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RESEARCH ARTICLE

Validity and reliability of the Turkish version of the Ottawa Sitting Scale in patients with acute stroke

Mustafa Ertuğrul Yaşa[a], Saniye Aydoğan Arslan[b], Tezel Yıldırım Şahan[a], Derya Çağlar[c], Cevher Savcun Demirci[d] and Pervin Demir[e]

[a]Gulhane Faculty of Physiotherapy and Rehabilitation, University of Health Sciences Turkey, Ankara, Turkey; [b]Department of Physiotherapy and Rehabilitation, Faculty of Health Science, Kırıkkale University, Kırıkkale, Turkey; [c]Güneysu Vocational School of Physical Therapy and Rehabilitation, Recep Tayyip Erdoğan University, Rize, Turkey; [d]Department of Physiotherapy and Rehabilitation, Faculty of Health Science, Balıkesir University, Balıkesir, Turkey; [e]Faculty of Medicine, Ankara Yıldırım Beyazıt University, Ankara, Turkey

ABSTRACT

Purpose: To investigate the validity and reliability of the Turkish version of the Ottawa Sitting Scale (OSS-T) in patients with acute stroke.

Materials and methods: The Berg Balance Scale (BBS) and Trunk Impairment Scale (TIS) were used to determine the validity of the OSS-T. The OSS-T was re-applied by the same rater after an interval of 7 days to determine the reliability. To test inter-rater reliability, the evaluation was repeated by a second rater 1 day after the first evaluation. Reliability was quantified using intraclass correlation coefficients (ICC), and validity was assessed by correlating the OSS-T scores with the results of the other measures.

Results: The ICC of the total OSS-T score for inter-rater reliability was 0.996 and for intra-rater reliability, it was 0.951. The Cronbach's α coefficient used to determine internal consistency was 0.980, which indicates excellent reliability. A strong positive correlation was found between OSS-T and TIS (rho = 0.861, $p < 0.001$), and between OSS-T and BBS (rho = 0.875, $p < 0.001$). An evident 2-factor structure was shown by the results of the factor analysis.

Conclusions: The results of this study indicated that the OSS-T has strong measurement properties, making it a valid and reliable tool for research and clinical practice in patients with acute stroke.

IMPLICATIONS FOR REHABILITATION

- Independent sitting function is an important indicator of functional recovery and discharge from hospital.
- Unlike other sitting balance tools, the Ottawa Sitting Scale can even categorize patients with low balance reserve by applying all the items with and without foot support.
- The Turkish version of the Ottawa Sitting Scale is a valid and reliable tool to evaluate sitting balance in patients with acute stroke.

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Stroke; postural balance; validation study; Ottawa Sitting Scale; Turkish

Introduction

Stroke, which is a common cause of hospitalization, disability and death in the general population, occurs due to the interruption or decrease of the flow in the cerebral blood vessels and problems in brain perfusion, which can subsequently cause motor, sensory and cognitive deficits [1]. A decrease in balance control after stroke is common and causes disruptions in daily life activities and functionality. Asymmetrical limb loading and deviation of the centre of mass from the midline have been identified as common problems in patients with acute stroke [2]. Consequently, patients become unstable in gravity-dependent positions such as standing or sitting.

Previous studies have reported that patients with acute stroke have weakness of the trunk muscles, decreased muscle tone, limitation of trunk control, and balance problems in the activities of sitting to standing or standing to sitting compared to healthy age-matched control subjects [3,4]. Competence in the independent sitting function is an important prognostic factor for motor recovery [5,6] and trunk performance and balance in a sitting position in the early period after stroke is a significant determinant of independence in the patient's daily life and an important indicator of functional recovery and discharge from hospital in the following period [7,8]. Therefore, given the importance of trunk control in a sitting position, the availability of validated tools to evaluate trunk performance and functional sitting balance is essential.

The Ottawa Sitting Scale (OSS) is a simple, cheap, and non-ambulatory tool that evaluates the patient's capacity to withstand the disruptive effects of various critical functions for independence while seated. First, it evaluates whether the static sitting function has been completed or not. Reaching activity, trunk rotation ability and mobility of the hips, which are certain activities used in the sitting position, are included in the OSS. A sitting position where the feet do not touch the ground means reduced kinesthetic sensory input and a reduced support surface, which

CONTACT Mustafa Ertuğrul Yaşa mustafaertugrul.yasa@sbu.edu.tr Gulhane Faculty of Physiotherapy and Rehabilitation, University of Health Sciences Turkey, Gulhane Complex, Emrah Mahallesi, Etlik/Keçiören, Ankara, 06018, Turkey.

makes it more challenging. Therefore, the OSS evaluates all the sitting activities with and without foot support, which make it a comprehensive functional sitting balance tool [9].

There are currently various scales available for the evaluation of trunk performance in stroke patients [10]. It is crucial that the scale selected is appropriate for the patient's degree of physical ability and has the sensitivity to evaluate the remaining reserve. In contrast to the widely used trunk performance tools such as the Trunk Impairment Scale (TIS), the OSS was created to distinguish between individuals with poor levels of functional sitting balance with the contribution of trunk and extremity movements [9]. A Turkish cross-cultural adaptation study of OSS conducted on patients in cardiopulmonary intensive care has been published, in which it was stated that the internal consistency of the OSS was good, and the intra-rater reliability was excellent [11]. However, the physical status following a stroke is very different from that of a cardiopulmonary intensive care patient. When a stroke patient experiences hemiplegia or hemiparesis, which involves motor loss in one side of the body, trunk control differs from that of a typical patient in cardiopulmonary intensive care [12]. Therefore, the aim of this study was to investigate the validity and reliability of the Turkish version of the OSS (OSS-T) in patients with acute stroke.

Materials and methods

Study design

This cross-sectional study was conducted in the Neurology Department of the Gülhane Education and Research Hospital (University of Health Sciences Türkiye), between 2020 and 2021. Permission for the study was obtained from Gülhane Scientific Research Ethics Committee (protocol number: 2020-363). All patients provided written consent personally or by proxy before participation. This trial was registered with clinicaltrials.gov (registration no: NCT04752878). This study was carried out in accordance with the guidelines of the Helsinki Declaration.

Participants

Although there is no set formula for calculating the sample size to be used in validity and reliability studies, the common consensus is that each scale item should have at least 3 or 5–10 participants [13]. As the OSS-T is a 10-item scale (5 ft supported and 5 ft unsupported), it was planned to recruit 80 (8 participants per item) acute stroke patients who were hospitalized for post-stroke treatment in the Gülhane Education and Research Hospital, Neurology Service.

Patients were included if they met the following criteria: (a) aged >18 years, (b) diagnosed with ischemic or hemorrhagic stroke, (c) no cooperation or communication abnormalities, (d) stroke onset within 14 days before admission to the hospital. Patients were excluded if they had (a) inability to comprehend instructions (b) any other disease that may affect balance, (c) poor respiratory functions, (d) hearing or vision loss.

Procedures

Permission to use the scale was obtained from the authors of the initial OSS study [9] and the Turkish cross-cultural adaptation study of the OSS [11]. To determine the reliability of the OSS-T, two tests were conducted at an interval of 7 days by the same rater. To test the inter-rater reliability, the evaluation was repeated by a second rater 1 day after the first evaluation. The raters completed the scoring sheet but did not calculate the scores to further reduce memory bias. The two raters who assessed the patients were physiotherapists, both of whom completed a training process before starting the study with the training videos sent by Ms. Thornton M., the author of the original study.

Standardized questionnaires were used to collect demographic and physical characteristics (age, gender, BMI, dominant side, hemiplegic side, cause of stroke) and disease duration and medical history were also noted. The raters stayed close to the patient throughout the entire assessment as a safety precaution to avoid a fall. The Berg Balance Scale (BBS) and Trunk Impairment Scale (TIS) were applied together with the OSS-T to analyze the scale validity.

Outcome measures

Ottowa Sitting Scale

The OSS consists of 10 items, 5 items with feet support and 5 items without feet support, designed to resemble both functional performance and current measures of sitting balance. An ordinal scale (0–4) is used to score each test item, providing a total score ranging between 0 and 40. The scale evaluates; (a) patient's independent static sitting balance, (b) the ability to reach in four directions (forward-backward-right-left) without disturbing the balance while sitting on the edge of the bed, (c) the ability to turn the body to the right and left while the hip is fixed on the bed, and (d) the function of moving forward and backward on the bed with the hips using alternate pelvic elevations. The test is easy to administer and can be completed in less than 15 min [9].

Berg Balance Scale

The BBS was designed to quantitatively assess balance and determine the risk of falling and it is widely used because it assesses the ability to maintain balance while performing functional activities. This scale consists of 14 items which are scored from 0 to 4 according to the patient's performance. Four points indicate the ability to complete the task independently and 0 points that the task cannot be initiated. The scores taken from this test, are interpreted as "high risk of falling (0 – 20 points)," "moderate risk of falling (21 – 40 points)," "low risk of falling (41 – 56 points)" and the highest score of 56, indicates the best balance performance [14,15]. The BBS has been shown to have excellent test-retest and inter-rater reliability (ICC = 0.98, ICC= 0.97) in patients with acute stroke [16].

Trunk Impairment Scale

The TIS was developed to evaluate motor disorders in the trunk after stroke. This scale consists of 3 subsections and 17 tests that evaluate static sitting balance, dynamic sitting balance and coordination. The highest value that can be obtained from the test is 40 points. High scores indicate good balance [17]. The TIS has also been found to have excellent test-retest and inter-rater reliability (ICC = 0.969, ICC = 1; respectively) in patients with stroke [18].

Statistical analysis. The statistical analyses were performed using the following R-language packages: the "psych," [19] "lavaan," [20] "semPlot." [21] The statistical significance level was set at two-sided p-value < 0.05. The distribution of variables was examined using normality plots and the Shapiro-Wilk test. The data were summarized as frequency (percentage), median (minimum-maximum), or mean ± standard deviation values according to variable type and distribution. The following analysis was applied to evaluate the psychometric properties of the OSS-T in patients with acute stroke. The construct validity of OSS-T was examined by Confirmatory Factor Analysis (CFA) based on the Polychoric correlation matrix for ordered categorical data. The overall fit of the models (for Factor 1, Factor 2 and All) was evaluated with commonly used goodness-of-fit indicators including the Chi_Square/df (≤2), root mean square error of approximation (RMSEA, ≤0.08), standardized root means square residuals (SRMR ≤ 0.08), comparative fit index (CFI > 0.90), Tucker-Lewis index (TLI > 0.90) and goodness of fit index (GFI > 0.90) [22]. The Cronbach alpha values were reported and >0.90 was accepted as excellent internal consistency [23]. The intra-rater reliability and test-retest reliability (reproducibility, two-way mixed model, absolute agreement) were determined using the intra-class correlation coefficient (ICC) for total scores and the kappa coefficient for an individual item. The Kappa results were interpreted as follows: <0.40:fair, 0.41–0.60: moderate, 0.61–0.80: substantial, and >0.80: almost perfect agreement [24]. The ICC was interpreted as follows: <0.50: poor, 0.51–0.75: moderate, 0.76–0.90: good, >0.90: excellent reliability [25]. The Spearman rho correlation coefficient between two scale scores was calculated to examine the convergent validity. The correlation coefficient was interpreted as follows: <0.40: weak, 0.40–0.69: moderate, 0.70–0.89: strong, ≥0.90: very strong correlation [26].

Results

Initially, 123 patients were contacted for inclusion in the study. A total of 43 patients were excluded; 15 did not wish to participate in the study, 16 were not sufficiently cooperative, 3 had partial vision loss, and for 9, the second measurement could not be taken. Finally, the study was completed with a total of 80 acute stroke patients aged 69.5 ± 11.8 years. The demographic and clinical characteristics of the patients are presented in Table 1.

Construct validity

The construct validity of the OSS-T was analyzed using confirmatory factor analysis (CFA) based on the predetermined two-factor structures (F1: Outside base of support (BOS) and F2: within BOS).

Table 1. Demographic and clinical characteristics ($n = 80$).

	n (%) Median (min-max) Mean±*SD*
Gender	
Female	37 (46.2)
Male	43 (53.8)
Age (years)	71.5 (42.0–92.0)69.5 ± 11.8
BMI (kg/m^2)	26.8 (19.5–44.6)28.4 ± 4.9
Days since stroke	4.0 (1.0–21.0)5.6 ± 4.4
Stroke type	
Hemorragic	12 (15.0)
Ischaemic	68 (85.0)
Dominant side	
Right	77 (96.2)
Left	3 (3.8)
Affected side	
Right	41 (51.2)
Left	39 (48.8)
TIS score	14.0 (3–21)13.4 ± 4.5
BBS Score	39.0 (0–54)32.9 ± 16.8

n (%): frequency (percentage); min-max: minimum-maximum; *SD*: standard deviation; BMI: Body Mass Index; TIS: Trunk Impairment Scale; BBS: Berg Balance Scale.

A high correlation was observed between some item pairs in factors (Polychoric correlation coefficients: 0.985 for items 1–6, 0.979 for items 2–7, 0.958 for items 6–7, 0.962 for items 3–8, 0.998 for items 4–9, and 0.931 for items 5–10). The second-order factor model of CFA is summarized in Figure 1. The CFA model indicates which items load on which factors and which factors are correlated. The SRMR value (0.056) was lower than the determined limit of 0.08. The RMSEA value was obtained as 0.071 for the second-order model ($p = 0.246$). The χ^2/df statistic for the model was 1.39 (≤2). The CFI values, not very sensitive to sample size, were very high. The CFI, TLI and GFI values were higher than 0.95. The median score obtained was 31 (min = 6, max = 39, mean±*SD* = 28.34 ± 8.80), and there was no ceiling and floor effect.

Consistency, agreement and reliability

The Cronbach alpha of the OSS-T was obtained as 0.980 (95%CI: 0.958 – 0.994). The κ (*SE*) and ICC values used in the assessment of the inter/intra-rater agreement are summarized in Table 2. The test-retest reliability coefficients were statistically significant for each item and for the total score ($p < 0.001$). According to the test-retest results of the total score, excellent reliability was obtained. The test-retest and intra-ICC for the total score was 0.951 (95%CI: 0.925–0.968).

External construct validity

When examining the correlation among the scale scores, a strong correlation was determined (Table 3). All correlation coefficient values were higher than 0.85.

Discussion

The original OSS was developed by Thornton et al. in an acute population, almost all of whom were stroke patients or had other neurological diseases [9]. A cross-cultural adaption of the OSS for a Turkish population was later conducted by Aktaş et al. on an intensive care patient group in which neurological involvement was excluded and only cardiopulmonary patients were included [11]. In the current study, the validity and reliability of the OSS-T was investigated in a population of acute stroke patients. The results of the study indicate that the OSS-T has strong measurement properties, making it a valid and reliable tool for patients with acute stroke in both research and clinical practice.

In order to establish good postural control against the disruptive effects of gravity, achieving the sitting function is a crucial first step. Independent sitting ability has been reported to be a sign of improved motor and functional performance following a stroke and an important step in the process of returning to normal life after stroke [27]. However, the sitting activity includes not only the capacity to maintain a seated posture, but also the capacity to reach for a variety of objects located in various directions [28]. Therefore, scales that aim to determine sitting balance must include functional activities performed while sitting, even in patients with low functional levels. The OSS, created by Thornton et al. is a scale for the assessment of sitting balance, which has been shown to be able to distinguish between individuals with poor levels of sitting function [9].

According to current literature, the tools available to evaluate sitting balance in stroke patients are more limited than for standing balance and postural control. Of these, the TIS, Function in Sitting Test (FIST), Sitting Balance Scale (SBS), and Postural Assessment Scale for Stroke Patients (PASS) have undergone cross-cultural adaptation to the Turkish language and are ready to use in the Turkish

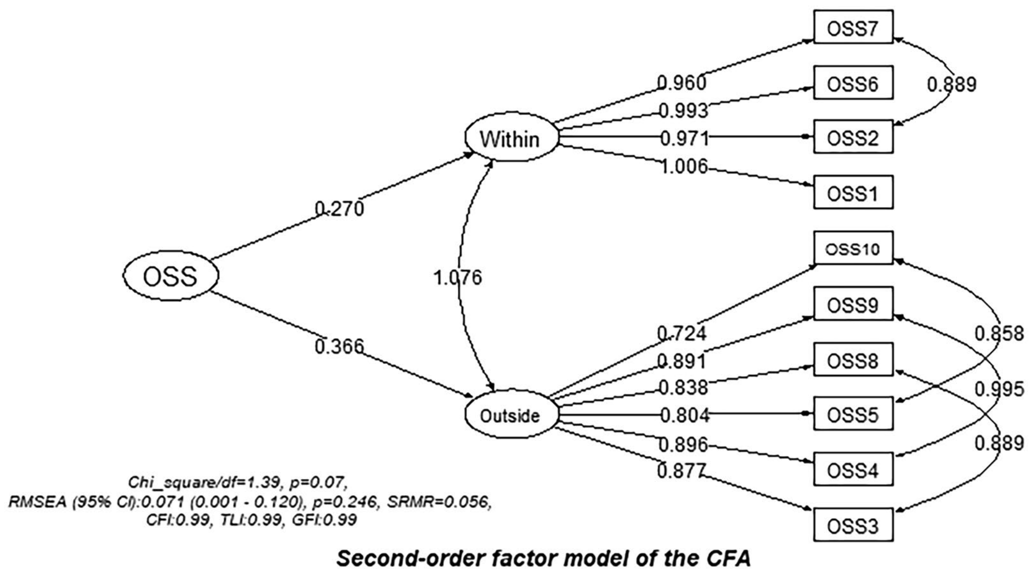

Figure 1. Confirmatory factor analysis results of the OSS-T. (χ^2/df: Chi-square/degree of freedom; RMSEA: Root Mean Square Error of Approximation; CI: Confidence Interval; SRMR: Standardized Root Mean Square Residuals; CFI: Comparative Fit Index; TLI: Tucker-Lewis Index; GFI: Goodness of fit Index; OSS: Ottawa Sitting Scale).

Table 2. Inter/intra-rater reliability for the OSS-T (*κ (SE)* and ICC with 95% CI limits)*.

Items	Inter-rater reliability (between R1 and R2)	Test-retest reliability (R1 first and R1 after 7 days)
Feet supported		
1. Maintaining a static sitting position	0.920 (0.054)	0.470 (0.108)
2. Moves short distance	0.953 (0.032)	0.488 (0.081)
3. Moves longer distance	0.984 (0.016)	0.535 (0.065)
4. Trunk rotation ability	0.935 (0.037)	0.769 (0.065)
5. Walking on hips	0.962 (0.026)	0.499 (0.077)
Feet unsupported		
6. Maintaining a static sitting position	0.933 (0.046)	0.515 (0.094)
7. Moves short distance	0.938 (0.035)	0.626 (0.071)
8. Moves longer distance	0.967 (0.023)	0.692 (0.061)
9. Trunk rotation ability	0.857 (0.052)	0.912 (0.043)
10. Walking on hips	0.965 (0.024)	0.547 (0.072)
Total Score of the OSS-T	0.996 (0.994–0.998)	0.951 (0.925–0.968)

κ (*SE*): Kappa value (Standard error) of each item; ICC (95% CI lower – upper): Intra class correlation coefficient with a confidence interval for total scores (absolute agreement, two-way mixed model).
*All p-value < 0.05. R1: Rater 1; R2: Rater 2; OSS: Ottawa Sitting Scale.
κ results were interpreted as follows: <0.40:fair, 0.41–0.60: moderate, 0.61–0.80:substantial, and >0.80: almost perfect agreement [24].
ICC was interpreted as follows: <0.50: poor, 0.51–0.75: moderate, 0.76–0.90: good, >0.90: excellent reliability [25].

Table 3. The correlation among the OSS-T and the TIS-BBS scores (convergent validity).

	TIS	BBS
OSS-T	0.861 (0.766–0.915)	0.875 (0.797–0.924)

All $p < 0.001$, The correlation coefficient was interpreted as follows: <0.40: weak, 0.40–0.69: moderate, 0.70–0.89: strong, ≥0.90: very strong correlation [26].
OSS: Ottawa Sitting Scale; TIS: Trunk Impairment Scale; BBS: Berg Balance Scale.

population [18,29–31]. When these tools are compared based on the physical reserve that the patient must have to perform the tasks, the TIS, SBS and PASS require higher physical capacity than would be expected from an acute stroke patient. Especially tasks such as "unilateral lifting of one hip with lateral flexion of the trunk" or "single leg stance" can be challenging for a patient with limited balance reserve. Only the FIST is appropriate for individuals with low physical reserve, like the OSS, but the OSS can also even categorize patients with low sitting balance reserve by applying all the items with and without foot support.

A key sign of the reliability of a measurement tool is whether it can produce consistent outcomes when applied by different specialists. Since stroke is a chronic condition, patients may require a prolonged rehabilitation process. During this process, the scales used in the determination of prognosis can be re-applied by the same evaluator at different times, or the patients can be re-evaluated by different specialists. Therefore, it is essential that the scales used have good inter and intra -rater retest reliability. In the original study of the OSS, the ICC values for intra- and inter- reliability were 0.994 and 0.967–0.989, respectively, while in the study by Aktas et al. the ICC values were calculated as 0.998 and 0.989–0.994, respectively. In the current study, the ICC obtained for intra-rater reliability was excellent at 0.996 with individual item ICCs ranging between 0.994 and 0.998. Similarly, the ICCs for inter-rater reliability were also excellent at 0.951 with individual item ICCs ranging between 0.925 and 0.968. Based on these results and all other OSS studies, an ICC value above 0.80 indicates high reliability.

The internal consistency of a scale, which is determined as a Cronbach's *α* coefficient value, reveals how closely the items reflect the notion being measured and how the scale component parts relate to one another. The *α* value might be between 0 and 1, with values closer to 1 indicating stronger internal consistency. High internal consistency supports the reliability of a scale. While a value of ≥0.70 is considered sufficient in newly developed scales, a limit value of 0.80 is interpreted as acceptable for a scale adapted to a different population [32]. The internal consistency of the OSS-T was investigated in this study by calculating the Cronbach's *α* coefficient. It was calculated as 0.980 for the OSS total score, indicating a high level of internal consistency for the OSS. These findings are consistent with the results of previous studies [9,11].

The TIS, which is the clinical gold standard tool for trunk performance assessment, was used for concurrent validity and BBS was used for convergent validity together with the OSS-T. It was expected that high OSS scores, which indicate good sitting balance, would be correlated with higher BBS scores, which indicate effective postural control and with higher TIS scores, which indicate better trunk control. The results, which show a substantial positive correlation with both the BBS (rho = 0.875, $p < 0.001$) and the TIS (rho = 0.861, $p < 0.001$) are consistent with earlier research and demonstrate the reliability of the OSS-T with acute stroke patients [9,11].

It was observed that no patient received either the highest (40 points) or lowest (0 points) OSS-T score. The lack of ceiling and floor effects demonstrates that the OSS-T is appropriate for assessing acute stroke patients with different levels of sitting balance. In addition, the factor analysis findings showed that the OSS-T had a 2-factor structure, just like the original study (Factor 1 labelled as "outside BOS" and factor 2 labelled as "within BOS" by Thornton et al. [9]). Factor 1 includes the items 3–4–5–8–9–10, which are more challenging for sitting balance, and the remaining four items (item 1–2–6–7) are loaded to Factor 2. The presence of two factors is what principally distinguished movement either inside or outside the base of support. The use of the foot support was not determined as a criterion in the distinction of two factors.

Sitting balance may be impaired following stroke, especially with the contribution of the hemiplegic side of trunk [12]. To effectively manage the rehabilitation program, it is essential to track the performance of sitting balance from the early post-stroke period. Accordingly, the validity and reliability of the OSS-T in acute stroke patients was investigated in this study. The study results demonstrated that the OSS-T, which is used in the assessment of functional sitting balance in patients with acute stroke, is valid and reliable in the Turkish population.

The findings of this study must be interpreted considering some limitations. The fact that the study was conducted in a single centre is a limitation. With multicentre studies, the sample population can be expanded, and the results can be evaluated with a larger sample. The classical test theory was used to ensure comparability with the initial [9] and first Turkish cross-cultural adaptation [11] findings of the scale. By examining the internal validity on the basis of item response theory, item difficulty levels can also be evaluated. Further studies are required to be able to evaluate the responsiveness of the scale after a certain treatment and to determine the minimal clinical important difference.

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ORCID

Mustafa Ertuğrul Yaşa http://orcid.org/0000-0002-7796-2588
Saniye Aydoğan Arslan http://orcid.org/0000-0001-5470-9849
Tezel Yıldırım Şahan http://orcid.org/0000-0002-4004-3713
Derya Çağlar http://orcid.org/0000-0003-4167-3212
Cevher Savcun Demirci http://orcid.org/0000-0002-8786-7496
Pervin Demir http://orcid.org/0000-0002-6652-0290

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