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The role of religious coping and social support on medication adherence and quality of life among the elderly with type 2 diabetes

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Abstract

Purpose Type 2 diabetes is a major public health issue particularly in the elderly. Religion may affect the Health Related Quality of Life (HRQoL) in such patients, mediated by factors such as religious coping and social support. This study aimed to investigate the impact of religiosity on medication adherence and HRQoL.

Methods 793 adults (> 65 years old, 45% females) were recruited from 4 diabetes care centers and followed for 1 year. Duke University Religion Index, Spiritual Coping Strategies, Multidimensional Perceived Social Support, Medication Adherence Report Scale, WHOQOL-BREF and Diabetes-specific Quality of Life Questionnaire Module were used for assessment, as well as HbA1c and fasting blood glucose level. Using structural equation modeling, the potential paths were tested between religiosity, medication adherence and HRQoL; social support, religious coping and medication adherence served as the mediators.

Results Religious coping and social support were recognized as the significant mediators between religiosity and medication adherence (CFI = 0.983, TLI = 0.985, and RMSEA = 0.021). The relationships between religiosity and HRQoL were considerably mediated by social support, religious coping and medication adherence and these variables explained 12% and 33% of variances of generic and specific HRQoL, respectively. There was no significant direct effect of religiosity on HRQoL. HbA1c and fasting blood glucose level were successfully loaded on the latent construct of medication adherence (factor loading = 0.51 and 0.44, respectively).

Conclusions The impact of religiosity on medication adherence and HRQoL occurs through the mediators such as religious coping and social support. Therefore, to improve the adherence to treatment and quality of life, interventions may be designed based on these mediators.

Keywords Religious coping · Type 2 diabetes · Medication adherence · Quality of life · The elderly

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Introduction

Type 2 Diabetes mellitus (T2D) is a chronic disease that threatens many elderly people especially those with risk factors, such as obesity and sedentary lifestyle [1]. It is currently at an epidemic rate worldwide, with currently more than 420 million of the world population affected by T2D, and this may increase to nearly 600 million in 2035 [2]. There were more than 20 million people over the age of 65 years having T2D in the United States, and in developing countries such as China and Malaysia between one-third and one-fifth of the elderly have T2D [3–5]. In middle-level income countries, the leading cause of death can be attributed to uncontrolled blood glucose level for both men and women over the age of 50 years [2]. In the past two decades, there has been a growing incidence of T2D in Iran that may be due to the change of lifestyle to unhealthy types. As such, based on a recent report, more than 14% of older adults in Iran suffer from this condition [6].

There are several irreversible complications associated with T2D, such as nephropathy, retinopathy, atherosclerosis, and diabetic foot that can all negatively affect the health-related quality of life (HRQoL) and increase the risk of premature mortality in such patients [1]. In addition, there have been several studies reporting that HRQoL among diabetic patients is considerably lower than the general population [7, 8]. However, good adherence to medications may prevent the patients with T2D from these complications and improve their HRQoL [9]. Indeed, medication adherence (MA) has been recognized as the most influential factor in disease management in such patients [10]. Unfortunately, at least half of the diabetic patients do not take their medications as prescribed and a considerable number of patients change the dosage of the hypoglycemic agents without guidance from clinicians [11]. This problem may be more significant among older adults because many of these people (especially those in developing countries) are illiterate with insufficient knowledge or skills of self-care for chronic diseases, such as diabetes, or are affected by several physical and mental comorbidities that may negatively affect their abilities to manage such conditions.

Overall, none or poor MA may be due to various factors, such as low level of health knowledge, insufficient communication between the patients and healthcare providers, ignoring cultural differences among the patients by the health professionals, side effects of the medications, and unawareness of the negative outcomes of non-adherence [12, 13]. However, a number of factors have also been identified that may positively impact MA and eventually lead to better HRQoL—or in a broader sense, quality of life (QoL)—in patients. These factors may have mediation roles on MA and identifying them would be helpful because health professionals could then consider them when attempting to improve MA in patients.

Previous studies have examined the contribution of religiosity, religious coping (RC), and spiritual beliefs to the management of disease in patients with T2D [14, 15]. The relationship between these concepts and outcome measures such as diabetic management, coping capability, well-being, emotional stress, HRQoL, and glycemic control have been investigated, and overall positive correlations have been found [16–18]. People having religious/spiritual beliefs seem to have a better adjustment to their disease and acceptable compliance with drug therapy [17]. Moreover, they usually show a better mental health status with a lower frequency of reporting anxiety or depressive symptoms than the atheists [19].

Another factor associated with better MA and self-care behaviors among diabetic patients is social support (SS) [20]. This factor can improve self-efficacy and self-esteem, and provide helpful resources to patients that may positively affect their adaptation process and disease management [21]. Several authors indicated that social support (SS) is necessary to enable patients towards lifestyle change and adherence to treatment [22]. It is also revealed that patients with T2D may seek lower levels of social connections and supports than healthy people and that may be disruptive to MA [23]. In addition, for the elderly who are more dependent on family members and relatives than the general population due to aging-related disabilities, SS should be considered as an important factor that may determine the health status among these people.

Despite the important roles of religious coping (RC) and SS on MA and HRQoL in patients with T2D, there is limited literature regarding how these factors may be associated with the health outcomes (i.e. MA, QoL and HRQoL); and the potential relationships between such factors are unclear. Therefore, this study intended to investigate the relationships between the factors (RC and SS) and outcomes (MA, QoL and HRQoL) and identify the mediation effects of such variables among older adults.

Methods

The participants

This study was a longitudinal study, conducted in three diabetes care centers affiliated with two medical universities and the Iranian Diabetes Society in Tehran and Qazvin between the years 2015–2017. Convenience sampling was used to recruit elderly patients with T2D who attended the Outpatient Diabetic Unit of university hospitals and the

Iranian Diabetes Society. Inclusion criteria were: a confirmed diagnosis of T2D for at least 1 year before the study; aged 65 years or older; taking anti-diabetes medications regularly, and; agreeing to participate in the study. Patients were excluded from the study if they had a severe cognitive impairment (i.e. a score in Mini Mental State Examination (MMSE) < 19), were not able to read and speak Persian, or were not responsible for taking their medications. In total, we approached 887 elderly patients with T2D and 43 refused to participate and 51 did not meet the inclusion criteria. The study was approved by the Human Ethics Committee of Qazvin University of Medical Sciences, and all participants signed the Informed Consent Form before enrolling in the study.

Measures

Religiosity: duke university religion index (DUREL)

This is a brief scale to assess three types of religion-related activities including, (1) organizational religious activity or frequency of participation in religious events (1 item); (2) non-organizational religious activity or individual religious activities such as private praying and studying Quran (1 item), and; (3) intrinsic religiosity that consists of believing in the God/divine, impact of religious beliefs on one's attitude towards life, and transferring religion into different aspects in the life (3 items). For the organizational and non-organizational religiosity, the frequency of involvement was responded to using a Likert scale ranging from 1 (never)—6 (multiple times a day). In the intrinsic religiosity section, the response options ranged from 1 (definitely not true) to 5 (definitely true). A higher score in the DUREL indicates greater religiosity in the three types of religion-related activities (viz., organizational religious activity [scoring 1–6], non-organizational religious activity [scoring 1–6], and intrinsic religiosity [scoring 3–15]). Additaionlly, the three types of religion-related activities can be combined and a total DUREL score can be obtained with the range between 5 and 27. The Iranian version of the DUREL was shown to have acceptable psychometric properties in a previous study (Cronbach's alpha = 0.87–0.92; test–retest reliability using the intraclass correlation coefficient [ICC] = 0.62–0.79) [24].

Spiritual coping strategy (SCS) scale

The SCS consists of two sections, RC (9 items) and non-RC (11 items). For the purpose of this study, we only used the RC section. The items included are related to issues such as attending the mosque, receiving religious programs on TV or radio, praying individually or in a group, the relationship with God or a higher power, trust in God, etc. For all the items, the Likert responses range from 0 (never used) to 3 (often used) that generate a total score ranging between 0 and 27. The higher the score, the greater use of RC is expected. The modified Persian version of SCS in Muslims has been found to be a valid and reliable tool (Cronbach's alpha = 0.87; test–retest reliability using the weighted kappa = 0.88 [25]).

Multidimensional scale of perceived social support (MSPSS)

Bagherian-Sararoudi et al. established the validity and reliability of the MSPSS in an Iranian population in a previous study [26]. This 12-item instrument was used to examine the different resources of SS, including family members, significant people in one's life, and friends, with four items in each category. All items are rated using a 7-point Likert scale ranging from 1 (very strongly disagree) to 7 (very strongly agree). The total score ranged between 12 and 84. A higher score indicates better SS from all resources. The psychometric properties of the MSPSS are satisfactory (Cronbach's alpha = 0.84–0.93; test–retest reliability using Pearson's $r = 0.74$ to 0.84) [26].

Medication adherence (MA)

The Medication Adherence Report Scale with five items (MARS-5) was used to assess common non-adherent behaviors in the patients. The items are rated using a five-point Likert scale from 1 (always) to 5 (never), where a higher score indicates a better adherence. The validation of the version translated into the Persian language has been confirmed in the previous research (Pearson's $r = 0.7$ with a medication possession rate) [27, 28].

World health organization quality of life scale brief version (WHOQOL-BREF)

This is a self-report measure of QoL that consists of 26 items and assesses 4 domains, including physical, psychological, social, and environmental aspects of the QoL. Items are responded to on a five-point scale from 1 to 5 with higher scores in the direction of better QoL. For each domain, the total score can range from 0 (worst situation) to 100 (best situation). Specifically, the total score is calculated by summing the item scores (with negatively worded items reverse coded), taking the average of the sum, multiplying the average by 25, and then subtracting 25 from that number. For example, if a person has an average item score of 2 in the physical domain, the total score for the person's physical QoL is $2 \times 25 - 25 = 25$. This questionnaire has shown adequate psychometric properties in Iranian populations (Cronbach's alpha = 0.90; test–retest reliability using Spearman's rho = 0.85 to 0.92) [29].

Diabetes-specific quality of life questionnaire module (DMQoL)

This instrument has been developed as a diabetes-specific measure of HRQoL that may also be used as a supplementary module for WHOQOL-BREF. Ten items with a response scale from 1 (very dissatisfied) to 5 (very satisfied) are included in the questionnaire. Satisfaction with treatment, weight control, physical activity, diet control, the management of diabetes-related complications, glycemic control, family relationship, adaptation, the time and expenses of diabetes care are assessed. Those who obtain a higher score are considered to have better HRQoL. This instrument has previously been translated and validated in Iran (Cronbach's alpha = 0.89; test–retest reliability using ICC = 0.79 to 0.92) [30].

Mini-mental state examination (MMSE)

To assess the cognitive function of the participants at the recruitment, the MMSE was applied. This is a brief screening test for cognitive impairment. The maximum score for this scale is 30. In our study, those with a score between 24 and 30 were considered cognitively normal. The culturally adapted Persian version of the MMSE was used in the current study (Spearman's rho = 0.46 with the education level and − 0.77 with age; sensitivity and specificity using cutoff at 23 = 98% and 100%, respectively) [31].

Other measurements

Demographic information on age, gender, education level, marital status, accommodation, and smoking history was recorded. In addition, information about any diabetes-related complications, such as neuropathy and retinopathy, as well as the duration of the disease were extracted from the medical records. Body mass index and blood pressure of the participants were measured in the clinics. In addition, biochemical tests such as fasting blood glucose level, HbA1c, blood urea nitrogen, lipid profile, and eGlomerulus Filtration Rate (eGFR) were performed.

Procedure

All the patients with T2D who had been referred to the Diabetes Units to receive routine care were approached to participate in this study. In a short session with the research assistants, the study aims were described to the patients. The eligibility of the patients was then assessed by two physicians, while the participants were asked to complete a written Informed Consent Form. Then, the baseline measurements including DUREL, SCS, MSPSS, and MMSE were performed. Twelve months later, the same patients were asked to complete the follow-up measurements including MARS, DMQoL, and WHOQOL-BREF. An overnight fasting blood sample was also taken from each participant.

Data analysis

The data were analyzed using SPSS 23.0 and AMOS 24.0 software packages. Quantitative data were expressed as mean [Standard Deviation (SD)], while categorical variables were expressed as n (%). To assess the factors associated with MA and QoL/HRQoL, three models were used. In all models, the latent constructs were used to measure religiosity (i.e., three dimensions: intrinsic religiosity, organizational religious activity, and non-organizational religious activity) and MA (i.e., fasting blood glucose level, HbA1c level and MARS). Moreover, all the models were adjusted for age, gender, duration of the illness, the number of comorbidities, MMSE, and education. In the first model, the relationship between religiosity and MA was examined through RC and perceived SS. In the second model, diabetes-specific measurements were added to the model to further assess the relationships between MA and diabetes-specific HRQoL. In the third model, a generic measurement of QoL was replaced with the diabetes-specific measurement. The proposed models were analyzed using structural equation modeling (SEM) [32]. Furthermore, all the models included an interaction effect (i.e., RC and SS) on MA. Overall, the number of missing values was low (ranging from 3.1 to 6.7%). Therefore, missing data were estimated by a full information maximum likelihood method. Moreover, the mediating roles of RC, perceived SS, and MA were examined based on the four-step Baron and Kenny's recommendations: in the first step, dependent and independent variables were significantly related. The independent variable and the mediator were significantly related in the second step. The mediator and the dependent variable were significantly related in the third step. In the final step, the relationship between the independent and dependent variable became non-significant (full mediation) or became weaker after the addition of a mediator (partial mediation) [33].

Several indices of model fit were used: comparative fit index (CFI), Tucker–Lewis index (TLI), root mean square of error approximation (RMSEA), and standardized root mean square residual. Values higher than 0.90 for the CFI and TLI indices suggest good model fit. Regarding RMSEA and standardized root mean square residual, values less than 0.08 indicate acceptable model fit [34–36]. To ensure that the mediating effect occurs, 5000 bootstrap resamples and the 95% bias-corrected confidence estimates were used.

Results

Among the 793 participants with T2D, 357 (45.0%) were females. The average age of the patients was 70.21 (± 15.10) years. The average years of education were 4.16 (± 2.11) years. The most common complication was hypertension (59.4%), followed by neuropathy (51.7%), and ischemic heart disease (38.2%). Around two-thirds of the participants ($n = 581$) lived in the city. The characteristics of the patients are shown in Table 1.

In terms of model fit, the three proposed models yielded acceptable outcomes (Figs. 1, 2, 3); In Model 1, the fit indices were χ^2 (df) = 140.56 (51), CFI = 0.968, TLI = 0.953, RMSEA = 0.061, and SRMR = 0.053. In model 2, the fit indices were χ^2 (df) = 63.12 (58), CFI = 0.983, TLI = 0.970, RMSEA = 0.031, and SRMR = 0.025. In the third model, the fit indices were χ^2 (df) = 145.22 (55), CFI = 0.994, TLI = 0.976, RMSEA = 0.059, and SRMR = 0.021. In terms of factor loading for the latent constructs, all manifest variables were significantly loaded on their correspondent latent structures: intrinsic (factor loadings = 0.64 to 0.69), organizational (factor loadings = 0.74 to 83), and non-organizational religiosity (factor loadings = 0.41 to 57) loaded on the latent construct of religiosity; MARS-5 (factor loadings = 0.73 to 0.87), fasting blood glucose level (factor loadings = 0.22 to 0.35), and HbA1c level (factor loadings = 0.40 to 0.43) loaded on the latent construct of MA; physical health (factor loadings = 0.54 to 69), mental health (factor loadings = 0.60 to 73), social relationships (factor loadings = 0.68 to 79), and environment (factor loading = 0.51 to 66) loaded on the latent construct of generic QoL.

Overall, the three models sufficiently explained the variance of MA (52.2% for Model 1 and 48.0% for Models 2 and 3), diabetes-specific HRQoL (59.1%), and generic QoL (17.1%). In addition, all paths were significant between the study variables in three models except for the direct relationship between religiosity and diabetes-specific HRQoL (standardized beta = − 0.053, $p > 0.05$) and generic QoL (standardized beta = 0.010, $p > 0.05$).

Table 2 shows the direct, indirect, and total effects between SEM variables. In all models RC and perceived SS partially mediated the relationships between religiosity and MA. In addition, the interaction between RC and SS was significantly associated with MA (standardized beta = 0.401, $p < 0.001$ for Model 1; standardized beta = 0.663, $p < 0.001$ for Model 2; standardized beta = 0.393, $p < 0.001$ for Model 3). However, the effects of religiosity on both diabetes-specific HRQoL and generic QoL were fully mediated by MA, RC and SS (Table 2).

Table 1 Participants' characteristics ($n = 793$)

Characteristics	*n* (%) or mean (SD)
Baseline	
Age (year)	70.21 (15.10)
Gender (male)	436 (55.0%)
Years of education	4.16 (2.11)
Marital status	
Single	68 (8.6%)
Married	542 (68.3%)
Widowed	183 (23.1%)
Current smoker	173 (21.8%)
Accommodation	
Rural	212 (26.7%)
Urban	581 (73.3%)
Diabetes-related complication	
Hypertension	471 (59.4%)
Neuropathy	410 (51.7%)
Nephropathy	291 (36.7%)
Retinopathy	260 (32.8%)
Diabetic foot	223 (28.1%)
Ischemic heart disease	303 (38.2%)
BMI (kg/m^2)	27.1 ± 2.9
Systolic blood pressure (mmHg)	147.6 ± 22.1
Diastolic blood pressure (mmHg)	83.6 ± 15.9
Blood creatinine (mg/dl)	1.0 ± 0.4
Blood urea nitrogen (mg/dl)	18.1 ± 7.6
Triglycerides (mg/dl)	142.7 ± 55.4
Total cholesterol (mg/dl)	199.4 ± 44.3
LDL cholesterol (mg/dl)	125.3 ± 59.4
HDL cholesterol (mg/dl)	41.2 ± 28.3
Duration of diabetes (years)	14.3 ± 6.1
eGFR (ml/min per 1.73 m^2)	80.3 ± 13.9
MMSE	22.4 ± 4.6
Religiosity	
Intrinsic	9.3 ± 4.9
Organizational	3.73 ± 1.9
Non-organizational	4.1 ± 1.9
Religious coping	20.1 ± 5.4
MSPSS	
Total	59.9 ± 16.7
Family	21.9 ± 6.8
Friends	17.2 ± 7.3
Significant others	20.7 ± 8.3
1 year later	
Medication Adherence Report Scale	12.7 ± 6.8
Fasting blood glucose level (mg/dl)	148.3 ± 73.2
HbA1c (%)	7.6 ± 1.9
DMQoL	
WHOQOL-BREF Total score	50.7 ± 5.8
Physical health	11.1 ± 1.9
Psychological health	12.4 ± 2.1
Social relationships	12.8 ± 3.3
Environment health	14.2 ± 2.0

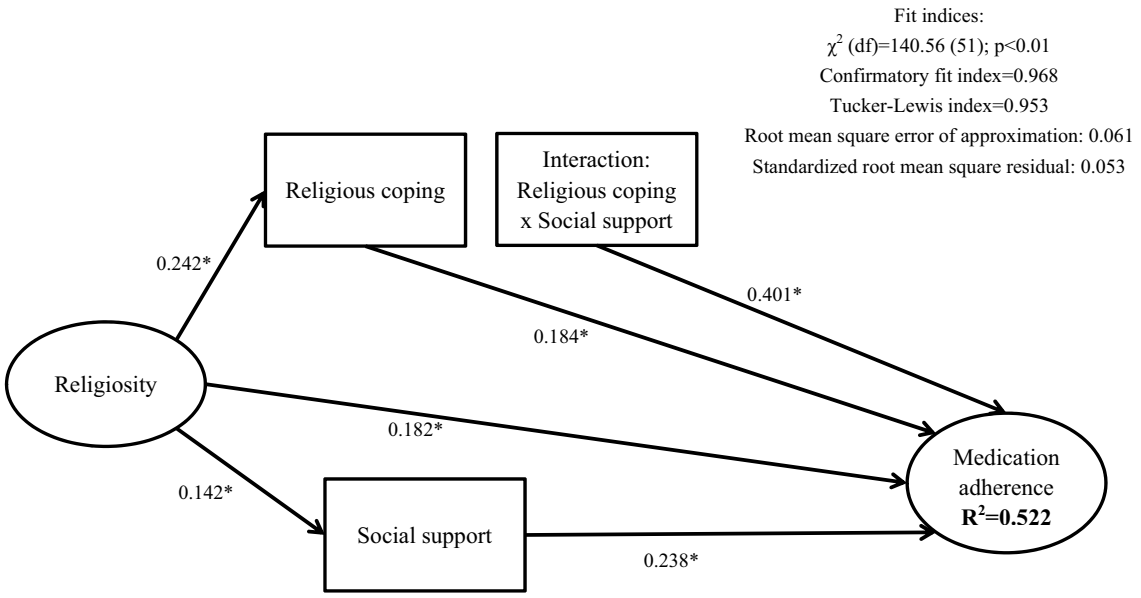

Fig. 1 Model 1: Relationships between religiosity, religious coping, and medication adherence. Religiosity consists of intrinsic, organizational, and non-organizational religiosity; medication adherence includes fasting blood glucose level, HbA1c and Medication Adherence Report Scale Score. Age, gender, duration of the illness, number of comorbidity and education were adjusted for in the model. *$p < 0.001$

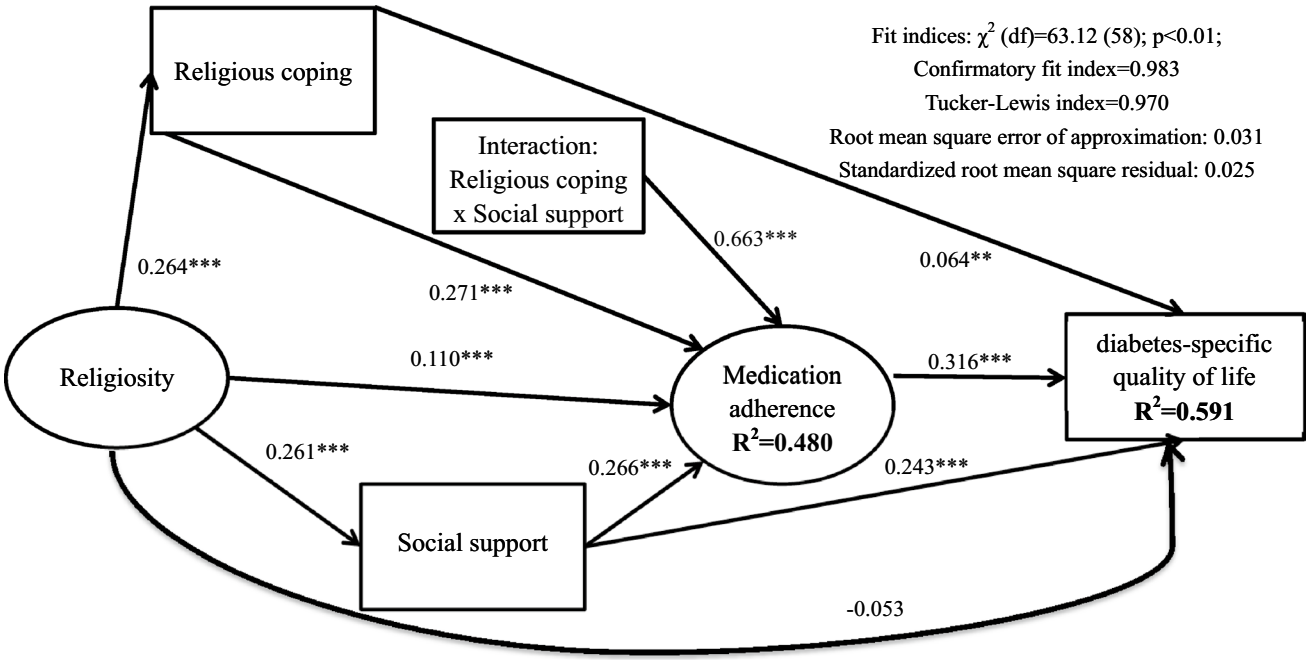

Fig. 2 Model 2: Relationships between religiosity, religious coping, medication adherence, and diabetes-specific quality of life. Religiosity consists of intrinsic, organizational, and non-organizational religiosity; medication adherence included fasting blood glucose level, HbA1c and Medication Adherence Report Scale score; the quality of life was measured using the diabetes-specific quality of life questionnaire module. Age, gender, duration of illness, number of comorbidity, MMSE and education were adjusted for in the model. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

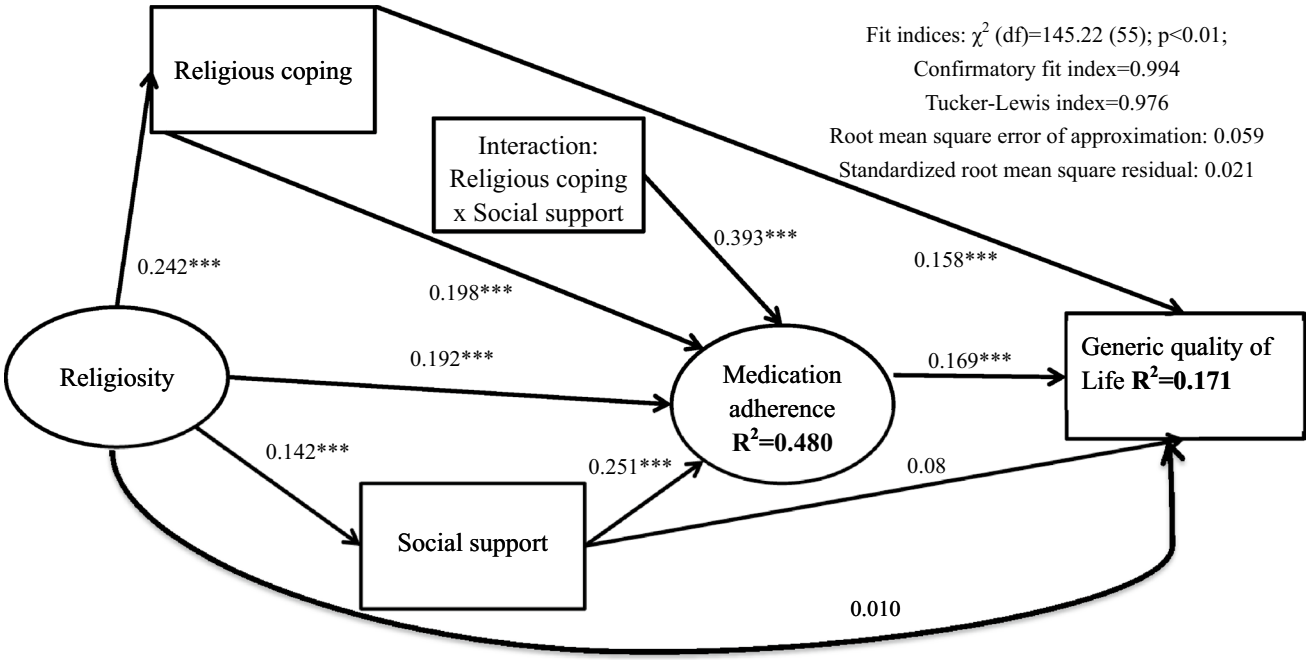

Fig. 3 Model 3: Relationships between religiosity, religious coping, medication adherence, and generic quality of life. Religiosity consists of intrinsic, organizational, and non-organizational religiosity; medication adherence included fasting blood glucose level, HbA1c and Medication Adherence Report Scale score; the quality of life was measured using the World Health Organization Quality of Life scale brief version. Age, gender, duration of illness, number of comorbidity and education were adjusted for in the model. *$p<0.05$; **$p<0.01$; ***$p<0.001$

Discussion

In this longitudinal study, we aimed to investigate how religiosity may affect disease-specific HRQoL and generic QoL and whether factors such as RC, SS, and MA may mediate the effects of religiosity on QoL/HRQoL. We found that the impact of religiosity on quality of life is significantly mediated by our predicted factors (RC, SS, and MA) and the direct effects of religiosity on the QoL and HRQoL can be considered as unremarkable. Therefore, all our hypothesized models were consistent with the literature that addressed the roles of RC, SS, and MA on the QoL. We discovered there may be new types of association between religiosity and quality of life through variables such as RC, SS, and MA. Additionally, our results demonstrated that compared with fasting blood glucose level (factor loadings = 0.22 to 0.35), HbA1c (factor loadings = 0.40 to 0.43) serves as a stronger biomarker to determine the MA for elderly people with T2D.

There are several mediation studies that attempted to investigate the potential factors affecting the QoL in diabetic patients. Sugiyama et al. examined the effect of a self-management empowerment intervention on the mental health aspect of HRQoL in African American and Latinos with T2D [37]. They aimed to investigate whether this intervention has a direct effect, independent of glycemic control, SS, and perceived empowerment, on the generic HRQoL (assessed by SF-12). In their causal mediation analysis, the program indicated a direct effect on HRQoL and all the hypothesized factors (i.e., HbA1c, SS, and perceived empowerment) did not show any indirect effects. In another study, sleep quality was considered as the mediator between depression and anxiety symptoms and HRQoL in 86 veterans with diabetes [38]. In this study, the mediation effect of sleep quality was confirmed and there were significant indirect effects between psychological distress and QoL for the patients with T2D. The relationship between the fear of hypoglycemia and psychological well-being using the mediation effect of specific HRQoL has also been investigated, where significant indirect effects were found [38]. However, here we found that other significant factors, such as MA, SS, and religiosity may also be associated with QoL. These factors have rarely been studied previously.

In a systematic review, Jaam et al. assessed the variables associated with MA among diabetic patients in two culturally similar regions (i.e., Middle East and North Africa). They found religiosity-related factors to be associated with MA in several studies. In addition, they found good social interactions may help increase adherence among patients. They concluded that cultural components may be considered when designing interventions to improve drug adherence in

Table 2 The direct, indirect, and total effects between structural equation modelling variables (standardized regression weights) for Models 1, 2 and 3

Observed variables and latent variables	Model 1			Model 2			Model 3		
	Direct effect (95% bias-corrected confidence interval)	Indirect effect (95% bias-corrected confidence interval)	Total effect (95% bias-corrected confidence interval)	Direct effect (95% bias-corrected confidence interval)	Indirect effect (95% bias-corrected confidence interval)	Total effect (95% bias-corrected confidence interval)	Direct effect (95% bias-corrected confidence interval)	Indirect effect (95% bias-corrected confidence interval)	Total effect (95% bias-corrected confidence interval)
Religiosity-Social Support	0.142*** (0.078–0.216)	–	0.142*** (0.078–0.216)	0.261*** (0.194–0.345)	–	0.261*** (0.194–0.345)	0.142*** (0.078–0.216)	–	0.142*** (0.078–0.216)
Religiosity-religious coping	0.242*** (0.171–0.321)	–	0.242*** (0.171–0.321)	0.264*** (0.196–0.343)	–	0.261*** (0.194–0.345)	0.242*** (0.171–0.321)	–	0.242*** (0.171–0.321)
Religiosity-medication adherence (religious coping as mediator)	0.182*** (0.094–0.372)	0.072*** (0.012–0.143)	0.286*** (0.137–0.494)	0.111*** (0.026–0.206)	0.072** (0.010–0.125)	0.252*** (0.101–0.369)	0.192*** (0.107 1–0.374)	0.075** (0.014–0.138)	0.299*** (0.171–0.501)
Religiosity-medication adherence (social support as mediator)	0.182*** (0.094–0.372)	0.034*** (0.008–0.083)	0.286*** (0.137–0.494)	0.111*** (0.026–0.206)	0.070*** (0.013–0.133)	0.252*** (0.101–0.369)	0.192*** (0.107 1–0.374)	0.036*** (0.012–0.094)	0.299*** (0.171–0.501)
Religiosity-quality of life (medication adherence as mediator)	–	–	–	–0.053 (−0.115 to 0.021)	0.035** (0.010–0.066)	0.107** (0.035–0.199)	0.010 (−0.49–0.090)	0.032** (0.006–0.039)	0.103** (0.033–0.180)
Religiosity-quality of life (religious coping as mediator)	–	–	–	–0.053 (−0.115 to 0.021)	0.041** (0.009–0.064)	0.107** (0.035–0.199)	0.010 (−0.49–0.090)	0.062** (0.040–0.099)	0.103** (0.033–0.180)
Religiosity-quality of life (social support as mediator)	–	–	–	−0.053 (−0.115 to 0.021)	0.087** (0.059–0.134)	0.107** (0.035–0.199)	0.010 (−0.49 to 0.090)	0.018** (0.004–0.038)	0.103** (0.033–0.180)

**$p < 0.01$; ***$p < 0.001$

this population [13]. In a study performed in Iranian patients with T2D, the relationship between HRQoL and spiritual well-being was assessed. A positive association between the components of HRQoL and spirituality was found, and those with higher levels of spiritual well-being showed better QoL [16]. These studies are consistent with our findings in this study which showed a significant correlation between religious beliefs and QoL. However, we also investigated novel factors through which religiosity may affect QoL and HRQoL. Indeed, we identified that the impact of religiosity was mediated by factors, such as RC and SS, both of which are part of religious practice. In other words, religiosity is a broad concept which exerts its effects on MA, QoL and HRQoL via its components, including RC and SS.

However, it needs to be noted that RC and SS are two context-based variables and may have different interactions with MA, QoL and HRQoL in other cultural and religious settings. For example, in a systematic review of the factors influencing MA among patients with T2D who were mainly from religions other than Islam, Peeters et al. did not report any association between religion-related components and MA [12]. In the Islamic doctrine, high importance and value are placed on health, and any action to threaten good health is criticized. As such, non-adherence to medication is not accepted by the culture and patients need to try their best to restore their health. Additionally, in Islamic religion, there is a strong emphasis on helping those who are in need, forlorn or disabled. Therefore, when Muslim people are sick, they expect their important others, such as parents, offspring, relatives and friends, to support them. The important role of SS in MA has been confirmed in several studies on patients with T2D in other cultures as well; thus it is not strictly religion or culture dependent [20, 39].

The current study still had a number of limitations. Firstly, our study was a follow-up study without any intervention to investigate the causal mediation effects. According to the hypothesized models, these mediations may exist; thus, randomized controlled trials are needed in future studies to confirm these models. Second, as mentioned earlier, SS and RC are context-based. Therefore, our findings may not apply well to people from other cultures or ethnic groups. However, there is some evidence indicating that SS and RC may affect variables such as MA and QoL/HRQoL (as measured in this study) in older people with chronic diseases [40–43]. Furthermore, as we have found, the association between RC and social SS has been recognized in previous studies [44, 45]. Nevertheless, we did not find any study that addresses how the interaction between RC and SS may affect MA. Our study seems to be the first to invesitigate such an interaction in diabetic patients. Third, there may be other factors associated with religiosity, such as locus of control, spiritual coping, and self-efficacy that we could not assess here. Including such factors might improve our models and better explain potential mediators. Finally, we used a convenience sampling method to recruit participants from those who were referred to the Diabetes Care Centers. In future studies, the patients with T2D who do not receive care from these centers also need to be included.

Conclusion

Religiosity shows both direct and indirect effects on MA. However, the effect of religiosity on generic and diabetes-specific HRQoL is mediated through MA, RC, and SS. Given the strong associations between RC and SS with MA, using programs to improve MA via developing RC skills and promoting SS may be effective to increase MA among diabetic patients. The significant interaction effect between RC and SS on MA may also indicate the importance of applying interventions using RC and SS concurrently. Specifically, patients' adherence to prescribed treatments may be improved when healthcare providers simultaneously consider using RC and SS. Subsequently, older patients with T2D may have positive impacts on both general QoL and disease-specific HRQoL. Future studies of this type need to be carried out with patients from other cultures and religious backgrounds to investigate the broader application of our theory.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval The study was approved by the Ethics Committee of the Qazvin University of Medical Sciences. All procedures involving human participants were in accordance with the ethical standards of the institutional and/or national research ethics committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

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