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**PSYCHOMETRIC EVALUATION OF A KURDISH
VERSION OF MEDICATION ADHERENCE REPORT
SCALE AND BELIEFS ABOUT MEDICATION
QUESTIONNAIRE IN PATIENTS WITH
CARDIOMETABOLIC CONDITIONS**

MASTER THESIS

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APPROVAL

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DECLARATION

I hereby declare that this thesis is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which has been accepted for the award of any other degree except where due acknowledgment has been made in the text.

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LIST OF SYMBOLS AND ABBREVIATIONS

MARS-5 Medication Adherence Scale

BMQ Belief about medication questionnaire

BMQ-S Belief about medication questionnaire-Specific

NCDs Noncommunicable diseases

CVDs Cardiovascular diseases

CHD Coronary Heart Disease

DOT Directly Observed Therapy

MMAS-8 Morisky Adherence Medication Scale

n Sample size

p *p*-value

SPSS Statistical Package of Social Sciences

WHO World Health Organization

TRA Theory of Reasoned Action

TPB Theory of Planned Behavior

HBM Health Belief Model

SRT Self-Regulation Theory

CSM Common-Sense Model

NCF Necessity Concern Framework

PCA Principal Component Analysis

HbA1c Glycated Hemoglobin

LDL Low-Density Lipoprotein

KMO Kaiser Meyer Olkin

ICC Intraclass Correlation Coefficient

SBP Systolic Blood Pressure

DBP Diastolic Blood Pressure

CFI Comparative Fit Index

GFI Goodness of Fit Index

RMSEA Root Mean Square Error of Approximation

CFA Confirmatory Factor Analysis

UAE United Arab Emirates

ABSTRACT

Jawhar, H. (2023). Psychometric Evaluation of a Kurdish Version of Medication Adherence Report Scale and Beliefs About Medication Questionnaire in Patients With Cardiometabolic Conditions. Yeditepe University Institute of Health Sciences, Department of Clinical Pharmacy, MSc Thesis, Istanbul.

Objective: This study aimed to evaluate the psychometric properties of the Kurdish versions of the Medication Adherence Report Scale (MARS-5) and specific domains (necessity and concern domains) of the Beliefs About Medication Questionnaire (BMQ) among patients with cardiometabolic conditions.

Materials and Methods: In this cross-sectional study, patients with cardiometabolic conditions undergoing treatment for at least a year at various medical centres in Erbil, Iraq, from February to July 2023 were included. Translation and cultural adaptation of two tools: MARS-5 and specific domains (necessity and concern domains) of BMQ were done. principal component analysis, analysis of internal consistency, and test-retest reliability were performed. The correlation analysis between clinical indicators (including blood pressure, HbA1C, and lipid profiles) and the score of MARS-5 was done.

Results: Among 407 patients, almost half of participants (52%) were female with a median age of 60 (ranging from 25 to 88 years). Principal component analysis confirmed one component for MARS-5, and two components (Specific-Necessity and Specific-Concern) for BMQ. Cronbach's alpha values were 0.87 for the MARS-5 and 0.91 and 0.89 for the necessity and concern domains of BMQ, respectively. The intraclass correlation coefficients ranged from 0.84 to 0.95 for both tools at baseline and after two weeks. There were significant correlations between the score of MARS-5 and HbA1c levels using the chi-square test and Spearman correlation (ρ : -0.45, $p < 0.001$), as well as with blood pressure levels (ρ : -0.21 for systolic blood pressure, $p < 0.001$ and -0.17 for diastolic blood pressure, $p < 0.05$)

Conclusion: The Kurdish versions of MARS-5 and BMQ specific domains (necessity and concern domains) have shown good psychometric properties in the study population hence are suitable to evaluate medication adherence and beliefs about medication in Kurdish-speaking populations.

Keywords: Medication Adherence, cardiometabolic condition, psychometric evaluation

ABSTRACT (Turkish)

Jawhar, H. (2023). Kardiyometabolik durumlu hastalarda ilaç uyum raporu ölçeğinin ve ilaçlar hakkındaki inançlar anketinin Kürtçe versiyonunun psikometrik değerlendirmesi. Yeditepe Üniversitesi Sağlık Bilimleri Enstitüsü, Klinik Eczacılık ABD., Master Tezi. İstanbul.

Amaç: Bu çalışmanın amacı, kardiyometabolik durumları olan hastalar arasında İlaç Uyum Raporu Ölçeği'nin (MARS-5) ve İlaç Hakkında İnançlar Anketi'nin (BMQ) belirli alanlarının (gereklik ve endişe alanları) Kürtçe versiyonlarının psikometrik özelliklerini değerlendirmektir

Gereç ve Yöntem: Bu kesitsel çalışmada, Şubat ile Temmuz 2023 arasında Erbil, Irak'taki çeşitli tıp merkezlerinde en az bir yıldır tedavi gören kardiyometabolik durumlu hastalar dahil edilmiştir. İki aracın çevirisi ve kültürel uyarlama yapılmıştır: MARS-5 ve BMQ'nun gereklik ve endişe alanları. Ana bileşenler analizi, iç tutarlık güvenirliği analizi ve test-tekrar test güvenirliği gerçekleştirilmiştir. Klinik göstergeler (kan basıncı, HbA1C ve lipid profilleri dahil) ile MARS-5 skoru arasındaki korelasyon analizi yapılmıştır.

Bulgular: 407 hastadan yaklaşık yarısı (%52) kadın olup, medyan yaşları 60'tır (25 ile 88 yaş aralığı). Ana bileşenler analizi, MARS-5 için bir bileşen ve BMQ için iki bileşen (Özel-Gereklik ve Özel-Endişe) doğrulamıştır. Cronbach alfa değerleri MARS-5 için 0.87, BMQ'nun gereklik ve endişe alanları için sırasıyla 0.91 ve 0.89'dur. Sınıf içi korelasyon katsayıları, her iki araç için de başlangıçta ve iki hafta sonra 0.84 ile 0.95 arasında değişmiştir. MARS-5 skoru ile HbA1c seviyeleri arasında ki-kare testi ve Spearman korelasyonu (ρ : -0.45, $p < 0.001$) kullanılarak anlamlı korelasyonlar bulunmuştur, aynı zamanda kan basıncı seviyeleri ile de anlamlı korelasyonlar vardır (ρ : -0.21 sistolik kan basıncı için, $p < 0.001$ ve -0.17 diyastolik kan basıncı için, $p < 0.05$).

Sonuç: Kardiyometabolik durumları olan hastalarda ilaç uyum problemlerini değerlendirmek için MARS-5 ve BMQ'nun gereklik ve endişe alanlarının Kürtçe versiyonları kullanılabilir.

Anahtar kelimeler: İlaç Uyum, Kardiyometabolik Durum, Psikometrik Değerlendirme

1. INTRODUCTION

According to WHO In Iraq, noncommunicable diseases (NCDs) are the main cause of mortality and morbidity [1]. It is believed that 30 percent of Iraqi's have hypertension, 14 percent have diabetes, and more than 30 percent are obese. The Iraqi government declared that the cost of an extensive variety of drugs requiring a prescription, including chronic disease expenses made by the government on health care was US\$82.2 billion [2]. The quality of treatment and care in Iraq is still below par and not very efficient in managing patients with long-term diseases [2]. This situation calls for a comprehensive examination of medication adherence and the associated challenges faced by patients in Iraq.

Medication non-adherence is a worldwide issue that reduces any treatment's effectiveness. The rates of death, illness, and healthcare expenditures, the direct medical cost of nonadherence in the United States alone has \$170 billion per year [3] and 125,000 potentially avoidable deaths, 50% of treatment failure, and up to 25% of hospital admissions [4] which is estimated to be much lower in developing countries[5]. While the burden of non-adherence on healthcare and society has been extensively studied in developed countries [6–8], its impact in developing nations, including Iraq, remains relatively unexplored.

Furthermore, research findings reveal that patients in Gulf countries, including Iraq, exhibit a higher prevalence of chronic disease medication non-adherence, leading to increased disease-related complications and mortality [9]. Therefore, understanding medication adherence among patients with chronic cardiometabolic conditions and the underlying factors is vital for improving healthcare outcomes in the region.

Presently, no standardized approach for evaluating medication adherence exists in regular clinical practice. Objective measures, such as medication concentration in body fluids, are accurate but costly, impractical, and do not show any pattern or cause of nonadherence [10]. In contrast, patient self-reporting of adherence, including the Medication Adherence Report Scale (MARS) developed by Professor Horne, provides a cost-effective and convenient method for assessment in clinical practice [11].

Findings also suggest that adherence is a complex concept and is affected by several factors including beliefs about medication significantly influencing adherence, and the

Beliefs about Medication Questionnaire (BMQ) developed by Horne [12] is widely used to assess these beliefs. However, research on beliefs in low and middle-income countries, including Iraq, remains limited [13].

The lack of validated questionnaires for the Kurdish-speaking population poses a challenge for researchers aiming to improve adherence to treatment in this group. Poor adherence to treatment has been associated with increased mortality, morbidity rates, and healthcare costs [3]. Therefore, the translation and validation of medication adherence questionnaires become essential to understand and address adherence issues across different populations.

Limited information is available about validated questionnaires for the Kurdish population [5], which challenges researchers to develop programs that could improve adherence to treatment for this patient group. Adherence to treatment has been studied extensively and collated findings of such research indicate that low level of adherence can increase mortality and morbidity rates, in addition to healthcare costs [3], [14]. Therefore, the translation and validation of medication adherence questionnaires become essential to understand and address adherence issues across different populations.

We believe that validating these scales in Kurdish will enable healthcare providers and researchers to more accurately evaluate patients' adherence to treatment and their attitudes toward medications. Ultimately, this will lead to more effective treatment plans, precise interventions, and greater patient satisfaction, as a deeper understanding of patients' drug-related behavior and attitudes is achieved.

Therefore, this study is conducted in Iraq to validate the MARS and BMQ questionnaires among a Kurdish-speaking population as well to investigate the extent of non-adherence and beliefs about medication in patients with cardiometabolic diseases and identify factors affecting outcomes.

2. LITERATURE REVIEW

2.1. Overview of the healthcare in Iraq

The Iraqi Ministry of Health oversees the nation's public healthcare system in Iraq. However, depending on where you reside care quality and accessibility may differ significantly [15]. According to the World Health Organization (WHO), years of conflict, economic sanctions, and underinvestment have harmed Iraq's healthcare system. This results in a lack of medical workers, obsolete facilities, and limited access to life-saving medications. Despite these obstacles, the Iraqi government has been attempting to improve the healthcare system by, among other things, increasing funding in the sector and implementing reforms to improve healthcare administration and delivery [16, 17]. It is likely that the shortcoming in the governance system of the Iraqi healthcare has had an impact on medication adherence in the country, however, it is difficult to assess the nature and extent of this impact in the lack of data. Iraq's healthcare system must confront these challenges head-on to enhance patient care and medication adherence.

2.2. Challenges of health care in Iraq

Iraq's healthcare system, faces a lot of obstacles, First the per capita health expenditure remains considerably low. As per the World Bank [18]. Iraq's health spending per capita in 2019 was substantially below the global average. The 2020 healthcare spending for Iraq being at \$202 per capita was low especially when compared to global standards and compared to both developed and many developing countries [18]. In the Middle East, countries with high oil revenues like Saudi Arabia, UAE, and Qatar typically have much higher health expenditures per capita, often in the range of \$1,000 to \$2,500 or even higher. Middle income countries like Jordan or Lebanon, as well tend to have higher health expenditure comparing to Iraq [18].

Second, the out-of-pocket expenses for healthcare remain barrier for many, particularly the lower-income groups. Chronic shortages of medical consumables and other resources pose a significant difficulty for healthcare facilities [19]. It is inexpensive for Iraqis to attend the public hospital. However, the quality of care is so low that those who can afford it frequently seek treatment elsewhere. Without access to private health insurance, the

majority of Iraqis must pay out of pocket for medical care, driving up the price of even the most fundamental medical services. Many Iraqis travel to neighboring nations like India, Iran, Jordan, Lebanon, and Turkey in hope of better medical facilities [19].

Additionally, Iraq faces the dual challenge of dealing with the aftermath of prolonged conflicts and the rising cases of non-communicable diseases (NCDs) [20]. The trauma and health complications arising from wars and displacements have stretched the healthcare system. On top of that, NCDs like cardiovascular diseases, diabetes, are rising and also indicating that the country's health system is currently not properly equipped to handle those concern [20].

Lastly, In Iraq, noncommunicable diseases such heart disease and diabetes, account for 55 percent of fatalities. At least thirty percent of the population is overweight or obese, and fourteen percent have diabetes. According to the World Bank, there are 1.3 hospital beds per 1,000 Iraqis, down from 1.9 in 1980, and there are 0.8 doctors per 1,000 persons, a significant decrease from 1.0 in 2014. Compared to other countries in the Middle East, this number is alarmingly low [18, 19].

2.3. Hypertension, Diabetes, and Dyslipidemia Burden in Iraq

Noncommunicable illnesses account for the majority of fatalities and hospitalizations in Iraq. According to experts, 14% of Iraqis have diabetes, 30% have hypertension, and 30% or more are overweight or obese[21] and according to the World Health Organization (WHO), non-communicable diseases (NCDs) accounted for 56%. Of the NCDs, cardiovascular diseases (CVDs) accounted for 21% of the total deaths, diabetes 1%, and in 2014, 19% of all deaths were due to NCDs accounting for 81%. CVDs accounted for 33% of all deaths and averaged 57.40% between 2000 and 2016 [22].

In addition to being the top cause of mortality in Iraq, noncommunicable diseases (NCDs) have a significant impact on the country's economy including cardiovascular disease and diabetes, The healthcare system and the economy as a whole bear the weight of the direct and indirect costs associated with these diseases. According to a study published in the Journal of Public Health in Developing Countries, it was estimated that noncommunicable illnesses will cost the Iraqi economy a total of \$4.7 billion in direct and indirect costs in 2013,

this includes costs related to healthcare, productivity losses due to illness and disability, and informal care provided by family members, the study also found that the lowest income group in Iraq has the most financial impact from noncommunicable illnesses (NCDs) [23]. lastly the reason why the focus of this Master thesis was on cardiometabolic diseases was because these conditions are such major contributors to morbidity and mortality, and because the burden of these conditions has such a significant impact not only on individuals but also on society as a whole, healthcare systems, and economies.

2.4. Medication Adherence: Exploring Definitions and Concepts

Throughout time, various terms have been used to describe the practice of taking medication most common ones include:

2.4.1. Compliance

The term "compliance" was first used to describe patients' way of following their prescribed medications. A definition of compliance is: "the extent to which the patient's behavior matches the prescriber's recommendations"[24] it means that the Patients should be expected to passively accept their doctors' recommendations this doesn't represent the patient's primary role in drug taking [25] the term has been criticized for suggesting a negative dynamic between patients and medical professionals [26].

2.4.2. Concordance

The Royal Pharmaceutical Society of Great Britain first proposed concordance in 1995 [27] the implication being that the doctor and patient should reach a mutual decision over the patient's treatment plan [28]. According to the concordance approach clinicians should recognize that patients have the freedom to decline medication treatment. A therapeutic agreement between the therapist and patient is the ultimate goal of concordance, care that is centered around the patient is synonymous with concordance [29]. The primary objective of concordance is to ensure that the patient is receiving the treatment they desire, that they are motivated to adhere to the treatment plan, and that their needs are being met. This has the potential to improve patient satisfaction, health outcomes, and quality of life [28], Its importance to add that the term does not refer to medicine-taking behavior or how well a patient follows their doctor's instructions. It rests on the premise that doctor-patient

consultations are a two-way conversation between equals that's why Actual behavior cannot be expressed by concordance [30].

2.4.3. Persistence

persistence is the degree to which a patient continues to take prescription drugs as instructed over time or the length of time a patient continues to take a prescribed prescription, It is an essential indicator of a medication's efficacy and is often used to evaluate the quality of treatment a patient is getting[25] It takes into account things like renewal frequency, time between refills, and prescription use stability. low persistence is indicative of inconsistency in medication use, whereas high persistence indicates that the patient consumes their medication consistently and without long gaps. This concept is essential for determining how medications will perform over time and what impact they will have on health outcomes [31]

While adherence, on the other hand, relates to the extent to which a patient adheres to the suggested treatment plan, which may involve taking drugs as prescribed, implementing lifestyle modifications, and attending follow-up visits[28] Persistence and adherence are essential for ensuring that patients obtain the full advantages of their therapy and avoiding undesirable outcomes. Insufficient persistence or adherence may result in unsatisfactory treatment results and have a substantial influence on the efficiency and cost of healthcare[32].

2.4.4. Adherence

According to real world data quite so many as half of all patients do not rigorously follow their prescription medication [33]. World Health Organization defines adherence as “the extent to which a person’s behavior-taking medication, following a diet, and/or executing lifestyle changes corresponds with agreed recommendations from a healthcare provider”[8].

Medication non-adherence is a worldwide issue that reduces any treatment’s effectiveness. The rates of death, illness, and healthcare expenditures, the direct medical cost of nonadherence in the United States alone has \$170 billion per year [3] and 125,000 potentially avoidable deaths, 50% of treatment failure, and up to 25% of hospital admissions [4]. which is estimated to be much lower in developing countries [8]the burden of non-adherence on healthcare and society is well-studied [6–8].

There isn't any "standard" way to evaluate medication adherence in clinical practice, although a different strategies have been used as each and every method has its strengths and limitation[34],even though objective measures of adherence, such as the measurement of medication concentration in body fluids, are regarded accurate, they are costly, difficult to perform and do not show any pattern or cause of nonadherence[10]while patient self-report of adherence is the quickest and most straightforward way to collect information, as it is an inexpensive and convenient method of adherence assessment in clinical practice [11].

It's worth noting that medication adherence is a complex multifaced behavior. A variety of factors may influence the adherence of individuals with chronic illnesses to their prescribed medications. In addition to health literacy, self-efficacy, and cognitive capacities such as remembering, personal and cultural beliefs about medication use are an example of a psychosocial factor that influences medication adherence [35].

2.5. New taxonomies of medication adherence (ABC taxonomy)

Over the years numerous disciplines have contributed new concepts and expressions about medication taking behavior making it harder to find meaningful bridges between them. These terms overlap but are still different enough to cause conceptual confusion and methodological inadequacy. The problem is made worse by the fact that conceptual and practical meanings and measurements sometimes fail to match up.

That's why Vrijens developed a new taxonomy for medication adherence can be described as the act of patients following their prescribed drug regimen, based on a particular classification, According to Vrijens et al. , it is evident that there are three distinct stages of adhering to drug that includes the process of initiation, implementation and discontinuation [27].

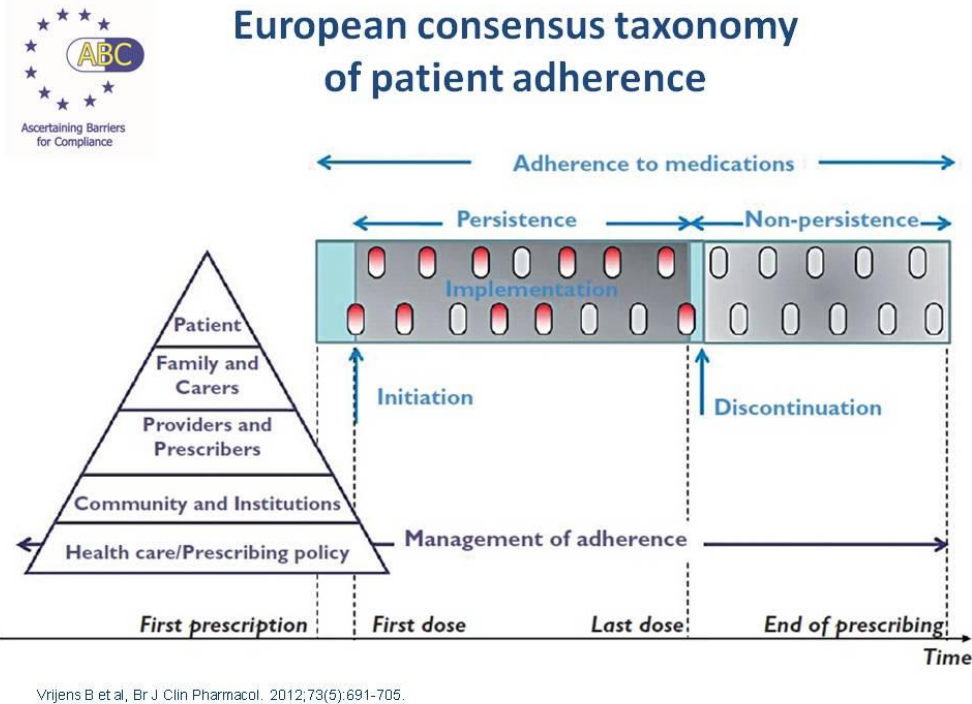


Figure 2.1. A new taxonomy for describing and defining adherence developed by the European consensus Taxonomy [27]

An initiation occurs when a patient receives their initial dose of a medication. In contrast, discontinuation refers to the act of discontinuing the use of a prescribed medication. Implementation refers to the extent to which a patient's actual medication practice corresponds with the specified dosage during the course of treatment which means from initiation of treatment to the discontinuation of treatment [27]. Even though this labeling method is still new and hasn't been widely used in the past, but it seems like a good way to standardize how patients' drug use is reported.

2.5.1. Classification of medication taking behavior (non-adherence taxonomy)

Non adherence can be intentional or unintentional , unintentional-nonadherence to a treatment plan happens when a patient is negligent or forgetful about following it, as opposed to actively resisting or avoiding it, while when a patient intentionally deviates from their recommended therapy, this is referred to as intentional nonadherence, in which it seems to be the result of a logical decision-making process in which the person assesses the advantages of therapy against the undesirable consequences of treatment [36].

Positive perspective on treatment has been demonstrated to boost patients' probability of completing their recommended regimen [37] Another study found that patients with a more optimistic attitude on treatment were more likely to finish it [38] Medicine beliefs are substantially connected with intentional medication adherence and the degree to which individual plans to stick to their medication schedule has been shown to be influenced by their perceptions of that regimen.

It's proven that patients are more likely to finish their recommended medicine regimens if they have trust in the therapy's usefulness and utility while negative thoughts regarding medication, such as concerns about adverse effects or questions about the drug's need or effectiveness, or patients who dread the bad side effects of their drugs may be less inclined to take them as recommended or may even intentionally skip doses [8] Alternatively, if a person is unintentionally missing doses, it may be necessary to address the practical issues that make it difficult for them to adhere to their treatment regimen. Aiding an individual in overcoming barriers to medication adherence may include assisting them with memory aids providing easier access to the prescription itself [39].

Regardless of whether non-adherence is intentional or unintentional, Poor medication adherence will result in negative health consequences, such as a deterioration of the initial illness or the development of new health problems; therefore, it is important to address the issue to improve the individual's health outcomes and more importantly determining the fundamental causes of non-adherence and employing effective therapies can improve medication adherence and, by extension, an individual's health and quality of life [40].

2.6. Measurements of medication adherence

A reliable method to assess medication adherence is important for identifying patients who do not adhere to their prescribed treatment regimens. It also helps in determining appropriate interventions and assessing their outcomes [41] there isn't any "standard" approach to evaluating medication adherence in regular clinical practice at the moment, although a variety of strategies have been used as each method has strengths and limits [34]. The World Health Organization classifies adherence to medication measures as either subjective or objective [8].

Subjective measures are based on evaluations either by the patient or the healthcare provider. For example, when patients self-report on their medication usage, it can be a useful way to give insight into their adherence patterns. However, these self-reports may be influenced by biases such as wanting to appear compliant (social desirability bias) or inaccuracies in recalling actual medication usage (memory bias). Similarly, assessments by medical professionals fall into this category and has its own biases [42].

On another hand, objective measures provide more concrete data, like Biochemical tests, or biomarker analyses, which will check for the presence or lack of a drug or its byproducts in the patient's system. These tests offer immediate insights into medication adherence but might not be applicable across all drugs and has its own limitation.[10]Additionally, electronic devices, such as smart pill dispensers will track when a patient administers their medication, delivering another way of getting objective data. Yet, their cost and suitability can be limiting factors. overall, objective tools are favored more over subjective ones due to their precision and accuracy [43].

Further classification labels include direct and indirect methods [39]. Measurements of a drug (or metabolite) or biological marker concentrations in blood or urine are examples of direct methods that can be used to confirm that a patient is adhering to their treatment plan. Patient questionnaires, self-reports, pill counts, prescription refill rates, clinical response assessments, electronic medication monitoring systems, physiological marker measurements, and patient diaries are all examples of indirect approaches [44].

2.6.1. Direct measurement of adherence

Ensuring that patients consistently take their prescribed medications is a crucial element in the healthcare sector. but the traditional methods that are used are not without challenges. Monitoring patients directly, such as through Directly Observed Therapy (DOT), ensures that medications are consumed in the presence of a healthcare worker. This approach, although effective, can be labor-intensive and may not be practical for all situations, particularly for patients with long-term treatments or those residing away from healthcare centers [45].

Another direct way to test for medication adherence is by analyzing presence of medication or its metabolites. Blood tests can detect the presence or absence of a drug, giving a data of recent medication intake[46]. However, it doesn't always paint an accurate picture of routine adherence since patients could consume their dose shortly before the test. Similarly, urine tests can provide evidence of certain drugs but might not reflect consistent usage patterns [44].

Recent advancements have introduced digital medicine systems, where medications are embedded with tiny sensors. Upon ingestion, these sensors send signals to an external device, providing near-real-time evidence of drug intake. Though promising, such systems have their limitations in terms of availability and potential privacy concerns [47].

While direct methods offer concrete evidence of medication consumption, they come with a lot of challenges. for example, they can be invasive, expensive, and sometimes difficult to apply in practice, especially for long-term treatments [48] However, in scenarios where medication adherence is crucial, these methods provide the most reliable data [44]

2.6.2. Indirect measures of adherence

Most common indirect measures include:

2.6.2.1 Pill Counts

Counting pills is a frequently used technique to determine medication adherence, where the aim is usually for patients to achieve 80% compliance. By examining the number of pills taken between visits. but this method has its flaws, as patients might not always bring back the pills they haven't taken. Although it's an affordable technique, it doesn't guarantee that the medicine was indeed ingested [49].

A different method assesses the discrepancy between the number of pills a patient has left and the number they should have if they were fully compliant. this method was favored in the past[50], but it often gives an inflated view of adherence. This is due to factors like improper usage or intentionally not taking the medicine. It also depends on the ability of the patient to remember and bring their medication containers, which introduces room for error, and there's also the risk of patients losing their pill containers [51].

2.6.2.2. Pharmacy Prescription refill records

Another method to evaluate this adherence is by analyzing pharmacy prescription dispensing records, this method offers several advantages, primarily because adds into an existing dispensing infrastructure, easing the burden on healthcare facilities. And Its efficiency makes it a cost-effective strategy to evaluate adherence across different populations over extended period of time. Plus, these records provide valuable insights into primary adherence because it captures the essential stage of medication dispensing, shedding light on whether patients collect their prescribed medication [52]. However, while pharmacy prescription dispensing records serve as a convenient and economical tool in medication adherence research, they have limitations. They don't offer a detailed view of medication-taking behaviors, can't show actual consumption, and aren't flexible for short-term treatments.

2.6.2.3. Clinical outcome

Adherence Assessed Using Clinical Outcomes Traditionally, clinical outcomes have been used as method for medication adherence. This strategy is predicated on the premise that improved health outcomes will result from increased compliance. For example, in the treatment of epilepsy, missing doses have been shown to increase the risk of adverse clinical outcomes. But this is not always the case, despite the correlation between clinical outcomes and patient adherence [53].

Clinical Outcomes and Their Complicated Nature: Although studies have demonstrated a correlation between strong adherence and positive clinical outcomes, it is vital to note that adherence alone is not a guarantee of success. Several factors influence clinical outcomes; adherence is only one of them. Consequently, using clinical outcomes as the primary metric of adherence can be excessively simplistic and potentially misleading. That's why to achieve a more accurate and nuanced evaluation of medication adherence, some researchers consider multiple measures and not solely rely on clinical outcomes.

2.6.2.4 Electronic monitoring devices

Electronic monitors can effectively monitor medication adherence. They function by recording the time and date that a medicine container is opened and can even remotely

transmit this data to prevent its loss. Such technology provides a distinct advantage over more traditional approaches since it allows for the accurate collection of adherence patterns demonstrated by participants. Andrejak, for instance on research tested adherence to two antihypertensive drugs by electronically monitoring patients' adherence to each. Although the proportion of each medication consumed was comparable, electronic monitoring revealed that one medication was taken more regularly and on time than the other[54]. Important information provided by these monitors to healthcare providers is whether a patient consistently misses a specific dose, occasionally avoids doses, or takes extended pauses in their drug regimen. other adherence assessment methods cannot typically collect such granular data to differentiate between dose and schedule adherence.

Nevertheless, the limitations of electronic monitoring instruments must be acknowledged. Similar to a pill count, once the bottle is opened it is impossible to determine whether the drug was consumed or not. According to research, a large proportion of study participants opened their medication containers for purposes other than taking a dose, necessitating the need to discard data in some instances [55]. Therefore, it is not surprising that electronic documents demonstrate lower compliance rates than other methods This is why some devices ask users if they opened the container to take a dose to strengthen the association with pill counts. This modification does not address willful nonadherence when patients open the container exclusively to discard the dose. Most importantly in developing nations, the infrastructure required for electronic monitoring systems is typically lacking. Electricity, internet connectivity, and healthcare infrastructure issues can all hinder the successful deployment of these devices.

2.6.2.5. Patient self-reports of adherence

In addition to other methods, self-report measures, such as questionnaires, interviews, and diaries, are used to assess adherence. But there are also challenges posed by recollection biases and the subjectivity of patient-reported data to investigate the advantages and disadvantages of self-reporting as a method for monitoring medication adherence. There are a number of benefits to measuring drug compliance with self-reported metrics. Because they do not require high-tech equipment, they are inexpensive and straightforward to implement. In addition, the majority of patients find it simple to disclose their own symptoms.

However, despite these advantages, self-report methodologies have its drawbacks, such as subjectivity and measurement difficulties for adherence. And subjectivity of self-reported information. Due to this subjectivity, exact rates of adherence cannot be determined. And also due to the difficulty of validating high self-reported adherence, contend that self-reports are better adapted for diagnosing nonadherence than adherence.

Recall biases make it harder the accurately quantify of self-report measures Self-reports of adherence over shorter time periods are more credible than lengthier assessments because patients tend to recall current occurrences more accurately. This characteristic is consistent with the a book of Oppenheim (1992), which suggest that questions regarding recent adherence elicit more accurate insights than questions regarding adherence over a longer period of time [56].

Memory and recall can be distorted by factors such as mental health and emotions, influencing self-report assessments. Depressed individuals, for example, may be more likely to recall negative events, which may contribute to their claims of nonadherence This highlights the significance of considering patients' mental health when analyzing self-reported data [57].

lastly, patient-reported outcomes offer a low-effort, low-cost, and high-quality method for assessing drug adherence. Subjective evaluations can be used to identify nonadherence behaviors and direct interventions, as opposed to as a limitation. By combining self-reports with objective adherence evaluation methods such as electronic monitoring, it is possible to acquire a more complete picture of adherence habits. By providing these benefits of self-reporting healthcare providers can improve adherence and, ultimately, the health outcomes of their patients.

2.7. Prevalence of non-adherence to medications In Iraq

In Iraq, noncommunicable diseases (NCDs) account for the majority of deaths and hospitalizations. An estimated 30% of Iraqis are overweight, 14% have diabetes, and 30% have high blood pressure [15] By the year 2020, experts predict that the toll of chronic illness will have risen by as much as 57%. It is expected that the financial effects of the rising prevalence of chronic illnesses would increase over time [58].

Very little is known about the prevalence of medication non-adherence among Iraqis who use medications for common chronic conditions. it's estimated to be anywhere around 50% in developed countries and assumed to be lower in developing countries like Iraq [59]. Here are some of researches done to investigate medication adherence status in Iraq:

In a cross-sectional examination of 400 hypertension patients in Iraq, that examined adherence using a specially developed questionnaire The researcher discovered that treatment consistency was substantially associated with uncontrolled hypertension 58.8 percent of the patients were not taking their recommended antihypertensive medications [60].

A study in Misan, Amara, Iraq used a mixed method for the first time, by utilizing drug concentrations in dried blood spot samples linked to Morisky adherence medication scale (MMAS-8) results to establish the degree to which Iraqi patients were taking their prescribed cardiovascular medicine. Analysis of patient dried blood spot samples indicated that only 50.8% of Iraqi patients adhered to at least one of their CVD medications [61].

A cross sectional study conducted in three Baghdad hospitals from June 2010-2011, the study included 81 stroke patients (36 females, 45 males, aged 33-82) and 110 myocardial infarction patients (46 females, 64 males, aged 23-76). the results showed that salt-free non-adherence was observed in 69% of myocardial infarction patients and 62% of stroke patients. Silent hypertension occurred in 6.3% of myocardial infarction and 19.7% of stroke patients. Treatment non-adherence was 61% overall, 71% in myocardial infarction, and 48% in stroke patients. Regarding medication, angiotensin-converting enzyme inhibitors were most common, with variations between the two groups [62].

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Cross-sectional research on a survey of 100 hypertension patients that took place at Nasiriyah Teaching Hospital. Findings showed a notable link between education and compliance, as well as between disease duration and complications. A significant 63% of participants didn't fully comply, with a majority being less-educated males. Of these non-compliant patients, 70% faced complications, with 21% experiencing cerebrovascular issues [63].

This study was carried out from January to July 2013 at Marjan Teaching Hospital, to assess the treatment adherence of 323 hypertensive adults using the Morisky 8-Item Medication Adherence Scale. Results revealed the average patient age was 51.28. Only 24.8% showed good treatment compliance, while 57.9% had poor compliance. 34.1% couldn't recall their last reading and only 22.3% effectively managed their blood pressure. The study concluded that medication adherence is low and closely tied to blood pressure control. Factors like higher education, disease complications, longer disease duration, and single medication usage improved compliance [64].

A cross-sectional study that examined drug adherence's importance in chronic disease treatment, The research in Garmian region, Data collection utilized a specific project questionnaire and the Morisky green scale (MMAS-8) to examine adherence levels. Results indicated high adherence in 29.8% of participants, while 50.6% showed moderate adherence, and 19.6% had low adherence. The primary reasons for low adherence were patients finding the treatment plan complex to understand and challenging [65]

Descriptive cross-sectional research conducted at An Nasiriyah Heart Center from January to July 2021, involved 195 cardiovascular disease patients. A questionnaire was used to collect data on adherence patterns, and factors related to non-adherence. Its content validity and internal consistency were verified by experts and a pilot study, respectively. Adherence assessment used the Medication Compliance Questionnaire, 54.4% of participants were non-adherent to cardiovascular medications. Top barriers included forgetfulness (44.4%), financial constraints (25.6%), taking multiple medications (11.3%), and being too busy

(11.3%). Elderly participants (>60 years) and those on multiple medications were more likely to be non-adherent [66].

A cross-sectional study of 300 diabetes patients at the National Diabetes Center, Baghdad, from January-April 2015 used the 8-item Morisky Medication Adherence Scale to assess drug adherence in type 2 diabetes Iraqi patients on oral hypoglycemic agents. revealed that no patients displayed high adherence, 1.32% had medium adherence, and 98.68% showed low adherence to prescribed diabetes medications [67]. Collectively, these studies show concerning results of medication adherence among Iraqi patients, especially those dealing with conditions like cardiovascular disease and hypertension.

Table 2.1. Studies on adherence to medications in patients with cardiometabolic diseases in Iraq

Study/setting/Duration	Method	Sample size	Tool/measure	Findings
study conducted in Erbil city between April 2011 and March , 2012 involved a convenience sample of 400hypertensive patients attended outpatient clinics at Rizgary teaching hospital in Erbil city[60]	Cross sectional using self-report questionnaire	400 hypertensive patients	Self-report questionnaire designed by the researcher	58.8 percentage of the patient were non adherence to their prescribed treatment More than half of the hypertensive patients were uncontrolled. The factors associated with uncontrolled hypertension were non adherence to treatment, sedentary life style and smoking

Cardiovascular patients were recruited from Misan/Amara Alsader Teaching Hospital and Misan Cardiac Centre Iraq during a routine clinical checkup [61]	Mixed method study- MMAS-8 adherence questionnaire and patient blood spot samples	303 cardiovascular patients	MMAS-8 adherence questionnaire and patient blood spot samples	Adherence to medication was found to be 81.8% based on the MMAS-8 questionnaire and 50.8% based on the laboratory-based DBS analysis. There was poor agreement between the indirect (MMAS-8) and direct (DBS analysis) approaches to assessing medication adherence.
The study was conducted in 3 hospitals in Baghdad between June 2010 and June 2011[62]	Cross sectional study-self report questionnaire	study involving 191 hypertensive patients from two groups: acute ischemic stroke patients with hypertension (81 patients) and acute myocardial infarction patients with hypertension (110 patients)	Self-report questionnaire antihypertensive treatment compliance	Salt-free diet noncompliance was observed in 69% and 62% of myocardial infarction and stroke groups, respectively. Silent hypertension was seen in 6.3% and 19.7% of myocardial infarction and

				stroke groups, respectively. Noncompliance on antihypertensive therapy was observed in 61%, 71%, and 48% of the total, myocardial infarction, and stroke groups, respectively.
A study conducted in Nasiriyah consisted of patients who were attending the out-patient clinic of Nasiriyah Teaching Hospital, including (60) male and (40) female[63]	Cross-sectional study-self report questionnaire	100 patients diagnosed with essential hypertension	Self-reported questionnaire constructed and designed by the researcher	The study's findings showed a strong link between the level of education and overall patient adherence. There was also a notable correlation between the length of illness and its complications. Notably, 63% of the participants did not adhere to recommended guidelines, and the majority of these were males with limited education.

				Among them, 70% experienced complications, with 21% having a Cerebrovascular accident.
the study was conducted in Duhok city, Iraq and it was carried out over a four-month period in 2007 patients were collected from the out patients department of Azadi general teaching hospital[68]	Cross-sectional study-self report questionnaire	total of 707 hypertensive patients were interviewed for the study.	MORISKY-GREEN TEST	The study revealed a compliance rate of 54.6% among the patients according to the Morisky-Green test. the majority of the patients had low levels of education (70.3% were illiterate or had only primary education) and lived in intermediate socio-economic conditions (more than 60%).
The study that has been carried out in Garmian province in Iraq from 2013 to Jan 2014, patients data were mainly collected in hospital in general hospital in Kalar and three health	Cross-sectional study-self report questionnaire	195 cardiovascular patients	eight item Morisky green scale	adherence level among diabetic and hypertensive patients, with high adherence at 29.8%, and moderate and lower adherence at 50.6% and 19.6%

centers from Kalar, Kifry and and Rzgari[65]				respectively. Low adherence was mainly attributed to intentional behavior, with patients feeling hassle and difficulty with the treatment plan
Patients were recruited from Baghdad national diabetes center from January to April 2015[67]	cross-sectional study-self report questionnaire	300 diabetes patients	eight item Morisky medication adherence scale (8-MMAS)	The mean age of the diabetic patients in the study was 52.48 ± 8.17 years, and the mean duration since diagnosis was 7.35 ± 4.5 years Out of the 300 patients, 46.3% were males and 53.7% were females, with a male-to-female ratio of 0.86:1 Educational level had a significant impact on mean Morisky score, with illiterate patients having the highest score and patients with higher education

				having the lowest score
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2.8. Medication Non-adherence Consequences*outcome

Medication non-adherence has been linked to several negative outcomes, including treatment failure, disease progression, and an increase in morbidity and death[69,170,172] A meta-analysis comprising ten studies and 106,002 patients with cardiovascular disease confirms that better adherence to CVD medications is associated with a lower risk of all-cause mortality, a lower risk of cardiovascular mortality, a lower risk of myocardial infarctions, as well as a lower risk of hospitalization[70] and Greater treatment adherence in diabetes patients was associated with better glycemic control and clinical outcome[71] This is particularly concerning given that many chronic conditions, such as hypertension, diabetes, and cardiovascular disease, need lifelong medication treatment to manage symptoms and prevent complications. For example, if a patient with hypertension does not take their medication as prescribed, their blood pressure may not be controlled and they may be at risk for cardiovascular complications such as heart attacks and strokes. Similarly, a diabetic patient who does not take insulin or oral hypoglycemic medications as advised may suffer neuropathy, retinopathy, and kidney damage.

The economic consequences of medication non-adherence are also significant, studies revealed that Healthcare systems expenditures are highly strained by nonadherence[72], for example, it was found that across 14 illness categories, the annual economic impact of non-adherence, including hospital expenses, ranged from \$949 to \$44,190 per patient[72], A systematic review of studies undertaken between 1990 and 2005 showed that people with the greatest rates of adherence to their anti-diabetic treatment programs had the lowest overall health care costs[73], while according to a thorough examination of the economic burden of cardiovascular diseases as a group, the annual cost of non-adherence to CVD medications per patient is anticipated to exceed \$10,000[72].

Non-adherence can cost society productivity too, as significant evidence shows that it is associated with fewer sick days, which minimizes the cost to society even though the relationship between adherence and workplace productivity has received the least attention[74,75] It is recommended that further research be performed on the topic of job productivity[75].

Additionally, when patients do not take their medications as recommended, pharmaceutical waste can happen too. This waste may be in the form of unused pills being thrown away or returned to the pharmacy [76], In England, wasted pharmaceuticals amount to over £300 million annually, but in the United States, consumers wasted over \$418 billion in 2012 due to inefficient prescription use [77, 78]. Unfortunately, In Iraq, medicine nonadherence research is scarce, hence there are no readily available statistics about the impact of nonadherence on health expenditures or medical waste related with non-adherence.

In conclusion, medication non-adherence can have serious consequences for the health and well-being of patients and That's why, it is essential to recognize the importance of medication adherence in improving health outcomes and take steps to eliminate any barriers that may be contributing to poor adherence. If this is done, health outcomes may improve.

2.9. Factors Related to Medication Adherence

There is more than one factor at play in patients' inability to take their medications as prescribed. Because of this, the World Health Organization (WHO) developed the Multidimensional Adherence Model for comprehending and solving drug adherence. According to the WHO Multidimensional Adherence Model, several elements may influence drug adherence, including:: socioeconomic-related factors, 2) healthcare system-related factors, 3) condition-related factors, 4) treatment-related factors, and 5) patient-related factors [8].

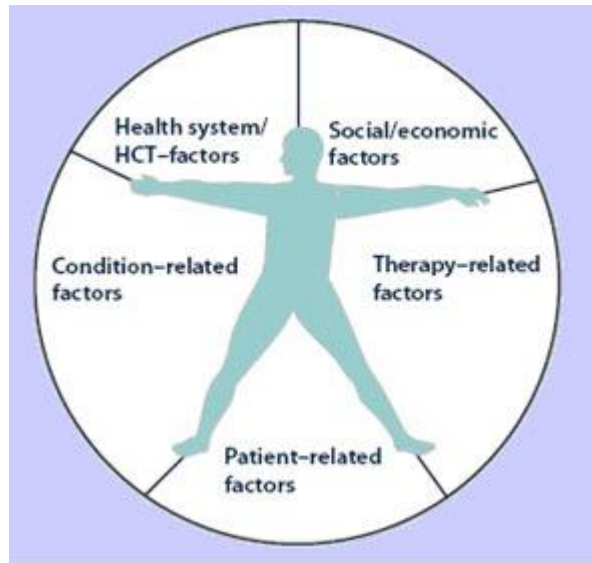


Figure 2.2. The five dimensions of adherence as suggested by the World Health Organization [8]

2.9.1. Socioeconomic-related factors

It has an impact on the degree to which a patient adheres to their treatment plan. Some examples of these factors include age, level of education, and gender, socioeconomic status, study reviews showed that education can have a beneficial effect on compliance [79], [80] or Inadequate encouragement from loved ones can have a major effect on patients' ability to stick to treatment plans [81]. Overall, that's why it is essential to recognize the influence that socioeconomic status may have on medication adherence and to design strategies to overcome related obstacles. Individuals with a lower socioeconomic level may benefit from improved adherence and improved health outcomes if this is accomplished.

2.9.2. Health care system-related factors

Regarding health care system factor a poor relationship between the provider and the patient or a lack of communication with the provider, health insurance, and accessibility to medical care, but when it comes to patients with chronic illnesses, it remained unclear whether patients' health insurance status affects adherence [82] However, in Iraq, the relationship between patients and doctors has weakened. Many Iraqi medical professionals are considering leaving the country due to insecurity, professional pressures, and a political and violent environment, all of which have contributed to a high rate of turnover and emigration. Since the remaining doctors in Iraq were unable to provide the adequate health

care provided to Iraqis, many of whom are already dissatisfied [83]. The rate of intentional violence-related deaths among Iraqi medical professionals has reached 47.6 per 1,000 doctors annually[84]all of these factors play a role in worsening patient-health care providers relationship.

2.9.3. Condition-related factors

Condition-related factors refer to aspects of a patient's medical condition that can impact their medication adherence which may include symptom severity, comorbidities, and side effect, their effect is proportional to the degree to which they alter patients' perceptions of risk and the priority given to adherence. Important modifiers of adherence behavior include the presence of co-morbidities including depression (in HIV or diabetes) and substance abuse [85].

2.9.4. Treatment-related factors

Treatment-related factors refer to aspects of a patient's treatment that can impact their medication adherence for example the intensity of illness and any disease-related disability, the type of symptoms and condition of the disease, and the degree of progression all have a significant impact on the degree of adherence. Which highly influences the consumption of medicines [82]

2.9.5. Patient-related factors

The patient's outlook on therapy, their sickness, and the healthcare system as a whole, as well as their hopes for and fears about the treatment's effectiveness, as well as their drive to keep their condition under control, all play a role [86] There been extensive research into the connection between patient-related factors and drug adherence across a variety of illnesses [87–90] Patients' younger age, non-white race, Asymptomatic, chronic conditions that need long-term treatment all have a role in medication non-adherence [8]. because it affects the whole of a patient's interaction with the healthcare system, it must be given special consideration. Patient involvement is considered as an important key to adherence, so population-level interventions must address issues that are personally important to each patient [91].

2.10. Social cognition models to medication-taking behaviors

According to the Social Cognitive Theory, medication adherence may be affected by an individual's cognitive and behavioral responses to social signals and influences, such as the statements and actions of healthcare providers and family members. This concept proposes that individuals are more likely to take their medication when reminded of its significance and rewarded for doing so.

The health behaviors model to enhance medication adherence is one of the most essential models explaining modifiable elements influencing medication adherence. Part of this model involve individual's health beliefs, which are an intrinsic part of the decision-making process of patients [43, 92]. This model conclude that Changing one's beliefs can have a significant impact on health outcome and disease duration [93–95].

Several theories suggest that, for a wide variety of chronic illnesses, an individual's beliefs are robust predictors of medication adherence. Several health behavior models have been applied to medication adherence during the past few decades [96] including The Health Belief Model [48], the Common Sense Model, the Locus of Control, [97] and the Stages of Change [98] are often used models of health behavior. Each theory describes a different set of assumptions concerning the role of the individual's beliefs and attitudes in determining the individual's choices regarding medicine use for example the Beliefs about Medicines Framework suggests that individuals make decisions about adhering to their medication through a cost-benefit analysis, in which beliefs in the perceived necessity of medicine are weighed up against beliefs in the perceived concerns of medicine. This allows individuals to make decisions about whether or not they will adhere to their medication [92,99].

The Theory of Reasoned Action (TRA) and the Theory of Planned Behavior (TPB), are widely used in health behavior studies. The theory of reasoned action (TRA) suggests that behavior is determined by intention, which is influenced by a positive attitude toward the behavior and social norms. TPB, an extension of TRA by Ajzen, includes perceived behavior control to account for constraints and support. It consists of internal (akin to self-efficacy) and external (similar to controllability) factors, impacting both intention and behavior. Which a has a direct and mediated effect on adherence behavior [167].

Compared to the Health Belief Model (HBM), TRA and TPB offer advantages such as explicit and testable concepts, consideration of social factors, and a focus on the role of intention in predicting behavior. However, they have been criticized for their inability to explain why some patients with strong intentions do not perform the behavior, their limited ability to explain habitual behavior, and their neglect of emotional factors [168].

Self-Regulation Theory (SRT), also known as the Common-Sense Model (CSM), was developed by Leventhal and colleagues in the 1980s. It originated from research on fear-arousing messages and their impact on health behaviors like vaccine uptake. SRT suggests that individuals actively address health threats in three stages: **Awareness**: Individuals become aware of health threats through internal (e.g., symptoms) and external stimuli. They form initial cognitive representations of emotions and health threats, including identity, timeline, cause, consequence, and control. **Coping**: Depending on their representation, individuals choose either approaching coping (e.g., treatment, consulting with doctors) or avoidant coping (e.g., denial, non-adherence). **Appraisal**: Individuals assess the results of their coping strategies, leading to adjustments in their expectations of effectiveness. They may continue with their current coping or switch to an alternative one. This process repeats until the problem is resolved [167].

CSM has advantages over other models like HBM and TRA/TPB because it includes emotional representation and explains the difference between initiating and maintaining behavior. It's widely used in predicting medication adherence and other health behaviors. However, CSM may have limitations in predicting some health behaviors, as it does not account for practical barriers, external cues, self-efficacy, and personality factors. Researchers have extended CSM to address these issues by adding components like cognitive representations and emotional responses toward treatment [167].

2.10.1. Beliefs about Medicines and Related Models

Beliefs about medicines, specifically medication-related beliefs, are significant predictors of adherence behavior in various chronic conditions. Horne extended the Common-Sense Model (CSM) by incorporating beliefs about prescribed and general treatments. These beliefs consist of general attitudes about medicines, including their

perceived benefit, harm, and overuse, as well as specific beliefs about necessity and concerns related to particular medications [168].

The Necessity-Concern Framework (NCF) categorizes attitudes toward medicines into Ambivalence, Accepting, Skeptical, and Indifferent. Necessity beliefs motivate adherence, while Concerns can lead to non-adherence. These beliefs interact with illness perceptions, including perceived severity and effectiveness of treatment [169].

Horne's Beliefs about Medicine model integrates internal emotional factors, external environmental factors, and the intention to adhere to treatment. Patients appraise the outcomes of adherence, adjusting their representations of illness and treatment parallelly [169].

This model focuses on medication-taking behavior and provides the Beliefs about Medicines Questionnaire (BMQ) to assess beliefs from both general and specific perspectives. It offers a dynamic framework to understand the interplay between adherence behavior and determinants, considers mediated effects of intention on adherence behavior, and is a suitable theoretical framework for studying adherence [169].

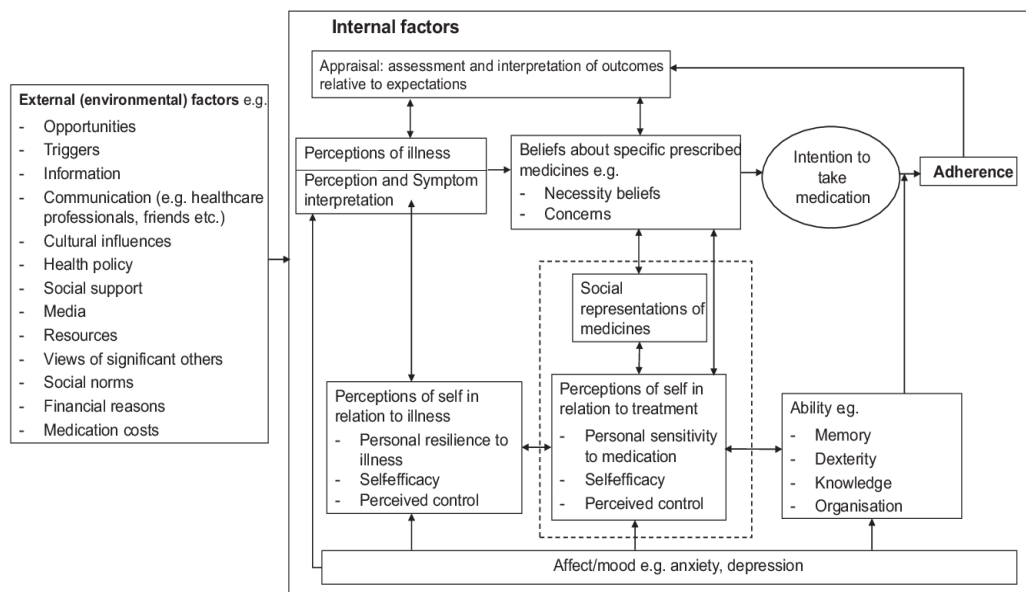


Figure 2.3. Beliefs about Medicine model [100]

2.10.2. Beliefs about medication scale

To better understand how to foretell healthy actions, researchers developed the Health Belief Model (HBM). The initial concept dates back to the 1950s, and it was revised in the 1980s. The approach is predicated on the idea that individuals' views of their health are the primary drivers of their motivation to make positive lifestyle changes [92].

It has been utilized in the study of a wide variety of behaviors, including adherence to medication regimens. Medication beliefs explain ways beliefs about medications can influence medication adherence [92] beliefs about medication can have a significant effect on a patient's adherence to their medication regimen. It is believed that if a patient has positive beliefs about their medication, such as confidence in its effectiveness and minimal concerns about side effects, they are more likely to adhere to their treatment [92]. On the other hand, negative beliefs about medication, including concerns about side effects, the necessity of the medication, or the belief that the medication will not work, can lead to lower adherence. Additionally, a patient's beliefs on the nature of their disease and the role of medicine in its management might impact adherence. A patient who feels their condition is mild or that they can handle it without medicine may be less likely to stick to their therapy [92,171].

(Horne et. al) was able to quantify patients' personal beliefs about the necessity of their prescribed medication and their concerns about taking it and to assess relations between beliefs and reported adherence among 324 patients from four chronic illness groups (asthma, renal, cardiac, and oncology). Professor Horne presented a novel method for assessing cognitive representations of medication: the Beliefs about Medicines Questionnaire (BMQ).

The Beliefs about Medicines Questionnaire (BMQ) is the most widely used tool and has been validated in a number of different patient populations. and has been used to study the relationship between beliefs and adherence to treatment (Horne et al., 1999). it measures medication beliefs and is broken up into two primary parts: the general and the specific. The Specific portion comprises two scales: necessity and concerns, and it is used to evaluate the patient's beliefs regarding the medications that have been prescribed for a particular ailment both an individual's ideas regarding the necessity of taking medication, as well as their concerns regarding the potential adverse effects of prescribed medications, are taken into consideration.

The General section discusses beliefs that are more general about medicines and is comprised of two scales: the General-overuse scale, which focuses on perspectives regarding how medicines are used by medical practitioners, and the General-harm scale, which evaluates beliefs regarding the extent to which patients perceive medicines as being fundamentally harmful and/or toxic [101] this information can be used to develop interventions to improve adherence, such as providing education about the medication and addressing concerns about side effects or long-term effects. Overall, the Beliefs about Medicines Questionnaire (BMQ) is a valuable tool for evaluating beliefs about medication in patients and for determining the relationship between beliefs and adherence to treatment.

2.10.3. Belief about medication studies in Iraq

The study aims to assess the level of adherence, knowledge, and belief to medications among elderly patients in primary healthcare centers in Baghdad. It found that a significant percentage (83.4%) of the sample had low adherence levels, the majority of participants had low belief levels (86%) and only a small percentage (7%) had a high level of knowledge about their medications. Low adherence levels were associated with more frequent visits to healthcare centers [102] The study does not explore specific chronic diseases or medications, which may have different adherence patterns and factors and doesn't mention whether the questionnaire used in the study was validated or not.

This research investigated beliefs and misconceptions regarding medication for diabetes mellitus (DM) in the general population. Conducted in Duhok Province, Kurdistan Region of Iraq, the study involved 2,305 adult participants. The findings revealed common misconceptions, such as concerns about insulin addiction and the role of sugar intake in causing DM. Males had more misconceptions, and diabetics seeking treatment from non-professionals were prone to misconceptions. Education levels significantly influenced misconceptions, while healthcare workers, although generally better informed, still held certain misconceptions [103].

This study compared medication adherence in cardiovascular disease patients in Australia and Iraq, focusing on factors influenced by the Theory of Planned Behaviour (TPB). It involved 246 patients from one Sydney hospital (Australia) and three Baghdad

hospitals (Iraq) between October 2016 and December 2017. Iraqi patients exhibited significantly lower medication adherence (64.3%) compared to Australians (37.5%). Adherence in both countries was linked to beliefs about medication and the ability to self-administer and refill prescriptions. Notably, outpatients in Iraq demonstrated better adherence than inpatients. The study highlights the need for healthcare providers to address patient beliefs and medication management to improve adherence in cardiovascular care [104].

This cross-sectional study examined medication beliefs among 380 diagnosed type 2 diabetes patients in Iraq. The research aimed to assess the association between patient beliefs about medication and glycemic control, along with other patient-specific factors. The findings showed that most patients had strong beliefs in the necessity of anti-diabetic treatment (76.3%), while a smaller percentage expressed strong concerns (18.4%). A minority (5.3%) had equal scores for necessity and concern. Despite these beliefs, the study found that patient beliefs about medication were not a strong predictor of good glycemic control [105].

One study examined medication beliefs in 200 Iraqi type 2 diabetes patients and their potential impact on glycemic control. While many patients believed in the necessity of anti-diabetic treatment, a significant portion had concerns about side effects. The study found that these beliefs were not strong predictors of good glycemic control. However, it's important to note that the sample size of 200 patients may not represent the full diversity of beliefs and adherence behaviors within this population, which can be considered as a limitation of the study [106].

Overall, these studies highlight the need for more research on medication adherence and related factors in Iraq's healthcare context. The limited number of studies and variations in findings shows the importance of conducting further research to better understand medication adherence challenges and develop targeted interventions to improve patient outcomes in this region. Since Addressing the gaps in knowledge in this region can contribute significantly to enhancing healthcare practices and patient well-being in Iraq.

3. MATERIALS AND METHODS

3.1. The Aim of the Study

The primary aim of this study was to develop validated a Kurdish version of MARS-5 and BMQ-specific secondly, we aimed to better understand impact of beliefs about medication and its relation with adherence among patients suffering from cardiometabolic illnesses. Last but not least, this validation provides an important tool that clinicians and researchers can utilize when examining Kurdish-speaking patients with such chronic cardiometabolic conditions also, this tool can be used as a comparator for validating other similar scales in the future

3.2. Study design and Population

This study is a cross-sectional observational study conducted at four medical centers located in Erbil, Iraq between February 2023 and July 2023. A questionnaire was delivered for male and female patients with a cardiometabolic disease, aged 18 years or older, speaking Kurdish language as first language. Convenience sampling method was used to collect individuals who had been diagnosed with cardiometabolic diseases, including Hypertension, Diabetes mellitus, and/or dyslipidemia, and had been prescribed medications for managing these conditions for a minimum duration of one year. Participants were required to have either completed a consent form or provided verbal consent prior to the study. Exclusion criteria included patients with incomplete patient files, or identified with a cognitive disease that may hinder their ability to communicate.

3.3. Questionnaires used in the study

3.3.1. Demographic section of the scale

In the first section of the questionnaire, demographic information and clinical parameters of the study participants were collected. This included basic demographic data such as age, gender, employment status and level of education. Additionally, we gathered the number of medications each participant was currently taking, and specific clinical parameters related to the participants' respective diseases, such as HbA1c levels, blood pressure, LDL cholesterol levels, the number of co-existing diseases, and the duration of the diagnosed disease.

To further gather information on the methods participants used for medication adherence we asked about their current strategies, which could include support from family members, the use of mobile applications, phone reminders or none. While to assess lifestyle factors, we collected data on participants' exercise habits, smoking status, and the use of complementary and alternative medicine. Lastly, we obtained participants' Body Mass Index (BMI) to examine the potential impact of body weight on disease management.

3.3.2. Medication Adherence Report Scale-5

Medication Adherence Report Scale-5 (MARS-5) was created as a simplified version of the ten itemed Medication Adherence Report Scale (MARS-10). The scale has 5 items each scoring on a 5 levels Likert scale from 1 to 5, with higher MARS-5 scores suggesting greater treatment adherence. Participants were asked to respond to each of the five MARS-5 questions using a Likert scale, offering a range of response options from "Always" to "Never." These questions. M1: I forget to take them. M2: I alter the dose. M3: I stop taking them for a while. M4: I decide to miss out a dose. M5: I take less than instructed. higher scores indicate a greater adherence level. The range of the total score of the scale is 5 to 25. As with the MARS-10, the MARS-5 has been validated as a valid and reliable instrument for monitoring medication adherence across a wide range of demographics. The MARS-5 is used extensively in clinical practice because of its quickness and simplicity in assessing patients' adherence to prescribed drugs[107]

3.3.3. Beliefs about Medicines Questionnaire-Specific

Research has shown that patients' beliefs about their medication including beliefs about the necessity of the medication, and concerns about potential side effects play an important role in their adherence to treatment that's why addressing patients' concerns and necessity beliefs would be possible for healthcare professionals help in increasing patients' adherence [100]. The BMQ is a well-validated instrument used to assess patients' belief about certain medicine. The BMQ-Specific is an 11-item scale that divides into two subscales measuring opinions about the necessity of prescription medication and medication concerns. items were scored by using a five-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = uncertain, 4 = agree, and 5 = highly agree).

3.4. Translation of the Questionnaires

In this research, a two-step method was adopted to translate the MARS-5 and BMQ-specific questionnaires into Kurdish. This method followed guidelines from the World Health Organization (WHO) and the ISPOR Task Force for Translation. First, we had two different translators independently translate the questionnaires from English to Kurdish. Next, we had another pair of translators, who weren't familiar with the questionnaire, translate the Kurdish version back into English. Once back translation process was complete a bilingual committee integrated the final version share it with the original developer for approval. To further ensure the clarity and comprehensibility of the Kurdish translations, a pilot study with 30 participants was carried. The feedback confirmed the successful adaptation of the questionnaires to the Kurdish population, endorsing their readiness for broader research usage. The typical time required to complete both scales was approximately 10 minutes in a face-to-face setting.

3.5. Sample Size Calculation

We used the item-to-respondent ratio to determine the appropriate sample size, specifically by utilizing a ratio of 1:20. This ratio means a sample size of 220[108] However, we actually gathered data from 407 patients during the data collection phase, which is considered sufficient for the study.

3.6. Statistical Analysis

Statistical analyses were conducted using SPSS 25 and AMOS 26. Internal consistency and reliability were assessed via Cronbach's alpha and test-retest reliability. Normality of outcome variables was assessed; Data were summarized using descriptive statistics. Confirmatory factor analysis and Principal Component Analysis evaluated construct validity of MARS-5. A Chi-square test was used to evaluate association between categorical variables and adherence status. Additionally, the two-tailed spearman correlation test was used to evaluate the relationship between continuous variables. p values <0.05 were considered statistically significant.

3.7. Ethical Consideration

Obtained ethical was approval for our research protocol from the Ethical Committee at the University of Suleimani College of Pharmacy. This approval was granted under registration number PH 88-23 on February 22, 2023. Written or verbal informed consent was obtained from participants.

Patient written consent forms were obtained and research was conducted in accordance with the Declaration of Helsinki. Patients were informed that only their initials would be used during the study without recording other related non-clinical essential individual data.

4.RESULTS

4.1. Descriptive Analyses Findings of patient characteristics

In the 407 sampled patients, the distribution slightly involved more females (52.6%, $n=214$) than males (47.4%, $n=193$). The majority were below 65 years of age (62.2%, $n=253$), with a median age of 60 (IQR). Most had an educational level below a bachelor's degree (89%, $N=364$) and were not employed (61.6%, $n=247$). In lifestyle factors, the majority were non-smokers (88.1%, $n=356$) and did not consume herbal medication (91.6%, $n=373$). About 60.2% ($n=233$) did not engage in exercise more than three times a week. When it came to BMI categories, 49.8% ($n=126$) had a normal BMI. Most managed their medication independently (93.6%, $N=381$), with a small fraction relying on family (6.4%, $n=24$). Additionally In the study sample 60.4% ($n=246$) were adherent to medication, while 39.6% ($n=161$) were not. A smaller number had comorbidities (26.5%, $n=108$), and most had a disease duration of less than 10 years (75.7%, $n=281$) with a median duration of 8 years. Hypertension (HTN) was prevalent in 56.5% ($n=230$) of patients, followed by Type 2 diabetes mellitus (DM2) (66.8% $n=272$), dyslipidemia (38.6% $n=167$), and other diseases (41.1% $n=165$). The majority of responders were on fewer than five medications (63.6%, $n=253$) with a median total number of medications being. Table 4.1.

Table 4.1. Patients Characteristics of ($n = 407$)

Variables	<i>n</i> (%)
Gender	
Male	193 (47.4)
Female	214 (52.6)

Age	
<65	253 (62.2)
≥65	154 (37.8)
Age Median [IQR]	60 (54-67)
Educational level	
< bachelor's degree	364 (89)
≥ bachelor's degree	43 (11)
Employment status	
Yes	154 (38.4)
No	247 (61.6)
Smoking status	
Yes	45 (11.1)
No	356 (88.1)
Herbal consumption	
Yes	34 (8.4)
No	373 (91.6)
Exercise status	
Do not exercise	233 (60.2)
More than three times a week	154 (39.8)

BMI	
underweight <18.5	5 (2)
Normal 18.5-24.9	126 (49.8)
Overweight 25.0-29.9	75 (29.6)
Obese ≥ 30	47 (18.6)
The current method of medication taking	
None	381 (93.6)
Family	21 (5.7)
Mobile reminder	3 (0.7)

Table 4.2. Adherence and Medication-related findings

Variables	<i>n</i> (%)
Adherence	
Yes	246 (60.4)
No	161 (39.6)
Presence of Comorbidities	
Yes	108 (26.5)
No	299 (73.4)
Duration of disease	
< 10 years	281 (75.7)
≥ 10 years	75 (24.4)
Duration of disease (y) [IQR]	8 (2-10)

Diseases ¹	
HTN	230 (56.5)
DM2	272 (66.8)
Dyslipidemia	167 (38.6)
Other diseases	165 (41.1)
Number of medications	
<5	253 (63.6)
≥5	145 (36.4)
Total number of medications Median [IQR]	4 (3-5)

¹Some patients had more than one disease.

4.2. Findings for the Reliability Analysis

In assessing the internal consistency of the MARS-5 scale. Cronbach's alpha values were 0.87 for the MARS-5 and 0.91 and 0.89 for the necessity and concern domains of BMQ, respectively. Corrected item-total correlations ranged from 0.645 to 0.776, and Cronbach's Alpha if items were deleted varied between 0.835 and 0.868. For example, the item "I stop taking them for a while" had the highest corrected item-total correlation of 0.776 and would result in the lowest Cronbach's Alpha of 0.835 if deleted. and the item "I alter the dose" had the lowest corrected item-total correlation of 0.645 but would lead to the highest Cronbach's Alpha of 0.868 if removed. This data suggested that each item significantly contributes to the scale's internal consistency. Table 4

Table 4.3. Results of internal consistency tests for MARS-5 items

MARS-5 Items	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
1- I forget to take them	0.658	0.863
2- I alter the dose	0.645	0.868
3- I stop taking them for a while	0.776	0.835
4- I decide to miss out a dose	0.774	0.836
5- I take less than instructed	0.699	0.853

Regarding the BMQ Necessity scale the corrected item-total correlations ranged from 0.666 to 0.831. Specifically, the item "My medicines protect me from becoming worse" showed the highest corrected item-total correlation of 0.831, and its removal would result in a Cronbach's Alpha of 0.881. On the other hand, the item "Without my medicines I would be very ill" had the lowest corrected item-total correlation of 0.666 but would lead to the highest Cronbach's Alpha of 0.914 if deleted. As it shown in Table 4.4.

Table 4.4. Results of internal consistency tests for BMQ-necessaty items

BMQ-Necessity Items	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
BS1 My health, at present, depends on my medicines	0.784	0.891
BS3 My life would be impossible without my medicines	0.810	0.886

BS4 Without my medicines I would be very ill	0.666	0.914
BS7 My health in the future will depend on my medicines	0.795	0.889
BS10 My medicines protect me from becoming worse	0.831	0.881

For the BMQ-Concern scale, the corrected item-total correlations varied from 0.617 to 0.803. The item "I sometimes worry about long-term effects of my medicines" exhibited the highest corrected item-total correlation at 0.803, with a resulting Cronbach's Alpha of 0.862 if deleted. while, the item "My medicines disrupt my life" had the lowest corrected item-total correlation of 0.617 but had the highest Cronbach's Alpha of 0.891 if removed. As it shown in Table 4.5.

Table 4.5. Results of internal consistency tests for BMQ-Concern Items

BMQ-Concern items	Corrected Item- Total Correlation	Cronbach's Alpha if Item Deleted
BS2 Having to take medicines worries me	0.786	0.864
BS5 I sometimes worry about long-term effects of my medicines	0.803	0.862
BS6 My medicines are a mystery to me	0.697	0.879
BS8 My medicines disrupt my life	0.617	0.891
BS9 I sometimes worry about becoming too dependent on my medicines	0.783	0.865

BS11 These medicine give me unpleasant side effects	0.620	0.891
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The test-retest reliability of the Medication Adherence Report Scale-5 (MARS-5) was assessed using Wilcoxon test and Interclass correlation Coefficient (ICC), This method involved 33 patients completed the questionnaires for the second time after 2 weeks then comparing the consistency of the responses. The findings demonstrate a high test-retest reliability for MARS-5. Wilcoxon test between the test and retest scores was found to be not significant between the two-time period ($p > 0.05$, $N = 33$). This indicated no significance difference between the two sets of scores, suggesting a high level of consistency in the responses over time. The MARS 5 scale's test-retest reliability analysis results showed an Intraclass Correlation Coefficient (ICC) of 0.952, within a 95% confidence interval of 0.902 to 0.976

Similarly for the test-retest reliability of the Beliefs about Medicines Questionnaire-Specific (BMQ-S) for both Necessity and Concern. For the Necessity aspect, no significant correlation of ($p > 0.05$) was observed between the first and second period, showing consistent results over repeated tests. with Intraclass Correlation Coefficient (ICC) of 0.842, within a confidence interval of 0.685 to 0.921. while for the Concern aspect of BMQ-S, the two sets of measurements showed no significant correlation between the two-time period ($p > 0.05$), the ICC for Concern was 0.868, with a 95% confidence interval ranging from 0.733 to 0.935. as shown in Table 4.6. below.

Table 4.6. Interclass correlation coefficient for MARS, BMQ-Specific Items

Items	Intraclass correlation coefficient (95% CI)
MARS-5	0.952(0.902-0.976)
BMQ-Necessity	0.842(0.685-0.921)
BMQ-Concern	0.868(0.733-0.935)

4.3. Findings for the Validity Analyses

Factor analysis was used. Kaiser-Meyer-Olkin (KMO) and Bartlett's tests of sphericity were used to determine whether or not the sample was enough and representative. According to the sources, the KMO must exceed 0.5 to assure adequate sampling[109], and our result was 0.869, which is considered reasonable. In this regard, Bartlett's test results were ($p = 0$). we determined the total number of factors the scales using Eigenvalues.

Principal component analysis of MARS and BMQ-specific scales was performed on the Kurdish translations of the MARS and BMQ-specific measures to examine construct validity for use by patients with cardiometabolic disorders. All items and their loadings are shown in Table 4.8. and table Component 1 was assumed to be the component that reflected the underlying construct of medication adherence for Table 4.8.

Table 4.7 KMO and % of variance of the scales

	MARS	BMQ-N	BMQ-C
KMO	0.869	0.881	0.890
% of variance	67.205	74.637	65.448
P value	0.000	0.000	0.000

Table 4.8.Factor analysis of the 5-item MARS-5 questionnaire

MARS-5 items	Factor loading
I forget to take them	0.779
I alter the dose	0.768
I stop taking them for a while	0.870
I decide to miss out a dose	0.869
I take less than instructed	0.817

Similarly, The structure of the eleven-item BMQ-Specific is based on two dimensions. Items falling under "Specific Necessity" have direct correlations to component 1 whereas those falling under "Specific Concern" have direct correlations to component 2. The results are presented in Tables 4.9. through below.

Table 4.9. Factor analysis of BMQ-Specific

BMQ items	Factor loading necessity	Factor loading concern
My health, at present, depends on my medicines	0.754	
Having to take medicines worries me		0.785
My life would be impossible without my medicines	0.815	
Without my medicines I would be very ill	0.777	
I sometimes worry about long-term effects of my medicines		0.808
My medicines are a mystery to me		0.758
My health in the future will depend on my medicines	0.778	
My medicines disrupt my life		0.643
I sometimes worry about becoming too dependent on my medicines		0.784
My medicines protect me from becoming worse	0.815	
These medicine give me unpleasant side effects		0.690

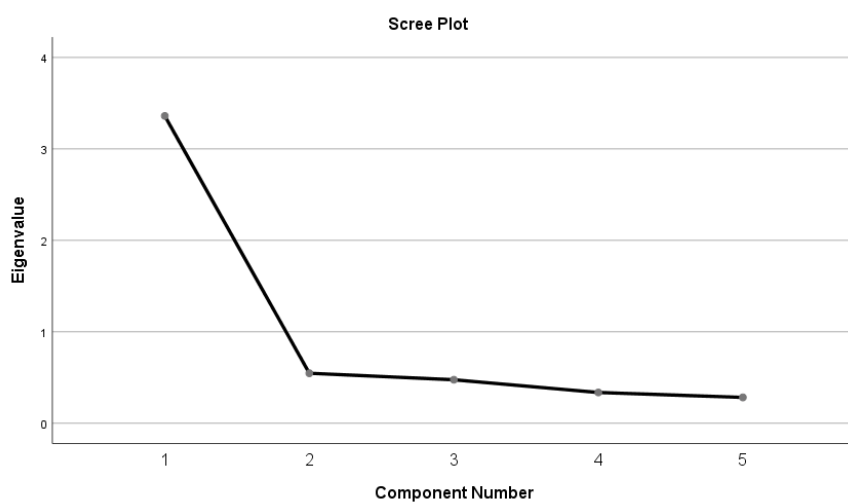


Figure 4.1. Scree plot of MARS-5.

Eigenvalue greater than 1. The retention of a single segment was also supported by the scree plot, Scree plot suggested two factors model as shown in Figure 4.2. and 4.3 below

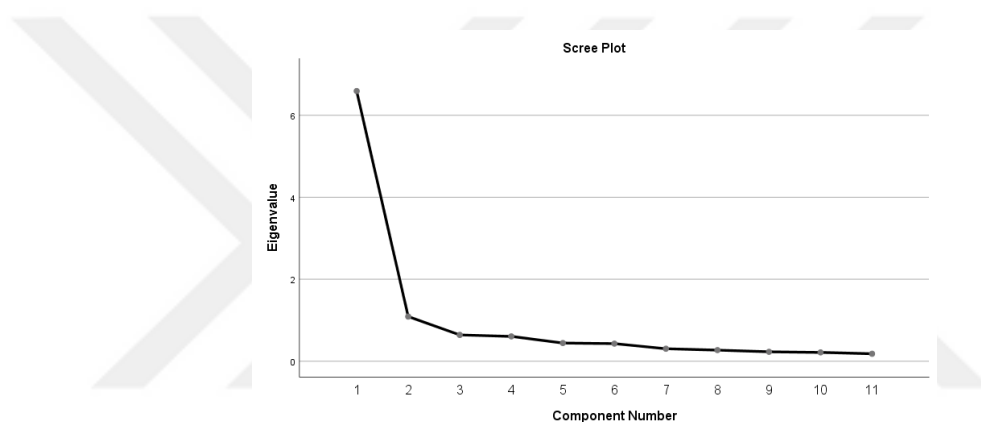


Figure 4.2. Scree plot of BMQ-specific.

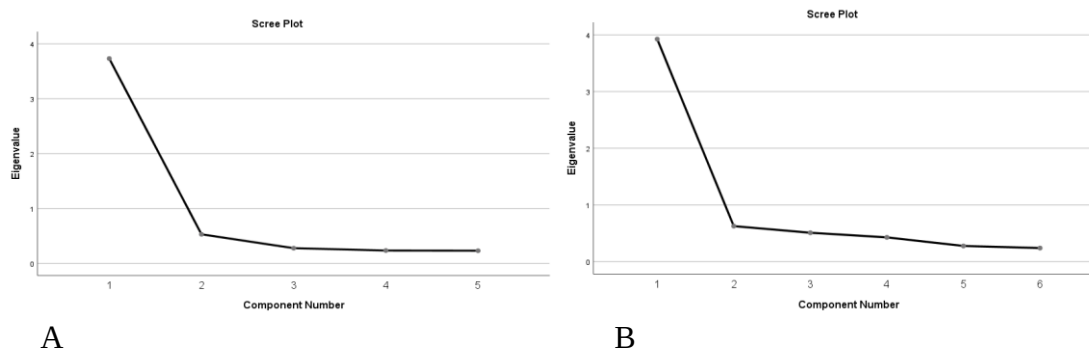


Figure 4.3 Scree plots of parent BMQ necessities (A) and concerns (B)

Following PCA, a CFA was done to validate the MARS-5 and BMQ model structures. The CFA results support a one-factor model for the MARS-5 scale. Several good model fit indicators lead to this conclusion: A Comparative Fit Index (CFI) of.988, which is near to the optimal value of 1, suggests that the model is well fitted. The CMIN/DF ratio, often known as the chi-square/degrees of freedom ratio, is 2.39, which is typically regarded as satisfactory.

The Goodness of Fit Index (GFI) is also near to the ideal value of 1 at 0.98. Furthermore, the Root Mean Square Error of Approximation (RMSEA) score of 0.058 indicates a reasonable approximation error. Together, these measurements demonstrate the suitability of the MARS-5's one-factor structure.

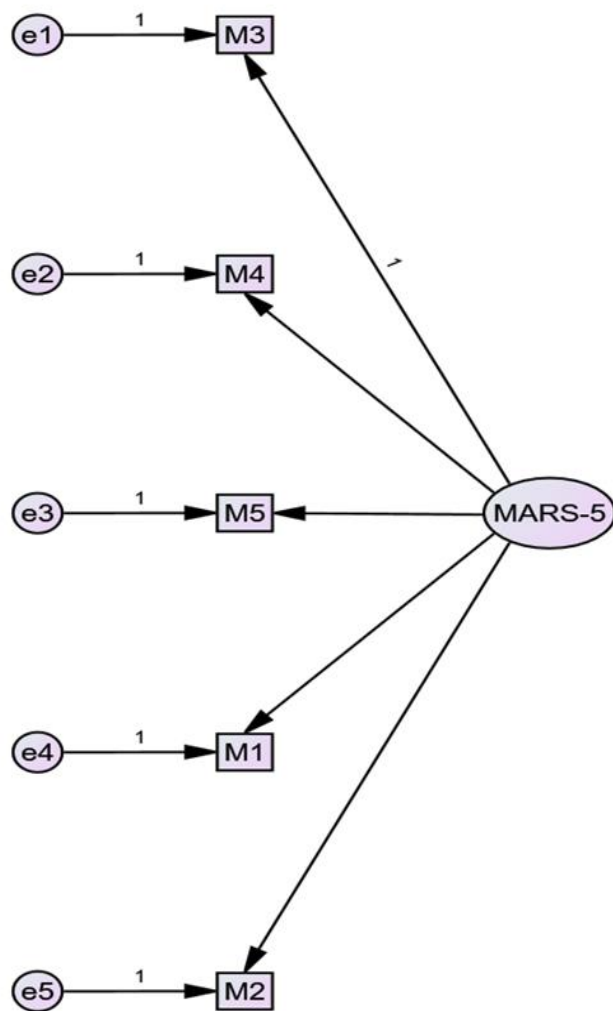


Figure 4.4. Confirmatory factor analysis for MARS-5.

Similarly, for the BMQ scale, the CFA supports a two-factor model. This is indicated by fit metrics like a CFI of 0.962, a CMIN/DF of 3.75, a GFI of 0.93, and an RMSEA of 0.082. These values, show a reasonable to good fit for the two-factor model structure of BMQ.

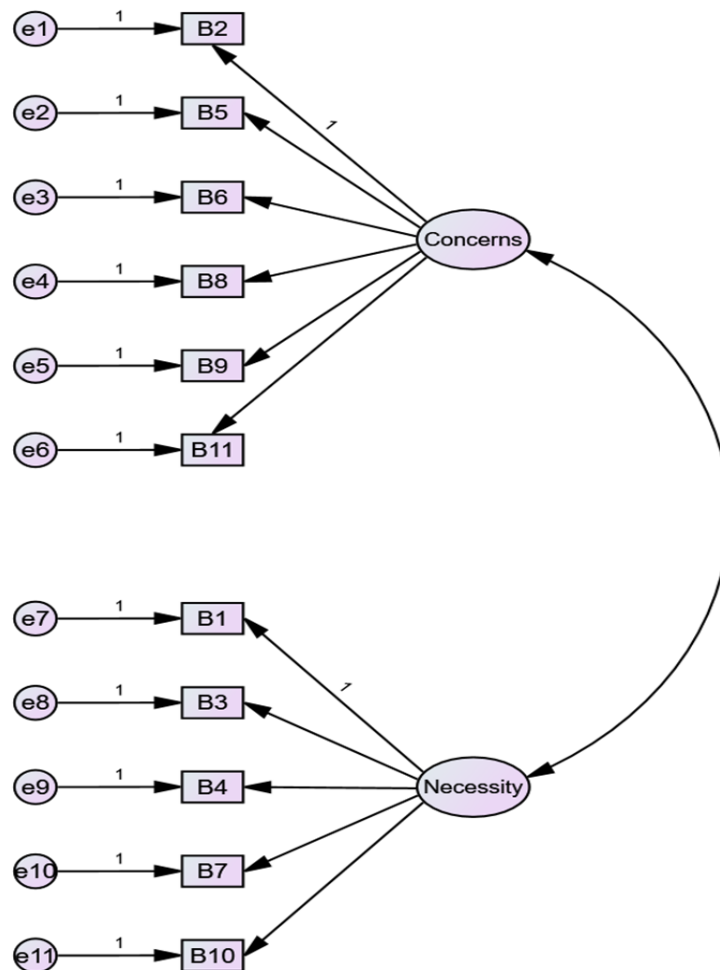


Figure 4.5. Confirmatory factor analysis for BMQ- specific.

4.4. Findings for the criterion related validity analyses

272 (66.8%) diabetic, 230(56.5%) hypertensive, and 157(38.6%) dyslipidemia patients were enrolled in this study. Laboratories provided Glycated Hemoglobin (Hba1c), Blood Pressure, and Lipid Profile, and the MARS-5 was used to evaluate Adherence. The results of the primary test used to determine whether there was a correlation between medication adherence (adherent versus non-adherent) and laboratory parameters are presented in Table 12. First test used, was the Spearman correlation test, which was used to assess the correlation between medication adherence, as a continuous variable, and clinical parameters, results showed that there was a statistically significant correlation between blood pressure and HBA1c. Blood pressure readings were obtained by averaging three recent measurements taken from each patient[110]. For diabetes patients' hemoglobin A1c was recorded the levels were also significantly correlated with MARS-5 scores. While no correlations were found between lipid profile and MARS-5

As it's shown in there is a negative correlation between adherence (measured by MARS-5) and systolic blood pressure (systolic Bp Average of three reading). The Spearman's rho correlation coefficient is -0.221, with a significance level (p -value) of 0.001. This suggests that as adherence scores increase (i.e., better medication adherence), systolic blood pressure tends to decrease, and vice versa. The sample size for patients who had blood pressure recorded was is 230.

Regarding diastolic blood pressure correlation with MARS-5 as presented from the table 12 below show a statistically significant, weak, negative correlation between adherence (measured using MARS-5) and diastolic blood pressure. The Spearman's rho correlation coefficient is -0.188, and the p -value is 0.004, which is below threshold of 0.05. This suggests that there is a tendency for higher medication adherence scores to be associated with lower diastolic blood pressure readings, and vice versa. The analysis was conducted with a sample size of 230 hypertensive patients with available diastolic blood pressure reading

Table 4.10 Correlations of MARS-5 to clinical parameters

Clinical parameters	Clinical Data	Spearman's correlation	p-value
HBA1C	272	-0.435	<0.001
Systolic BP	230	-0.221	0.001
Diastolic BP	230	-0.188	0.004
Cholesterol	167	0.785	0.817
Triglyceride	167	0.492	0.582
LDL	167	0.233	0.304

Table 4.10. also shows results indicate a statistically significant, negative correlation between adherence (measured by MARS-5) and Hba1c levels. Specifically, the Spearman's rho correlation coefficient is -0.435 with a p-value of less than 0.001, suggesting a moderate negative correlation. This implies that as adherence scores increase (indicating better medication adherence), Hba1c levels tend to decrease, and vice versa. The negative correlation suggests that better medication adherence might be associated with better glycemic control, as reflected by lower Hba1c levels. The analysis was based on a sample size of 272

Lastly regarding lipid profile analysis shows weak negative correlations between medication adherence (MARS) and various lipid profiles. With a 0.785 correlation between adherence and cholesterol ($p=0.817$), a 0.492 correlation with triglycerides ($p=0.582$), 0.233 correlation with LDL ($p=0.304$). these correlations suggest no correlation between medication adherence to improved lipid outcomes, the relationships are not statistically significant at the 0.05 level.

The second Test used The Chi-Square was used to assess the association between medication adherence (adherent vs. non-adherent), and the Systolic blood pressure control (SBp<130) vs. Poor Systolic blood pressure (SBp ≥ 130). Diastolic blood pressure control (DBp<80) vs. Poor diastolic blood pressure (DBP ≥ 80) glycemic control (poor glycemic control (HbA1c ≥ 7) vs. good glycemic control (HbA1c < 7).

First, glycemic reports of diabetes patients indicate a significant relationship between adherence to medication and glycemic control in patients with diabetes, as evidenced by the p-value of $P < 0.001$. Specifically, among patients who are adherent to their medication, a greater number have good glycemic control ($HbA1c < 7$) compared to those with poor glycemic control ($HbA1c \geq 7$). On the other hand, nonadherence is associated with a higher number of patients having poor glycemic control, as shown in the table below

Table 4.11. Association Between Medication Adherence and Hba1c

Adherence	Good Glycemic Control ($HbA1c < 7$)	Poor Glycemic Control ($HbA1c \geq 7$)	Chi-Square test	Mann whitney t test
Adherence	91(76.5%)	59(38.6%)	$p < 0.001$	$p < 0.001$
Nonadherence	28(23.5%)	94(61.4%)		

Secondly The Chi-Square result with a p-value of 0.004 indicates a statistically significant association between medication adherence and systolic blood pressure control among the subjects. Specifically, among those who are adherent to their medication regimen, a greater number have controlled systolic blood pressure ($SBP < 130$) as opposed to poor control ($SBP \geq 130$). Conversely, nonadherence to medication is linked with a higher prevalence of poor systolic blood pressure control.

Table 4.12. Association Between Medication Adherence and systolic blood pressure

Adherence	Systolic blood pressure control ($SBp < 130$)	Poor Sys Blood pressure ($SBp \geq 130$)	Chi-Square test	Mann whitney t test
Adherence	83(78.3%)	70(56.5%)	$p < 0.001$	$P = 0.272$
Nonadherence	23(21.7%)	54(43.5%)		

Similarly, the Chi-Square analysis for a Diastolic blood pressure showed a significant association between adherence with medication and diastolic blood pressure, as shown by a p-value $P < 0.001$ the majority of hypertensive patients who follow their medication regimen

exhibit well-controlled diastolic blood pressure levels (DBP < 80) as opposed to poorly controlled levels (DBP ≥ 80). As it shown in the Table 4.13. below

Table 4.13. Association Between Medication Adherence and systolic blood pressure

Adherence	Diastolic blood pressure control (DBp<80)	Poor diastolic blood pressure (DBP ≥ 80)	Chi-Square test	Mann whitney t test
Adherence	117(77.0%)	32(45.1%)	$p<0.001$	$P=0.112$
Nonadherence	35(23.0%)	39(54.9%)		

Lastly, while The Chi-Square test results for lipid profile indicate that there is no statistically significant association between medication adherence and lipid control, as suggested by the high p-values (0.817 for cholesterol, 0.582 for triglycerides, and 0.304 for LDL). which means that medication adherence does not appear to significantly affect the control of cholesterol, triglyceride, or LDL levels in our research samples.

Table 4.14. Association Between Medication Adherence and Lipid profile

Adherence	Chol control <200	Poor Chol level ≥200	TG control <150	Poor TG level ≥150	LDL control <100	Poor LDL level ≥100	Chi-Square test	Mann whitney t test
Adherence	62(52.5%)	31(63.3%)	42(56.8%)	51(54.8%)	62(53.0%)	31(62.0%)	$p=0.204$	$P=0.700$
Nonadherence	56(47.5%)	18(36.7%)	32(43.2%)	42(45.2%)	55(47.0%)	19(38.0%)	$p=0.804$	$P=0.469$
							$p=0.283$	$P=0.573$

Lastly the Mann-Whitney U test results indicated that there were no significant differences in medication adherence impacting cholesterol, triglyceride, and LDL control, with P-values of 0.700, 0.469, and 0.573 respectively. Similarly, the relationship of adherence on both diastolic and systolic blood pressure control was not statistically significant, as shown by P-values of 0.112 and 0.272. However, in the case of HbA1c levels, where the P-value was

0.00. This indicates a statistically significant difference between glycemic control and adherence levels.

4.5. Adherence relation to characteristics of the patients

The Chi-square test was used to compare demographic and clinical characteristics between adherent and non-adherent patients, including gender, age, education, employment status, smoking status, herbal consumption, exercise status, duration of cardiometabolic condition, number of cardiometabolic conditions, number of medications, polypharmacy, and data collection method.

patients were categorized into two groups: those who adhere to their medicines (246 patients) and those who didn't (161 patients). Gender didn't show a significant difference in adherence rates, with both men and women missing medications similarly. Age too, whether under or over 65, had comparable adherence rates. The educational background of participants varied, but it didn't impact medication adherence. People's working status, be it employed, unemployed, or retired, also didn't show a significant difference in taking medicines. Notably, whether someone smoked or not, or exercised frequently or not, didn't dramatically impact their adherence. but those who relied on family reminders or mobile reminders were better at taking medications than those who didn't have a reminder system. People's health conditions,

For the number of diseases, a patient has, those with one disease had the highest adherence rate and the non-adherence rates increased with the increase in the number of diseases. Regarding the duration of the disease, patients who had their disease for less than 10 years showed the highest adherence. In contrast, those who had their disease for more than 10 years had lower adherence rates. A significant observation was made in terms of the number of medications a patient was prescribed. Patients taking fewer than five medications had a higher adherence rate, while adherence dropped for those taking more than five medications. The non-adherence rate was significantly higher for patients on more medications. As its presented in the table 4.15. below

Table 4.15. Factors associated with adherent or non-adherent status

Patient characteristics	Patient with adherence (246)	Patient with Non-adherence (161)	<i>p</i> -Value
Gender			0.265
Male	111 (57.5%)	82 (42.5%)	
Female	135 (63.1%)	79 (36.9%)	
Age			0.294
Under 65	156 (61.7%)	97 (38.3%)	
Above 65	90 (58.4%)	64 (41.6%)	
Educational level			0.435
Bachelor's degree	119 (61%)	76 (39%)	
Under Bachelor's degree	92 (39%)	85 (65%)	
Employment status			0.158
Yes	88 (57.1%)	66 (42.9%)	
No	135 (61.1%)	86 (38.9%)	
Retired	20 (76.9%)	6 (23.1%)	
Smoking status			1.00
Yes	216 (60.2%)	143 (39.8%)	
No	27 (60%)	18 (40%)	
Herbal consumption			0.027
Yes	14 (41.2%)	20 (58.8%)	
No	232(62.2%)	141 (37.8%)	

Exercise status			
Do not exercise	82 (56.2%)	64 (43.8%)	0.569
Once a week	48 (55.2%)	39 (44.8%)	
Twice a week	33 (62.3%)	20 (37.7%)	
More than three times a week	64 (63.4%)	37 (36.6%)	
BMI			0.412
<18.5	3 (60%)	2 (40%)	
18.5-24.9	77 (61.1%)	49 (38.9%)	
25.0-29.9	37 (49.3%)	38 (50.7%)	
≥30	25 (53.2%)	22 (46.8%)	
The current method of medication taking			0.010
None	223 (58.5%)	158 (41.5%)	
Family support	21 (87.5%)	3 (12.5%)	
Number of diseases			0.292
1	72 (66.7%)	36 (33.3%)	
2	110 (57.6%)	81 (42.4%)	
>3	64 (59.3%)	44 (40.7%)	
Duration of disease			0.074
1-10 years	121 (63%)	71 (37%)	
More than 10 years	61 (52.6%)	55 (47.4%)	
Number of medications			0.006
<5	76 (51.7%)	71 (48.3%)	
>5			

Hypertension			0.002
Yes	154 (67%)	76 (33%)	
No	92 (52%)	85 (48%)	
DM2			0.001
yes	149 (54.8%)	123 (45.2%)	
No	97 (71.9%)	38 (28.1%)	
Dyslipidemia			0.002
Yes	80 (51%)	77 (49%)	
No	166 (66.4%)	84 (33.6%)	

4.6. Adherence (MARS) and beliefs (BMQ-specific) about medication findings

Forgetting to take medication was common among patients. About 31 (7.6%) people always forget, 56 (13.8%) often forget, and 81 (19.9%) sometimes have this issue. Altering the dose was admitted by 27 (6.6%) always, 54 (13.3%) often, and 61 (15.0%) sometimes. And temporarily stopping medication was 15 (3.7%) always, 63 (15.5%) often, and 96 (23.6%) sometimes, suggesting that some patients might not be sticking to their medication schedule all the time. Deciding to miss out a dose was reported by 17 (4.2%) always, 43 (10.6%) often, and 63 (15.5%) sometimes, while taking less than instructed was reported by 18 (4.4%) always, 56 (13.8%) often, and 79 (19.4%) sometimes. as presented in Table 4.16.

Table 4.16. Adherence status among patients with cardiometabolic condition (n=407)

MARS-5 Variables	N (%)
I forget to take them	
Always	31(7.6)
Often	56(13.8)
Sometimes	81(19.9)

Rarely	146(35.9)
Never	93(22.9)
I alter the dose	
Always	27(6.6)
Often	54(13.3)
Sometimes	61(15.0)
Rarely	99(24.3)
Never	166(40.8)
I stop taking them for a while	
Always	15(3.7)
Often	63(15.5)
Sometimes	96(23.6)
Rarely	116(28.5)
Never	117(28.7)
I decide to miss out a dose	
Always	17(4.2)
Often	43(10.6)
Sometimes	63(15.5)
Rarely	128(31.4)
Never	156(38.3)
I take less than instructed	
Always	18(4.4)
Often	56(13.8)
Sometimes	79(19.4)
Rarely	116(28.5)
Never	138(33.9)

When analyzing the BMQ-S subscales, the findings show a multifaceted information about the patients' beliefs about their medication, showing their perceived necessity and some underlying concerns. For example, a significant number of participants believes in the current necessity of their medication, with 238 (58.5%) agreeing and 64 (15.7%) strongly agreeing

that "My health, at present, depends on my medicines." This is reflected similarly in future health dependency beliefs where 250 (61.4%) agree and 56 (13.8%) strongly agree that "My health in the future will depend on my medicines." Additionally, regarding the protective impact of medication, with 62 (15.2%) strongly agreeing and 237 (58.2%) agreeing that "My medicines protect me from becoming worse." This, along with the views that "My life would be impossible without my medicines," shared by 234 (57.5%) and strongly agreed by 64 (15.7%), and "Without my medicines I would be very ill," shared by 238 (58.5%) and 56 (13.8%), This suggests that there is a general necessity belief regarding the protective qualities of medicine during patients' illness.

However, there were also underlying concerns about medication taking amongst patients, with statements like "Having to take medicines worries me" where 94 (23.1%) agree and 27 (6.6%) strongly agree, showing that there is a segment of the population that feels worried about their medication intake. This worry is not just about the intake but also about the repercussions as seen in "I sometimes worry about long-term effects of my medicines," where 103 (25.3%) agree and 22 (5.4%) strongly agree. Further, there were mystery surrounding their medications for some patients, 93 (22.9%) agree and 3 (0.7%) strongly agree that "My medicines are a mystery to me,". Also, there are a high concern regarding dependency on medicines, with 95 (23.3%) agreeing and 21 (5.2%) strongly agreeing to "I sometimes worry about becoming too dependent on my medicines." This reflects some concern about reliance and the potential challenges it might face in the long run. Also, 130 (31.9%) agreeing and 7 (1.7%) strongly agreeing that "My medicines disrupt my life," which means that their medicine affecting their lifestyle negatively. Lastly, regarding side effects, 95 (23.3%) agree and 16 (3.9%) strongly agree that "These medicines give me unpleasant side effects," showing a significant number of participants experiencing discomfort due to their medication. The rest of the variables are presented in Tables 4.17.

Table 4.17. Belief about medication among cardiometabolic conditions (n=407)

BMQ-S Variables	n (%)
My health, at present, depends on my medicines	
Strongly disagree	4(1.0)
Disagree	71(17.4)
Uncertain	30(7.4)
Agree	238(58.5)
Strongly agree	64(15.7)
Having to take medicines worries me	
Strongly disagree	42(10.3)
Disagree	232(57.0)
Uncertain	12(2.9)
Agree	94(23.1)
Strongly agree	27(6.6)
My life would be impossible without my medicines	
Strongly disagree	2(0.5)
Disagree	79(19.4)
Uncertain	28(6.9)
Agree	234(57.5)
Strongly agree	64(15.7)
Without my medicines I would be very ill	
Strongly disagree	0(0.0)
Disagree	67(16.5)
Uncertain	46(11.3)
Agree	238(58.5)
Strongly agree	56(13.8)
I sometimes worry about long-term effects of my medicines	
Strongly disagree	24(5.9)
Disagree	234(57.5)
Uncertain	24(5.9)

Agree	103(25.3)
Strongly agree	22(5.4)
My medicines are a mystery to me	
Strongly disagree	38(9.3)
Disagree	244(60.0)
Uncertain	29(7.1)
Agree	93(22.9)
Strongly agree	3(0.7)
My health in the future will depend on my medicines	
Strongly disagree	3(0.7)
Disagree	66(16.2)
Uncertain	32(7.9)
Agree	250(61.4)
Strongly agree	56(13.8)
My medicines disrupt my life	
Strongly disagree	32(7.9)
Disagree	225(55.3)
Uncertain	13(3.2)
Agree	130(31.9)
Strongly agree	7(1.7)
I sometimes worry about becoming too dependent on my medicines	
Strongly disagree	44(10.8)
Disagree	237(58.2)
Uncertain	10(2.5)
Agree	95(23.3)
Strongly agree	21(5.2)
My medicines protect me from becoming worse	
Strongly disagree	1(0.2)
Disagree	73(17.9)
Uncertain	34(8.4)

Agree	237(58.2)
Strongly agree	62(15.2)
These medicines give me unpleasant side effects	
Strongly disagree	47(11.5)
Disagree	235(57.7)
Uncertain	14(3.4)
Agree	95(23.3)
Strongly agree	16(3.9)

4.7. Adherence (MARS) and beliefs (BMQ-specific) about medication correlation

The subscales of BMQ-S did exhibit the correlation between self-reported adherence and the BMQ Specific-Necessity scale was significant (0.245; $P < 0.01$). There were also correlations between MARS-5 and BMQ-Specific concern ($= -0.294$; $P < 0.01$). the correlations between the MARS-5 and BMQ-S Specific-Concerns and Specific-Necessity scale were statistically significant and in the expected direction (see Table 19). In summary, the positive correlation between MARS and BMQ Necessity implies that as the MARS value increase, the value of BMQ Necessity is likely to increase as well. Conversely, the negative correlation between MARS and BMQ Concern shows that as one variable increases, the other tends to decrease, indicative of an inverse relationship.

Table 4.18. Adherence (MARS) and beliefs (BMQ-specific) about medication correlation

BMQ-Subscale	Spearman's correlation	P-value
BMQ-Necessity	0.245	<0.001
BMQ-Concern	-0.294	<0.001

5. DISCUSSION AND CONCLUSION

In this study, we aimed to develop a Kurdish version of the Medication Adherence Report Scale (MARS-5) and specific domains (necessity and concern domains) in cardiometabolic conditions, to our knowledge, it's the first study to assess validity and reliability in to Kurdish language Scale (MARS-5) and Beliefs about medicines questionnaire (BMQ-S) specific domains (necessity and concern domains) in to Kurdish language and along the factors assessed the factors that impact medication adherence.

The internal consistency reliability of Kurdish version of the Medication Adherence Report Scale (MARS-5) and specific domains (necessity and concern domains), were measured using Cronbach's Alpha both MARS-5 and BMQ-S questionnaires Cronbach's alpha values within an acceptable value[111], 0.87 for the MARS-5. This observation aligns with findings from previous reliability studies has been translated in German, Swedish, Arabic, Portuguese and Italian [112–115] with our results being closest to Italian with a Cronbach's alpha of 0.86 [115].

While Cronbach's alpha of BMQ-S sub-scales in this study also exhibited coherence with results from other studies, with our results having the value of 0.91 and 0.89 for the necessity and concern domains of BMQ, respectively while the Cronbach alpha values for the BMQ-specific part from the original BMQ validation ranged from 0.55 to 0.86 [100]. The Arabic (0.89-0.93) and Persian translation (0.85 – 0.93) studies revealed close Cronbach's alpha values across various sub-scales in different patient populations [100], [116], This variation across diverse studies can be attributed to distinctions in study sample characteristics, data variability [117], sample size [118], as well as cultural, linguistic factors, and differences in questionnaire administration methods.

The intraclass correlation coefficient (ICC) for the MARS-5 and BMQ-S scale showed high consistency (ICC=0.95) and 0.91 necessity and 0.89 concern. This is comparable to its English version, which had an ICC range of 0.67 to 0.89 across three different patient groups, while for the BMQ-Specific scale, ICCs were slightly lower, at 0.76 for Specific-Concern and 0.77 for Specific-Necessity[117], these finding suggest stability over short periods. These slight differences in test retest reliability across different studies might be due to the distinct patient populations: the Kurdish version involved individuals

with cardiometabolic conditions, whereas the original study also included asthmatic patients [117].

Regarding construct validation the analysis of principal components revealed that the construct validity of the Kurdish translations of the MARS questionnaire for patients with cardiometabolic conditions was acceptable, as they obviously measured one construct all items loaded good on the medication adherence construct (all factor loadings >0.4) This was evidenced by the distinct scree plot, the presence of only one component with an Eigenvalue greater than 1, Similarly, the BMQ-concerns and necessity assessments for cardiometabolic patients all loaded to intended construct. Because all KMO values were 0.881 and 0.890 for BMQ-S and BMQ-C respectively, all subscales exhibited appropriate sampling. The scree plots for BMQ-S found that two components were reported which aligned with acceptable values in literature and previous studies [119]. Furthermore, in our own study, the values for the CFI, SRMR and RMSEA for Kurdish translations were all within the predetermined thresholds. while, these values for both the Hungarian and Polish versions did not meet these criteria for BMQ [120].

As for the known group validity findings, The Chi-Square test revealed significant associations between medication adherence with HBA1c and both systolic and diastolic blood pressure control, with p-values <0.001 , indicating that adherence is linked with better control of blood pressure levels. but no significant associations were found between medication adherence and lipid control, suggested by high p-values.

These findings were inconsistent with another study, which found that nonadherence to diabetes medication wasn't associated with poor glycemic control [121]. The inconsistency between findings could be caused to the fact that they studied a different population, and they used different scales and outcome measurements. The other study had a population with a higher rate of poor glycemic control (63.2%). However, in our study population, there was a lower rate of poor glycemic control (56.3%). In addition to that, the other study had a smaller sample size (129) , Also, the other study used the Morisky scale, and they classified adherence into three levels [121].

Similarly with Spearman correlation of continuous variables data significant correlations were found between the score of MARS-5 and HbA1c levels (Spearman's rho: -0.43, $p < 0.001$), as well as with blood pressure levels (Spearman's rho: -0.22 for systolic blood pressure, $p < 0.001$ and -0.18 for diastolic blood pressure, $p < 0.05$), implying improved control over blood pressure and HbA1c with better medication adherence. These findings underline the convenience and importance of evaluating medication adherence during patient's visits using self-reported measures for better management of cardiometabolic conditions.

To put it differently, as patient adherence improved, HbA1c and blood pressure levels decreased, indicating better control over blood pressure and HbA1c. Similar to previous studies [122,123] The DELTA Study in Geisinger Health System also found that better self-reported adherence is linked to improved glycemic control in adult patients with type 2 diabetes. These findings all show how evaluating medication adherence during a patient's visit using self-reported measures remains the most convenient approach for clinicians [124]. However, these findings were inconsistent with another study [125], which found that nonadherence to antihypertensive medication was not associated with hypertension control. This difference in result can be due to lower sample size of 128 patients and measuring MPR (means of the medication possession ratio) instead of blood pressure records. MPR doesn't account for instances where a patient may miss doses or take medications irregularly, which can affect the actual therapeutic benefit of the medication. In addition to that we used blood pressure records from three consecutive times while MPR doesn't necessarily reflect actual clinical outcomes.

Despite the considerable difference in MARS-5 questionnaire findings and medication adherence between diabetes and hypertensive patients, lipid profile was not significant and higher levels of LDL Cholesterol and Triglyceride were associated with higher adherence scores with MARS-5. Which is not in agreement with previous studies [122,126]. The reported positive connection between MARS-5 questionnaire adherence scores and cholesterol 0.785, triglycerides 0.492, and LDL 0.233 were contradictory to a previous study which found that medication adherence correlated between BP- and lipid-lowering medications. There are a few possible explanations for the observed relationship. Firstly, the study involved a larger sample size (3,188 patients), different study design and population [127] or the results might have been affected by external factors like diet, genetic predispositions,

and other concurrent health conditions can have a significant impact on lipid profiles. Thus, even with great medication adherence, other lifestyle factors may result in increased lipid levels[128].

Our study findings of adherence to cardiometabolic disease medications showed that the level of adherence rate was relatively low, approximately 40%. It was stated that generally (40-50%) of patients were non-adherent to the medication of chronic diseases [129] These findings showed that the non-adherence level for the Kurdish population was lower than the Arab population. In comparison to other studies in the Iraq, the nonadherence rate was (69%) for Baghdad city and (81.8% %) for Masan city [61, 62].

In comparison to some of the studies among Kurdish population in Iraq about medication nonadherence levels were found to be close to our study medication nonadherence levels. A Cross sectional study using self-report questionnaire conducted in Erbil city between April 2011 and March , which involved a sample of 400 hypertensive patients attended outpatient clinics in Erbil city [60] 58.8 percentage of the patient were non adherence to their prescribed treatment Also, Cross-sectional study-self report using eight item Morisky green scale The study revealed an adherence rate of 54.6% the differences in medication adherence levels could be attributed to differences in how adherence is measured, variations in treatment regimens, and distinctions in sample characteristics [130–132].

A Previous study results showed that sociodemographic and economic factors health literacy, and income were main predictors of diabetes treatment adherence [133] but, not all of these factors, such as age, income, and race-ethnicity, are consistently related with adherence across all studies [134], [135] also the patient's understanding and beliefs regarding their treatment [8]. Furthermore it is well studied that Patient beliefs significantly influence medication adherence [136–138] and potentially modifiable, determinants of both adherence and nonadherence [110] As its previously has been studied patients with hypertension [139] diabetes [140] dyslipidemia [141].

In our analysis also suggests Correlation between beliefs about medicines and medication adherence our results suggested that patients with stronger necessity beliefs about medication might adhere more to prescribed medication. Whereas, patients who are more

concerned about potential risks of their medication, might be less likely to adhere to treatment. With the significant positive correlation between adherence and the necessity score which is also in line with our predictions, these findings indicate the Necessity-Concern Framework is an effective model to predict adherence behaviors. Our findings were consistent with previous meta-analysis showed that the Necessity-Concerns Framework (NCF) holds as an important model for understanding how patients assess their medications necessity belief and specific-concern about medicine showed associations with low adherence [142] as our result demonstrate the same associations of MARS-5 with Necessity and Concern BMQ ($\rho = 0.138$, $p < 0.01$; $\rho = -0.185$, $p < 0.01$ respectively). Overall patients who perceived concerned about disease more and found it more necessity in taking their medication are more inclined to stick to their prescribed medications. This aligns with many earlier studies [139,140,143].

Our findings show a significant relationship between herbal drugs use and medication adherence ($p = 0.027$). As our results shows that 62.2% of those who did not use herbal drugs adhered to their prescriptions, compared to 41.2% of those who did. Similar to observational study involving 240 patients at a geriatric clinic investigated the correlation between herbal use and medication adherence. Those with hypertension who used herbal remedies were less likely to take their prescribed medications as directed [144]. This can be because misconceptions and nervousness about conventional medication, might be rooted in beliefs about their side effects and perceived inadequacy in the patient-doctor relationship, often lead a preference for herbal medicine and less medication adherence [145].

In contrast, our findings show the critical importance of family support and involvement in medication adherence. ($p = 0.010$) Patients who have significant family support, have higher adherence because the ongoing encouragement and care from the family boosts the patient's confidence and helps to alleviate the psychological burdens associated with disease and treatment [146] several studies have found that the closeness and quality of familial interactions can improve a patient's persistence and adherence to therapy [147,148] for example Diabetes, it is said, must be understood not only by the person who has it but also by his or her closed ones and other significant others. As its well-studied that throughout the duration of diabetes, social and emotional supports are of great benefit to those affected

[149,150] the findings imply that training family members in therapeutic and psychological interventions might help improve patient adherence even further.

Furthermore our research shows that solutions such as medication reminder apps are effective in improving medication adherence ($p=0.010$), similar to the findings of several non-randomized studies and, highlighting their utility in chronic health conditions [151–153]. one randomized controlled trial found that After 6 months, patients with post-MI who used the app had higher rates of ticagrelor adherence than those in the control group (83.4% vs. 77.0%, $p=0.025$) ($n=174$) [154]. Another study focused on patients with coronary heart disease (CHD) to evaluate the efficacy of using medication reminder applications to improve medication adherence which found out that people with chronic health disorders who use medication reminder applications have higher drug adherence rates than those who receive conventional treatment [155]. These technologies have the potential to address the gaps left by healthcare providers' limitations In improving medication adherence.

According to our results the linked relationships between herbal medicine intake, familial support, and technological interventions all play important roles in shaping medication adherence, suggesting a multifaceted approach to address the many variables and improve overall treatment outcomes. To address adherence thoroughly, the primary focus should be on disproving myths about traditional medication, boosting familial support, and implementing technological solutions.

Lastly In the current study, patients taking fewer than five medications had a higher adherence rate, while adherence dropped for those taking more than five medications. The non-adherence rate was significantly higher for patients on more medications (with the p value of 0.006) This is consistent with the results of previous research [156–160] these findings imply that it may be advantageous to reduce the number of drugs that patients with must take daily when designing treatment regimens.

On another hand there was no statistically significant correlation observed between education and medication adherence in the present analysis ($p>0.05$). This result is consistent with Ethiopian, Indian, and Nigerian studies.[161–163] This similarity between studies could be because to the fact that the majority of participants were elderly individuals who might lacked a comprehensive understanding of their illness or its treatment[164]. On the other

hand, in the literature it was reported that education level was one of the factors related to medication adherence patients in the Iraq.[102, 165].

Firstly, it's the first study to validate and translate MARS-5 and BMQ-specific questionnaire in Kurdish population Secondly, we combined two measurements to provide more concrete evidence on both validation and adherence measure since to evaluate since measures that rely on self-reporting are criticized for overestimating adherence, according to guidelines for best practice in adherence measurement, suggested combining multiple measures (such as electronic monitoring, clinician assessment, and prescription refill record) in studies to increase the accuracy of the result; consequently, we combine both of these measures to provide more accurate and concrete evidence to validate a scale [166]. secondly, relevant statistical analyses were performed and justifications were given. Lastly this study fills the knowledge gap regarding medication adherence and beliefs about medication among Kurds population Iraq by providing a validated Kurdish scale for future research.

This research had a number of limitations. First, while the sample size was sufficient for the validation phase, ensuring reliability, but the study sample size may have influenced the analytical outcomes, many of the participants were older, which increased the likelihood of recall bias regarding medication information. also, the desire to provide a positive response may result in skewed reporting. The limited target population was another disadvantage. Since this study only included Erbil, the results may not be applicable to all Iraq. Finally, there were limitations from the study's approach. Even though cross-sectional designs are efficient in terms of time, but they restrict the issues and variables that can be investigated.

Implications for further research

Future studies can address the following concerns: Firstly, although items in BMQ-S, Harm and Overuse subscales were not presented and validated in our study However, the Benefit and two additional subscales of BMQ The future study should optimize the presenting of beliefs in this population. Secondly the future study may broaden the research scope into other research method (ex. longitudinal data) treatment forms, diverse health conditions and a larger group of participants to gather more robust evidence about the factors that influence medication adherence.

This is the first study to validate a Kurdish scale for medication adherence and belief about medication evaluation. The Kurdish version of both scales proved to be a valid and reliable scale to be utilized by researchers in Kurdish speaking populations. The adherence level among Kurdish population was lower than the general population adherence level in Iraq. The availability of a validated scale will help patients to overcome the language barrier, while studying on their medication adherence and related barriers, which will help to understand their barriers and suitable design needed programs to improve their medication adherence

There were some differences between some of the findings of this study and the literature. The differences between the current study findings and previous studies could be due to the sample size, cross-sectional study design, the cultural diversity of the study populations, and the differences in methodologies used and adherence scales. More research is needed for the Kurdish population in different cities and on a larger sample size to give stronger evidence about the factors affecting adherence and to assess chronic disease burden in this growing segment of the population. Identification of these factors will help in performing culturally appropriate intervention programs and developing policies for adherence improvement among this population.

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7.APPENDICES

7.1. Ethical Approval

ethical was approval for our research protocol from the Ethical Committee at the University of Suleimani College of Pharmacy. This approval was granted under registration number PH 88-23 on February 22, 2023. written informed consent was obtained from participants.



وهراره‌ی حویندی بالا و ئویرینه‌ی زانستی
سەرۆکایه‌تی زانکۆی سلیمانی
کۆلیژی دهرمانسازی
لێژنه‌ی ناکار و تۆمارکردنی ئویرینه‌ی زانستی

Registration Number: PH88-23
Date: 22. 2.2023

Ethics & Research Registration Committee

We, the members of the Ethics & Research Registration Committee, approved the research project below in the meeting (No: 15) on the date (22/ 2/ 2023).

Title of the research project:

Validation of the Kurdish version of the medication adherence report scale questionnaire and beliefs about medication- specific questionnaire among patients with cardiometabolic conditions

Name and title of the participants:

1. Kawa Ahmed Obeid, Assistant Professor, Department of Clinical Pharmacy, College of Pharmacy, University of Sulaimani
2. Abdikarim M. Abdi, Assistant Professor, University of Yeditepe, Istanbul, Turkey
3. Huda Jabbar Jawhar, Pharmacist, University of Yeditepe, Istanbul, Turkey

Place of research study: College of Pharmacy, University of Sulaimani

Members of Ethics & Research Registration Committee of the College of Pharmacy



Scientific Research Registration Form

Title of the research: Validation of the Kurdish version of the medication adherence report scale questionnaire and beliefs about medication-specific questionnaire among patients with cardiometabolic conditions.

	Name & title of the Researcher	Academic Degree	Specialty	Signature
1	Dr Kawa A. Obeid	PhD	Clinical Pharmacy	
2	Dr Abdikarim Abdi	PhD	Clinical Pharmacy	
3	Huda Jabbar	MSc candidate	Clinical Pharmacy	
4				

Date of Submission: 24 / 01 / 2023

Date of Starting of the Project: 01 / 02 / 2023

Date of finishing of the project: 01 / 09 / 2023



Decision of the Ethics & Scientific Research Registration Committee:

The Committee has approved the above research a registration number (PH 88-23) on the date 22.2.2023

Assistant Professor
Dr Bushra Hassan Marouf
Head of the Committee

Decision of the Scientific Committee of the College of Pharmacy:

The Scientific committee at the College of Pharmacy approved the above research project in the meeting (No : 6) on the date (21 / 2 / 2023).

Dr Tavga Ahmed Aziz
Head of the Scientific Committee

7.2. CONSENT FORM

Title of the study: Validation of the Kurdish version of the medication adherence report scale questionnaire and beliefs about medication-specific questionnaire among patients with cardiometabolic conditions

All participants in the study should be at least 18 years of age. No participant younger than 18 will be allowed to participate. For your participation, you will be asked to complete a questionnaire about factors that impact how well you take your medication using the student investigator. The questionnaire will take about 10-15 minutes to complete. The results of this research will assist us in better understanding the factors that impact how well Kurdish-speaking patients take their medication. If you decide to take part in this study, you will be asked to sign a consent form. After you sign the consent form, you are still free to withdraw at any time and without giving a reason. Withdrawing from this study will not affect the relationship you have, if any, with the researcher. If you withdraw from the study before data collection is completed, your data will be returned to you or destroyed.

Insights gathered by you will be used in writing a research report. Please note that your name and other identifying information will be kept anonymous.

CONSENT

I have read and I understand the provided information and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I understand that I voluntarily agree to take part in this study.

Participant's signature _____ Date _____

Investigator's signature _____ Date _____

7.3. Demographic-Clinical information form

Name	
age	
gender	
Phone number	
Disease	
Clinical parameters accordant to disease HbA1c Blood pressure LDL	
Number of diseases	
Duration of disease	
Education level	
employment	
number of medications that are been taken	
current methods of medication adherence by the patient (family, app, phone reminder)	
Exercise	
Smoking	
Use complementary and alternative medicine	
BMI	

7.4. APPENDIX: English Version of scales



QUESTIONS ABOUT USING YOUR MEDICINES

- Many people find a way of using their medicines which suits them.
- This may differ from the instructions on the label or from what their doctor has said.
- We would like to ask you a few questions about how you use your medicines

Here are some ways in which people have said that they use their medicines

For each of the statements, please tick the box which best applies to you

	Your own way of using your medicines	Always	Often	Sometimes	Rarely	Never
M1	I forget to take them					
M2	I alter the dose					
M3	I stop taking them for a while					
M4	I decide to miss out a dose					
M5	I take less than instructed					

YOUR VIEWS ABOUT MEDICINES PRESCRIBED FOR YOU

- We would like to ask you about your personal views about medicines prescribed for you.
- These are statements other people have made about their medicines.
- Please show how much you agree or disagree with them by ticking the appropriate box.

**There are no right or wrong answers.
We are interested in your personal views**

	Views about MEDICINES PRESCRIBED FOR YOU:	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
B51	My health, at present, depends on these medicines					
B52	Having to take medicines worries me					
B53	My life would be impossible without these medicines					
B55	I sometimes worry about long-term effects of these medicines					
B54	Without these medicines I would be very ill					
B56	These medicines are a mystery to me					
B57	My health in the future will depend on these medicines					
B58	These medicines disrupt my life					
B59	I sometimes worry about becoming too dependent on these medicines					
B510	These medicines protect me from becoming worse					
B511	This medicine gives me unpleasant side effects					

APPENDIX 7.5. Kurdish Version of scales



پرسىار دەربارەى بە کارهينانى دەرمانە کەت

- زۆر کەس رينگايەک دەدۆز نەو بۆ بەکار هينانى دەرمانە کانين که له گەليان بگونجيت
- که لهوانەيه جياواز بيت له رينمايه کاني سەر لهيبلە که يان لهوہى که دکتۆره کهيان پياني وتووہ
- ئيمە حەزەدە کەين چەند پرسياريت لى بکەين سەبارەت بەوہى که چۆن دەرمانە کانت بە کاردينيت

لېرەدا چەند رينگەيەک هەيە که خەلک ئاماژەيان پيداوہ له بە کارهينانى دەرمانە کانين
بۆ هەريەک له ليدوانە کان، نکايە ئەو سندوقە که هەلېژيرە که بەسەر تۆدا جيبەجى دەبيت

هەرگيز	بەدەگمەن	هەندىک جار	زۆر جار	هەميشە	رينگاي خۆت بۆ بە کارهينانى دەرمانە کانت	
					بىرم دەچيت وەريانبگم	۱م
					ژەمە دەرمانە که دەگۆرم	۲م
					بۆ ماوہيە ک واز له وەريگرتنيان دينم	۳م
					من برپيار دەدەم ژەمە دەرمانيتک بازبەدەم	۴م
					کەمتر وەردەگرم لهوہى که رينمايم پيدراوہ	۵م

تېروانينت دهرباره دهرمان

- هزدهكهن پرسپارت لی بکهن سهبارت به تېروانيني تايبهتت بۇ نهو دهرمانانهی بۇت نووسراووه

- نهمانه نهو لیدوانانهن کهخه لکی تر لهبارهی دهرمانهکانياتهووه داوويانه

- تکاپه نيشانی بده که تاچهند لهگهلان هاوورای يان نا به ههلزاردنې سندوقي گونجاو

هيچ وهلامیک راست يان هه له نييه ئيمه تېروانيني تايبهتتي تۆمان بهلاووه گرینگه

زور دژيم	هاوورانيم	دلنيا نيم	هاوورام	زور هاوورام		
					تهدروستی من له ئیستادا پهيوهسته بهم دهرمانانهوه	ب س ۱
					ناچاربوونم بۆ وهگرتنی ئەم دهرمانانه نیگه رانم دهکات	ب س ۲
					ژيانم بهې ئەم دهرمانانه مهحال دهبوو	ب س ۳
					هه نديک جار کاریگهرييه دريځخايه نه کانی ئەم دهرمانانه نیگه رانم دهکات	ب س ۵
					بهې ئەم دهرمانانه زور نهخوش دهبووم	ب س ۴
					دهرمانهکانم بهلاوه ناروونه	ب س ۶
					تهدروستيم له داهاتوودا بهنده بهم دهرمانانه	ب س ۷
					ئەم دهرمانانه ژيانم دهشپوتين	ب س ۸
					هه نديک جار نیگه رانی ئەوهم ههيه که زور پهيوهستی ئەم دهرمانانه بم	ب س ۹
					ئەم دهرمانانه دهپارزين له خراپتريوونم	ب س ۱۰
					ئەم دهرمانه کاریگهري لاوه کی ناخوشم پڻ ده دات	ب س ۱۱

8. CURRICULUM VITAE

Personal Informations

Name	Huda	Surname	Jawhar
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Education

Degree	Department	The name of the Institution Graduated From	Graduation year
Master			
University	Pharmacy	Hawler Medical University- Pharmacy	2019
High school	-		

All the grades must be listed if there is more than one (KPDS, ÜDS, TOEFL; EELTS vs),

Languages	Grades (#)
English	

Work Experience

Position	Institute	Duration (Year - Year)
Pharmacist	Darun pharmacy	2019-2021

Computer Skills

Program	Level
word	Excellent

*Excellent , good, average or basic