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# Relationship Between Medication Adherence And Quality Of Life Among Older Patients With Type 2 Diabetes Mellitus In Saudi Arabia

Ibrahim Hadi Alsharyah, Hamad Mohammed Saleh Zubaid, Dhafir Farj Alalhareth, Ali Hussain Alyami, Hamad Saleh M Alzabaid, Manea Hadi Hussain Alsleem, Salem Saleh Alzubaidi, Nader Saleh Alzubaidi, Hussain Mohammed Alsulaiman, Mohammed Hadi Alalhareth, Dhafer Jaber Zabid, Abdullah Saleh Alalhareth

## Abstract

***Objectives***

*This cross-sectional study examined 266 patients from the King Khaled Hospital in Najran, Saudi Arabia, in order to examine whether there is a relationship between the level of adherence to oral hypoglycemic medication (OHM) and health-related quality of life (HRQoL) in older patients diagnosed with Type 2 diabetes mellitus (T2DM).*

***Methods***

*The questionnaire that were used in this study combined the 8-item Morisky Medication Adherence Scale and the HRQoL with additional demographic questions. Pearson's correlation matrix as well as ordinary least squares regression methodology were employed to test the relationship between the Morisky Medications Adherence scale and the HRQoL.*

***Key findings***

*Our analysis suggested that the overall score for HRQoL was comparable across all 4 sub-domains of: Physical (PQoL), Psychological (YQoL), Social Relationships (SRQoL) and Environment (EQoL). The mean average for medication adherence (MA) stood at approximately 5. Our findings supported the hypothesis that patients adhering to their medication exhibit higher levels of HRQoL. Furthermore, there was no statistical significance in relation to education as the sample was concentrated at the primary level, suggesting that participants left school at the approximate age of 11. When examining the sub-samples based on gender, there was no difference between males and females regarding the correlation between MA and HRQoL apart from in the PQoL which showed that females had a significantly higher correlation than males.*

***Conclusion***

*The reported positive correlation can give healthcare providers confidence and an expectation that there will be more initiatives that enhance MA. Improved MA must be initiated with advancements in medication safety and a reduction in prescription errors.*

***Keywords:*** *Health-related quality of life, Medication adherence, Type 2 diabetes mellitus, Over 50 patients.*

## 1. Introduction

According to Tuomilehto et al. (2001) type 2 diabetes mellitus (T2DM) is classified as a chronic illness that originates from a genetic predisposition in combination with environmental and behavioural influences. The American Diabetes Association (2010) stated that the aforementioned illness can initiate as an outcome from a mix of insulin resistance and ineffectual compensatory insulin secretory responses. Despite the genetic cause related to T2DM still eluding identification, prior research determined that the associated risks such as physical inactivity and obesity were the vital non-genetic causative elements linked to progression of the disease (Ohlson et al., 1998; King and Dowd, 1990; Way et al., 2016).

It was estimated in 2017 that amongst individuals in the age range of 20 to 79 years there were around 430 million documented cases of diabetes globally (Cho et al., 2018). It is reported that Saudi Arabia is in the midst of an unprecedented increase in instances of T2DM (Al-Rubeaan et al., 2014). Furthermore, it is maintained that incidence levels of diabetes in Saudi Arabia are projected to increase from approximately 19% in 2017 to 24% in 2045 (Atlas, 2017).

Moreover, it is noteworthy to mention that the causative influences related to glycemic control in T2DM patients in Saudi Arabia demands further investigation, as shown by prior research (Badedi et al ., 2016; Alzaheb and Altemani, 2018). Zheng and colleagues (2018) found that around 90% of the incidences of diabetes mellitus were diagnosed as T2DM and that the main contributing factors of the global T2DM epidemic emanate from obesity and over-eating, physical inactivity and a rise in the ingestion of unhealthy foods such as refined grains, processed meats and sugar sweetened beverages.

The primary health-related complications associated with T2DM are neuropathy, nephropathy, retinopathy, strokes and heart disease where it is estimated that around 60% of those diagnosed with T2DM were predicted to have microvascular or macrovascular problems (Mitka, 2007; Zhuo et al., 2013).

Previous research has substantiated the notion that improving self-care counters the physiological difficulties felt by patients diagnosed with T2DM, as well as contributing to positive cognitive and emotional outcomes (Campbell et al., 2009). Additionally, it is postulated that clinicians in Saudi Arabia are encouraged to mitigate the risks linked with reduced glycemic control in patients with T2DM to significantly decrease the incidence of potential health complications (Alzaheb and Altemani, 2018). Furthermore, evidence suggests that more focus is required to tackle the increase in diabetes related premature death rates among patients in Saudi Arabia. (Badedi et al., 2016). Medication is currently the most utilised method of controlling TD2M; however, the matter of patients failing to take medication as prescribed, is frequently referred to as non-adherence and is considered an obstacle to T2DM management. Previous research stated that adherence is characterised as the degree to which an adult's actions in terms of adhering to dietary routines, taking medications or executing lifestyle changes with respect to medical advice (Haynes et al., 1979). Consequently, it can be assumed that successful treatment is positively linked with medication adherence (MA) (Ahmad et al., 2013). Prior studies hypothesised that good MA is a significant factor in improving glycemic control, reducing the need of healthcare resources, lowering associated complications and lastly, reducing fatality levels connected to diabetes (Asche et al., 2011; Osterberg and Blaschke 2005).
It was reported that adherence to longstanding treatments for chronic illnesses in developed countries was at around 50% (WHO, 2003).

Levels of adherence were found to be greater in individuals with acute illness in comparison to patients with chronic diseases. Osterberg and Blaschke (2005) rationalised that this is linked to the chronic diseases' enduring nature owing to the decrease in adherence observed after the 6 months of treatment given. Moreover, reduced adherence rates can precipitate higher healthcare expenditure and could result in unwanted health related outcomes (WHO, 2003).

Badedi et al. (2016) found that individuals in Saudi Arabia who have had a diagnosis of T2DM are confronted with increased risks of complications in comparison to others states and this may be a result of the low probability of them adhering to prescribed medications which in turn could be due to the weak relations they are known to have with their clinicians.

Health-related quality of life (HRQoL) can be defined as the extent to which an individual takes part in everyday life and their understanding of how they feel in relation to social, mental and physical health domains (Killewo et al., 2010). Furthermore, Killewo and colleagues determined that well-being is defined as one's own feelings.

Additionally, there are a multitude of ways in which quality of life (QoL) can be characterised with reference to the current published literature. For example, QoL can be described as the act of making a mindful decision concerning how fulfilled individuals are with their lives and an understanding of their position in life in relation to the cultural and ethical principles (Rejeski and Mihalko 2001).

Previous studies postulated that MA is predicted to result in greater levels of HRQoL (Perwitassari and Urbayatum, 2016; Chew, 2015) and this may be the consequence of a lessening in the indications that individuals encounter after the disease is considered to be stabilised.

However, it is still uncertain as to what degree the substantial impact of positive HRQoL or the negative influence of non-MA predominates in those individuals that have had a diagnosis of T2DM. A previous study has shown that MA and QoL are linked, however, this contradicts results by Côté et al. (2003).

The main aim of this study was to investigate the degree of adherence to oral hypoglycemic medications (OHM) and their HRQoL in an older demographic of individuals with T2DM in Saudi Arabia. The second aim was to understand the link between adherence and HRQoL with a view to corroborate the supposition that individuals who adhere to their medication have a greater HRQoL. Lastly, this study aimed to ascertain the connection between explicit demographic variables and significant outcomes (adherence and HRQoL).

## 2. Material and methods

### 2.1 Study design and sample

This was a cross-sectional study that was conducted in the King Khaled Hospital in Najran, Saudi Arabia, which is the main hospital for Chronic Disease in Najran and 12 nearby villages. The aforementioned centre receives approximately 500 patients diagnosed with T2DM on average per week. Potential participants were given an information sheet (see Appendix 1) related to the project when they first arrived at the clinic so that they could decide whether or not to take part in this study. Those who agreed to take part were subsequently given the paper questionnaire translated into Arabic after their appointment. Copies of both the English and Arabic versions of the questionnaire can be found in Appendix 2.

The questionnaires that were used in this study combined the Medications Adherence scale (Morisky et al., 2008) and the HRQoL (World Health Organization, 1996) with additional demographic questions and an initial question confirming consent. It is important to note that the demographic questions that were asked related to gender, age, level of education, marital status and were asked to list the medication they take for their T2DM.

#### 2.1.1 Medication Adherence

The Morisky Medication Adherence Scale (MMAS) has proven to have suitable contemporary and prognostic validity that can be adopted as a screening framework in the case of outpatient settings which have numerous patient groups. The advantages that this instrument offers compared with other frameworks is embedded in its practicality, how fast it can be conducted and the associated cost benefits (Lee et al., 2013).
To empirically test our hypothesis we utilised the 8-item MMAS questionnaire in order to study the subject's use of medications over a 2 week period (Morisky et al., 2008).
All the examined items apart from the fifth item were coded in reverse, 'no' denotes '0' while 'yes' signifies '1'. Particularly, item 8 consisted of five queries measured in a negative form ranging from 1-5. The Items ranging from 1–4 and 6–8 were coded in reverse; additionally, when determining the total result, item 8 was divided by four. The entire scale consisted of a range of values 0–8, high adherence was denoted by a score of 8, medium adherence (6–7) and low medication adherence (0-5).

#### 2.1.2 Health-related quality of life

The HRQoL measure is widely accepted and accredited by health professionals and researchers in order to investigate the effect of short and long term illnesses, treatments and therapies (Office of Disease Prevention and Health Promotion, 2010). It is comprised of four domains and scores: (1) Physical domain (PQoL), (2) Psychological domain (YQoL), (3) Social Relationships domain (SRQoL) and (4) Environment domain (EQoL) (Skevington et al., 2004). Furthermore, there were 2 items that had been evaluated individually: question 1 enquired about the subject's general view of QoL and question 2 delved into the subject's awareness of their own health.

### 2.2 Participants

The inclusion criteria for a participant to be eligible to take part in the study were as follows: they had to be diagnosed with T2DM for a period of at least one year, they had to be over 50 years of age but could be of either gender, they had to originate from Saudi Arabia or reside there and they had to have been prescribed at least one medication for managing diabetes for at least 1 year.

### 2.3 Sample size estimation and data analysis

The sample size was calculated via GPower 3.1.9 software based on a predicted relationship effect of r = 0.17 as previously reported by Chew (2015), using the power of 0.80 and significance at 0.05. The estimated sample size was determined to be at 266. Accordingly, we calculated the total scores for MA and HRQoL's 4 main sub-domains.
The methodology employed in this paper was Pearson's correlation by utilising the two-tailed criterion at the 0.01 level, which was measured via SPSS version 25 in order to investigate the bivariate relationships between the total score for MA and the four domains of HRQoL described as (1) Physical domain (PQoL), (2) Psychological domain (YQoL), (3) Social Relationships domain (SRQoL) and (4) Environment domain (EQoL). We further utilised Ordinary Least Squares Regression (OLS) methodology via STATA version 14 software in order to empirically investigate the relationship among the aforementioned variables. Furthermore, there were no collinearity among the variables and the number of outliers were limited which confirms the validity of our reported findings.

### 2.4 Confidentiality, Anonymity and Privacy

All collected data was anonymous as there was no patient name or any other identifying patient details such as hospital number being collected in this study. A number of demographic details were collected, such as date of birth and gender but these would not permit the patient to be identified from them.

### 2.5 Ethics

This study received ethical approval by the ethics committee of the University of Brighton (see Appendix 3 for a copy of the approval letter, in addition to the approval of the Ministry of Health in Saudi Arabia (see Appendix 4 for a copy of the approval document).

## 3. Results

The participants' response rate was 83.1% (266/320) due to eligibility criteria. Accordingly, 266 patients participated in this cross-sectional study which was conducted in Najran, Saudi Arabia. As can be seen in Table 1, the percentage of participants of each gender was fairly even split with 51.13% registering as female and 48.87 as male. The mean (SD) age was 65.61 (8.6) years and this was comparable among both genders. The majority of the respondent's level of education were limited to primary school and with only 10% of either gender having recorded taking part in any education above this. When examining the marital status, approximately 45% of participants were married. To a great extent the number of adults with separated, widow and widower status was similar among men and women. The MMAS mean score for the total sample was 4.83; however, females appeared to demonstrate a higher level at 5.02 in comparison to a score of 4.63 exhibited by males. The HRQoL was evidently balanced with no significant variance among both genders as shown in Table 1.

**Table 1:** Breakdown of variables used in this research

| | **Total, N (%)** | **Gender, N (%)** | |
|---|---|---|---|
| | | Men | Women |
| Total | 266 (100%) | 130 (48.87%) | 136 (51.13%) |
| Education: | | | |
| Primary school | 244 (91.73%) | 118 (90.76%) | 126 (92.64%) |
| Secondary school | 21 (7.89%) | 12 (9.23%) | 9 (7.14%) |
| Tertiary | 1 (0.38%) | 0 (0%) | 1 (0.73%) |
| Marital status: | | | |
| Married | 114 (42.86%) | 55 (42.30%) | 59 (43.38%) |
| Separated | 21 (7.89%) | 10 (7.69%) | 11 (8.08%) |
| Widow/Widower | 131 (49.24%) | 65 (50%) | 66 (48.52%) |
| Age, mean (SD) | 65.61 (8.60) | 65.56 (8.79) | 65.66 (8.45) |
| MMAS, mean (SD) | 4.83 (1.96) | 4.63 (2.03) | 5.02 (1.88) |
| HRQoL, mean (SD) | 60.88 (7.86) | 60.42 (7.82) | 61.32 (7.90) |
| PQoL, mean (SD) | 53.44 (8.48) | 53.13 (8.93) | 53.74 (8.04) |
| YQoL, mean (SD) | 62.65 (10.45) | 61.46 (10.41) | 63.78 (10.39) |
| SRQoL, mean (SD) | 66.16 (15.03) | 66.66 (15.92) | 65.67 (14.16) |
| EQoL, mean (SD) | 61.39 (11.23) | 60.41 (11.79) | 62.35 (10.63) |

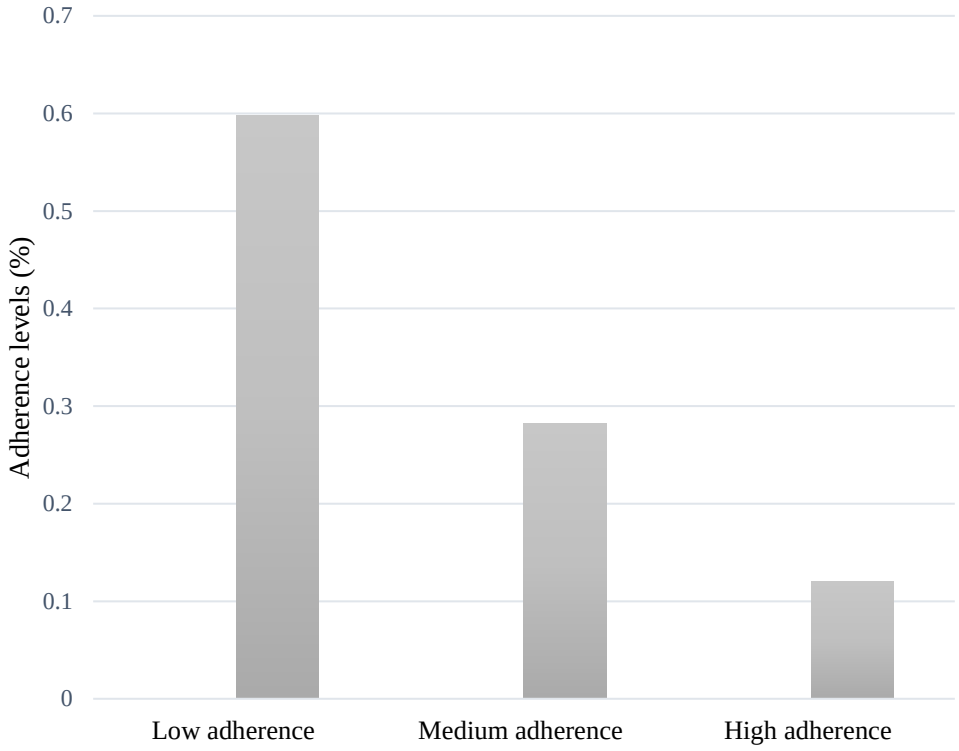
Notes: MMAS illustrates Morisky Medication Adherence Scale which can range from 0–8, high adherence is denoted by a score of 8, medium adherence (6–7) and low medication adherence (0-5). PQoL represents the physical quality of life, YQoL shows the psychological quality of life, SRQoL indicates social relationships quality of life while EQoL denotes environment quality of life. SD shows standard deviation.

Furthermore, metformin was found to be the most regularly prescribed OHM at approximately 65% by the participants and this was followed by glimepiride and sitagliptin at 15% and 10% respectively. The remaining 10% was comprised of various other medications.

When analysing the Morisky Medications Adherence scale in King Khaled Hospital in Najran, Saudi Arabia, our results suggest that 159 (59.7%) patients had a low adherence rate, 75 (28.20%) had a medium adherence and 32 (12.03%) patients demonstrated a high adherence as depicted in Figure 1. The imbalances exhibited in the dataset concerning the

MMAS score derived from a high number of T2DM patients with a low adherence rate. Accordingly, it was not feasible for this study to further categorise the patients into a set of 3 parallel groups in order to analyse the difference between the low, medium and high MA categories; this was due to the insufficient number of patients.

**Figure. 1** Adherence breakdown




MMAS illustrates Morisky Medication Adherence Scale which can range from 0–8, high adherence is denoted by a score of 8, medium adherence (6–7) and low medication adherence (0-5).
Source: author's own estimations

Table 2 represents the summary of statistics for the MMAS scores and the overall score for HRQoL and its domains of (PQoL, YQoL, SRQoL and EQoL). We encountered two missing data with respect to EQoL; however, the majority of data was determined to be valid for our analysis. The HRQoL mean value for the total sample displayed a similar score to the 61% that was observed between the sub domains of EQoL and YQoL.

Our analysis indicates that the 4 domains of the HRQoL and its overall score correlate significantly with MMAS total score, this is presented in scattered plots as shown in Figure 2, it can be inferred that correlation among the overall HRQoL, YQoL, SRQoL and EQoL was positive in all instances and statistically significant at the 0.01 level; however, the correlation between PQoL and MMAS total score statistically significant at the 0.05 level. This can be observed via the r and p values presented on the enclosed scatter plots.

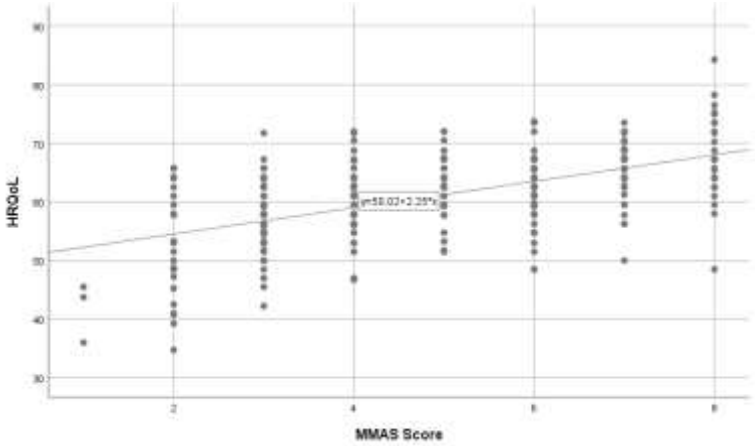
**Table 2:** Summary statistics for the MMAS score and the HRQoL 4 domains

| | **MMAS** (0-8) | **HRQoL** (0-100) | **PQoL** (0-100) | **YQoL** (0-100) | **SRQoL** (0-100) | **EQoL** (0-100) |
|---|---|---|---|---|---|---|
| N | 266 | 264 | 266 | 266 | 266 | 266 |
| Valid | 266 | 264 | 266 | 266 | 266 | 264 |
| Mean | 4.83 | 60.83 | 53.44 | 62.65 | 66.16 | 61.39 |
| Std. Deviation | 1.964 | 7.86 | 8.48 | 10.45 | 15.03 | 11.24 |
| Range | 7 | 49.5 | 50.00 | 63.00 | 81.00 | 57.00 |
| Minimum | 1 | 34.75 | 38.00 | 31.00 | 19.00 | 31.00 |
| Maximum | 8 | 84.25 | 88.00 | 94.00 | 100.00 | 88.00 |

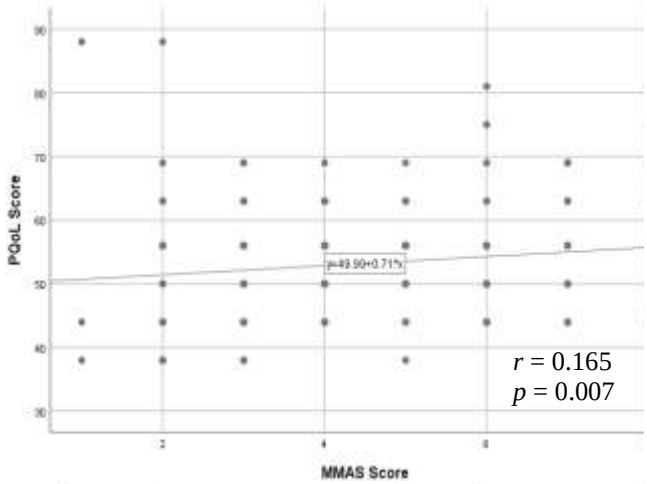
Notes: MMAS illustrates Morisky Medication Adherence Scale which can range from 0–8, high adherence is denoted by a score of 8, medium adherence (6–7) and low medication adherence (0-5). PQoL represents the physical quality of life, YQoL shows the psychological quality of life, SRQoL indicates social relationships quality of life while EQoL denotes environment quality of life.

**Figure 2:** Scatter plots showing the correlation between the total MMAS Score and HRQoL and its 4 domains (PQoL. YQoL, SRQoL and EQoL)

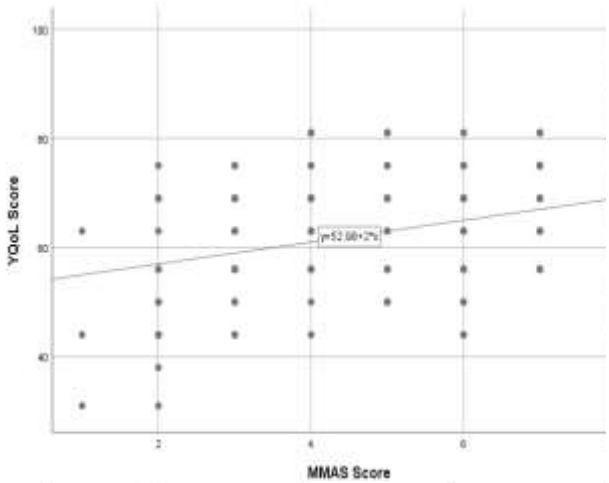
$r = 0.376$
$p < 0.0001$

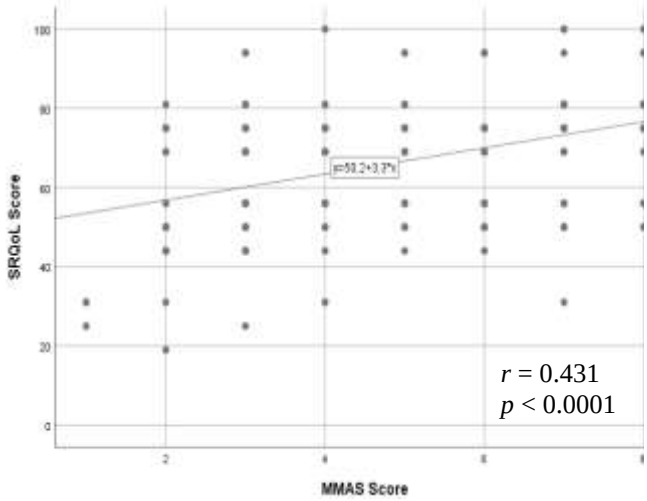



$r = 0.564$
$p < 0.0001$

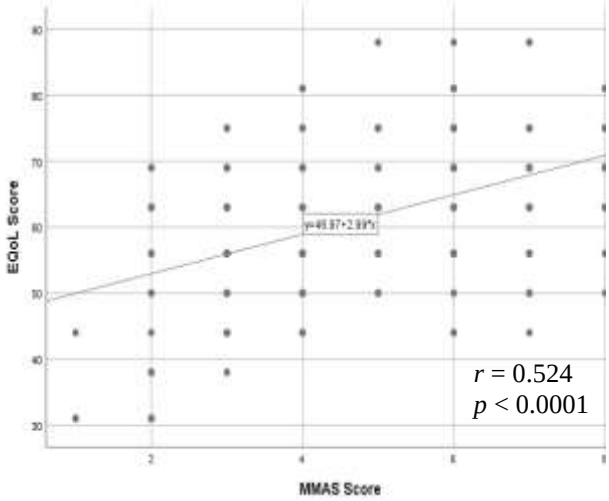



$r = 0.165$
$p = 0.007$




$r = 0.431$
$p < 0.0001$




$r = 0.524$
$p < 0.0001$

It can be said that T2DM patients in Saudi Arabia with a higher MMAS total score had mostly scored higher across all 4 main domains of HRQoL. These findings were statistically significant at the 0.01 level in most instances apart from on PQoL which was statistically significant at the 0.05 level as shown in Table 3. In addition, we further

considered the demographic nature of the dataset by including variables such as age, gender, level of education and marital status. We found that our findings were robust after

the inclusion of the aforementioned variables. Yet, these predictor variables failed to be statistically significant when adding to our models and therefore were not reported.

Table 4 looks at the sub-samples based on gender and from analysing this data it can be said that there was no difference between males and females regarding the influence of the MMAS on HRQoL apart from the PQoL which was statistically significant only in the case of the female category.

**Table 3:** Ordinary Least Square Regression model

| | PQoL | YQoL | SRQoL | EQoL |
|---|---|---|---|---|
| | **1** | **2** | **3** | **4** |
| MMAS | 0.0383** | 0.0707*** | 0.0564*** | 0.0919*** |
| | (2.73) | (6.60) | (7.77) | (9.96) |
| Intercept | 2.786*** | 0.405 | 1.104* | -0.811 |
| | (3.66) | (0.60) | (2.24) | (-1.41) |
| $R^2$ | 0.027 | 0.141 | 0.186 | 0.274 |
| Adjusted $R^2$ | 0.024 | 0.138 | 0.183 | 0.271 |
| Observation | 266 | 266 | 266 | 264 |

Ordinary Least Square Regression model was used in our analysis, where the dependent variable is characterised by Physical domain (PQoL), Psychological domain (YQoL), Social Relationships domain (SRQoL) and Environment domain (EQoL). Independent variables were 8-item Morisky Medication Adherence Scale Adherence Scale (MMAS). The figures inside the brackets () represent t-statistic while the numbers above show the coefficient. We also accounted for Age, Gender, Level of Education and Martial Status. The symbols ** and *** indicate significance levels of a statistic at the 5%, and 1% respectively. Stata 14 was utilised in order to compute the results.

**Table 4:** Ordinary Least Square Regression mode

| | **Male** | | | | **Female** | | | |
|---|---|---|---|---|---|---|---|---|
| | PQoL | YQoL | SRQoL | EQoL | PQoL | YQoL | SRQoL | EQoL |
| | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** |
| MMAS | 0.113 (0.29) | 1.901*** (4.52) | 3.946*** (6.61) | 3.284*** (7.78) | 1.367*** (3.91) | 2.031*** (4.58) | 2.702*** (4.46) | 2.616*** (6.06) |
| Intercept | 52.61*** (26.78) | 52.65*** (24.76) | 48.36*** (15.99) | 45.18*** (21.15) | 46.88*** (25.01) | 53.59*** (22.54) | 52.11*** (16.03) | 49.23*** (21.28) |
| $R^2$ | 0.01 | 0.137 | 0.254 | 0.321 | 0.102 | 0.135 | 0.129 | 0.217 |
| Adjusted $R^2$ | 0.01 | 0.131 | 0.248 | 0.315 | 0.095 | 0.128 | 0.122 | 0.211 |
| Observation | 130 | 130 | 130 | 130 | 136 | 136 | 136 | 134 |

Ordinary Least Square Regression model was used in our analysis, where the dependent variable is characterised by Physical domain (PQoL), Psychological domain (YQoL), Social Relationships domain (SRQoL) and Environment domain (EQoL). Independent variables were 8-item Morisky Medication Adherence Scale Adherence Scale (MMAS). The figures inside the brackets () represent t-statistic while the numbers above show the coefficient. We also accounted for Age, Gender, Level of Education and Martial Status. The symbols ** and *** indicate significance levels of a statistic at the 5%, and 1% respectively. Stata 14 was utilised in order to compute the results.

## 4. Discussion

Saudi Arabia offers free health services and medicine to its citizens; however, we found that the number of T2DM patients with a high level of MA was approximately 12%. Despite this finding being moderately higher than the 9% observed by Mohd et al. (2015) in the UAE, it was significantly lower than the 40% previously reported by Aloudah et al. (2018) in Saudi Arabia and approximately 50% in both Malaysia and India (Manan et al., 2014; Arulmozhi and Mahalakshmy, 2014). This can be partially explained by the number of participants used in these studies; however, from our analysis it can be inferred that this result may stem from the poor education level of the participants. It is noteworthy to mention that the aforementioned studies employed the 8-item MMAS as a measure of adherence.

Furthermore, this outcome was less than what was found in research conducted in the United States of America which was approximately 90% (Boccuzzi et al., 2001). The aforementioned rate was approximately 28% and 60% with reference to medium and low adherent T2DM patients respectively. Chew et al., (2015) rationalised that whether or not the participants were prescribed OHM or insulin medication may impact patients MA. Therefore, it is suggested that pharmacists in Saudi Arabia give out key information, in addition to providing instructions on what to do if a dose is missed or if they experience adverse side effects associated with the prescribed medication in order to enhance MA.

When analysing the overall HRQoL and its main domain scores reported in this study, there was a lack of available literature to compare our findings with except for a study conducted by Chew (2015) in Malaysia which reported similar scores that confirm the accuracy of our results.

The results of this research show that patients who are more adherent to their T2DM medication have a higher quality of life in all the domains of PQoL YQoL, SRQoL and EQoL. Moreover, the reported findings here were in line with a study conducted by Chew (2015).

Furthermore, Jannoo et al. (2017) examined 497 T2DM patients from Malaysia and documented that non adherent patients had shown a lower HRQoL. It must be mentioned that the authors utilised the 8-item MMAS together with SF-36 which retained some of the principal features of HRQoL and it is proven to be applicable across cultures; however, this measure is not as conclusive as the HRQoL.

Additionally, Chew (2015) evaluated the same research questions in a sample of 700 Malaysian T2DM patients by employing the same methodology used in our study which subsequently found a link between MMAS score and HRQoL; however, the author used a sample age range of 30 years and above, which is different to our study as we focused on an older demographic with a rising occurrence rate of T2DM in Saudi Arabia.

Moreover, Ose et al. (2011) found that those patients taking part in diabetes management courses for T2DM presented with an improved HRQoL whilst adhering to appropriate self-care routines in Germany. Similarly, Saleh et al. (2014) found that patients that were not adhering diabetes self-care routines largely exhibited lower levels of HRQoL in Bangladesh.

Previous studies (Côté et al., 2003; Holzemer al., 1999) conducted self-reporting while (Billups et al., 2000; Sung et al., 1998) utilised digital prescription data. The aforementioned studies ascertained no relationship between all of the QoL domains and MA. Additionally, a study by Martínez et al. (2008) failed to establish if higher scores in QoL may have been responsible for adherence or if non-adherence was instigating lower scores in QoL. This could be due to the design, population and the number of participants employed by the aforementioned studies which could in turn account for the non-existent relationship between MA and QoL.

Low levels of MA and an absence of understanding related to instructions for medications are key obstacles to the effective treatment of T2DM (Heissam et al., 2015). Our analysis supports a link between MA and HRQoL among T2DM patients aged over 50 in Saudi Arabia. This also demonstrates that this finding may be construed as evidence of the beneficial effects of the anti-diabetic pharmacological medicines that patients were experiencing and that these medications were most likely prescribed appropriately by the doctors (Chew, 2015).

Given that the majority of the participants in our study were educated to primary school level, we were unable to investigate the potential impact of this demographic factor. The low MA rates reported in these findings could be linked to poor education which could be enhanced via government initiatives and educational health campaigns; however, this needs further work in order to fully ascertain the reason behind this relationship. Furthermore, T2DM patients should be encouraged to take their medication by local pharmacists and health professionals since this could result in a higher QoL.

### 4.1 Further work

This research can be further enhanced in future studies by taking into account other demographics variables that can influence MA and HRQol among older patients diagnosed with T2DM. This can be conducted by evaluating whether other comorbidities are related to adherence. Moreover, in order to fully ascertain the direction of some of the relationships, research conducted in the future should endeavour to examine a longitudinal setting via the collection of a panel data set in consecutive time intervals with a view to further analyse the time-consistent or time-varying association of MA with HRQoL. This can be attributed to the cross-sectional design element of this research and as a result no conclusion related to the causal relationship between MA and HRQoL could be satisfactorily drawn from our findings. Lastly, this research could further be enhanced by the organised systematic collection of data in order to examine the differences between 3 adherence types as highlighted by (Morisky et al., 2008).

## 5. Conclusion

Improved adherence to medication was positively correlated with HRQoL among T2DM patients in Najran, Saudi Arabia. This result offers reassurance concerning current

pharmacological treatments for T2DM and the prescribing abilities of present-day primary care professionals. The reported positive correlation may give healthcare providers more confidence and a reasonable expectation that there will be more initiatives that enhance MA; however, it can be postulated that individuals with high HRQoL have greater levels of psychological positivity resulting in better adherence to medications. These should be the areas that future research should address in order to establish causation or correlation. A greater variety of options and an increased availability of much simpler dosing routines to treat T2DM and its associated conditions is an additional approach that could improve MA. It is further recommended for the relevant authorities and pharmacists to continue their efforts of health promotion with respect to the importance of MA as this could positively impact HRQoL.

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