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Validation of the Turkish version of medication regimen complexity index among elderly patients

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Abstract

Objective The aim of this study was to validate the Turkish version of the 'Medication Regimen Complexity Index' (MRCI).
Methods This validation study has been conducted in prescriptions of the first 100 elderly patients who had visited the pharmacy for their prescription refill to evaluate convergent and divergent validity of the Turkish version. The reliability of the Turkish version was assessed with inter-rater and test-retest analysis after its translation and cultural adaptation.
Results The mean age of the 100 patients (53 women) was 74.9 years (SD = 7.58, 65–95). The scale showed high inter-rater reliability and test-retest reliability for the total and subscale scores ($p < 0.05$). A strong and positive correlation between the number of medications in a prescription and the total Medication Regimen Complexity Index scores ($r = 0.930$, $p < 0.001$) was determined. There were no statistically significant differences between age, gender and MRCI scores ($p > 0.05$).
Conclusion These results show that the Turkish version of MRCI is a reliable and valid tool in elderly patients.

Introduction

Polypharmacy, commonly defined as the use of 5 or more medications at one time [1], is extremely prevalent among elderly [2]. Adverse drug event related healthcare visits were associated with patient age and polypharmacy [3]. Polypharmacy resulted in increased medication related problems [1]. Davies *et al*. found that the number of medications was only a significant predictor for experiencing adverse drug reactions in hospitalized patients [4]. Evans *et al*. [5] defined numbers of comorbidities, drug administration–dosage, administration route, and number of concomitant drugs as the risk factors for adverse drug reaction. Most of the elderly patients were exposed to complex medication regimens as a consequence of increased comorbidities [6,7]. In addition to number of medications used, medication complexity increases with various pharmaceutical dosage forms, dosage frequency (posology), use-specific instructions [8]. All these factors play influential roles on medication adherence in patients [9]. In many studies conducted in different study populations, it was determined that a complex medication regimen was an influential factor on medication adherence [10–12].

George *et al*. [9] developed a scale called the "Medication Regimen Complexity Index" (MRCI) in 2004 through literature and expert panel reviews. This tool was the first of its kind to quantify medication complexity. MRCI is a scale composed of 65 items and it has 3 sections that evaluate dosage forms, dosage frequency and additional user instructions. [9]. The validity and reliability of this scale in medication complexity assessment has been demonstrated in studies [9,13].

Since its development, MRCI has been used frequently to evaluate the medication complexity particularly in elderly patients [8,13–21]. Medication complexity should be reduced in the care of elderly patients during their hospital visits [8,14,22]. Number of medications and medication complexity is associated with factors such as advanced age and co-morbidities among elderly [15]. In a prospective cohort study, the investigators determined that those with higher medication complexity were less likely to be directly discharged from the hospital as compared to those with lower medication complexity. On the other hand, the same study could not find any association between polypharmacy and hospital discharge [8]. Another study emphasized the importance of evaluating medication complexity during hospitalization in order to identify the risk of readmission due to adverse drug events [23]. High MRCI scores were associated with adverse drug reactions for medications used at home and furthermore, high post-discharge MRCI scores increased 30-day unplanned hospital readmissions [24].

The reliability and validity were shown for the German and Portuguese versions of the original English MRCI [25,26]. In addition, McDonald *et al*. tested the reliability and the validity of an automated MRCI [27]. Turkish pharmacists, who had recently been introduced to patient-orientated care concepts such as clinical pharmacy and pharmaceutical care would benefit from a valid Turkish MRCI to evaluate the medication complexity of their elderly patients, and thus; determine causes of their low medication compliance. Therefore, the aim of the present study is to determine the reliability and validity of the Turkish version of the MRCI.

Methods

Study population and setting

The first 100 elderly patients (65 years or older) who had visited the participating pharmacy for their prescription refill between December 1st, 2014 and December 30th, 2014 were included in the present study.

The type of pharmacy was metropolitan, close to the financial centre and also hospitals. The ratio of participation was 95%. The demographic comparison was not performed between patients accepted or declined to participate in the present study. Patient profile record was used to identify demographic and clinical information. This study received approval from the Ethical Committee of Marmara University Institute of Health Sciences and informed consent was obtained from the patients.

Translation process

After obtaining permission for the translation and academic use from the developing author [9], the MRCI scale was translated to Turkish from English by two fluent English speaking Turkish pharmacists, whose native language was Turkish, and who were introduced to the aim and scope of the study. The two translations were reconciled by an independent team after the discussion on language differences. The latest reconciled Turkish translation was back-translated to English by translators with a medical background, who were native English speakers and were also fluent in Turkish but who were not introduced to the aim and scope of the investigation. An independent team evaluated the differences between the English translations and the original scale then the latest version was back-translated to Turkish, and the scale was developed. Next, the latest Turkish translation was edited for cultural and conceptual content and equivalence in addition to grammar. For cultural adaption of the Turkish version of MRCI; a group of Turkish pharmacists ($n = 12$) who worked both in the community and hospital pharmacy were evaluated in the Turkish version of MRCI at language and comprehensibility. In addition, two pharmacists who did not participate previously in the study assessed the utilization of the Turkish version of MRCI by using unreal prescriptions. Those brand names used in the original version's instructions were changed to generic name and instead, we used those drugs which were similar in indication, dosage, pharmaceutical administration and posology. To make such a change, we informed the corresponding author of the original article [9].

Validation process

Two of the researchers (M.S. and B.O.) had evaluated each prescription independently and determined their MRCI scores. Inter-rater reliability was evaluated through comparing the scores assigned to the same prescription by the two researchers. Each prescription was evaluated for the second time three weeks after the first assessment by one of the researchers (B.O.). The test-retest reliability was assessed through comparing the first and the second scores assigned for the same prescription.

Statistical analysis

Descriptive statistics are presented as mean ± SDs (standard deviations) and medians (25^{th} and 75^{th} percentiles). Normal distribution of the data was evaluated through the Kolmogorov-Smirnov test. Wilcoxon test was used for comparing continuous data for two dependent groups (test- retest MRCI scores). Continuous data for three or more independent groups (education level, groups for number of medications) were evaluated through Kruskal-Wallis test and for two independent groups (gender, marital status, smoking status) through the Mann Whitney U test. Spearman correlation was used to evaluate the correlations. $p < 0.05$ was determined as the level of statistical significance. Convergent validity was assessed through evaluating the correlation between the total number of medications and the MRCI total scores by using Spearman correlation coefficient. Associations between total scale score and the independent variables as gender and age were also determined to assess divergent validity.

Results

The mean age of the 100 patients (53 women) was 74.9 years (SD = 7.58, 65–95), and the majority of the samples were married (85). The mean ± SD number of medications per prescription was 4.75 ± 2.34. Descriptive characteristics of patients are presented on Table 1.

Inter-rater and test-retest reliability were high for the MRCI total and subscales (Table 2). There was no statistical significant difference between the test and retest scores ($p > 0.05$) (Data not shown).

Table 1 Characteristics of patients

Characteristics	
Age, years (mean ± SD) (min–max)	74.9 ± 7.58 (65–95)
Gender – Female (%)	53
Marital status – Married (%)	85
Education level (%)	
0–5 years	61
6–11 years	32
>11 years	7
Body mass index (Min–Max)	18.75–55.22
Mean ± SD	28.92 ± 4.82
Median (25–75 percentiles)	26.15 (23.93 – 29.00)
Current Smokers (%)	10
Number of Medications (min–max)	(1–11)
Mean ± SD	4.75 ± 2.34
Median (25–75 percentiles)	4 (3–6)
MRCI total score (min–max)	(2–46)
Mean ± SD	13.84 ± 8.89
Median (25–75 percentiles)	12 (7.5–19)

SD, standard deviation; MRCI, Medication Regimen Complexity Index.

Table 2 Inter-rater and test–retest reliability of the Turkish version of the medication regimen complexity index (MRCI)

	Inter-rater reliability	Test-retest reliability (after 3 weeks)
Section A	0.995	1.000
Section B	0.991	1.000
Section C	0.971	1.000
MRCI total	0.995	1.000

This table shows intraclass correlation coefficients (Spearman's rho). All coefficients are statistically significant ($p < 0.001$). MRCI, Medication Regimen Complexity Index.

Table 3 Number of medications being used and medication regimen complexity index (MRCI)

Number of medications	Number of patients	Median (25–75 percentiles) of MRCI	Mean (SD) of MRCI
1–4	54	8 (6–9)	7.76 ± 2.84
5–9	41	19 (15–23)	19.04 ± 5.74
>10	5	37 (29.5–45.5)	37.40 ± 8.20

There is a significant difference between the groups (number of medications) for MRCI scores, $p = 0.0001$. MRCI, Medication Regimen Complexity Index; SD, standard deviation.

MRCI scores according to number of medications being used were shown on Table 3. The highest total MRCI scores were attained by those prescriptions with 11 medications (median score = 45) and the lowest score (median = 2) by those prescriptions with only one medication.

There was a strong and a positive correlation between the number of medications per prescription and the total MRCI score ($r = 0.930$, $p < 0.001$). There was a weak and negative correlation between the total MRCI score and BMI ($r = -0.228$, $p < 0.05$), (Table 4). The total MRCI scores were not statistically different by gender, marital status and educational level, and smoking status ($p > 0.05$) (Table 5).

Table 5 Characteristics of patients and medication regimen complexity index (MRCI)

	MRCI total score (min–max) Mean ± SD Median (25–75 percentiles)	*p*
Gender		
Female	12.80 ± 7.06 (2–33) 12 (8–16)	0.580
Male	15.08 ± 10.59 (2–46) 12 (6–21)	
Marital status		
Married	13.65 ± 8.97 (2–46) 12 (7.5−12.5)	0.508
Single	15.13 ± 8.89 (4–31) 14 (8–22)	
Education level		
0–5 years	15.01 ± 8.91 (2–46) 13 (8–20)	0.124
6–11 years	12.01 ± 8.95 (2–45) 9 (6–15)	
>11 years	12.42 ± 8.54 (4–26) 10 (5–21)	
Smoking status		
Current Smoker	12.90 ± 9.30 (5–37) 9.5 (7.75–14.5)	0.654
Non–smoker	13.98 ± 8.93 (2–46) 12 (7.75–20)	

MRCI, Medication Regimen Complexity Index.

Discussion

Medication Regimen Complexity Index receives high attention in evaluation of medication adherence because this scale accounts not only for the number of medications but also difficulty complexity level due to instructions and dosage forms. The number of dosages can be the same for two prescriptions containing the same number of drugs. However; the medication burden on the patient might not be the same due to some differences in dosage forms and instructions. Therefore, the MRCI scale developed by George *et al*. through 134 medications regimen [9] is a prime candidate of a scale to fill the need in the literature with its three subscales. This scale, developed in Australia, was in use for different compliance studies since 2004, and was translated to Portuguese in 2007 [25], and then to German in 2010 [26] with their respective validations reported.

Nowadays, the public attention has increased in Turkey on clinical pharmacy, pharmaceutical care, and rational drug use. These

Table 4 Correlation between MRCI scores and patient characteristics

	Coefficient of correlation (Spearman's rho)			
Variables	MRCI total	Section A	Section B	Section C
Number of medications	0.930 ($p = 0.0001$)	0.888 ($p = 0.0001$)	0.937 ($p = 0.0001$)	0.076 ($p > 0.05$)
Age	0.107 ($p > 0.05$)	0.108 ($p > 0.05$)	0.085 ($p > 0.05$)	0.043 ($p > 0.05$)
BMI	−0.228 ($p = 0.022$)	−0.246 ($p = 0.014$)	0.185 ($p > 0.05$)	−0.074 ($p > 0.05$)

MCRI, Medication Regimen Complexity Index; BMI, body mass index.

concepts and their practical applications not only entered the university educational programs but also started to appear in the priority action plans of the Turkish Ministry of Health and professional associations. Patient compliance is consequential to offer quality health care. It was recognized in the contribution of multidimensional MRCI in scientific investigations and in providing patient-oriented healthcare services in Turkey to evaluate patient compliance. Because of the need to adapt for cultural differences, we aimed to evaluate the validity and reliability of the Turkish version of the MRCI.

In this study we showed high test-retest and inter-rater reliability. Similar results were attained in studies for Portuguese and German versions [25,26].

The substantial need for major changes did not exist when translating from original to other languages, because MRCI is a health-professional and not a patient-reported outcome measure. Exactly three subscales were used in the validity study of the Portuguese version [25], main sections were maintained the same in the German translation study [26], and only minor changes were made for section 9 ("effervescent tablet" and "take at specified times"). Similar to these studies, we did not make any major changes.

It was demonstrated that the MRCI scores had a strong and positive correlation with the number of medications and this correlation was valid for A and B subsections. These results are similar to findings of previous studies [9,13,25–27]. No significant difference has been found for section C. This result would be attributed to a few instructions that have been detected for section C in the present study.

George *et al*., who developed the first MRCI scale, showed the convergent validity by a strong correlation between MRCI scores and number of medications, and divergent validity by lack of correlations between MRCI total scores and age and gender [9]. Investigators reported similar convergent and divergent validity results by measuring the MRCI scores determined from electronic medical records (EMRs) of patients' prescribed and OTC drugs in an investigation of interventions to minimize drug related problems and to improve compliance [28]. Similarly, inter-rater reliability for both MRCI total score and Section A, B, and C subsection scores were determined in the present study. Also, no association between these scores and the variables including age and gender has been detected, as a sign of divergent validity.

In addition to the number of medications, it was conducted statistical analyses for variables which are associated with MRCI scores directly, as expected in studies for development of new scales or adaptation of existing scales to new cultural contexts. In the present study, it was found that there was no association between MRCI scores and variables including age, gender, marital status, smoking status and education level. A weak negative correlation with BMI was determined. Melchiors *et al*. [25], who conducted the validation of the scale in Portuguese, didn't report a correlation between MRCI scores and BMI, but demonstrated an association between MRCI scores and gender, and age. Contrary to our findings, Mansur *et al*. [13] reported an association between MRCI scores and age, and gender. Therefore, we need to conduct more studies to understand the different association results between MRCI scores and subsections.

There were many studies aimed to determine the factors associated with MRCI. However, the number of intervention studies to reduce medication complexity regimen is scarce. Stange *et al*. [29] demonstrated that complexity could be reduced by the pharmacist's intervention in hospitals. Eliott *et al*. [30] demonstrated the applicability of interventions by pharmacist to reduce medication complexity on discharge from the hospital. In a study that evaluated the effect of pharmacist intervention of medication review on the medication complexity of in-patients, MRCI score rate increased less in those groups under pharmacist intervention between the time of admission and discharge, as compared to those who were not [14]. Another study demonstrated improvement in treatment outcomes of patients with type 2 diabetes as a result of community pharmacists' interventions, independently from the number of medications or medication regimen complexity [31].

It was observed that the number of medications and MRCI score averages are lower as compared to other studies conducted with geriatric patients [16,32]. We also observed lower rate of polypharmacy, as defined by use of 5 or more medications at one time when compared to other studies [16,32]. We believe that this discrepancy occurred because researchers did not seek to obtain data on drugs of patients except for the list of drugs present on prescriptions in the present study.

Limitation of study

The one of the limitations of the study was not to calculate sample size. When considering the other validation study of MRCI, in Portuguese validation (25) ($n = 96$) and in German validation (26) ($n = 20$), the first 100 elderly patients were chosen in the present study. In the present study, the sample size was greater than these studies. The selection of elderly patients applied to one community pharmacy as a study population could be another limitation of study. We assumed that the property of prescriptions in elderly patients rather than general population would not change the results of validation study; because elderly patients' prescriptions would consist of a wide range of medications taken for both acute and chronic diseases. When considering the reliability results of the present study, population selection was not seemed as bias.

When the MRCI was first developed, investigators sought for the information of only those medications listed in the prescriptions of patients. However; investigators of later studies calculated MRCI scores for all used drugs, including OTCs [16,27,28]. When considering the result of the study, it was seen that validation and translation process could not effect on medication list.

As in the original study, a similar path was followed in our pilot study which is aimed to validate Turkish version of the scale when considering loss of standardization and avoiding obtaining a wrong medication list of patients. However, this scale would be applied to all drugs of patients including OTCs in future studies.

Conclusion

In conclusion, it was determined that the validity and reliability of the Turkish MRCI version in the present study was similar to results of those studies in the literature [9,25,26]. It could widely be used for scientific investigations that evaluate compliance as well as in professional practical applications.

Conflict of interest

The authors declare no conflict of interest.

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Supporting Information

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