

# The relationship between the theory of planned behavior and medication adherence in patients with epilepsy



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## ABSTRACT

**Purpose:** The aim of this study was to apply the theory of planned behavior (TPB) with two other factors (action planning and coping planning) to the medication adherence of adults with epilepsy.

**Methods:** We measured the elements of the theory of planned behavior (attitude, subjective norm, perceived behavioral control, and behavioral intention), action planning, and coping planning at baseline among adults with epilepsy ( $n = 567$ , mean  $\pm$  SD age =  $38.37 \pm 6.71$  years, male = 48.5%). Medication adherence was measured using the Medication Adherence Report Scale (MARS) and antiepileptic serum level at the 24-month follow-up. Structural equation modeling (SEM) examined three models relating TPB elements to medication adherence.

**Results:** Three SEM models all had satisfactory fit indices. Moreover, attitude, subjective norms, perceived behavioral control, and intention together explained more than 50% of the variance for medication adherence measured using MARS. The explained variance increased to 61.8% when coping planning and action planning were included in the model, with coping planning having greater association than action planning. In addition, MARS explained 3 to 5% of the objective serum level.

**Conclusion:** The theory of planned behavior is useful in understanding medication adherence in adults with epilepsy, and future interventions may benefit by improving such beliefs as well as beliefs about coping planning.

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## 1. Introduction

The prevalence of epilepsy is high among the neurological disorders [1,2], with 4 to 10 in every 1000 people worldwide and 18 in every 1000 people in Iran diagnosed with the disorder. The issue of epilepsy is particularly important in developing countries as the incidence rates of epilepsy (~100 to 190 per 100,000 person-years) are higher than those in industrialized countries (~40 to 70 per 100,000 person-years) [2].

Fortunately, epileptic seizures can be controlled using antiepileptic drugs (AEDs): nearly 60% of patients with epilepsy can have seizures fully controlled by taking prescribed medication [3]. However, medication nonadherence among patients with epilepsy is between 30 and 50% [4–6], and nonadherence results in treatment failure [7]. Studies that use continuous objective measures of adherence also show high rates of nonadherence, with less than half of patients taking one-third or fewer of the prescribed AED doses [8], and only 76% of doses are taken overall [9]. In addition to reducing control over epileptic seizures, poor

adherence affects other important health-related outcomes, including number of hospital admissions, inpatient treatment days, and emergency room visits; healthcare costs [10,11]; and subjective quality of life [12]. Therefore, improving medication adherence is a critical issue for clinicians caring for patients with epilepsy.

As medication adherence is a behavioral issue, we hypothesized that the theory of planned behavior could provide insight into factors that reduce adherence. The theory of planned behavior was proposed by Ajzen [13], and it provides a theoretical framework for researchers to systematically understand the factors that affect behavioral change. The theory posits that three key elements (attitude, subjective norm, perceived behavioral control) predict a person's intent to engage in a behavior such as medication adherence, and behavioral intention, in turn, predicts behavior. Ajzen [13] defines attitude as a person's positive or negative evaluation of performing the behavior, subjective norm as the perception that other important people approve or disapprove of the behavior, and perceived behavioral control as a person's views on his or her capability to do the behavior. Moreover, perceived behavioral control is thought to predict not only intentions but also directly predict behavior [14]. As prior research supports the use of the theory of planned behavior in predicting intention and behavior across different populations and behavioral domains [15–17], we propose that the

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theory could also help explain medication adherence among patients with epilepsy.

In addition to the theory of planned behavior, some studies suggest that two other factors (action planning and coping planning) predict people's intentional behavior [18,19]. Action planning refers to specifying the when, where, and how of engaging in a particular behavior, and once a person has established an intention to engage in a behavior, action planning is thought to help translate the intention into behavior [20]. Coping planning refers to anticipating barriers that might come in the way of enacting a behavior [21]. For example, when patients utilize coping planning for medication adherence, they consider barriers that might prevent them from taking medication as well as ways to overcome those barriers. Moreover, action planning and coping planning should each mediate the association of intentions on behavior [22,23]. Therefore, the theory of planned behavior, as well as a revision that adds action planning and coping planning, has been shown to predict adherence to healthy behavior [24].

In the present study, we explored the factors that associate with medication adherence in adult patients with epilepsy. In order to assess the causal effects of intention on medication adherence, we used a 24-month follow-up of adherence behavior. Based on the theory of planned behavior and the literature on action and coping planning, we proposed three models to explain the medication adherence. The first model (Model 1, see Fig. 1) is the simplest model, which only adopted the theory of planned behavior. The behavior measured in Model 1 is self-report medication adherence, and we hypothesized that attitude, subjective norm, and perceived behavioral control would associate with self-reported medication adherence through behavioral intention. In addition, perceived behavioral control would also directly associate with self-reported medication adherence. The second model (Model 2, see Fig. 2) added one index of objectively measured AED serum level in Model 1. As prior research shows self-reported adherence to be associated with objective measures of adherence [25,26], we examined the extent to which theoretical factors predicted both self-reported and objectively measured adherence. The third model (Model 3, see Fig. 3) added action planning and coping planning to Model 2. In addition to the above hypotheses, Model 3 also hypothesized that behavioral intention would affect medication adherence through action planning and coping planning and that perceived behavioral control would relate to medication adherence through action planning and coping planning.

## 2. Methods

### 2.1. Participants and procedures

The study was performed in five neurologic clinics in Tehran and Qazvin from February 2012 through July 2015. The ethics committee of Qazvin University of Medical Sciences approved the study prior to participant recruitment.

Patients with epilepsy were invited to participate in this study if they a) were 18 years old or older, b) were responsible for taking their own medication, and c) were prescribed AEDs. Patients were excluded from the study if they a) did not agree to complete informed consent, b) had intellectual disability, or c) had a progressive medical or neurological disorder. The participants who agreed to participate first signed a written informed consent and a background information sheet. Participants then completed the questionnaire for theory of planned behavior. At a 24-month follow-up, participants filled out the MARS and had their serum level measured. The reason for measuring MARS and serum level at a 24-month follow-up is based on the nature of the theory of planned behavior. The theory of planned behavior claims that an individual performs a given behavior depending on a combination of particular individual and social factors, while the presence or absence of these factors can predict a person's future behavior. Therefore, we need longitudinal evidence when using the theory of planned behavior. Baseline behavior is considered as past behavior that cannot be viewed as future behavior. Moreover, according to the recommendations from the developer, Ajzen, of the theory of planned behavior, past behavior may not be a good predictor for future behavior because the past behavior would represent as a habit [27]. As a result, this study was designed prospectively to assess the behavior of medication adherence at a 24-month follow-up.

### 2.2. Instruments

The methods of data collection were questionnaires and a blood assay. All questionnaires were written in Persian for the Iranian population.

#### 2.2.1. Medication Adherence Report Scale (MARS)

The MARS is a self-report questionnaire for medication adherence. We used the brief version of MARS, which contains five items each

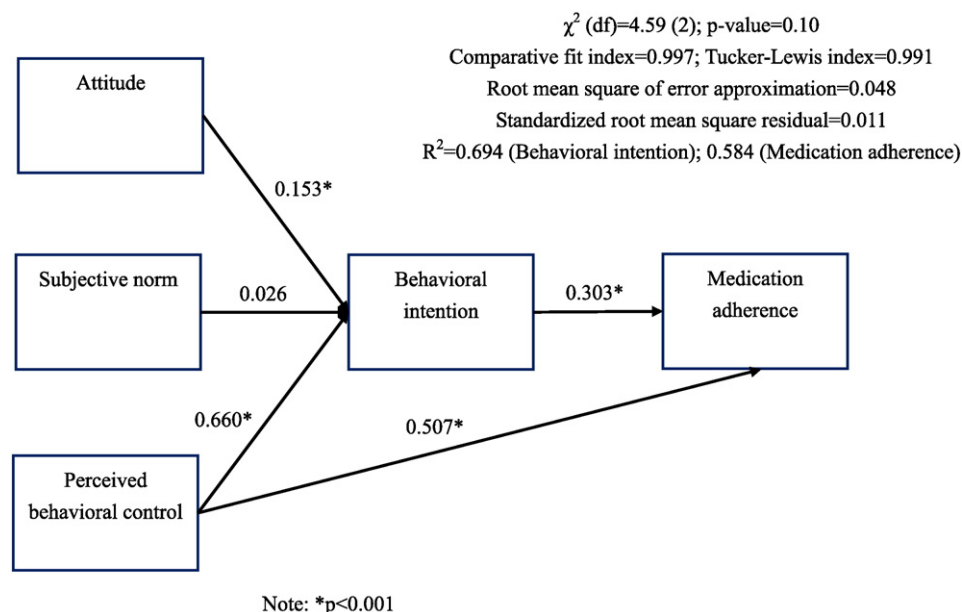


Fig. 1. Model 1: Medication adherence model.

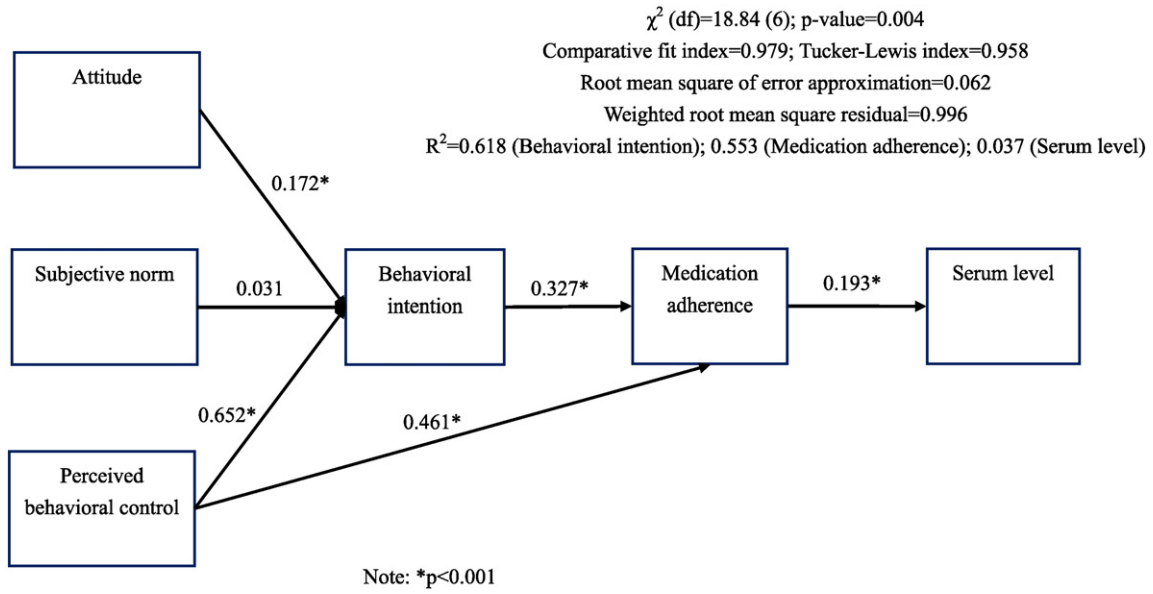


Fig. 2. Model 2: Medication adherence and serum level model.

rated on a 5-point Likert scale from never (score = 1) to always (score = 5). The score is summed, and a higher score represents a higher level of adherence [6]. Moreover, the concurrent validity of the MARS is supported by significant correlations to health personnel scores ( $r = 0.50$ ) and serum concentration of medication ( $r = 0.52$ ) [25]. Although no studies have examined the psychometric properties of the Persian version of MARS, its linguistic validity is supported by the employment of a standard translation procedure (forward translation, back translation, and reconciliation).

2.2.2. Questionnaire for theory of planned behavior

The theory of planned behavior questionnaire included 20 items which assessed the concepts proposed by Ajzen [13] with items adopted from Pakpour et al. [28]. The questionnaire consists of four parts: attitude (8 items), subjective norm (3 items), perceived behavioral control (4 items), and behavioral intention (5 items). Attitude toward

antiepileptic medication adherence was measured by eight 5-point evaluative semantic differential scales: “taking medication regularly as prescribed every day would be: unpleasant–pleasant, good–bad, harmful–beneficial, wise–foolish, correct–incorrect, unenjoyable–enjoyable, satisfying–unsatisfying, useful–useless”. The internal consistency for this scale, as assessed using Cronbach’s  $\alpha$ , was 0.91. Subjective norm was measured using the following three items: “People who are important to me would approve of me taking medication regularly as prescribed every day”, “I feel under social pressure to take medication regularly as prescribed every day”, and “It is expected of me that I should take medication regularly as prescribed every day”. All items were measured on a 5-point Likert scale ranging from 1 to 5 with satisfactory internal consistency ( $\alpha = 0.90$ ). Perceived behavioral control was measured using four items (e.g., “For me to take regular medication in the future is ...”), rated on a 5-point Likert scale from 1 (difficult) to 5 (simple). Behavioral intention was measured using five items

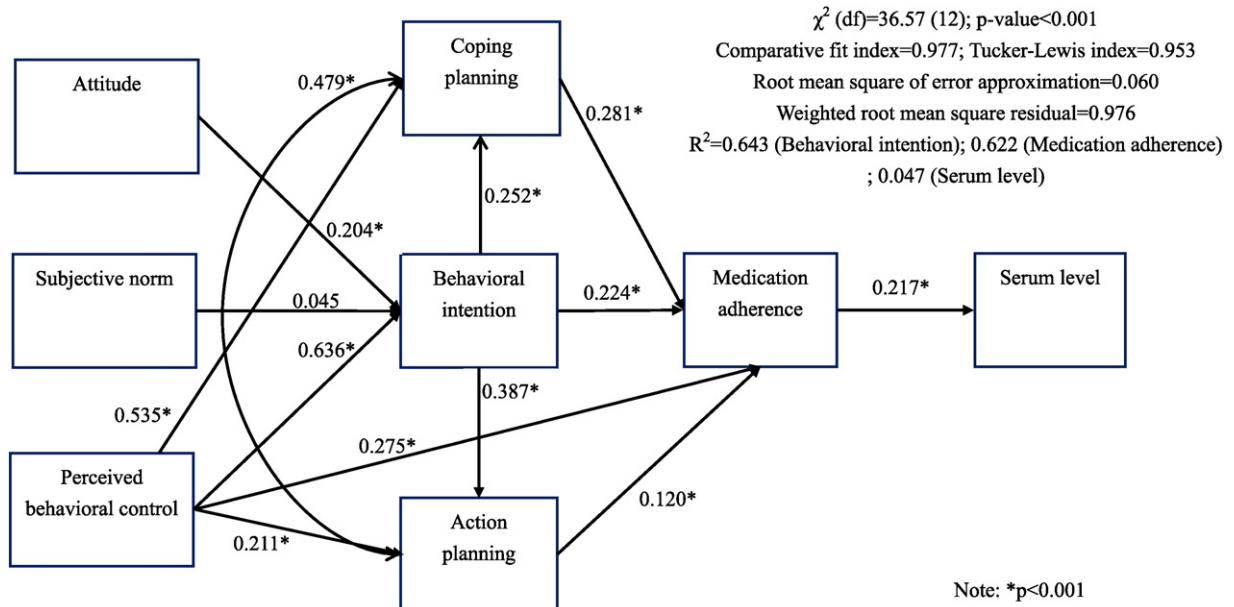


Fig. 3. Model 3: Medication adherence and serum level model with action and coping planning.

(e.g., “I intend to take regular medication in the future”), rated on a 5-point Likert scale from 1 (completely disagree) to 5 (completely agree). All items of perceived behavioral control and behavioral intention were adopted from Pakpour et al. [28], and both have satisfactory internal consistency ( $\alpha = 0.93$  for perceived behavioral control and 0.86 for behavioral intention).

### 2.2.3. Questionnaires for action planning and coping planning

As in Pakpour et al. [28], we used four 5-point Likert scale items (1 = completely disagree, 5 = completely agree) reflecting action planning using the stem of “I have made a detailed plan regarding” to assess (a) when to, (b) where to, (c) how often to, and (d) how to “take medication”. Similarly, coping planning was measured using four 5-point Likert scale items (1 = completely disagree, 5 = completely agree) with the stem of “I have made a detailed plan regarding ...”. The following descriptions for the coping planning were (a) what to do if something interferes, (b) what to do if I forget it, (c) how to motivate myself if I do not feel like it, and (d) how to prevent being distracted. Both action planning and coping planning had satisfactory internal consistency ( $\alpha = 0.92$  for both).

### 2.2.4. Objective antiepileptic drug serum level

We used microparticle enzyme immunoassay (MEIA) (Abbott AxSYM®, Abbott Laboratories, Abbott Park, IL, USA) to measure the AED drug concentrations in the plasma or serum [29]. The blood samples were derived from the participants before they took the next routine dose of drugs, and we classified all patients into three groups (below the usual therapeutic range, within the usual therapeutic range, and above the therapeutic range). The group within the usual therapeutic range is defined as having phenytoin at 10 to 20 mg/l, carbamazepine at 4 to 10 mg/l, and valproic acid at 50 to 100 mg/l [30].

### 2.3. Statistical analysis

Descriptive statistics were used to demonstrate the participant characteristics and their scores on instruments. Structural equation modeling (SEM) was used to examine three models: the medication adherence model (Model 1, Fig. 1), the medication adherence and serum level model (Model 2, Fig. 2), and the medication adherence and serum level model with action and coping planning (Model 3, Fig. 3). Model 1 examined whether the theory of planned behavior can explain the behavior of medication adherence for patients with epilepsy. Model 2 examined how much the self-report medication adherence measure (MARS) associates with objective AED serum level. Model 3 examined the mediating roles of action planning and coping planning in predicting adherence.

We used a maximum likelihood (ML) estimator on Model 1 and a diagonally weighted least squares (DWLS) estimator on Models 2 and 3 because the latter two models contain a categorical outcome variable (i.e., serum level). Moreover, we used a series of fit indices to determine an acceptable model. For both ML and DWLS estimators, acceptable fit was based on comparative fit index (CFI), a Tucker–Lewis index (TLI)  $>0.95$ , and a root-mean-square error of approximation  $<0.08$  [31,32]. For the ML estimator, a standardized root-mean-square residual (SRMR)  $<0.08$  indicates acceptable fit. For the DWLS estimator, a weighted root-mean-square residual (WRMR)  $<0.10$  indicates acceptable fit [33,34].

Descriptive statistics were analyzed using SPSS 17.0, and SEMs were conducted using the lavaan package [35] in the R software.

## 3. Results

Approximately 600 patients were invited to participate in the study. Twenty-three patients were not eligible to be included in the study, and 10 patients did not agree to participate, resulting in a response rate of 94.5%.

### 3.1. Descriptive results

The mean age (SD) of the participants ( $n = 567$ ) was 38.37 years (6.71); BMI was 22.92 kg/m<sup>2</sup> (4.21); educational year was 5.81 years (1.32). Approximately half of the participants were male (48.5%) and were employed (50.8%), and slightly more than half of the participants were married (58.0%). Less than one-fifth of the participants were current smokers (13.8%) or current drinkers (14.8%). Nearly half of the participants (46.7%) were diagnosed as having symptomatic partial epilepsy; most of the participants (61.9%) had monotherapy (Table 1). Moreover, the scores of the questionnaire for theory of planned behavior, action planning, coping planning, and MARS are reported in Table 1. At the 24-month follow-up, slightly less than half of the participants had their AED serum level below the suggested therapeutic range (47.6%). We note that medication adherence did not differ between those with monotherapy and those with polytherapy, while controlling for age, gender, and time since diagnosis; therefore, we did not include therapy type in any subsequent analyses.

### 3.2. Structural models

All three models showed acceptable fit. The CFI and TLI were above 0.95, and RMSEA was less than 0.08 in all three models. Model 1 (Fig. 1) had an SRMR = 0.011, Model 2 (Fig. 2) had a WRMR = 0.996, and Model 3 (Fig. 3) had a WRMR = 0.976. All coefficients were positive and significant in the three models, except for the nonsignificant effect of subjective norm on intention (standardized coefficient = 0.026 in Model 1, 0.031 in Model 2, and 0.045 in Model 3).

Moreover, attitude, subjective norm, and perceived behavioral control explained a substantial proportion of the variance for behavioral intention from 61.8% (Model 2) to 69.4% (Model 1). Direct and indirect effects of attitude, subjective norm, perceived behavioral control, and

**Table 1**  
Participant characteristics (N = 567).

Age (years) (mean $\pm$ SD)	38.37 $\pm$ 6.71
Education (years) (mean $\pm$ SD)	5.81 $\pm$ 1.32
Gender (male), n (%)	275 (48.5%)
Employment (yes), n (%)	288 (50.8%)
Married (yes), n (%)	329 (58.0%)
Current smoker (yes), n (%)	78 (13.8%)
Current drinker (yes), n (%)	84 (14.8%)
Body mass index (kg/m <sup>2</sup> ) (mean $\pm$ SD)	22.92 $\pm$ 4.21
Types of epilepsy, n (%)	
Idiopathic generalized epilepsy	164 (28.9%)
Symptomatic partial epilepsy	265 (46.7%)
Cryptogenic partial epilepsy	138 (24.3%)
Treatment regimen	
Monotherapy	351 (61.9%)
Polytherapy	216 (38.1%)
Comorbid conditions	
Depression	62 (10.93%)
Hypertension	58 (10.23%)
Dyspepsia	17 (3.0%)
Migraine	51 (8.95%)
Age at onset of seizures, years (mean $\pm$ SD)	19.21 $\pm$ 6.91
Time since diagnosis, years (mean $\pm$ SD)	13.38 $\pm$ 7.39
Scores on theory of planned behavior (mean $\pm$ SD)	
Attitude	3.95 $\pm$ 0.63
Subjective norm	3.26 $\pm$ 0.68
Perceived behavioral control	3.41 $\pm$ 1.03
Behavioral intention	3.58 $\pm$ 1.06
Action planning (mean $\pm$ SD)	2.66 $\pm$ 0.82
Coping planning (mean $\pm$ SD)	2.53 $\pm$ 0.87
Medication adherence measured by MARS <sup>a</sup> (mean $\pm$ SD)	12.81 $\pm$ 6.14
Serum level <sup>a</sup> , n (%)	
Below therapeutic range	270 (47.6%)
Within therapeutic range	226 (39.9%)
Above therapeutic range	71 (12.5%)

MARS = Medication Adherence Report Scale.

<sup>a</sup> Measured at 24-month follow-up.

intention explained 58.4% (Model 1) and 55.3% (Model 2) of the variance for medication adherence measured using MARS. The explained variance increased to 61.8% when coping planning and action planning were added in Model 3 to explain the variance for medication adherence. The variances of serum level, an objective index for measuring adherence, explained by the subjective measures on medication adherence (i.e., MARS), were 3.7% in Model 2 and 4.7% in Model 3.

We found that behavioral intention had more direct effects ( $R^2 = 0.478$ ) on medication adherence than indirect effects ( $R^2 = 0.130$  through action planning,  $R^2 = 0.237$  through coping planning), though direct and indirect effects were both significant (Table 2).

#### 4. Discussion

To the best of our knowledge, this is the first study using the theory of planned behavior to understand medication adherence in a sample with epilepsy. Our main finding was the evidence of the associations between behavioral intention and medication adherence. Overall, our proposed models all had satisfactory fit indices and indicated that the theory of planned behavior can be useful in understanding the medication adherence of patients with epilepsy.

However, contrary to the theory of planned behavior's propositions, our results showed that subjective norm had no association with behavioral intention. Consequently, subjective norm had no association with medication adherence for patients with epilepsy. Despite the finding that subjective norm is an important predictor of medication adherence among people with schizophrenia [36], reviews of the theory of planned behavior generally show that subjective norm has a relatively weak association with intention and behavior [15,37]. In the context of this study, attitudes and perceived behavioral control were both relatively high, so patients generally felt positively about their medication and felt control over taking it. Given these positive beliefs, it is possible that the association between subjective norms and medication adherence was diminished given that other beliefs also supported intentions toward medication adherence [38,39]. Nevertheless, our results showed that behavioral intention is important for a patient with epilepsy to adhere to prescribed medication, including its direct effect ( $R^2 = 0.478$ ) and indirect effects ( $R^2 = 0.367$ ). This finding is comparable to Pakpour et al.'s [28] finding that intentions strongly predicted medication adherence among patients undergoing coronary artery bypass graft (CABG) surgery. In addition, patients with heart failure with more favorable beliefs about medication adhere better to the prescribed medications and consequently had a longer event-free survival time [40]. The present findings also corroborate prior findings regarding the theory of planned behavior: attitude and perceived behavioral control were related to behavior via either direct or indirect pathways. Additionally, motivational interviewing, one type of intervention developed to increase behavioral intention, has been developed to improve medication adherence [41], and the effects on patients with epilepsy have also been shown [6].

Coping planning and action planning, as expected, had mediating roles between intention and behavior. Moreover, our results show that coping planning (coefficient = 0.281) had a stronger relationship with medication adherence than action planning (coefficient =

0.120), a pattern that is consistent with previous research on physical activity [24,42]. The relatively strong association between coping planning and medication adherence is an important finding of this study, as it suggests that patients' lack of anticipating barriers to adherence is an important but understudied factor that determines their adherence to prescribed medications. As such, interventions for improving medication adherence among patients with epilepsy may benefit by encouraging patients to anticipate barriers and consider ways to overcome those barriers.

There are some limitations in the study. First, although intentions and adherence were measured at different timepoints, the associations of attitude, subjective norm, and perceived behavioral control with intention were based on correlational data, and so, causality cannot be determined. However, the causal relationships among the variables have strong theoretical justification [13,27]. Second, another major limitation is that we were unable to control all possible confounders on medication adherence in our study design. The medication adherence was measured at the 24-month follow-up, and we did not use an experimental design; thus, many factors (e.g., life events) that we cannot control may influence the medication adherence. Third, the low correlation between subjective and objective measures of medication adherence limited the extent to which the elements of the theory of planned behavior predicted objectively assessed adherence behavior. Fourth, given the participants of this study were adults, our results cannot generalize to younger populations [31]. Lastly, no study has examined the psychometric properties of all the Persian version questionnaires in our study. Questionnaires for theory of planned behavior and those for action planning and coping planning were designed by our team. Although our data showed that all the questionnaires have acceptable internal reliability, we cannot ensure their validity and test-retest reliability. However, we maintain that the use of our self-designed questionnaires is acceptable as Ajzen [13] argues that questionnaires for theory of planned behavior constructs should be designed for each study based on each specific aim or population. As for the MARS, we only ensured its linguistic validity, and future studies may want to examine other psychometric properties of the Persian version of MARS.

In conclusion, the theory of planned behavior can help understand the factors that correlate with medication adherence among patients with epilepsy. Clinicians may want to design interventions based on the theory of planned behavior to improve the medication adherence for patients with epilepsy. Specifically, interventions could benefit by enhancing favorable attitudes toward the medication and beliefs of perceived behavioral control. In addition, as our results indicate the strong association between coping planning and medication adherence, clinicians may want to help patients with epilepsy develop some coping skills to overcome commonly faced barriers. For example, the patients may confront the problems of forgetfulness and low motivation for them to adhere to medication. Examples of interventions that might address these problems include the use of short message service to remind the patients to take medication or emphasizing beneficial drug effects to enhance patients' motivation to adhere to medication.

#### Conflict of interest

All the authors declare that they have no conflict of interest.

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**Table 2**

Direct and indirect effects of behavioral intention on the Medication Adherence Report Scale (MARS).

	Coefficient (SE)	p-Value	R <sup>2</sup>
Direct effect	4.00 (0.18)	<0.001	0.478
Indirect effect through action planning	–	–	0.130
Behavioral intention on action planning	0.45 (0.03)	<0.001	0.338
Action planning on MARS	4.67 (0.25)	<0.001	0.384
Indirect effect through coping planning	–	–	0.237
Behavioral intention on coping planning	0.55 (0.03)	<0.001	0.445
Coping planning on MARS	5.13 (0.20)	<0.001	0.532

SE = standard error.

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