic diseases, such as asthma, diabetes and psychiatric conditions from hospital clinics, and cardiac, general medical and renal (haemodialysis recipients) from in-patients; these were chosen to reflect a variety of disease and treatment characteristics. Datasets from several chronic diseases have been employed from several research groups [24-30]. Marbdy et al. [31] presented a study with a total unconditional sample, where the participants are selected using only three inclusion criteria: a) to understand the Swedish language, b) to be over 18 years old, and c) to take a queue number to a specific prescription counter for Swedish pharmacies. As a result, this sample holds none limitation about the disease of the patient.

BMQ in asthma: Apart from the studies which included mixed datasets, several studies were based in homogenous samples. The adherence to the medication for asthma patients has been investigated from different research groups [32-34]. Menckeberg et al. [34] investigated whether beliefs about inhaled corticosteroid relate to medication adherence objectively measured by prescription refill records. They concluded that patients' beliefs about inhaled corticosteroids correlate not only with medication adherence by self-report but also with a more objective measure of medication adherence calculated by pharmacy dispensing records.

BMQ in HIV: Both Horne et al. [35] and Gaucher et al. [36] analyzed the BMQ records for the behavior of HIV patients in highly active antiretroviral therapy (HAART). It is common sense that adherence to medical regimens is extremely important for HIV patients. The results of the above studies revealed that medication adherence and patients' beliefs about treatment, satisfaction with treatment, confidence in the physician and duration of treatment and illness are significantly correlated. It also revealed that Specific-Necessity and Specific-Concerns factors of BMQ could be useful for understanding patient perspectives of HAART and predict medication adherence.

BMQ in diabetes: Diabetes patient samples are analyzed by Aikens and Piette [37] to reveal patient beliefs about antihyperglycemic and antihypertensive treatment and medication underuse. The authors also examined diabetes in another point of view, such as the patients' beliefs about their medication necessity and potential harmfulness in an economically distressed community. According to their findings, diabetic patients with low health literacy are concerned about medication harmfulness, which is in turn associated with medication underuse and higher blood pressure. To enhance medication adherence and outcomes, interventions should address patients' underlying concerns about potential adverse treatment effects and focus on both cultural factors and health literacy. Another study for diabetes chronic condition presented by Fall et al. [38], where the French translation of BMQ is validated.

BMQ in autoimmune diseases: The role of patient medication adherence in therapies for autoimmune diseases is extremely significant, due to the fact that insufficient medication could lead to irreversible disorders. Kumar et al. [39], Treharne et al. [40], Betegnie et al. [41] employed the BMQ to measure the beliefs about medication in patients with rheumatoid arthritis and systemic lupus erythematosus, while Neame and Hammond [42] investigated which factors are related to medication beliefs about rheumatoid arthritis, and whether these beliefs influence medication adherence. All these studies concluded that most people with rheumatoid arthritis have positive beliefs about the necessity of their medication. However, levels of concern are high and associate

with helplessness and non-adherence. The Beliefs about Medicines Questionnaire may identify people at risk of poor medication adherence and provide a focus for patients to discuss their beliefs, providing opportunities to improve medication adherence.

BMQ in gastro-oesophageal reflux: Gastro-oesophageal reflux disease (GORD) causes some of the most frequently seen symptoms in both primary and secondary care; between 20% and 30% of a 'Western' adult population experience heartburn and/or reflux intermittently [43]. Treatment of GORD includes a range of options, both medical and surgical. The simplest is self-administered antacids with advice to alter lifestyle factors such as dietary modification, smoking cessation and weight reduction. The role of surgery has traditionally been confined to the treatment of those with severe symptoms not responding to medication in appropriate dosage and medically fit for surgery. Grant et al. [35] focus on the effectiveness and cost-effectiveness of minimal access surgery amongst people with gastro-oesophageal reflux disease. Relative clinical effectiveness was assessed by a randomized trial (with parallel non-randomized preference groups) comparing a laparoscopic surgery based policy with a continued medical management policy. The economic evaluation compared the cost-effectiveness of the two management policies in order to identify the most efficient provision of future care and describe the resource impact that various policies for fund application would have on the NHS. For the above purpose a combination of BMQ and Beliefs about Surgery Questionnaire (BSQ) has been employed in 810 patients. Amongst patients requiring long-term medication to control symptoms of GORD, surgical management significantly increases general and reflux specific health-related quality of life measures, at least up to 12 months after surgery.

BMQ after liver transplantation: Medication adherence of patient after liver transplantation is measured by O'Carroll et al. [44]. Liver transplant recipients have diverse histories, ranging from an impulsive paracetamol overdose, to long-term alcoholic cirrhosis, to the autoimmune disorder primary biliary cirrhosis. However, regardless of cause, lifelong adherence to immunosuppressant medication is essential for the survival of each recipient. Non-adherence rates within the transplant population have been reported as ranging from 20 to 50%. Four different questionnaires have been employed in this study, including the BMQ. The results indicated that low self-reported patient medication adherence was related to greater concerns regarding the potential adverse effects of medication, and a stronger belief that medicines in general are harmful.

BMQ in inflammatory bowel disease: Crohn's Disease (CD) and Ulcerative Colitis are typical example of chronic diseases where patient treatment requires a long-life medication. Lots of studies in literature measure the beliefs about medication of IBD patients using BMQ [45]. Dongen et al. [46] validated their own developed questionnaire, using the results of BMQ in order to measure the beliefs of IBD patients in treatment with enema. Another study [47] attempts to correlate non-adherence to 5-ASA therapy in UC patients, between BMQ findings and urine analysis. The obtained results yield serious suspicions about the efficiency of self-report methods and report difficulties of accurately assessing medication compliance. Significant conclusions have drawn by Fu et al. [48] for attitude of adolescents patients who attended transition clinics. According to the study, transition patients have a stronger belief that medicine is necessary for their quality of life. In 2009, Horne et al. [49] presented an extensive study to assess patients' attitudes to maintenance for IBD. This study reveals that the way in which patients judge their personal need for maintenance relative to their concerns about maintenance, can be a significant barrier to medication adherence.

BMQ in other chronic conditions: Some other chronic conditions have been investigated in the literature such as cardiovascular disease, mental disorder, haemophilia, hypertension and patients after stroke-

events. Viktil et al. [50] presents a study for patients from an outpatient clinic which suffers from chronic cardiovascular diseases. According their conclusion about the one-third of patients had strong concerns for their medication, although cardiac conditions present high mortality. Especially, in Psychiatric patient medication adherence plays significant role for the patient himself, as well as for his environment. Thus, several studies have been present in the literature, where the beliefs of patient about their medication have been analyzed [51-53]. The study presented by Russel et al. [54] investigates the belief of patient about the necessity of antidepressants. The medication beliefs of patients with Haemophilia [55] and hypertension [56] have also been quantified by Llewellyn et al. [55] and Ross et al. [56] respectively. Finally, two other studies [57,58], assess the multidimensional effect of stroke-event and necessity beliefs on their medication adherence to stroke prevention medication.

Translations of BMQ

The achievements of the Beliefs about Medicine Questionnaire have been approved due to the attempts for translations in several languages. Since the beliefs of peoples are strongly related to their culture, as well as the diverse variety of demographic, psychosocial, and economic factors, it was meaningful to investigate the behavior of the patients in different countries. The first translation presented by Beléndez et al. [24] in Spanish, where diabetic patients have been participated. Cuevas et al. [52] and Torderas et al. [31] revalidated the Spanish translation for Psychiatric disorders and Asthma treatment respectively. BMQ have been translated also in Arabic [30,61], Swedish [31], French [36], Japanese [27], German [28], Italian [29], Portuguese [59] and Czech [60]. Finally, Komninos et al. [26] presented a translation and adaptation in Greek language, in order to validate the BMQ it in primary patients in Greece. Table 5 shows a variety of studies, which employed translations of BMQ.

Discussion

According to the literature review, BMQ it is a useful tool mostly for chronic conditions, where long-time medication is needed. In such cases, the internal validity of the questionnaire presents high reliability, according to the Cronbach's α . The number of studies per chronic condition, combined with the presented reliability, could be a simple indication of how valuable the questionnaire is, for each condition. Apart from the studies with mixed datasets, IBDs, Asthma and mental disorder have mostly been investigated. Specifically, in most of IBDs studies, beliefs groups have been extracted, presenting percentage values of subjects, which are categorized as accepting, skeptical, ambivalent and indifferent. Accessing these results a valuable conclusion could be the small number of skeptical patients. Focusing on the results for medication adherence

Work	Disease	Language Translation
Alhalaiqa et al. 2014 [30]	Chronic Diseases	Arabic
Beléndez et al. 2007 [24]	Diabetes, Chronic Diseases	Spanish
Cuevas et al. 2011 [52]	Psychiatric Outpatients	Spanish
Marbdy et al. 2007 [31]	Pharmacy clients	Swedish
Fall et al. 2014 [38]	Diabetes type2, HIV	French
Komninos et al. 2012 [26]	Chronic Diseases	Greek
Lihara et al. 2010 [27]	Chronic (Liver, GI, Nervous system)	Japanese
Mahler et al. 2012 [28]	Chronic Diseases	German
Salgado et al. 2013 [59]	Chronic Diseases	Portuguese
Tibaldi et al. 2009 [29]	Chronic (cardiac, asthma, diabetes, depression)	Italian
Tordera et al. 2008 [33]	Asthma	Spanish
Matoukova et al. 2013 [60]	Chronic (diabetes, hypertension, rheumatic disease)	Czech

Table 5: Works with translated BMQ

Work	Year	Disease	# of Patients	Reliability Testing (Cronbach's α)				Correlation with age				Correlation with number of medicine per day				Correlations among subscales	Belief groups (%)				
				Necessity	Concerns	Harm	Overuse	Necessity	Concerns	Harm	Overuse	Necessity	Concerns	Harm	Overuse		Accepting	Skeptical	Ambivalent	Indifferent	
Horne et al. [22]	1999	Asthma	78	0.80	0.75	0.47	0.74									Yes					
		Diabetes	99	0.74	0.80	0.66	0.80														
		Renal	47	0.55	0.73	0.83	0.77														
		Cardiac	120	0.76	0.76	0.51	0.74														
		Psychiatric	89	0.74	0.63	0.70	0.73														
		General	91	0.86	0.65	0.51	0.60														
Horne et al. [23]	1999	Chronic Diseases	324																		
Horne et al. [32]	2002	Asthma	100	0.82	0.71											Yes					
Llewellyn et al. [55]	2002	Heamophilia	104	0.86	0.51																
Ross et al. [56]	2004	Hypertension	514					0.02	0.05							Yes					
Trehanne et al. [40]	2004	Rheumatoid Arthritis	85	0.88	0.56	0.62	0.78	0.17	-0.06	-0.12	0.00	0.30**	0.10	0.01	0.08	Yes					
Neame & Hammond [41]	2005	Rheumatoid Arthritis	600					-0.07	-0.12*			0.26****	0.20***								
O'Carroll et al. [43]	2006	After Liver Transplantation	435																		
Beléndez et al. [24]	2007	Diabetes, Chronic Diseases	412																		
Gauchet et al. [36]	2007	HIV HAART	127	0.68	0.64	0.70	---									Yes					
Horne et al. [35]	2007	HIV (HAART Treatment)	136																		
Marbdy et al. [31]	2007	Pharmacy Clients	324													Yes					
Grant et al. [25]	2008	Chronic Diseases	1274													Yes					
Jonsdottir et al. [53]	2008	Mental Disorders	280	0.90	0.76	0.69	0.73									Yes					
Kumar et al. [39]	2008	Rheumatoid Arthritis & Systemic Lupus Erythematosus	200					0.16*	0.02	0.02	-0.02										
Menckeberg et al. [34]	2008	Asthma	233	0.81	0.77	0.66	0.68									Yes	30	19	24	27†	
Russel & Kazantzis [54]	2008	Depression	85																		
Tordera et al. [33]	2008	Asthma	126	0.83	0.72	0.68	0.70									Yes					
Aikens & Piette [37]	2009	Diabetes	803					-0.11***	-0.18***			0.22***	0.05								
Clatworthy et al. [51]	2009	Bipolar Disorders	223														43	8	42	7	
Horne et al. [49]	2009	IBD	1871														48	6	42	4	
Tibaldi et al. [29]	2009	Chronic Diseases	427	0.78	0.72												59	4	29	8	
Lihara et al. [27]	2010	Chronic Diseases	613																		
Cuevas et al. [52]	2011	Psychiatric Outpatients	843	0.72	0.80			0.20****		-0.11		0.34****				Yes					
Fu et al. [48]	2012	IBD Adolescents	112																		
Komninos et al. [26]	2012	Chronic Diseases	150	0.85	0.76	0.78	0.68	0.45*	0.23*	0.23*	-0.05	0.52*	0.28*	-0.01	-0.12	Yes					
Mahler et al. [28]	2012	Chronic Diseases	485	0.83	0.83	0.79	0.80									Yes					
Moshkovska et al. [47]	2012	IBD	169														67	4	21	8	
Salgado et al. [59]	2013	Chronic Diseases	300	0.76	0.66																
Sjolander et al. [58]	2013	After Stroke event	595	0.82	0.82	0.65	0.68									Yes					
Van Dongen et al. [46]	2013	IBD - enema use	112																		
Matoulkova et al. [60]	2013	Chronic Diseases	279	0.85	0.82	0.71	0.69														
Viktil et al. [49]	2013	Cardiovascular Disease	150							0.10*		0.06**				Yes					
Alhalaia et al. [30]	2014	Chronic Diseases	605	0.55	0.65	0.35	0.30	0.10**				0.23*****									
Fall et al. [38]	2014	Diabetes Type II	253	0.82	0.85	0.78	0.79	0.15*								Yes					
		HIV	123	0.72	0.68	0.64	0.70	0.28**													
Phillips et al. [56]	2014	After Stroke event	600														59	4	24	13	
Tsianou et al. [44]	2016	IBD	163	0.73	0.62	0.53	0.51	-0.29*	-0.25*	0.06	-0.03	-0.07	0.13	0.21*	0.05	Yes	16	12	31	41	

Table 6: Results presented in similar studies

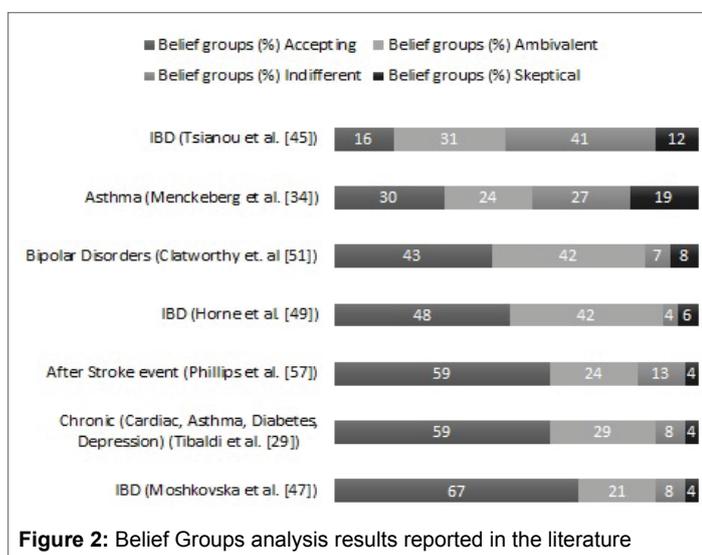
†calculated from Fig. 2 of [34], *P<0.0500, **P<0.0100, ***P<0.0050, ****P<0.0010, *****

(accepting patients), it seems that the nature of chronic condition is not the only dominant factor, since the number of accepting patients varies among different populations.

Table 6 summarizes results presented in similar studies. As presented in the table 6, most researchers use Cronbach's α as a reliability indicator, mainly assessing the internal validity of the BMQ subscales; the values for Necessity subscale range from 0.55 to 0.9, with average value of 0.77, while the values for the Concerns subscale range from 0.51 to 0.85, with 0.71 being the average value. The respective value for the Harm subscale ranges from 0.35 to 0.83, with 0.64 average value, and finally the value for the Overuse subscale ranges from 0.3 to 0.69, with 0.69 being the average value. It is clear that Necessity subscale presents the higher reliability, especially compared to Harm subscale; although these two subscales include the same number of items, there is a significant difference in their reliability.

Several researchers reported statistically significant correlation among patients' age and at least one of the subscales, however it is not easy to draw a general conclusion since the majority of the presented works do not implicitly state findings related to significant or non-significant correlations with age. Furthermore, all values reveal moderate to weak correlations (for $P < 0.05$), being in the range of $[-0.29, 0.45]$ for Necessity and $[-0.25, 0.23]$ for Concerns, while for Harm and Overuse subscales only one significant correlation has been reported for each, being 0.23 and 0.23, respectively. The same applies with the "number of medicines per day" variable; several researches reported statistical significant weak to moderate correlations among "number of medicines per day" variable and at least one of the subscales, being in the range of $[0.06, 0.52]$ for Necessity and $[0.20, 0.28]$ for Concerns, for Harm subscale only one researcher reported significant correlation, being 0.212, while no significant correlation with Overuse subscale has been reported.

Belief groups calculation based on BMQ General subscales is a procedure that is gaining strength as an analysis tool in recent studies. Belief groups analysis results reported from researchers are presented in figure 2. The reported results present a large variation in the percentages for all belief groups, with Accepting percentage being in the range of [16%, 67%], Ambivalent in the range of [21%, 42%], Indifferent in the range of [4%, 41%] and Skeptical in the range of [4%, 19%]. This could be partially explained from the differences among the medical conditions/disease of the patient population under study. However, even in studies for the same disease (there are 3 IBD related studies in figure 2), the differences are substantial.



Conclusions

BMQ has been a valuable tool for measuring the beliefs about medicines of patients from various chronic conditions. Furthermore, several researchers have emphasized the strong correlation between patients' beliefs about drugs and their medication adherence, thus (a) showing an easy and effective way to indirectly predict the medication adherence, and (b) providing an efficient method to improve the medication adherence by cultivating to the patients, positive beliefs about their medicines.

Conflict of Interest

The authors declare that they have no conflict of interest.

Ethical Approval

This article does not contain any studies with human participants or animals performed by any of the authors.

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