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Arabic Version of Mini-Balance Evaluation Systems Test (mini-BESTest-Ar): Transcultural adaptation and analysis of psychometric properties for patients with neurological balance disorders

A Thesis Submitted in partial fulfillments of the requirements for the master's degree of Physical Therapy

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بسم الله الرحمن الرحيم

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Abstract

Background. Mini- Balance Evaluation Systems Test (mini-BESTest) is a comprehensive functional scale for assessing dynamic and static balance. Yet, no prescribed Arabic version of the mini-BESTest is available.

Objectives: This study aimed to translate the mini-BESTest to Arabic, adapt it, and investigate its psychometric properties in patients with neurological balance disorders.

Design. A cross-sectional and psychometric testing study.

Methods. Mini-BESTest was translated and culturally adapted according to the established guidelines, to then obtain face and content validity by an expert committee. The psychometric properties of the Arabic version of the scale (mini-BESTest-Ar) were investigated on 56 participants aged 18-71 years. Construct validity was explored by correlating the Arabic Berg Balance Scale (A-BBS) and Arabic Dynamic Gait Index (A-DGI) with mini-BESTest-Ar. The relative reliability (test-retest reliability and internal consistency) and absolute reliability [standard error of measurement (SEM), minimal detectable change (MDC_{95} and MDC%), and limit of agreement (LOA)] were estimated. The responsiveness and accuracy of the test was investigated using receiver operating characteristic curve. The floor and ceiling effects were also measured.

Results. The mini-BESTest total and sub-scale scores correlated significantly and positively with A-BBS (r= 0.80-0.62) and A-DGI

(rho=0.79-0.38). The internal consistency and test-retest reliability of the total score and sub-scale scores were excellent (α ranged 0.96-0.81 and ICC=0.95-0.81, r= 0.92-0.68). The SEM, MDC_{95}, MDC% and LOA for total and subscale scores between baseline and 7-10 days later were (1.19 -0.31), (3.29-0.86), (16.5%-66.8%) and (-5.74-3.53) respectively. The area under the curve was 0.85. The sensitivity and specificity were 75% at cut-off score of 21.5. No floor or ceiling effects were found for total score, but ceiling effects were found in two subscales.

Conclusion. The mini-BESTest-Ar has appropriate face and content validity and psychometric properties. It can be used for research and clinical purposes to assess imbalance in patients with neurological disorders

Key words.

Balance, Mini-BESTest, Psychometric properties, Neurological balance disorders.

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ABC	Activities- specific Balance confidence Scale
AUC	Area under the curve
BBS	Berg Balance Scale
BESTest	Balance Evaluation Systems Test
BOS	Base of Support
COG	Center of Gravity
CMT	Charcot-Marrie-Tooth
CVI	Content validity index
DM1	Myotonic Dystrophy type 1
FRT	Functional Reach Test
GBS	Gullian Barre Syndrome
GROC	Global Rating for Change
K*	Modified Kappa coefficient
LOA	Limit of agreement
ICF	International classification of Functions and Disability
Mini-BESTest	Mini- Balance Evaluation Systems Test
MS	Multiple Sclerosis
MDC_{95}	Minimal detectable change
OLS	One leg stand
PD	Parkinson's disease

r	Pearson correlation
rho	Spearman correlation
ROC	Receiver operating characteristics
SCI	Spinal cord injury
SD	Standard deviation
SEM	Standard error of measurements
TBI	Traumatic brain injury
TUG	Timed up and go

Chapter I
Introduction

Chapter I

Introduction

1.1 Introduction

Balance is an essential part in everyday movement and activity (Hamre et al., 2017). It is defined as the ability to maintain the center of gravity (COG) within the base of support (BOS) under dynamic and static situations. Balance or postural control is very complex and influenced by vestibular, visual, somatosensory, biomechanical, nervous, and cognitive systems which are affected by numerous types of disorders (Maia et al., 2013). Meanwhile, balance dysfunctions are prevalent with orthopedic disorders, vestibular deficits, neurological diseases, and with elderly people (Pollock et al., 2000; Maia et al., 2013; Sibley et al., 2013). Accordingly, balance evaluation is a critical part of physical therapy (Bergstrom et al., 2012).

Numbers of balance assessment tools have been used to detect the balance dysfunctions such as timed up and go (TUG) test, one leg stance (OLS) test, berg balance scale (BBS), activities-specific balance confidence scale (ABC), dynamic gait index (DGI), and functional reach test (FRT) (Tsang et al., 2013; Oyama et al., 2018).

The previously mentioned outcome measures are focused to assess the balance deficits and to predict the risk of falling. TUG test, FRT, and OLS

test are single task tests that are unable to give a comprehensive balance information and to identify which system impairment causes the imbalance (Tsang et al., 2013). In addition, BBS lacks for an important domains for dynamic balance control during activities of daily living that reflect balance challenges such as standing on inclined surface, reacting to postural disturbances, and performance of cognitive task while walking (Franchignoni et al., 2010).

As a result, the need for assessment tool that detect the cause of balance defect and guide the physical therapy intervention is essential (Bergstrom et al., 2012). Consequently, Horak et al., 2009 developed a clinical balance test, Balance Evaluation Systems Test (BESTest), to differentiate postural control into six underlying subsystems to detect balance impairment and identify the underlying system at fault. (Horak et al., 2009; Franchignoni et al., 2010). The BESTest is a performance based and is classified as a body function and activity instrument according to international classification of functioning and disability framework (ICF) domains (Cathy, 2014).

Because the test is slightly extensive, its use in clinical settings may be limited (Bergstrom et al., 2012). Hence, a short version, mini- Balance Evaluation Systems Test (mini-BESTest) was established by removing redundant and unresponsive items from the BESTest. It contains four subsystems (anticipatory postural adjustments, postural response, sensory

orientation, and balance during gait) with 14 items and thought to measure dynamic balance (Franchignoni et al., 2010).

Dissimilar to other balance assessment tools, the mini-BESTest also measures postural responses and stability in gait and may provide a more comprehensive examination of postural control for subjects with neurological disorders. In addition, many studies reported the ability of mini-BESTest to predict the falling for a wide range of populations with different types of pathology (Lemay et al., 2019).

Mini-BESTest has shown to have good to high test-retest reliability, inter-rater reliability, and correlation with BBS. Moreover, ceiling effect has not been reported for the mini-BESTest (Godi et al., 2013). Accordingly, mini-BESTest has earned acceptance as balance assessment tool for both clinical and research purposes (Sofia et al., 2016; Lemay et al., 2019).

Mini-BESTest has been translated and transculturally adapted to many languages (Bergstrom et al., 2012; Maia et al., 2013; Sofia et al., 2016; Goljar et al., 2017; Hamre et al., 2017; Oyama et al., 2018; Lemay et al., 2019; Bustamante-Contreras et al., 2020; Naghdi et al., 2020; Cramer et al., 2020), and its psychometric properties remain excellent. However, the test has not been translated and cross-culturally adapted to Arabic language yet despite its large applicability and high psychometric properties

1.2 Research Questions

1. Is the Arabic version of mini-BESTest (mini-BESTest-Ar) transculturally appropriate?
2. Is the mini-BESTest-Ar valid (construct validity)?
3. Does the mini-BESTest-Ar achieve relative reliability (test-retest reliability and internal consistency)?
4. Does the mini-BESTest-Ar achieve absolute reliability (measurement of error (SEM), minimal detectable of change (MDC_{95} and MDC%), and limits of agreement (LOA) between the mini-BESTest-Ar scores at baseline and the subsequent administration)?
5. Does the mini-BESTest-Ar represent floor and ceiling effects?
6. Is the mini-BESTest-Ar sensitive and accurate to detect the changes of balance?

to be used with patients with neurological balance disorders.

1.3 Significance of the study

Most of the common tools that assess patient's balance are developed in English language. However, for healthcare workers and therapists who are not native English speakers, translating these tools into other languages is needed to effectively use these tools while maintaining their validity and reliability.

Across the world, Arabic is the native language of between 186-323 million people and it is the 11th most spoken language in the Unit States (Alghwiri et al., 2016). There are a few tools that have been translated to Arabic, such as BBS (El-Gilany et al., 2012), ABC (Alghwiri et al., 2016), fall efficacy scale-international (FES-I) (Halaweh et al., 2016), and DGI (Alghwiri, 2014).

While a majority of Arabic speaking physical and occupational therapists have a basic understanding of written English, it is necessary to translate the mini-BESTest into the Arabic language to maximize its validity and reliability and unify the language of this assessment tool. On the other hand, the absence of an Arabic version may limit the use of the test in clinical and research settings.

Meanwhile, a comprehensive balance assessment tool is needed to identify which system contributes to the imbalance in patients with different disorders with various levels of severity and to guide the decision-making process.

1.4 Purposes of the study

1. Translate and cross-culturally adapt the mini-BESTest to Arabic language.
2. Investigate the construct validity of the of mini-BESTest-Ar.
3. Investigate the relative test-retest reliability and internal consistency of mini-BESTest-Ar.
4. Investigate the absolute reliability (measurement of error, MDC_{95}-MDC%, and LOA between the mini-BESTest-Ar scores at baseline and the subsequent administration).
5. Examine the floor and ceiling effects.
6. Examine the responsiveness, accuracy, and sensitivity to change for mini-BESTest-Ar.

as a measure of balance in patients with neurological balance disorders.

1.5 Hypotheses

1. The mini-BESTest-Ar is culturally appropriate and represents good face and content validity.
2. Using the hypothesis testing method, the construct validity was predicted by a moderate to high positive correlation (≥0.5) between the mini-BESTest-Ar total score, its domains (anticipatory, sensory orientation, reactive postural control, and dynamic gait) and both A-BBS and DGI total scores (10 hypotheses). We also hypothesized

that if 75% to 90% of the 10 hypotheses mentioned above were confirmed, the construct validity would be good.

3. The mini-BESTest-Ar represents good to excellent relative test-retest reliability and internal consistency.
4. The mini-BESTest-Ar shows proper measurement of error, MDC_{95}, acceptable MDC%, and proper LOA with no proportional error.
5. The mini-BESTest-Ar has no floor and ceiling effects.
6. The mini-BESTest-Ar would have a moderate accuracy with the area under the curve (AUC) of 0.70 or higher.

as a measure of balance in patients with neurological balance disorders.

1.6 Definition of terms

Content validity: The degree to which items of a measurement tool reflects the targeted construct (Mokkink et al., 2010).

Construct validity: The extent of a measurement tool to measure the construct to be measured (Mokkink et al., 2010).

Internal consistency: The extent of the interrelatedness between the items (Mokkink et al., 2010).

Responsiveness: The ability of a measurement tool to detect changes over time in the targeted construct (Mokkink et al., 2010).

Absolute reliability: The extent to which the tool is free from measurement errors (Mokkink et al., 2010).

Relative reliability: The extent of the association of repeated measurements by calculating correlation between repeated measures (Mokkink et al., 2010).

Anticipatory postural adjustments: An active motion of the body's center of gravity in anticipation of postural change from position to another (Horak et al., 2009)**.**

Postural response: An external disturbance induced by the rater's hands using push and release technique (Horak et al., 2009).

Sensory orientation: Alteration of visual or somatosensory information to notice any increase in body sway during standing (Horak et al., 2009).

Stability in gait: Evaluation of balance during gait and when balance is challenged by different gait alterations (Horak et al., 2009).

Chapter II
Literature Review

Chapter II

Literature Review

In this chapter, the definition of balance as well as its objective measures especially mini-BESTest were explained. Furthermore, the psychometric properties of mini-BESTest were discussed. In addition, this chapter included an extensive review of the previous studies focused on translation, cross-cultural adaptation and testing the psychometric properties of mini-BESTest.

2.1 Balance

Balance is a popular term used across the health care professionals with different clinical specialties. It is defined as the ability to maintain the COG within the BOS under dynamic and static situations. Balance is a prerequisite of a numerous of postures and activities during the day (Cramer et al., 2020). Take into consideration that balance is no longer one system or a group of righting and equilibrium reflexes. In fact, the balance control results from interacting of many physiological systems and the understanding of these systems is critical for establishing effective assessment and rehabilitation of balance dysfunctions (Horak, 2006). Those systems are: vestibular, visual, somatosensory, biomechanical, nervous and, cognitive systems (Maia et al., 2013).

Due to different interacting systems regulating balance, balance impairment could be caused by any fault in those systems and known as one of the most popular disorders treated by physical therapist (Horak et al., 2009). The impairment may come with orthopedic disorders, vestibular deficits, neurological diseases and with elderly people. Meanwhile, neurological disorders such as stroke (Tsang et al., 2013; Winairuk et al., 2019), multiple sclerosis (MS) (Sofia et al., 2016), Parkinson's disease (PD) (Bergstrom et al., 2012; Maia et al., 2013), traumatic brain (TBI), and spinal cord injuries (SCI) (Sofia et al., 2016; Roy et al., 2021) were known to cause balance problems. Therefore, the use of balance assessment tool is crucial, to effectively assess patients and organizing a rehabilitation program to improve balance for those patients (Lampropoulou et al., 2019).

2.1.1 Balance outcome measures

The evaluation of balance is usually done through using outcome measures such as BBS which contains 14 items to measure balance and is commonly used as gold standard for balance assessment. Unfortunately, BBS cannot identify which system is in fault and causes balance disorder and that it lacks important dynamic aspects (Winairuk et al., 2019). Also, BBS has been shown a significant floor and ceiling effects (Oyama et al., 2018).

TUG test is a quick assessment of mobility for patients going through neurological rehabilitation (Bergstrom et al., 2012) it is considered as single-task assessment and cannot determine which system impairment caused the imbalance. Moreover, TUG test and BBS were found to have limited ability to estimate falls in individuals with stroke (Tsang et al., 2013).

DGI is an 8-items scale used to assess risk of fall and person's functional stability (Alghwiri, 2014). However, it does not contain static balance tests, tasks to evaluate the change of posture, and correction activities (Miqdad et al., 2017).

FRT is a simple balance test that examine the limit of stability during standing (Oyama et al., 2018). It is known as a single-task assessment tool and it has a significant floor and ceiling effect (Tsang et al., 2013).

ABC is self-reported, popular, valid, and reliable tool in assessing balance confidence, it’s consisting of 16 items with global score ranged from 0 to 100 with higher score indicating higher balance confidence (Alghwiri et al., 2016).

Subsequently, a comprehensive assessment tool is needed to examine the patients' balance and to identify the systems disorders that lead to the imbalance.

2.1.2 The Balance Evaluation Systems Test (BESTest)

BESTest is a balance assessment tool that was developed by(Horak et al., 2009), the tool was assessed on 22 participants, from both gender, aged from 50 up to 80 years old. It was applied on patients with PD, vestibular dysfunctions, peripheral neuropathy, and healthy subjects. For validity it was correlated with ABC test and as a result the test shown excellent reliability and very good validity. This test was designed to detect the underlying impairment and to identify which system contribute to the imbalance. The test is a performance based and classified as a body function and activity instrument in ICF domains (Cathy, 2014).

BESTest contains a 36-items to determine specific balance problem according to 6 subsystems that may restrict balance which are: biomechanical, stability limits, postural response, sensory orientation, anticipatory postural adjustment, dynamic balance during gait, and cognitive effect (Tsang et al., 2013). The BESTest was superior over other balance measurement tools in individuals with stroke because it does not show floor and ceiling effects (Winairuk et al., 2019). Unfortunately, the test application time is from 30 to 35 min which constraint its feasibility to clinical setting (Oyama et al., 2018).

2.1.3. Mini- Balance Evaluation Systems Test (mini-BESTest)

For the limited practicality of the BESTest, a short version was developed to shorten the time of application to 15–20 min. This version deletes two domains from the original version using Rasch model and factorial analysis, 115 participants with different balance disorders and from both gender with mean age of 62.7 were participating in the study. The results shown that, the new mini-BESTest offers a unique, brief clinical rating scale for dynamic balance that has excellent psychometric characteristic (Franchignoni et al., 2010). The remaining domains are: anticipatory postural adjustments, postural response, sensory orientation, and gait stability (Winairuk et al., 2019). Those systems provide the possibility of identifying the affected balance system. The items of each system category are shown in table 1. The test contains 14-items which already found in other tests BBS-TUG-DGI (Sofia et al., 2016).

Each item rated on a 3-level ordinal scale ranging from 0 which states (severe balance impairment) to 2 which states (no balance impairment) with 28 as a global test score, while a higher score indicates better balance (Oyama et al., 2018). The required equipment are: standard chair with arm sets, stopwatch, two shoes boxes, an inclined surface (10^{o}), and a 10-cm-thick temper foam (Bergstrom et al., 2012).

Table 1. Mini-BESTest items under each system category

i. Anticipatory postural adjustment	ii. Postural responses	iii. Sensory orientation	iv. Stability in gait
1.Sit to stand	4.Compensatory stepping correction-forward	7.Stance on firm surfaces, eyes open	10.Change in gait speed
2.Rise to toes	5.Compensatory stepping correction-backward	8.Stance on foam, eyes closed	11.Walk with head turns, horizontal
3.(a) Stand on one leg- right leg	6.(a) Compensatory Stepping correction-lateral (right side)	9.Stance on incline, eyes closed	12.Walk with pivot turns
3.(b) Stand on one leg-left leg	6.(b) Compensatory stepping correction-lateral (left side)		13.Step over obstacles
			14.TUG with and without dual tasks

(Bergstrom et al., 2012)

2.1.4 Translation and testing the psychometric properties of mini-BESTest

As shown in table 2, the test psychometric properties revealed that the test is valid and reliable to be used with different neurological disorders (Maia et al., 2013). It comprehensively provides a neurological examination for those patients. The content validity of mini-BESTest was investigated only in the Spanish version using Scale content validity index (S-CVI) with a value of 0.98 which is considered as acceptable (Bustamante-Contreras et al., 2020).

In term of construct validity, low to very high correlations (ranged from r=0.18 to 0.93) were found between mini-BESTest and BBS (Godi et al., 2013; Cramer et al., 2020; Dominguez-Olivan et al., 2020).In addition, moderate to very high correlations (ranged from 0.68 to 1) were found with DGI (Miqdad et al., 2017).

The internal consistency of the test indicates good to very good consistency with Cronbach's alpha (α) coefficient for total score ranged from 0.79 to 0.92 (Tsang et al., 2013; Godi et al., 2013; Löfgren et al., 2014; Potter et al., 2019; Lemay et al., 2019; Bustamante-Contreras et al., 2020), and for tests' domains ranged from 0.77 to 0.94 (Löfgren et al., 2014; Dominguez-Olivan et al., 2020).

In addition, test-retest reliability for total score was excellent (ICC > 0.80) (Tsang et al., 2013; Löfgren et al., 2014; Hamre et al., 2017; Potter et al., 2019; Anson et al., 2019). For tests' domains, the ICC ranged from good to excellent (0.65 to 0.99) (Hamre et al., 2017; Winairuk et al., 2019; Anson et al., 2019; Potter et al., 2019).

Furthermore, investigation of the measurement errors using the standard error measurement (SEM) and MDC in several studies revealed that the SEM ranged from 0.74 to 1.88 and MDC from 3 to 4.51 (Tsang et al., 2013; Löfgren et al., 2014; Jácome et al., 2016; Lemay et al., 2019; Anson et al., 2019). Moreover, most of the studies reported the absence of floor and ceiling effects (Godi et al., 2013;

Tsang et al., 2013; Yingyongyudha et al., 2016; Hamre et al., 2017; Oyama et al., 2018; Lampropoulou et al., 2019; Duchesne et al., 2020; Beauchamp et al., 2021). On the other hand, floor effect was found in one study (Winairuk et al., 2019) and ceiling effect for two subscales (reactive postural control and sensory orientation) was reported by Potter et al., 2019 (Potter et al., 2019).

In the term of test accuracy using the receiver operating characteristic (ROC) curve, the cutoff points ranged from 16 to 21.5 with sensitivity from 52% to 93%, specificity from 43% to 81%, and AUC from 0.64 to 0.92 (Tsang et al., 2013; Godi et al., 2013; Yingyongyudha et al., 2016; Schlenstedt et al., 2016; Jácome et al., 2016; Anson et al., 2019; Duchesne et al., 2020; Magnani et al., 2020). Based on that, the mini-BESTest is receiving acceptance to be used in clinical and research settings (Lemay et al., 2019).

Table 2. Literature review of the psychometric properties of Mini-BESTest Studies

Author & year	Sample	Internal Consistency	Intra-rater Reliability ICC	Reliability (r, rho)	Validity (r, rho)	Measurement error	Floor and Ceiling	Cutoff points	ROC	Bland Altman
1- (Leddy et al., 2011) (PD)	24 Mean age 68.2±9.3 Both sexes	—	ICC=0.92 Domain1=0.83 Domain2=0.87 Domain3=0.72 Domain4=0.72	—	With BESTest r=0.95	—	No floor or ceiling	20	AUC=0.86 Se=88% Sp=78%	—
2- (Bergstrom et al., 2012) (Swedish version)	18 PD age (46-80) Stroke age (66-90) Both sexes	—	—	—	Concurrent: with BBS rho=0.89, With TUG rho=-0.83, FES rho=0.26	—	No floor or ceiling	—	—	—
3- (Godi et al., 2013) (Patients with balance disorders)	99 mean age 66.1 ±13.1 Both sexes	α =.90, .91	ICC=0.96	—	Convergent with BBS r=0.85 and r=.58	SEM= 1.26 MDC_{95}= 3.5	No floor and ceiling effect	According to GROC	AUC=0.92 Se=94% Sp=81%	—
4- (Haakonsen, 2013) (Stroke)	24 Both sexes	—	ICC=0.94−0.99 and ICC=0.97−0.99	—	—	MDC_{95} ≤4	—	—	—	—
5- (Maia et al., 2013) (Brazilian version)	35 Older:73.8±7.4 PD: 66.5±10.3 Both sexes	—	ICC= 0.95 to 0.99	RASCH model: Mini-BESTest exhibits appropriate construct validity, response stability, and discriminatory capacity						

6- (Tsang et al., 2013) (Chronic stroke)	106 Mean age 57.1±11 Both sexes	α = 0.89, 0.93, 0.94	ICC= 0.97	__	With Chedoke-MCMaster stroke assessment score rho=0.53, and foot score rho= 0.64, MAS= rho = -0.22 and ABC= rho=0.50	MDC_{95} = 3	No floor and ceiling effect	17.5	AUC=0.64 Se= 64% Sp=64.2%	__
7- (Löfgren et al., 2014) (PD)	27 Mean age 73 Both sexes	α =0.88 Domains=0.77 to 0.88	ICC=0.80	__	__	SEMtotal=1.2 SRDtotal=3.4 SRD%=12.1 SEM domains=0.68-0.79 SRD domains=0.8to 2 SRD%=13.1%-26.7%	__	__	__	Measurement error highest for the postural Conversely, the measurement error was lowest for sensory orientation
8- (Jácome et al., 2016) (COPD)	46 Mean age 75.9±7.1 Both sexes		ICC = 0.88	__	With ABC rho=0.55	SEM=1.2 MDC_{95} =3.3 MDC%=14.9%	__	21.5	AUC=0.74 Se=68 Sp=65	No systematic bias with mean difference ranging from -0.7 to 0
9- (Schlenstedt et al., 2016) (PD)	85 Mean age 68.1±7.5 Both sexes	__	__	__	__	__	__	≤19	AUC=0.65 Se=0.52, Sp=0.70	__

10- (Sofia et al., 2016) (Greek version)	122 Mean age 67±18 years Both sexes	α = 0.83	ICC = 0.96	—	Concurrent: with BBS r=0.85, Convergent validity with TUG r=-0.74, With FRT r =0.61, with FES-I r=-0.52	—	No floor or ceiling	—	—	—
11- (Yingyongyudha et al., 2016) (Healthy elderly)	200 Mean age 70.3 ±7.3 Both sexes	—	—	—	—	—	No floor and ceiling effect	16	AUC=0.84 SE=85% Sp=75%	—
12- (Goljar et al., 2017) (Italian version)	159 Mean age 71±10.6 Both sexes	**RASCH Analysis: confirming the validity of three version and the equivalence of their adaptations**								
13- (Hamre et al., 2017) (Norwegian Version)	42 Mean age 71.7±14.8 Both sexes	—	ICC = 0.85,0.84 Domain1=0.78,0.77 Domain2=0.65,0.73 Domain3=0.86,0.85 Domain4=0.83,0.82	—	Concurrent: with FES-I rho = -0.50	SEM=1.78, 1.88 SDC_{95} =4.94,5.22	No floor or ceiling	—	—	—
14- (Madhavan et al., 2017) (Stroke)	41 Mean age: 59.4 Both sexes	—	—	—	With BBS r=0.72, With 10MWT r=0.57	—	—	18.5	AUC=0.80 Se=93% Sp=64%	—
15- (Miqdad et al., 2017) (Elderly)	30 Mean age 62.23±4.38 Both sexes	—	—	—	Convergent with DGI r ranged from =0.68 to 1	—	—	—	—	—

16- (Oyama et al., 2018) (Japanese version)	18 Mean age 59.1±27 Both sexes	α =0.80 to 0.87	—	—	Conccurrent: with BBS rho=0.66 FRT rho= -0.36	—	No floor or ceiling	—	—	—
17- (Anson et al., 2019) (Adults with history of falls)	58 Mean age 78.1±7.01 Both sexes	—	ICC = 0.84	—	—	SEM=1.4 MDC_{95} = 4	—	—	AUC=0.54	—
18- (Chan et al., 2019) (ISCI)	21 mean age 56.8±14.0 years Both sexes	—	ICC=0.98 Domain1=0.98 Domain2=0.94 Domain3=0.95 Domain4=0.97	—	Convergent: With Lower extremity strength r=0.73. Concurrent with COP r = 0.48–0.71	—	—	—	—	—
19- (Lampropoulou et al., 2019) (Chronic stroke)	21 Mean age 63 ± 16 Both sexes	_	ICC=0.96	—	Convergent with TUG r= -0.82 FES-I r= -0.73 FRT r=0.68	SEM=1.53 MDC=4.25	No floor or ceiling	—	—	Mean difference = −0.143 ± 0.73 very good agreement in the measurements
20- (Lemay et al., 2019) (French version)	20 Mean age 56.4±17.14 Both sexes	α =0.89-0.92	ICC=0.98	—	—	SEM=1.05-1.63 MDC_{95}=2.91-4.51	No floor or ceiling	—	—	Adequate agreement, confirms the absence of of systematic errors

21- (Potter et al., 2019) (MS)	32 Mean age 55.84±14.01 Both sexes	α =0.89	ICC= 0.97. Domain1= 0.85 Domain2=0.90 Domain3=0.92 Domain4=0.92	—	Convergent: with disease severity rho=-0.70to -0.84 With ABC rho =0.65 to 0.79	SEM total=1.32, MDC total=3.74 SEM1=0.51 MDC1=1.43 SEM2=0.66 MDC2=1.90 SEM3=0.34 MDC3=0.98 SEM4=0.83 MDC4=2.38	No floor effects, but ceiling effects were found for two subscales	—	—	—
22- (Winairuk et al., 2019) (Subacute stroke)	70 Mean age 55.42±12.11 Both sexes	—	ICC= 0.98 Domain1=0.95 Domain2=0.97 Domain3=0.95 Domain4=0.98	—	Concurrent: with BBS r= 0.95	SRM=1.28 MDC_{95} = 3.35	Floor effects were found	—	AUC= 0.71 Se=0.93 Sp=0.43	—
23- (Bustamante-Contreras et al., 2020) (Spanish version)	50 Mean age 69.14±8.65 Both sexes	α =0.84	—	—	Content validity 11 items I-CVI =1, and 3 items = 0.92. S-CVI=0.98	—	No floor or ceiling	—	—	—
24- (Cramer et al., 2020) (German version)	50 mean age 64.58±13.34 Both sexes	α =0.90	—	—	Convergent: with BBS rho=0.93 With TUG rho =-0.85	—	No floor or ceiling	—	—	Sufficient agreement between all test, the biases were -5.36 or 4.92
25- (Dominguez-Olivan et al., 2020) (Elderly)	30 Mean age 73±6.2 Both sexes	α total=0.79 1=0.94 2=0.80 3=0.84	—	—	FES-I, r = -0.18 BBS, r =0.18	SEMtotal=0.74 MDCtotal=2.04 SEM1=0.29 MDC1=0.79 SEM2=0.43	No floor and ceiling	—	—	—

		4=0.88				MDC2=1.19 SEM3=0.39 MDC3=1.07 SEM4=0.35 MDC4=0.97				
26- (Duchesne et al., 2020) (DM1)	59 Mean age 50.6±12.5 Both sexes	—	—	—	Convergent: With TUG rho= -0.76, 10mWT rho =0.48, 6MWT rho=0.82	—	No floor and ceiling	21.5	AUC= 0.87	—
27- (Lopes et al., 2020) (PD)	370 Mean age 65.8 ± 11 Both sexes	—	—	—	—	—	—	21.5	AUC=0.66 Se=70.7% Sp=55.1%	—
28- (Magnani et al., 2020) (Elderly)	264 Mean age 65.2±2.9 Both sexes	—	—	—	—	—	—	Cutoff points from 17 to25	AUC=0.68 to 0.79 Se=58% to78% Sp=68%to 74%	—
29- (Naghdi et al., 2020) (Persian version)	30 Mean age 54.2±16.1 Both sexes	—	—	—	Discriminative: with stroke mean =19.4 and SD5.4. Healthy subjects mean=24.8 and SD=2.3, P>0.001	—	—	—	—	—

30- (Beauchamp et al., 2021) (Stroke)	50 Mean age 60.8±9.4 Both sexes	__	__	__	__	SEMtotal=1.1 MDCtotal=3.2 SEM1=0.4, MDC1=1 SEM2=0.7 MDC2=1.8 SEM3=0.4 MDC3=1 SEM4=1 MDC4=2.6	No floor and ceiling	__	AUC according to MCID=0.77 Se=95.1% Sp=55.6%	__
31- (Roy et al., 2021) (SCI)	23 Mean age 55.2±14.5 Both sexes	__	ICC = 0.94	__	__	SEM=1.40 MDC=4 MDC%=13.7	__	__	__	No heteroscedasticity was observed no systematic error for total score

ICC; inter class correlation, r; Pearson's correlation, rho; Spearman correlation, ROC; Receiver operating characteristics, Se; Sensitivity, Sp; Specificity, SRD; Smallest real difference, SEM; standard error of measurements, MDC; Minimal Detectable change, SDC; Smallest Detectable change, AUC; Area under the curve, α; Cronbach's alpha, PD; Parkinson's disease, MS; Multiple sclerosis, TBI; Traumatic brain injury, I-SCI; Incomplete spinal cord injury, COPD; Chronic obstructive pulmonary disease, DM1;Myotonic dystrophy type 1, BBS; Berg balance scale, TUG; Timed up and go, FES-I; Fall efficacy scale international, MAS; Modified Ashworth scale, ABC; Activities-specific balance confidence, FRT; Functional reach test, DGI; Dynamic gait index, 10 MWT; 10 meter walk test, 6MWT; 6 minute walk test, COP; Measure of center of pressure, I-CVI; Items content validity index, S-CVI; Scale content validity index.

2.2 Summary

As shown in the literature review, mini-BESTest is a comprehensive tool to investigate static and dynamic balance on numerous populations and has high psychometric properties. Also, mini-BESTest was translated to various languages and earned acceptance in both clinical and research purposes. Yet the test has not been translated to Arabic language to be used on Arabic population.

Chapter III
Subjects and Methods

Chapter III

Subjects and Methods

3.1. Sample

A convenience sample of 56 patients of both sexes were recruited for this study. Age was ranged from 18– 75 years old (Lemay et al., 2019). Participants with various neurological disorders that causing balance dysfunctions were the targeted populations.

Sample Size estimation

According to Osborne et al., 2004, there are no absolute rules for the sample size required to validate constructs or study tools due to the different types of tools and the number of their items (Osborne et al., 2004). Guidelines for the respondent-to-item ratio ranged from 5:1, 10:1, 15:1, or 30:1 (Pedhazur, 1997). In accordance with the classic rule established by Kline, 2011 of using 2 to 20 subjects for each item, the authors decided to use 4 subjects for each item (4:1) with a total sample of 56 participants (Anthoine et al., 2014).

Meanwhile, test-retest reliability was analyzed in a subsample of the first consecutive 56 participants. This sample size was determined according to the study by (Bonett, 2002) who established that a minimum of 21 individuals were necessary to estimate an ICC of 0.9 with a 95% confidence interval width of 0.231 (α =0.05 and required number of sessions=2), also according to GROC results for stable patients.

For a possible 30% of withdraw, the sample was increased to 29 participants.

Inclusion criteria

1- Participants representing different neurological conditions such as MS, stroke, PD, SCI and, TBI were recruited to ensure heterogeneity of balance impairment (Sofia et al., 2016)
2- Ability to walk 6 m with or without a cane (Franchignoni et al., 2010).
3- To be able to meet for testing on two occasions with 7-10- day interval (El-Gilany et al., 2012).
4- Able to follow commands and instructions (Lemay et al., 2019).
5- Age from 18 to 75 years old (Lemay et al., 2019).
6- Ability to provide consent form.

Exclusion criteria

1- Non ambulatory patients.
2- Potential participants with medical conditions that could interfere with the evaluation process or may affect the results of the evaluation for causes other than balance disfunction, such as: participants with unstable or acute medical conditions and/or with balance impairments due to vestibular or visions disorders (Lemay et al., 2019).

3- Pregnancy and recent surgery to the lower limbs that could restrict the performance of the standing and walking activities included in the scale (Lampropoulou et al., 2019).

3.1.1 Ethical Consideration and Consent

This study was approved by Ethics Review Boards of the Collage of Medicine- King Saud University (No. E-20-4835) (Appendix 1) and Prince Sultan bin Abdul-Aziz Humanitarian City (No. 25/MSc/2020) (Appendix 2). The participants were informed about the study and signed an informed consent form prior to their participation (Appendix 3). In addition, the permission was taken from the main developer of the mini-BESTest (Appendix 4).

3.1.2 Sampling method

Convenient sampling method was used during this study.

3.2 Procedure of the study

3.2.1 Study Design

A cross sectional and psychometric testing study.

3.2.2 Materials and measurement tools

The measurement tools that were used in this study include: mini-BESTest -Ar (Appendix 5) , the Arabic version of Berg balance scale (A-BBS) (El-Gilany et al., 2012) (Appendix 6), the Arabic version of dynamic gait index (A-DGI) (Alghwiri, 2014) (Appendix 7), and global rating of change (GROC) (Childs et al., 2005) (Appendix 8).

Mini-BESTest

The mini-BESTest comprises of 14-items focusing on dynamic balance. Items are divided into four sub-scores: anticipatory postural adjustments (three items), reactive postural control (three items), sensory orientation (three items), and dynamic gait (five items) (Franchignoni et al., 2010). Each task rated on a 3-level ordinal scale ranging from 0 (severe balance impairment) to 2 (no balance impairment) with 28 as a maximal test score, and higher score indicates better balance. The test takes 15 minutes to administer (Lemay et al., 2019).

The A-BBS

The BBS is a quantitative and most used assessment tool for assessing balance and risk of falling in patients with neurological conditions and elderly. It has been translated to Arabic and its excellent intra-rater reliability (ICC= 0.97) and inter-rater (ICC= 0.95). In addition, it is valid with total matrix variance of 72.9% (El-Gilany et al., 2012). The scale contains 14 items to test either static or dynamic balance. It requires 10–20 minutes for administration. The scoring for each item is from 0 to 4, where a score of 0 states “inability to complete the task”, and a score of 4 states “independent in completing the task” (Berg et al., 1992).

The global score is 56 points. The score from 0-20 represents balance impairment and high risk of fall, from 21-40 reflects acceptable balance

and moderate risk of falling, and from 41-56 states good balance and low risk of falling (Berg et al., 1992).

The A-DGI

The DGI is utilized to assess the functional stability and risk of falling. It is a common gait assessment tool because of its little need for space and equipment, and its ability to be applied on patients with different conditions. The 8-items DGI tests the gait on flat surfaces, gait with speed changes, horizontal head turns, vertical head turns, gait and pivot turn, stepping over and around obstacles, and navigation of stairs (Alghwiri, 2014).

The DGI is 4-point ordinal scale from 0 to 3, where 0 states the lowest and 3 states the highest. The total score equals 24, where a score of 19 or less states risk of falling, while a score of 22 or more states safe ambulation. The test takes15 minutes to complete. The Arabic version of DGI is reliable with $ICC_{3,1}$ = 0.98; 95% CI, 0.97−0.99 and valid by moderately correlating with the Glasgow coma scale (rho =0.39, P < .01) and Beck depression inventory (rho = −0.50, P = .01) (Alghwiri, 2014).

The GROC

The GROC is a scale used to assess patients' overall perceptions of improvement since the beginning of treatment. The GROC ranges from -7 to 0 to +7, where -7 represents a very great deterioration, 0 represents about the same, while +7 represents a very great improvement. The GROC has been extensively used as an external reference standard to discriminate between assessment tools and has high reliability (ICC= 0.90) and significant correlation with numerical rating scale (r = 0.49).

Patients with a score of more than +3 were considered improved, those with a score of between +3 and -3 were considered stable, and those with a score of less than -3 were considered deteriorated (Fritz et al., 2001).

Equipment

The equipment used for the application of the mini-BESTest were a foamy material (Airex foam, medium density), a chair without armrests or wheels, a step of average height, a 10-degree incline ramp (at least 60 cm × 60 cm) to stand on, stopwatch, a box (23 cm height), and a 3 meters distance measured out and marked on the floor with tape (from chair). For the BBS application: a chair with armrests, a bed, a timer, a step with height of 22 cm, and a ruler of 5, 12 and 25 cm were used.

3.2.3 Protocol of data collection

3.2.3.1 Data Collection Period

Data were collected through the period between September 2020 to July 2021.

3.2.3.2 Participants Recruitment

The participants were recruited from the inpatient and outpatient physical therapy clinic at Prince Sultan bin Abdul-Aziz Humanitarian city in Riyadh based on the inclusion and exclusion criteria.

3.3.1 Procedure

This study was conducted in two phases

1- Translation and cross-cultural adaptation based on the guidelines of (Beaton et al., 2000).

2- Testing psychometric properties of mini-BESTest -Ar.

3.3.1.1 Translation and cross-cultural adaptation

The guidelines consist of 6 steps.

Step 1: The mini-BESTest was translated from English to Arabic (forward) by two independent bilingual translators who were native Arabic speakers. Then, a written report of the two versions was provided (T1 and T2).

Step 2: The two forward translations were compared and single consensus Arabic version of mini-BESTest was produced (T12) then Arabic mini-BESTest was constructed by the expert committee.

Step 3: A backward translation to English was undertaken by two independent native English speakers (BT1 and BT2), and they were blinded of the original version of mini-BESTest. After that, their two versions of the back-translation were submitted to the committee.

Step 4: An expert committee reviewed all reports, and they gave their grading on each item the content validity index (CVI) to test the face and content validity.

step 5: The pre-final version was piloted to 5 therapists to test on 10 patients with different balance disorders. Following a pretest in the clinic by five physiotherapists (experience ranging from 3 to 12 years) on neurological patients, minor adjustments were made to improve the instructions to the patient. Also, their suggestions for every item were asked and a final debriefing decision was sent to the developer for comments.

Step 6: After receiving and reviewing all comments, the panel experts were determining the final Arabic version of the mini-BESTest (**mini-BESTest -Ar**).

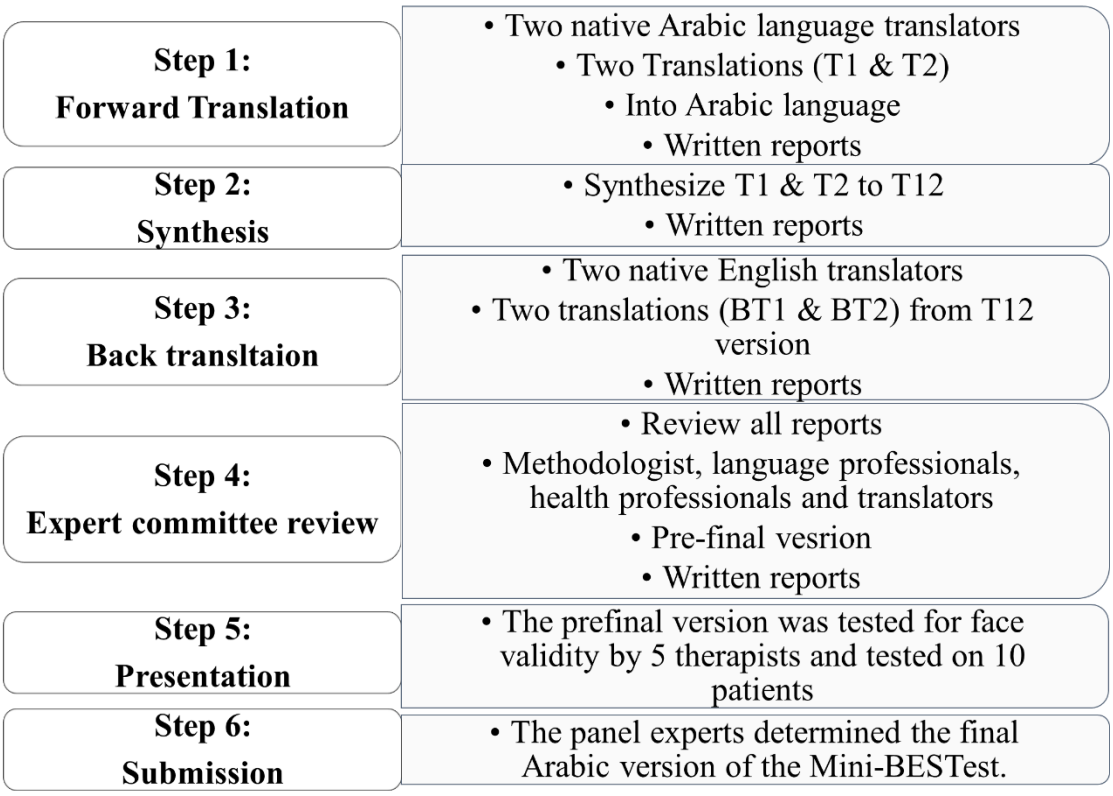

Figure 1. Steps of translation and cross-cultural adaption.

3.3.1.2 Testing the psychometric properties of the mini-BESTest -Ar

At the first session, the participants conducted a screening sheet as a part of baseline assessment to determine if they met the exclusion/inclusion criteria. The information related to demographic variables such as age, weight (kg), height (cm), and body mass index (BMI) (kg/cm^2) were collected. Weight and height were used to calculate the BMI (Visscher et al., 2006). The following tests were applied to eligible participants: the mini-BESTest-Ar, A-BBS, and A-DGI.

At the second session , after 7 to 10 days, the participants were asked to complete a GROC scale (El-Gilany et al., 2012), as a criterion for

"stable" conditions, and mini-BESTest-Ar was applied once again.

During the test, the participants were asked to wear comfortable clothing and footwear and take their medications according to their usual schedule. The evaluation room was kept quiet to ensure that the participants' performance was not hampered. Prior to testing, the participants were given analytical information and demonstrations for each activity, and they were allowed to relax as much as they needed. Each session was 30 to 90 minutes. Because the data was collected during the Covid-19 pandemic, every precautions were taken to keep the participants and researcher safe (World Health Organization, 2020).

3.3 Data analysis

Content validity

Content validity was assessed using CVI and modified kappa coefficient (K*). The index contains four-point Likert scale arranged as following: 1=Not relevant, 2=Somewhat relevant (item need some revision), 3= Quite relevant (relevant but need minor revision), and 4=Highly relevant. The whole items and instructions of the test were assessed for their relevance and clarity by five experts. They had experience with research methodology and neurology.

The experts were asked about their comments and recommendations to improve the quality of Arabic version of the test. After that, the ratings

of the scale were recorded as 1 if the relevance scale was 3 or 4, or 0 if the relevance scale was 1 or 2. Following that, the item-CVI (I-CVI) was calculated using the formula I-CVI = (agreed items/ number of experts) and the I-CVI is considered excellent if its value is 0.78 or above (Bustamante-Contreras et al., 2020).

Both scale-level CVI/universal agreement (S-CVI/UA) and scale-level CVI/average agreement (S-CVI/Ave) were calculated as quantitative data for scale-level content validity. The S-CVI/UA computed by formula S-CVI/Ave = (sum of UA score/ number of items) (Yusoff, 2019). Also, the S-CVI/Ave was calculated using the formula: S-CVI/Ave = sum of I-CVI scores / number of items. It considered acceptable if its value is 0.90 or more (Bustamante-Contreras et al., 2020).

Moreover, to assess the K*, the probability of chance (P_c) was computed using the equation $P_c = [N/A (N - A)] *0.5^N$ where N = number of experts and A = Number agreeing on good relevance. Later, the K* was computed using:

$k^* = (\text{I-CVI} - P_c)/(1 - P_c)$ (Polit et al., 2007).

Construct Validity

The construct validity of the mini-BESTest-Ar was investigated using the hypothesis testing method to predict a moderate to high correlation ($r \geq 0.5$) with A-BBS and A-DGI. The validity was measured using Pearson's correlation coefficient (r) if the data was normally distributed or

spearman's ranked correlation (rho) if the data was skewed. Where values of r and rho from 0.0 to 0.25 was considered as little correlation, 0.26 to 0.49 was indicated as low correlation, 0.50 to 0.69 equals moderate correlation , 0.70 to 0.89 was high correlation, and very high correlation was from 0.90 to 1.00 (Roach, 2006). Construct validity was also classified as very good if more than 90% of the 10 hypotheses were verified, good if 75% to 90% of the hypotheses were confirmed, and moderate if 40% to 74% of the hypotheses were confirmed (Devoogdt et al., 2011).

Relative reliability

Relative reliability was determined by calculating:

1. Internal consistency

The internal consistency of mini-BESTest-Ar was tested using α coefficient at baseline; the accepted value was 0.70. Moreover, values between 0.70-0.80 indicate good internal consistency, while values above 0.80 was considered as very good internal consistency (Munro, 2005).

2. Relative test-retest reliability using intraclass correlation coefficient

Test-retest reliability was tested using a 2-way analysis of variance random-effect, absolute agreement intraclass-correlation ($ICC_{2,1}$), with good and excellent reliability being, respectively, indicated by values of 0.60 to 0.80 and more than 0.80. Pearson's correlation (r) was also used to assess test-retest reliability. Where poor reliability equals value below 0.50, and moderate to good reliability equals value ranged from 0.51 to

0.75, while excellent reliability equals values above 0.75 (Roach, 2006). The initial assessment and a re-assessment were taken approximately at the same time and under the same conditions in a time frame of 7-10 days (Godi et al., 2013; Sofia et al., 2016).

Absolute reliability

Absolute reliability was determined by calculating:

1. ***Measurement error***

SEM was calculated using the formula: SEM =(SD×[√(1-ICC)]), where SD was the sample standard deviation and ICC was the test–retest ICC. True change in mini-BESTest -Ar that is beyond the measurement error was quantified using the MDC_{95}. MDC_{95} was estimated using the following formula: MDC_{95} = SEM ×1.96 ×√2 (Tsang et al., 2013). The MDC also was calculated as a percentage (MDC%) by the formula: MDC%= (MDC_{95} / mean) × 100, where "mean" is the mean of the scores acquired in the second testing sessions. An MDC% under 30% was acceptable (Jácome et al., 2016).

2. ***Bland-Altman plot***

Finally, using a Bland-Altman plot, the LOA between the mini-BESTest-Ar scores at baseline and the subsequent administration were visually examined. The reliability was assessed using only the data of patients who were categorized as stable (GROC scores of -3 to +3) (Fritz et al., 2001).

Responsiveness, accuracy, and sensitivity to change of mini-BESTest-Ar

ROC:

By creating a ROC curve from the change scores between the 7-10 days follow-up and the baseline, the sensitivity to change, or responsiveness, of the mini-BESTest-Ar was investigated. The ability of mini-BESTest-Ar to distinguish patients who improved from those who stayed stable based on the GROC was measured using the AUC. AUC values range from 0.5, which indicates little diagnostic accuracy, to 1, which indicates complete diagnostic accuracy. We predicted that the mini-BESTest-Ar would have an AUC value of 0.70 or higher. The sensitivity (patients who improved, true positive) and specificity (patients who stayed stable, true negative) values were determined (Winairuk et al., 2019). Cutoff values were calculated by maximizing sensitivity and specificity by selecting the smallest value of $(1- \text{sensitivity})^2 + (1- \text{specificity})^2$ (Schlenstedt et al., 2016).

Floor and ceiling effects

Floor and ceiling effects were present if more than 20% of respondents achieved the lowest or highest possible total score (Tsang et al., 2013; Winairuk et al., 2019).

All the analyses were conducted using Statistical Package of Social Science (SPSS, Inc., Chicago, IL) version 18.0. The level of significant was set at $P < 0.05$. Descriptive statistics were estimated for demographic variables (sex, age, height, weight, BMI, level of education, and residence) and medical condition. The data were investigated for normal distribution using Kolmogorov–Smirnov test.

Chapter IV
Results

Chapter IV

Results

4.1 Participants' characteristics

Table 3 represents the participants' characteristics. The anthropometric data are normally distributed (P >0.05) except age (P<0.05). Furthermore, the two trials of mini-BESTest-Ar (at baseline and after 7-10 days) and A-BBS scores are normally distributed (P >0.05). The A-DGI values are skewed (P<0.05). Fifty-six participants with different neurological conditions were recruited with median and range of age of 34 and 53 respectively (min.:18, max.:71 year). The mean ± SD of BMI was 26.6 ± 5.6. Most of the participants (67.9%) were men. About 35.7% were diagnosed with stroke followed by TBI (28.6 %) and SCI (14.3%).

Table 3. Participants' characteristics (n=56)

Variables	**Median**	**Range (min-max)**	
Age	34	53 (18-71)	
	Mean	**SD**	
Height (cm)	167.9	10.4	
Weight (kg)	75.5	15.9	
BMI (kg/cm$^{2)}$	26.6	5.6	
		Frequency	**%**
Sex	Men	38	67.9
	Women	18	32.1
Level of education	Illiterate	4	7.1
	Elementary	2	3.6
	Intermediate	3	5.4
	Secondary	24	42.9
	Bachelor's degree	20	35.7
	Master's degree	3	5.4
Residence	Central region	21	37.5
	Southern region	16	28.6
	Northern region	3	5.4
	Eastern region	8	14.3
	Western region	8	14.3
Medical condition	Stroke	20	37.5
	TBI	16	28.6
	SCI	8	14.3
	MS	4	7.1
	PD	1	1.8
	GBS	1	1.8
	Spinal Bifida	1	1.8
	Meningitis	1	1.8
	Lateral Sclerosis	1	1.8
	Cranioma	1	1.8
	CP	1	1.8
	CMT	1	1.8
	Mean±SD (min-max)		
Mini-BESTest1-Ar (n=56)	20±5.4 (6-28)		
Mini-BESTest2-Ar (n=29)	20±5.8 (8-27)		
A-BBS (n=56)	47.5±7.3 (13-56)		
	Median (range)		
A-DGI (n=56)	22 (3-24)		

All data represented as mean and standard deviation SD, or frequency and percentage %, except for age and DGI represented as median and range. min-max: minimum-maximum, n number of participants, BMI: body mass index, TBI: traumatic brain injury, SCI: spinal cord injury, MS: multiple sclerosis, PD: Parkinson's disease, GBS: Guillain Barre Syndrome, CP: cerebral palsy, CMT: Charcot-Marie-Tooth, Mini-BESTest1-Ar: total score of Arabic Mini-BESTest at baseline, Mini-BESTest 2-Ar: total score of Arabic Mini-BESTest after 7-10 days, A-BBS: total score of Arabic Berg Balance scale, A-DGI: total score of Arabic Dynamic Gait Index .

4.2 Translation and cross-cultural phase

Standard Arabic was used in the mini-BESTest-Ar to ease worldwide distribution and better understanding. Most semantic differences between the two Arabic versions produced during stage 1 were due to the use of synonyms or phrases with comparable meanings. The experts committee advised that the term "dynamic speed" be replaced with “walking speed”. The test's units were all changed to the worldwide metric system (feet to meters, inches to centimeters). The final version was deemed to be unambiguous, and it was thought to be appropriate and applicable for Arabic speakers to use. The main developer examined and approved the back translated English version (Appendix 9).

4.3 Psychometric Properties

Content Validity

The results of content validity elaborated excellent I-CVI for all items (I-CVI=1). The S-CVI was excellent, with values of 1 for both (S-CVI/Ave) and (S-CVI/UA). The P_c value was 0.031 for all items and K^* for each item was excellent (>0.74) (Table 4 and 5).

Table 4. Evaluation of I-CVIs with expert's agreement, scales' items

Item	Expert1	Expert2	Expert3	Expert4	Expert5	Expert in agreement	I-CVI	P_c	K^*	Evaluation
1.	1	1	1	1	1	5	1	.031	1	Excellent
2.	1	1	1	1	1	5	1	.031	1	Excellent
3.	1	1	1	1	1	5	1	.031	1	Excellent
4.	1	1	1	1	1	5	1	.031	1	Excellent
5.	1	1	1	1	1	5	1	.031	1	Excellent
6.	1	1	1	1	1	5	1	.031	1	Excellent
7.	1	1	1	1	1	5	1	.031	1	Excellent
8.	1	1	1	1	1	5	1	.031	1	Excellent
9.	1	1	1	1	1	5	1	.031	1	Excellent
10.	1	1	1	1	1	5	1	.031	1	Excellent
11.	1	1	1	1	1	5	1	.031	1	Excellent
12.	1	1	1	1	1	5	1	.031	1	Excellent
13.	1	1	1	1	1	5	1	.031	1	Excellent
14.	1	1	1	1	1	5	1	.031	1	Excellent
						S-CVI	1			
Proportion relevance	1	1	1	1	1					

I-CVI = item-level content validity index; P_c = probability of a chance computed by formula: $P_c = [N/A(N - A)]*0.5^N$ where N = number of experts and A = Number agreeing on good relevance; K* = modified kappa coefficient $k^* = (\text{I-CVI} - P_c)/(1 - P_c)$, [a] As stated by (Cicchetti & Sparrow, 1981);(Fleiss, 1981) about the criteria for K*, 0.40 to 0.59 = fair, 0.60 to 0.74 = good, and >0.74 excellent.

Table 5. Evaluation of I-CVIs with expert's agreement, scales' instructions

Instructions	Expert1	Expert2	Expert3	Expert4	Expert5	Expert in agreement	I-CVI	P_c	K^*	Evaluation
Pt. status	1	1	1	1	1	5	1	.031	1	Excellent
Instruments	1	1	1	1	1	5	1	.031	1	Excellent
Grading	1	1	1	1	1	5	1	.031	1	Excellent
1.	1	1	1	1	1	5	1	.031	1	Excellent
2.	1	1	1	1	1	5	1	.031	1	Excellent
3.	1	1	1	1	1	5	1	.031	1	Excellent
4.	1	1	1	1	1	5	1	.031	1	Excellent
5.	1	1	1	1	1	5	1	.031	1	Excellent
6.	1	1	1	1	1	5	1	.031	1	Excellent
7.	1	1	1	1	1	5	1	.031	1	Excellent
8.	1	1	1	1	1	5	1	.031	1	Excellent
9.	1	1	1	1	1	5	1	.031	1	Excellent
10.	1	1	1	1	1	5	1	.031	1	Excellent
11.	1	1	1	1	1	5	1	.031	1	Excellent
12.	1	1	1	1	1	5	1	.031	1	Excellent
13.	1	1	1	1	1	5	1	.031	1	Excellent
14.	1	1	1	1	1	5	1	.031	1	Excellent
						S-CVI/Ave	1			
Proportion relevance	1	1	1	1	1					

I-CVI = item-level content validity index; P_c = probability of a chance computed by formula: $P_c = [N/A(N - A)]*0.5^N$ where N = number of experts and A = Number agreeing on good relevance; K* = modified kappa coefficient $k^* = (\text{I-CVI} - P_c)/(1 - P_c)$, [a] As stated by (Cicchetti & Sparrow, 1981);(Fleiss, 1981) about the criteria for K*, 0.40 to 0.59 = fair, 0.60 to 0.74 = good, and >0.74 excellent.

Construct (Convergent) Validity

The total score of mini-BESTest-Ar, as well as its four domains demonstrated high to moderate significant positive correlation with A-BBS. The r value was 0.80 for the total score. Regarding the domains, r value ranged from 0.81 (Sensory orientation) to 0.62 (Dynamic gait). Furthermore, as shown in table 6, there was a moderate to high positive correlation between A-DGI and total score of mini-BESTest-Ar score as well as its four domains except sensory orientation domain (rho=0.38, P= 0.004). Fortunately, these results confirmed 90% of our predefined 10 hypotheses indicating that mini-BESTest-Ar had good construct validity.

Table 6. Construct validity

Mini-BESTest-Ar domains	**Instrument for correlation**	**Correlation coefficient (r, rho)**	**Hpotheses confirmed?**
Anticipatory domain	**A-BBS**	Expected: ≥ 0.5 Actual: r= 0.63**	Yes
Reactive postural control domain		Expected: ≥ 0.5 Actual: r= 0.63**	Yes
Sensory orientation domain		Expected: ≥ 0.5 Actual: r = 0.81**	Yes
Dynamic gait domain		Expected: ≥ 0.5 Actual: r= 0.62**	Yes
Mini-BESTest-Ar Total		Expected: ≥ 0.5 Actual r =0.80**	Yes
Anticipatory domain	**A-DGI**	Expected: ≥ 0.5 Actual: rho= 0.53**	Yes
Reactive postural control domain		Expected: ≥ 0.5 Actual: rho=0.62**	Yes
Sensory orientation domain		Expected: ≥ 0.5 Actual: rho=0.38*	No
Dynamic gait domain		Expected: ≥ 0.5 Actual: rho = 0.79**	Yes
Mini-BESTest -Ar Total		Expected: ≥ 0.5 Actual : rho = 0.75**	Yes

The correlation between mini-BESTest -Ar domains and total score with A-BBS and A-DGI; *P value is significant at <0.05; ** P value is significant at <0.001

Relative reliability

Internal Consistency and Test-Retest Reliability

Internal consistency of the mini-BESTest-Ar was excellent (α = 0.96). The four domains of mini-BESTest-Ar showed very high internal consistency ranged from α= 0.81 for reactive postural control to = 0.94 for anticipatory domain. With 29 participants, high test-retest reliability was

obtained for the total mini-BESTest-Ar ($ICC_{2,1}$= 0.95, 95% CI= 0.88- 0.98) and for the four domains.

The $ICC_{2,1}$ ranged from 0.81 to 0.94 for reactive postural control domain and anticipatory domain respectively. The four domains had moderate to high test-retest reliability, with r =0.68, P =0.00 for reactive postural control and r =0.90, P =0.00 for anticipatory domain. Furthermore, Pearson's correlation for total score (r = 0.92, P = 0.00) yielded excellent results (Table 7).

Table 7. Internal consistency, test–retest reliability, and floor and ceiling effects for the mini-BESTest-Ar (total and domains)

Variable	**Internal Consistency (α)**	**Test re-test (ICC)**		**Test retest (r)**	**Floor effect**	**Ceiling effect**
		ICC	**95% CI**	**r**	**No. (%)**	
Anticipatory domain	0.94	0.94	0.86-0.97	0.90**	1 (1.8)	4 (7.1)
Reactive postural control domain	0.81	0.81	0.60-0.91	0.68**	8 (14.3)	12 (21.4)
Sensory orientation domain	0.93	0.93	0.85-0.97	0.87**	1 (1.8)	32 (57.1)
Dynamic gait domain	0.93	0.93	0.84-0.97	0.88**	1 (1.8)	9 (16.1)
Mini-BESTest - Ar Total	0.96	0.95	0.88-0.98	0.92**	1 (1.8)	1 (1.8)

α: Cronbach alpha, ICC: Inter class correlation; CI: 95% confidence interval; r: Pearson correlation. *P value is significant at <0.05; ** P value is significant at <0.001

Absolute reliability

1. Measurement error

The SEM for total mini-BESTest-Ar was 1.19, with an acceptable MDC_{95} of 3.29 points and an MDC % of 16.45 %. The SEM for each domain varied from 0.31 (sensory orientation) to 0.88 (reactive postural control). The MDC_{95} ranged from 0.86 (sensory orientation) to 2.43 (reactive postural control) across the four domains. Table 8 shows that the MDC % was acceptable for all domains except anticipatory and reactive postural control.

Table 8. Standard error and minimal detectable change for mini-BESTest -Ar

Variable	**SEM**	**MDC_{95}**	**MDC%**
Anticipatory	0.38	1.05	30.6%
Reactive postural control	0.88	2.43	66.8%
Sensory orientation	0.31	0.86	16.6% (Acceptable)
Dynamic gait	0.49	1.35	17.3% (Acceptable)
Mini-BESTest-Ar Total	1.19	3.29	16.5% (Acceptable)

MDC: minimal detectable change; SEM: standard error of measurement

2.Bland-Altman plot

Figure 2 illustrated that the Bland-Altman analysis of the mean differences between repeated measurements [the mean difference of the mini-BESTest-Ar total score between the two tests was -1.103±2.4 (-5.73 to 3.53)] produced a distribution of differences that was within the limits of agreement and did not differ significantly from zero ($t = -2.51$, $p > 0.05$). The line of equality (zero) was contained in the 95% CI (-2.0 to -0.20) of the mean difference between the second and first testing sessions, showing that there was no systematic error or proportional bias between sessions.

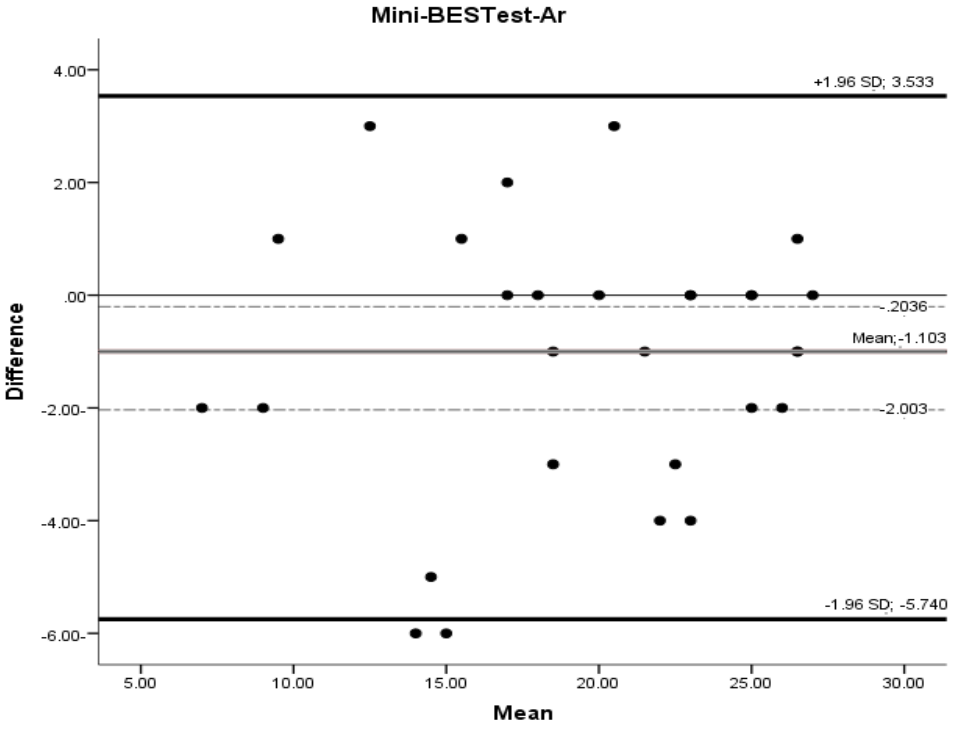

Figure 2. Graphical representation of discrepancies between test 1 and test 2 using the Bland-Altman technique. Bland-Altman Plot showing the difference between (vertical axis) vs. the mean (horizontal axis) for measurements taken in the test and retest sessions. The mean difference (n=29) is represented by the solid gray line in the middle (mean difference = -1.103). The black strong solid lines reflect the highest and lowest limits of agreement (mean ± 1.96×SD) between two sessions. The 95% CI of the mean difference between the two testing sessions is represented by the upper and lower dashed lines. The line above 0 (the line of equality) is represented by the thin solid black line in the middle.

Responsiveness, accuracy, and sensitivity to change of mini-BESTest-Ar ROC:

The sensitivity of mini-BESTest-Ar was tested with 29 participants. An AUC value of 0.85 (standard error 0.05; 95% CI, 0.74–0.96) was obtained after constructing the ROC (Figure 3). This value demonstrated moderate accuracy and was greater than we hypothesized and significant at 0.05 alpha level. Cut off points value were 21.5 with sensitivity of 75 % and specificity of 75%.

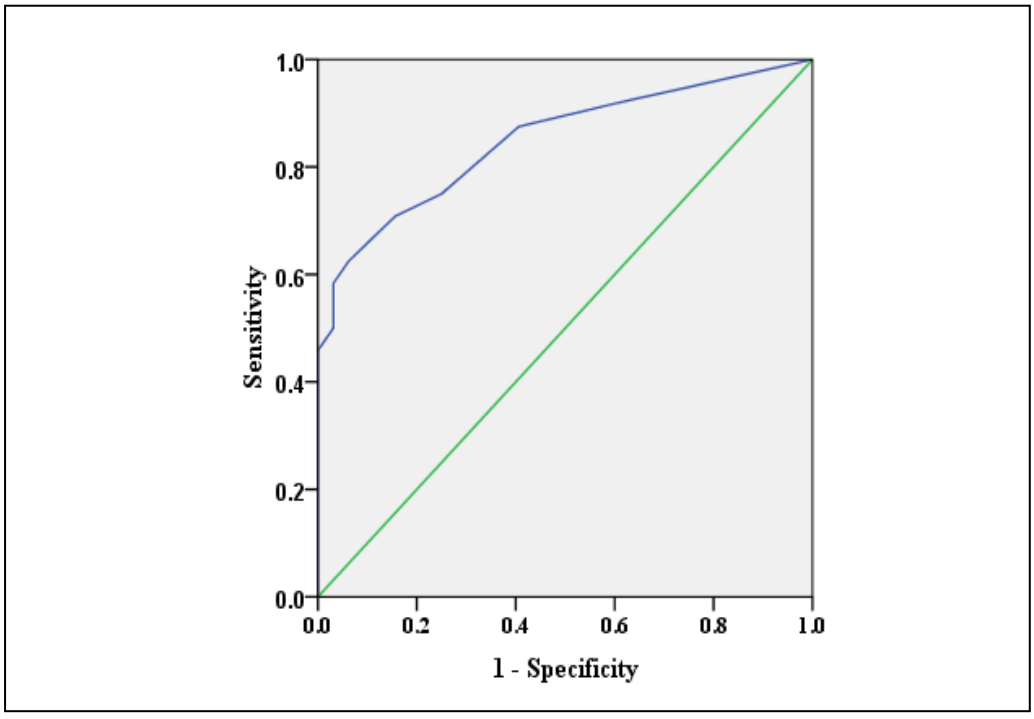

Figure 3. Receiver operating characteristic curve for mini-BESTest-Ar

Floor/Ceiling Effect

There was no floor effect for either the total mini-BESTest-Ar or the domains. All domains had no ceiling effect except reactive postural control and sensory orientation domains where 12 (21.4%) and 32 (57.1%) participants respectively obtained the maximum possible score. For the total scale only one participant achieved the maximum and minimum possible scores as shown in Table 7.

Chapter V
Discussion

Chapter V

Discussion

This study aimed to translate and cross-culturally adapt the mini-BESTest to Arabic language and to evaluate its psychometric properties for patients with neurological balance disorders. The results of face and content validity and psychometric properties are adequate. This study reported the sensitivity and specificity of the mini-BESTest-Ar which can assist rehabilitation professionals and researchers in interpreting their results.

In the validation of an instrument, reflection of population of interests is critical (de Vet et al., 2011). So that, we recruited different neurological conditions to ensure the heterogeneity of the sample. Hence, the results may be generalized to an enormous group of people with neurological diseases.

Beaton et al. (Beaton et al., 2000) presented a six-stage approach for transcultural adaptation and translation of self-reported measures, which they used in their research. One important distinction between self-reported and observational clinical assessments is that instructions for self-reported measures are directed at the person being

evaluated, whereas instructions for clinical measurement instruments like the mini-BESTest are primarily directed at the rehabilitation professional performing the evaluation. The adoption of standardized language by rehabilitation experts is important to maximize the validity and reliability and unify the language of this assessment tool.

Only a few adjustments such as the use of international metric measurements were made during stage 5 based on the feedback from the participating physical therapists. The therapists thought the Arabic version was understandable and comparable to the original. These findings are consistent with past translation studies (Sofia et al., 2016; Lemay et al., 2019; Bustamante-Contreras et al., 2020; Cramer et al., 2020).

Measuring scale's content validity is crucial for enhancing the construct validity of an instrument (Yusoff, 2019). Polit et al., 2007 confirmed that three experts are the minimum needed for a content validation effort (Polit et al., 2007). The number of experts in our study (experts = 5) was appropriate. The values of I-CVI, S-CVI, and S-CVI/UA were equal 1 for each which are considered excellent. The value of S-CVI in this study is higher than Spanish version (S-CVI = 0.98)(Bustamante-Contreras et al., 2020). Excellent K^* was achieved due the adequate number of experts, as if the number of experts increases the possibility of chance agreement decreases.

Fortunately, 90% of our predefined 10 hypotheses was confirmed indicating that mini-BESTest-Ar had good construct validity. The results revealed high correlation between mini-BESTest-Ar total score and A-BBS. These results nearly concurs with preceding validity studies correlated mini-BESTest with BBS (Tsang et al., 2013; Godi et al., 2013; Sofia et al., 2016). On the other hand, the r value was higher than Japanese version (r = 0.66) (Oyama et al., 2018) and lower than the values reported by Lampropoulou et al., 2019 (r=0.92), Winairuk et al., 2019 (r=0.95), and Cramer et al., 2020 (r=0.93). The discrepancy may be due to variety of balance disorders collected in this study to ensure the test's applicability in a wide range of abnormalities (Sofia et al., 2016; Hamre et al., 2017; Lemay et al., 2019).

In terms of test domains, there were a moderate to high correlations between the four domains of the mini-BESTest-Ar and the A-BBS. However , the r values are lower than those reported by Potter et al., 2019 who found excellent correlations between the total score of BBS and each domain of the mini-BESTest, the rho ranged from = 0.82 (Reactive Postural Control) to 0.94 (Stability in Gait) (Potter et al., 2019).

Specifically, there were moderate to high correlation between the total and domains scores of mini-BESTest-Ar and A-DGI except sensory orientation domain (rho=0.38). This is because, the DGI doesn't include items to test the static balance such as: stand with eyes open and eyes closed for evaluating the risk of falling (Miqdad et al., 2017).

Only one study tested the correlation between the mini-BESTest and DGI in elderly people with r = 0.80, 0.83, 0.84, and 1 for normal participants, paresis, parkinsonism, and vertigo patients respectively which was much higher than ours (Miqdad et al., 2017).

Mini-BESTest, on the other hand, showed moderate to high correlation with ABC (Tsang et al., 2013; Jácome et al., 2016; Potter et al., 2019), as well as significant correlation with TUG (Bergstrom et al., 2012; Sofia et al., 2016; Lampropoulou et al., 2019; Duchesne et al., 2020; Cramer et al., 2020).

This study revealed excellent internal consistency of mini-BESTest-Ar. The α value for total score was 0.96 which confirms the homogeneity of the test. This finding correlates with the already reported values in numerous studies with different samples with α ranged from 0.89 to 0.96 (Di Carlo et al., 2016). Moreover, in this study, the value of α was higher than that of Greek, German, and Spanish (α=0.88,0.90,and 0.85 respectively) (Sofia et al., 2016; Cramer et al., 2020; Bustamante-Contreras et al., 2020). The four domains of mini-BESTest demonstrated

very good internal consistency which is similar to previous studies with α ranged from 0.77 to 0.94 (Löfgren et al., 2014; Dominguez-Olivan et al., 2020).

In term of test-retest reliability, mini-BESTest-Ar showed excellent reliability with $ICC_{2,1}$ = 0.95, 95% CI= 0.88- 0.98 for total score which nearly equal to the previous studies (Sofia et al., 2016; Potter et al., 2019), Potter et al., 2019). However, mini-BESTest-Ar's ICC is higher than the value reported by Anson et al., 2019 (ICC = 0.84, 95% CI 0.73-0.90) (Anson et al., 2019).

Regarding the reproducibility of the test domains, the values of ICC were varied from 0.81 to 0.94 which are higher than those reported in Norwegian study (0.53–0.87) (Hamre et al., 2017), lower than ICC values reported by Winairuk et al., 2019 (0.95 – 0.98) and Naghdi et al., 2020, and nearly equal to ICCs estimated by Potter et al., 2019 (0.85 – 0.92).

The absolute reliability is possibly the most important reliability test for clinical uses (Hamre et al., 2017). In our study it's represented with SEM, MDC_{95}, MDC%, and LOA. For the mini-BESTest-Ar total score, the SEM and MDC_{95} generated during our study fall well within the range of what was previously reported in the systematic review by Di Carlo et al., 2016 (SEM= 0.86 – 1.26) and (MDC_{95}= 3 - 4.1) (Di Carlo et al., 2016). In French version, the SEM = 1.05 and MDC_{95} = 2.91 (Lemay et al., 2019) and for the Norwegian version the SEM =1.78 and 1.88 (Hamre et al.,

2017), which are nearly comparable to our value. In addition, our results were supported by the results of potter et al., 2019 (SEM = 1.32, MDC_{95} = 3.74), and recently by a study applied on stroke patients with the SEM = 1.1 and MDC_{95} = 3.2 (Potter et al., 2019; Beauchamp et al., 2021).

Regarding to the tests' domains, our results were similar to Potter et al., 2019, higher than Dominguez-Olivan et al., 2020 , and slightly lower than Beauchamp et al., 2021 (Potter et al., 2019; Dominguez-Olivan et al., 2020; Beauchamp et al., 2021).This may be explained by differences in protocols between the studies.

Our MDC_{95} value (3.29) was near to the value of 3 reported by Tsang et al., 2013 and confirms that a change between 3 and 5 points on this scale is required to be considered as a real change (Tsang et al., 2013). Subsequently, the small SEM of total score of mini-BESTest-Ar suggesting that it is a precise test with little measurement errors (Potter et al., 2019). The MDC values provide clinicians with useful parameters for interpreting changes in patients' functions and setting goals. The MDC% (16.45%) was acceptable and higher than the reported MDC% in patients with COPD (14.9%) and in patients with spinal cord injury (13.7%) (Jácome et al., 2016; Roy et al., 2021).

The homoscedasticity of variations between scoring, seen on the Bland-Altman plot proves the absence of systematic errors and supports the use of an absolute versus relative MDC_{95} (Lemay et al., 2019). Meanwhile, Bland-Altman plot was performed since that high correlation do not necessarily imply an agreement (Cramer et al., 2020). Our results are compatible with previous studies (Jácome et al., 2016; Lemay et al., 2019; Cramer et al., 2020).

With AUC=0.85, it was higher than we anticipated. In a systematic review by Di Carlo et al., the ROC was used in nine studies to distinguish between different populations such as Parkinson's disease, stroke, and the elderly. Our values fall well within the AUC range of 0.64 to 0.91, sensitivity of 62 % to 89 %, and specificity of 64% to 81% (Di Carlo et al., 2016).

One study on myotonic dystrophy patients had similar value as in this study (AUC =0.87) (Duchesne et al., 2020). Meanwhile, two studies measured the ability of mini-BESTest to distinguish between improved and unchanged stroke patients have lower values of AUC (0.71 to 0.77) (Winairuk et al., 2019; Beauchamp et al., 2021), with sensitivity of one study of 93% and specificity of 43% which are unsimilar to our values (Winairuk et al., 2019).

Two studies were conducted to assess the ability of mini-BESTest to determine the fall status on COPD and PD patients had an AUC ranged 0.65 – 0.74 with sensitivity starting from 52% to 68% and specificity starting from 65% to 70% (Jácome et al., 2016; Schlenstedt et al., 2016).

Additionally, we found no floor effect for the total and domains scores of mini-BESTest-Ar which is consistent with earlier researches in different populations (Sofia et al., 2016; Hamre et al., 2017; Lemay et al., 2019; Bustamante-Contreras et al., 2020; Cramer et al., 2020). Mini- BESTest, on the other hand, demonstrated a floor effect at baseline only in a 2019 study on patients with subacute stroke, and authors justified this by that mini-BESTest containing some items that are more difficult to do by patients with subacute stroke (Winairuk et al., 2019).

In line with our findings, a research of MS patients conducted in 2019 revealed ceiling effects in two domains: reactive postural control (37.5%) and sensory orientation (53.1%)(Potter et al., 2019). Based on the literature, they suggested that the clinicians should apply the whole test on the patients; because few patients did well in some domains but not in the entire test (Potter et al., 2019).

Furthermore, in our study, only one participant received the minimum and maximum total mini-BESTest-Ar score. These results may be due to the recruitment of participants who are independently ambulatory with different walking capabilities (Lemay et al., 2019; Potter et al., 2019).

Limitations

Several limitations of this study need to be acknowledged. The sample size was relatively small, even though it was higher than previous studies (Leddy et al., 2011; Bergstrom et al., 2012; Maia et al., 2013; Löfgren et al., 2014; Jácome et al., 2016; Hamre et al., 2017; Oyama et al., 2018; Potter et al., 2019; Cramer et al., 2020; Naghdi et al., 2020). Due to the relatively small sample size, we were unable to test further psychometric properties such as confirmatory factor analysis. Another issue was the convenience sample that was used, which affected the extent of the results produced.

Furthermore, the sample was drawn from a single Arab country (Saudi Arabia) however, this will have a minor impact on the generalizability of the results because the mini-BESTest was translated and adapted using Modern Standard Arabic, which is the language used in books, newspapers, magazines, media, formal speech, and communications, as well as the most common form of Arabic taught in primary schools in all Arab countries. Finally, the participants were ambulatory, which may have contributed to the lack of a floor effect;

additionally, results could not be generalized to patients with cognitive and severe neurological disabilities.

Clinical implications

This study provided a comprehensive, valid, reliable, and sensitive tool to assess balance and help decision making for Arabic patients with neurological balance impairment.

Chapter VI
Summary, Conclusion and Recommendations

Chapter VI

Summary

Summary

Background

Balance is an essential part in everyday movement and activity and is controlled by interacting of different physiological systems, which are influenced by numerous types of disorders which may cause balance impairments. Mini-BESTest is an assessment tool developed to comprehensively assess balance and detect which balance system fault leads to imbalance. Mini-BESTest is a short form of the BESTest which integrates clinical balance tests already in use with new items.

Its easiness in use, capability to detect the affected system of balance control, and the good psychometric properties make it a valuable tool for balance assessment. The test contains four domains: anticipatory postural adjustments, postural response, sensory orientation, and gait stability with 14-items. Each item rated on a 3-level ordinal scale ranging from 0 (severe balance impairment) to 2 (no balance impairment) with 28 as a global test score. The higher score indicates better balance.

Mini-BESTest has been validated on different populations and translated to various languages. However, no prescribed Arabic version of the mini-BESTest is available.

Objectives

This study aimed to:

1. Translate and cross-culturally adapt the mini-BESTest to Arabic language.
2. Investigate the construct validity of the of mini-BESTest-Ar.
3. Investigate the relative test-retest reliability and internal consistency of mini-BESTest-Ar.
4. Investigate the absolute reliability (measurement of error, MDC_{95}-MDC%, and LOA between the mini-BESTest-Ar scores at baseline and the subsequent administration).
5. Examine the floor and ceiling effects.
6. Examine the responsiveness, accuracy, and sensitivity to change for mini-BESTest-Ar.

Method

Mini-BESTest was translated and culturally adapted according to the established guidelines by Beaton et al., 2000, to then obtain face and content validity by an expert committee. It was piloted to 5 physical therapists for word comprehension and pre-tested on 10 patients with different neurological disorders. Psychometric properties of the mini-BESTest-Ar were investigated on a convenience sample of 56 participants aged from 18 to 71 year: 38 men and 18 women. They were recruited from Prince Sultan bin Abdul-Aziz Humanitarian city. The

collected data were statistically treated using IBM SPSS (version 18); a statistically significant level was set at 0.05. Data were represented as mean ± SD for normally distributed variables, and as median and range for non-normally distributed variables.

To confirm the construct validity of mini-BESTest-Ar, it was correlated with A-BBS and the A-DGI. According to the normality test, either Pearson or Spearman correlations were used.

Relative reliability was determined by calculating (1) Internal consistency using Cronbach α, (2) Test-retest reliability using $ICC_{2,1}$ and Pearson's/Spearman's correlation with 7- 10 days interval.

Absolute reliability with, SEM, MDC_{95}, MDC% and LOA were examined. Furthermore, the diagnostic accuracy: AUC, cut-off point, sensitivity, and specificity of mini-BESTest-Ar were estimated using ROC curve. Finally, floor and ceiling effects were measured.

Findings.

The results showed:

1. The translation process was completed without any difficulties. The comprehension and relevance of the scale were confirmed.
2. The experts committee advised to replace "dynamic speed" by "walking speed". The test's units were all changed to the worldwide metric system (feet to meters, inches to centimeters).

3. Fifty-six participants with different neurological conditions were recruited with median and range of age of 34 and 53 respectively (min.:18, max.:71 year).
4. The mean ± SD of BMI was 26.6 ± 5.6. Most of the participants (67.9%) were men. About 35.7% were diagnosed with stroke followed by TBI (28.6 %) and SCI (14.3%).
5. The results of content validity elaborated excellent I-CVI for all items (I-CVI=1). The S-CVI was excellent, with values of 1 for both (S-CVI/Ave) and (S-CVI/UA). The P_c value was 0.031 for all items and K^* for each item was excellent (>0.74)
6. The total score of mini-BESTest-Ar, as well as its four domains demonstrated high to moderate significant positive correlation with A-BBS: r=0.80 for total. For domains, r value ranged from 0.81 (Sensory orientation) to 0.62 (Dynamic gait).
7. Regarding the A-DGI, there was a moderate to high positive correlation with the total mini-BESTest-Ar score and its four domains except sensory orientation domain (rho=0.38, P= 0.004).
8. The results confirmed 90% of our predefined 10 hypotheses indicating that mini-BESTest-Ar had very good construct validity. The total score of mini-BESTest-Ar showed excellent internal consistency (α =0.96), while for its domains, it ranged from 0.81

(reactive postural control domain) to 0.94 (anticipatory domain). The test-retest reliability of the total score was ($ICC_{2,1}$= 0.95, 95% CI= 0.88- 0.98). For domains, the $ICC_{2,1}$ ranged from 0.81 (reactive postural control domain) to 0.94 (anticipatory domain). The four domains had moderate to high test-retest reliability, with r values =0.68, P =0.00 and 0.90, P =0.00 for reactive postural control and anticipatory domain respectively. Furthermore, Pearson's correlation for total score yielded excellent results (r = 0.92, P = 0.00).

9. The mini-BESTest-Ar showed SEM=1.19, MDC_{95}=3.29, and MDC%=16.45%. The SEM for the domains varied from 0.31 (sensory orientation) to 0.88 (reactive postural control). The MDC_{95} ranged from 0.86 (sensory orientation) to 2.43 (reactive postural control) across the four domains. The Bland-Altman analysis showed no measurement errors or proportional bias.
10. The sensitivity of mini-BESTest-Ar was tested with 29 participants. An AUC value of =0.85 which confirm moderate accuracy. With cutoff point=21.5, the sensitivity =75% and specificity =75%.
11. No floor effect was reported for the total and domains' score of mini-BESTest-Ar. All domains had no ceiling effect except reactive postural control (21.4%) and sensory orientation domains (57.1%).

For the total scale only one participant achieved the maximum and minimum possible scores.

Conclusion

The mini-BESTest-Ar is comprehensible and clear. Excellent psychometric properties verify that mini-BESTest-Ar could be applied to Arabic adult patients with different neurological balance disorders in rehabilitation and research settings.

Recommendations

1. It is highly recommended to validate the mini-BESTest-Ar on a specific balance disorder with more homogenous sample to confirm its validity to measure dynamic and static balance.
2. Further studies with considerably larger sample size are recommended to investigate other psychometric properties such as confirmatory factor analysis.
3. Further studies may include severe cases such as non-ambulatory patients or ambulatory with different assistive devices other than the cane, cognitive disorders, and pervious to rehabilitation program. It was supposed to measure balance periodically during rehabilitation using mini-BESTest to measure its ability to detect changes.

Chapter VII
References

Chapter VII

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Chapter VIII
Appendices

Appendix 8.1: The Collage of Medicine - King Saud University Ethical Approval

Kingdom of Saudi Arabia
King Saud University (KSU)
p.o. Box 7805 Riyadh 11472
Tel: +966 11 467 00 11
Fax: +96611 467 19 92
http://medicalcity.ksu.edu.sa

المملكة العربية السعودية
جامعة الملك سعود (KSU)
ص.ب ٧٨٠٥ الرياض ١١٤٧٢
هاتف ٠٠ ١١ ٤٦٧ ٠٠ ١١+
فاكس ١٩٢٣ ٤٦٧ ١١+

جامعة الملك سعود
King Saud University

المدينة الطبية الجامعية
Institutional Review Board

25.08.2020 (06.01.1442)
Ref. No. 20/0647/IRB

To: **Ms. Noha Ibrahim Alyousef**
Master Student in Physical Therapy
Department of Rehabilitation
King Saud University College of Applied Medical Sciences
Email: 439204063@student.ksu.edu.sa, No.ni28@hotmail.com
Principal Investigator

CC: Dr. Afaf Ahmed Shaheen – ashaheen@ksu.edu.sa
Supervisor

Subject: **IRB Approval on Research Project No. E-20-4835**
Study Title: "Arabic Version of Mini-Balance Evaluation Systems Test (Mini-BESTest): Transcultural adaptation and analysis of psychometric properties for patients with neurological balance disorders"
Type of Review: Full-Board
Date of Approval: 24 August 2020
Date of Expiry: 24 August 2021

Dear Ms. Noha Ibrahim Alyousef,

Thank you for your response to the comments of the Board regarding the above-mentioned research project which was initially reviewed and discussed in the IRB Meeting 08 held on 23 April 2020 (30 Sha'ban 1441). The revised proposal submitted in response to the comments of the board and the clarifications provided are satisfactory. You are now granted permission to conduct this study after SFDA registration of this clinical trial with the following documents which were reviewed and approved by the board:

Please be informed that in conducting this study, you as the principal investigator, are required to abide by the rules and regulations of the Government of Saudi Arabia, the KSUMC IRB policies and procedures and the ICH-GCP Guidelines. This approval shall remain valid until the expiry date noted above assuming timely and acceptable responses from the IRB's periodic requests for surveillance and monitoring information, with the following terms and conditions:

1. **Modifications to Research/ Amendments to the approved project:** any modifications to the research (including changes to the informed consent document(s) must receive IRB approval prior to implementation of the changes. Substantial variations may require new submission.
2. **Annual Reports:** continued approval of this project is dependent on the submission of annual reports. If you wish to have your protocol approved for continuation, please submit a completed request for reapproval of an approved protocol form (KSU-IRB 017E) at least 30 days before the expiry date. Failure to receive approval for continuation before the expiration date will result in automatic suspension of the approval of this protocol on the expiration date. Information collected following suspension is unapproved research and can never be reported or published as research data.
3. All unforeseen events that might affect continued ethical acceptability of the project should be reported to the IRB as soon as possible.

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المملكة العربية السعودية
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هاتف ٠٠ ١١ ٤٦٧ ٠٠١١ +٩٦٦
فاكس ١٩٩٢ ٤٦٧ ١١ ٤٦٧ +٩٦٦

جامعة الملك سعود
King Saud University

المدينة الطبية الجامعية
Institutional Review Board

4. Any serious unexpected adverse events should be reported within 48 hours (2 days).
5. Personal identifying data should only be collected when necessary for research.
6. Secondary disclosure of personal identifiable data is not allowed.
7. **Monitoring:** projects may be subject to an audit or any other form of monitoring by the IRB at any time.
8. **Retention and storage of data:** the PI is responsible for the storage and retention of original data pertaining to the project for a minimum period of five (5) years. Data should be stored securely so that a few authorized users are permitted access to the database.
9. **Future correspondence:** please quote the project number and project title above in any further correspondence.

The IRB is registered with the Office for Human Research Protection (OHRP) with OHRP Institution Registration No.: IORG0006829, OHRP IRB Registration No.: IRB00008189 and IRB KACST Registration No.: H-01-R-002. It is authorized to conduct the ethical review of clinical studies and operates in accordance with ICH-GCP Guidelines and all applicable national/local and institutional regulations and guidelines which govern Good Clinical Practices.

We wish you success in your research and request you to keep the IRB informed about the progress of the study on a regular basis by submitting a *Study Progress Report* every 6 months and a *Final Report* when the study has been completed.

Thank you!

Sincerely yours,

Prof. Abdulrahman AlSultan
Chairman of IRB
Health Sciences Colleges Research on Human Subjects
King Saud University College of Medicine
P. O. B ox 7805 Riyadh 11472 K.S.A.
Email: aalsultan1@ksu.edu.sa

كلية الطب
لجنة أخلاقيات البحوث الطبية
College Medicine
Institutional Review Board (IRB)

/rubie

Appendix 8.2: Prince Sultan bin Abdul-Aziz Humanitarian City Ethical Approval

مدينة سلطان بن عبد العزيز للخدمات الإنسانية
SULTAN BIN ABDULAZIZ HUMANITARIAN CITY

Date: 06/09/2020
IRB No.: 29-2020-IRB

To: **Ms. Noha AlYousef**
PI: "Arabic Version of Mini-Balance Evaluation Systems Test (Mini-BESTest): Transcultural adaptation and analysis of psychometric properties for patients with neurological balance disorders."
King Saud University
E-mail: 439204063@student.ksu.edu.sa
Co-Investigator: Ms. Lamia Faleh Al-Faleh
Sultan Bin Abdulaziz Humanitarian City
E-mail: lfaleh@sbahc.org.sa

Subject:	Approval for Research No. 25/MSc/2020
Study Title:	"Arabic Version of Mini-Balance Evaluation Systems Test (Mini-BESTest): Transcultural adaptation and analysis of psychometric properties for patients with neurological balance disorders'
Study Code:	25/MSc/2020
Date of Approval:	03/09/2020
Date of Expiry:	03/11/2021
Board approval:	All members except Ms. Samaher Abu Samrah

Dear Ms. Noha,

Your Project has been approved and you have the permission to conduct this study following your submitted documents as follow:

1. Curriculum Vitae for the PI researcher
2. Letter from the researcher requesting SBAHC participation in the clinical study
3. Letter from the researcher's supervisor requesting supervision in the clinical study
4. Research proposal according to SBAHC IRB Guidelines
5. SBAHC Informed Consent Template (English/Arabic)
6. Research Obligatory Agreement. Available upon the completion of the other requirements

You are required to obey by the rules and regulations of the Government of Saudi Arabia, the SBAHC IRB Policies and procedures and the ICH-GCP guidelines. You have to note that this approval mandate responding to IRB's periodic request and surveillance result. Drawing your attention to the following:

Page 1 of 2

- Amendment of the project with the required modification to providing Periodical report for this project specially when study extension is required or expiry before study completion
- All unforeseen events that might affect continued ethical acceptability of the project should be reported to the IRB as soon as possible
- Any serious unexpected adverse events should be reported within 48 hours (2 days)
- Personal identifying data should only be collected when necessary for research.
- Secondary disclosure of personal identifiable data is not allowed.
- Monitoring: projects may be subject to an audit by the IRB at any time.
- The PI is responsible for the storage and retention of original data pertaining to the project for a minimum period of five (5) years.
- Data should be stored securely so that a few authorized users are permitted access to the database.

The IRB registered with the IRB KACST Registration No. H-01-R-090. It is authorized to conduct the ethical review of clinic studies and operates in accordance with ICH-GCP Guidelines and all applicable national/local and institutional regulations and guidelines which govern Good Clinical Practices.

For Future Correspondence, please quote the project number and project title above and you are requested to keep IRB informed about your study progress and submit project progress report every six (6) months. A final report should be provided upon completion of the study.

Wish you a success in your research project.

Yours sincerely,

Prof. Khalid Al-Rubeaan
Chairman-IRB
Sultan Bin Abdulaziz Humanitarian City

Appendix 8.3: Informed consent

جامعة الملك سعود
King Saud University

نموذج الموافقة على المشاركة في بحث:

النسخة العربية للنسخة المصغرة من اختبار تقييم أنظمة التوازن والتكيف الثقافي وتحليل الخصائص السيكو مترية مع المرضى الذين يعانون من اضطرابات التوازن العصبي

الأخ والأخت المراجع/ة الأعزاء نرجو منكم المشاركة في بحث علمي يهدف إلى ترجمة اختبار تقييم أنظمة التوازن إلى اللغة العربية والتأكد من صحة ومصداقية هذا الاختبار في تحديد الأنظمة التي تسبب الخلل في التوازن على عينة من المرضى العرب الذين يعانون من اضطرابات التوازن العصبية. ولقد تم اختيارك للمشاركة لأنك تتوافق مع خصائص العينة المطلوبة. ويشمل هذا البحث على بعض اختبارات التوازن التي ستطبق عليك، وستساعد هذه الدراسة المختصين والباحثين في المجال الطبي على فهم أفضل وتقييم أكثر دقة للمرضى المتحدثين باللغة العربية.

سيتطلب منك الحضور مرتين خلال أسبوعين لعمل الفحص الأول في المرة الأولى ثم إعادته في المرة الثانية. وسيكون عليك ارتداء ملابس مريحه وحذاء مناسب والاستمرار على تناول الأدوية الخاصة بكم خلال فترة البحث. من المهم اتباع تعليمات التقييم من الأخصائي/ة المشرف/ة على حالتك واعلامه/ا في حال حدوث أي أعراض جانبية.

في حالة موافقتك على المشاركة في هذا البحث، فإن بياناتك الشخصية والصحية سوف تكون محفوظة بسرية تامة ولن يطلع عليها إلا الباحث والمشرف على هذا البحث، وسوف تستخدم لغرض البحث العلمي فقط. المشاركة في البحث تطوعية ولا يوجد أي عقوبات أو حرمان من العلاج في حال عدم قبولك المشاركة في البحث، ويحق لك الانسحاب أو قطع المشاركة في أي وقت. لا يترتب على المشارك دفع أي مبالغ مالية في حال قبوله المشاركة في البحث.

عند ظهور أي نتائج جديدة خلال فترة الدراسة من الممكن أن تؤثر على رغبة المشارك/ة في الاستمرار بالبحث سيتم ابلاغكم بها. ومن الممكن أنه تحت ظهور ظروف غير متوقعة من حق الباحثة أن تلغي اشتراكك في البحث دون اعتبار لموافقتكم المسبقة. وهناك احتمالية أن نتائج هذه الدراسة لمجمل الحالات سوف تنشر في المجلات العلمية بدوم أي تفاصيل تخص المشارك. ويمكنك الاتصال بالباحثة إذا أردت الاطلاع على نتائج البحث.

لا تتردد في سؤال الباحث إذا كان لديك أي استفسار يخص البحث. في حال وجود أي استفسار لديكم بإمكانكم التواصل مع الباحثة مباشرة من خلال الرقم الموضح أدناه.

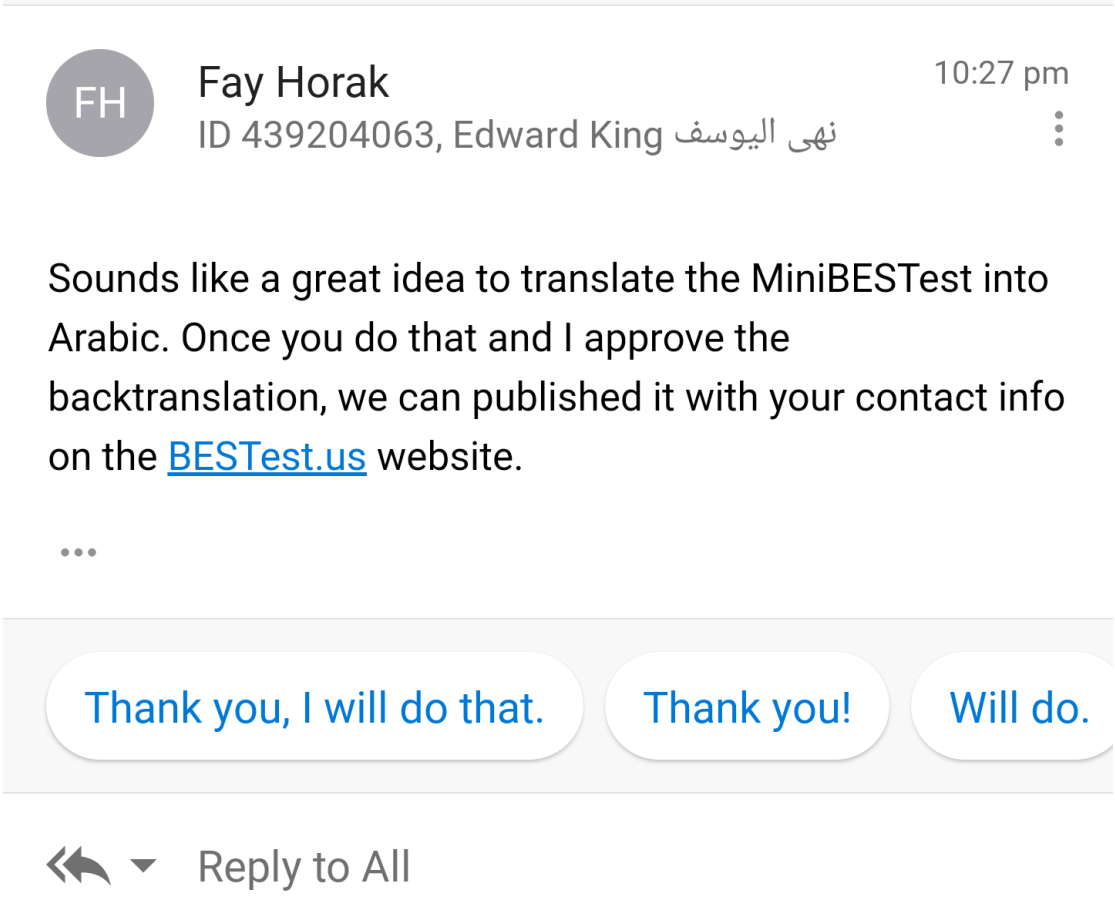
الاسم:.....
التوقيع:.....

اسم الباحثة:

نهى إبراهيم اليوسف

0554379981

Appendix 8.4: Permission from the main developer of the test



Appendix 8.5: Mini-BESTest-Ar

النسخة المصغرة من اختبار تقييم أنظمة التوازن: اختبار تقييم أنظمة التوازن

التوقعات **الدرجة الفرعية: --/6**

---

1. الوقوف من وضع الجلوس

التعليمات: "ضع ذراعيك متقاطعتين أمام صدرك. حاول ألا تستخدم يديك إلا إذا كان ذلك ضروريًا. لا تدع ساقيك تتكئا على الجزء الخلفي من الكرسي عند الوقوف. يرجى الوقوف الآن".

← **(2) طبيعي:** يقف بدون استخدام اليدين ويتوازن مستقلًا.

← **(1) متوسط:** يقف مع استخدام اليدين في المحاولة الأولى.

← **(0) شديد:** غير قادر على الوقوف من الكرسي بدون مساعدة، أو يحتاج إلى عدة محاولات باستخدام اليدين.

2. الوقوف على أصابع القدمين

التعليمات: " قف مع إبقاء المسافة بين قدميك مساوية لعرض كتفيك. ضع يديك على الوركين. حاول أن ترتفع على أصابع قدميك لأعلى ما يمكن. سوف أعد بصوت عالٍ حتى 3 ثوانٍ. حاول الاحتفاظ بهذه الوضعية لمدة 3 ثوانٍ على الأقل. انظر للأمام. ارفع الآن ".

← **(2) طبيعي:** متزن لمدة 3 ثوانٍ مع أقصى ارتفاع.

← **(1) متوسط:** الكعبان مرتفعان، ولكن ليس للمدى الحركي الكامل (أقل مما هو عليه عند الإمساك باليدين)، أو عدم اتزان ملحوظ لمدة 3 ثوانٍ.

← **(0) شديد:** ≥ 3 ثوان.

3. الوقوف على رجل واحدة

التعليمات: "انظر إلى الأمام مباشرةً. ضع يديك على الوركين. ارفع رجلك عن الأرض للخلف بدون أن تلامس رجلك المرفوعة الرجل المرتكزة على الأرض أو أن تستند عليها. ابق واقفًا على رجل واحدة قدر الإمكان. انظر للأمام. ارفع الآن "

الأيسر: الوقت بالثواني (التجربة 1: --, التجربة 2:---)

← **(2) طبيعي:** 20 ثانية.
← **(1) متوسط:** <20 ثانية.
← **(0) شديد:** غير قادر.

الأيمن: الوقت بالثواني (التجربة 1: --, التجربة 2:---)

← **(2) طبيعي:** 20 ثانية.
← **(1) متوسط:** <20 ثانية.
← **(0) شديد:** غير قادر.

لتسجيل كل جانب على حدة، استخدم التجربة ذات الوقت الأطول.

لحساب الدرجة الفرعية والنتيجة الإجمالية، استخدم الجانب [الأيسر أو الأيمن] ذي الدرجة الرقمية الأقل [أي الجانب الأسوأ].

التحكم الوضعي التفاعلي **الدرجة الفرعية: --/6**

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4. تصحيح الخطوة التعويضية – الأمامية

التعليمات: "قف مع إبقاء المسافة بين قدميك مساوية لعرض كتفيك، والذراعين على جانبيك. انحنِ إلى الأمام على يدي للحد الأمامي الأقصى. عندما أتركك افعل كل ما هو ضروري، بما في ذلك اتخاذ خطوة لتجنب السقوط ".

← **(2) طبيعي:** يستعيد توازنه مستقلًا بخطوة واحدة كبيرة (يُسمح بخطوة تعويضية ثانية).
← **(1) متوسط:** يستخدم أكثر من خطوة لاستعادة التوازن.
← **(0) شديد:** لم يتخذ أي خطوة، أو سيسقط إذا لم يتم الإمساك به، أو يسقط تلقائيًا.

5. تصحيح الخطوة التعويضية – الخلفية

التعليمات: "قف مع إبقاء المسافة بين قدميك مساوية لعرض كتفيك، والذراعين على جانبيك. انحنِ للخلف على يدي للحد الخلفي الأقصى. عندما أتركك افعل كل ما هو ضروري، بما في ذلك اتخاذ خطوة لتجنب السقوط ".

← **(2) طبيعي:** يستعيد توازنه مستقلًا بخطوة واحدة كبيرة.
← **(1) متوسط:** يستخدم أكثر من خطوة لاستعادة التوازن.
← **(0) شديد:** لم يتخذ أي خطوة، أو سيسقط إذا لم يتم الإمساك به، أو يسقط تلقائيًا.

6. تصحيح الخطوة التعويضية– الجانبية

التعليمات: "قف على قدميك معًا، والذراعين على جانبيك. انحنِ على يدي للحد الجانبي الأقصى، عندما أتركك افعل كل ما هو ضروري، بما في ذلك اتخاذ خطوة لتجنب السقوط ".

اليسار **اليمين**

← **(2) طبيعي:** يستعيد توازنه مستقلًا بخطوة واحدة (بخطوة متقاطعة أو جانبية).

← **(1) متوسط:** عدة خطوات لاستعادة التوازن.

← **(0) شديد:** يسقط، أو لا يستطيع أن يخطو.

← **(2) طبيعي:** يستعيد توازنه مستقلًا بخطوة واحدة (بخطوة متقاطعة أو جانبية).

← **(1) متوسط:** عدة خطوات لاستعادة التوازن.

← **(0) شديد:** يسقط، أو لا يستطيع أن يخطو.

استخدم الجانب ذي الدرجة الأدنى لحساب الدرجة الفرعية والنتيجة الإجمالية.

التوجه الحسي **الدرجة الفرعية: --/6**

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7. الوقوف (القدمان متلاصقتان)؛ العينان مفتوحتان، سطح صلب

التعليمات: "ضع يديك على الوركين. ضع قدميك معًا حتى تتلامس. انظر للأمام. كن متوازنًا وثابتًا بقدر الإمكان حتى أقول توقف ".

الوقت بالثواني:

← **(2) طبيعي:** 30 ثانية.

← **(1) متوسط:** <30 ثانية.

← **(0) شديد:** غير قادر.

8. الوقوف (القدمان متلاصقتان)؛ العينان مغلقتان، سطح إسفنجي

التعليمات: "خذ خطوة على السطح الإسفنجي، ضع يديك على الوركين. ضع قدميك معًا حتى تتلامس. كن متوازنًا وثابتًا بقدر الإمكان حتى أقول توقف. سأبدأ التوقيت عندما تغمض عينيك ".

الوقت بالثواني؛

← **(2) طبيعي:** 30 ثانية.

← **(1) متوسط:** <30 ثانية.

← **(0) شديد:** غير قادر.

9. سطح مائل، العينان مغلقتان

التعليمات: "خذ خطوة على السطح المائل. يُرجى الوقوف على السطح المائل مع أصابع قدميك نحو الأعلى. اجعل المسافة بين قدميك مساوية لعرض كتفيك وضع ذراعيك على جانبيك. سأبدأ التوقيت عندما تغمض عينيك ".

الوقت بالثواني؛

← **(2) طبيعي:** يقف مستقلًا لمدة 30 ثانية ويتوافق مع الجاذبية.

← **(1) متوسط:** يقف مستقلًا <30 ثانية أو محاذاة للسطح.

← **(0) شديد:** غير قادر.

المشية الديناميكية **الدرجة الفرعية: --/10**

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10. التغيير في سرعة المشي

التعليمات: "ابدأ في المشي بسرعتك المعتادة، عندما أخبرك" بسرعة "، امشِ بأسرع ما يمكن. عندما أقول "أبطئ"، امشِ ببطء شديد".

← **(2) طبيعي:** يغير إلى حد كبير سرعة المشي دون اختلال التوازن.

← **(1) متوسط:** غير قادر على تغيير سرعة المشي **أو** ظهور علامات اختلال التوازن.

← **(0) شديد:** غير قادر على تحقيق تغيير كبير في سرعة المشي **مع** اختلال التوازن.

11. المشي مع التفاف الرأس – أفقيًا

التعليمات: "ابدأ في المشي بسرعتك المعتادة، عندما أقول" يمينًا، أدر رأسك وانظر إلى اليمين. عندما أقول "يسارًا" أدر رأسك وانظر إلى اليسار. حاول أن تمشي في خط مستقيم ".

← **(2) طبيعي:** يلف الرأس دون تغيير في سرعة المشي مع توازن جيد.

← **(1) متوسط:** يلف الرأس مع تقليل سرعة المشي.

← **(0) شديد:** يلف الرأس مع اختلال التوازن.

12. المشي مع الدوران حول نقطة الارتكاز

التعليمات: "ابدأ في المشي بسرعتك المعتادة، عندما أقول لك "در وتوقف"، در بأسرع ما يمكن، وواجه الاتجاه المعاكس، وتوقف. بعد الدوران، يجب أن تكون قدماك متقاربتان ".

← **(2) طبيعي:** يدور مع تقارب القدمين بسرعة (≤ 3 خطوات) مع توازن جيد.

← **(1) متوسط:** يدور مع تقارب القدمين ببطء (≤ 4 خطوات) مع توازن جيد.

← **(0) شديد:** لا يستطيع الدوران مع تقارب القدمين بأي سرعة دون اختلال التوازن.

13. المشي مع تخطي العقبات

التعليمات: "ابدأ في المشي بسرعتك المعتادة، عندما تصل إلى الصندوق، تخطه، ولا تلتف حوله واستمر في المشي ".

← **(2) طبيعي:** قادر على تخطي الصندوق بأقل تغيير في سرعة المشي مع توازن جيد.

← **(1) متوسط:** يمشي ويخطو فوق الصندوق، ولكنه يلمسه **أو** يظهر سلوكًا حذرًا عن طريق إبطاء المشي.

← **(0) شديد:** غير قادر على تخطي الصندوق **أو** يخطو حوله.

14. القيام والمشي الموقوت مع المهمة المزدوجة (مشي ثلاثة أمتار)

تعليمات اختبار القيام والمشي الموقوت: "عندما أقول" انطلق"، قف من الكرسي، وامشِ بسرعتك المعتادة واتبع الشريط الملصق على الأرض، واستدر، وعُد للجلوس على الكرسي."

تعليمات اختبار القيام والمشي الموقوت مع المهمة المزدوجة: "عد تنازليًا بمقدار ثلاثة أرقام بدءًا من رقم ___. عندما أقول "انطلق"، قف من الكرسي، امشِ بسرعتك المعتادة واتبع الشريط الملصق على الأرض، واستدر، وعُد للجلوس على الكرسي. استمر في العد التنازلي طوال الوقت".

اختبار القيام والمشي الموقوت: _____ ثواني. **اختبار القيام والمشي الموقوت مع المهمة المزدوجة:** _____ ثواني.

← **(2) طبيعي:** لا يوجد تغيير ملحوظ في الجلوس أو الوقوف أو المشي أثناء العد التنازلي عند مقارنته باختبار القيام والمشي الموقوت بدون المهمة المزدوجة.

← **(1) متوسط:** تؤثر المهمة المزدوجة إما على العد أو المشي (< 10٪) عند مقارنتها باختبار القيام والمشي الموقوت بدون المهمة المزدوجة.

← **(0) شديد:** يتوقف عن العد أثناء المشي أو يتوقف عن المشي أثناء العد.

عند تسجيل البند رقم 14، إذا تباطأت سرعة الشخص بأكثر من 10٪ بين اختبار القيام والمشي الموقوت بدون ومع المهمة المزدوجة، فيجب تقليل النتيجة بنقطة.

الدرجة الكلية: --/28

تعليمات النسخة المصغرة من اختبار تقييم أنظمة التوازن

حالة الشخص: يجب اختبار الشخص وهو يرتدي حذاءً بكعب مسطح أو بدون أحذية وجوارب.
المعدات: سطح إسفنجي (وتسمى أيضًا Airex foam, بسمك 2 إنش)، كرسي بدون مساند أذرع أو عجلات، سطح مائل، ساعة توقيت، صندوق (ارتفاع 9 بوصات أو 23 سم) ومسافة 3 أمتار تم قياسها وتمييزها على الأرض بشريط [من الكرسي].
الدرجات: نتيجة الاختبار هي **28 نقطة** كحد أقصى من **14 عنصرًا** يتم تسجيل كل منها من 0–2. يشير "0" إلى أدنى مستوى وظيفي و "2" إلى أعلى مستوى وظيفي.

إذا كان يجب على الشخص استخدام جهاز مساعد لأداء عنصر ما، فقم بتسجيل هذا البند بفئة واحدة (مستوى وظيفي) أقل.

إذا كان الشخص يحتاج إلى مساعدة بدنية لأداء عنصر ما، فقم بتسجيل "0" لهذا العنصر.

- **بالنسبة للبند رقم 3** (الوقوف على رجل واحدة) **والبند رقم 6** (خطوة تعويضية – جانبية) يشملان فقط درجة لجانب واحد (الدرجة الأسوأ).
- **بالنسبة للبند رقم 3** (الوقوف على رجل واحدة) اختر الوقت الأفضل من بين التجربتين [من جانب معين] ليتم احتسابها.
- **بالنسبة للبند رقم 14** (القيام والمشي الموقوت مع المهمة المزدوجة) إذا تباطأت سرعة الشخص بأكثر من 10٪ بين اختبار القيام والمشي الموقوت بدون ومع المهمة المزدوجة، فيجب تقليل النتيجة بنقطة.

1. الوقوف من وضع الجلوس	لاحظ بدء الحركة، واستخدام يدي الشخص على مقعد الكرسي، أو الفخذين، أو دفع الذراعين إلى الأمام.
2. الوقوف على أصابع القدم	اسمح بمحاولتين للشخص وسجل أفضل محاولة. (إذا كنت تشك في أن الشخص استخدم أقل من الارتفاع الكامل، فاطلب من الشخص أن يرتفع أثناء إمساك أيدي الفاحصين). تأكد من أن الشخص ينظر إلى هدف غير متحرك أمامه على بعد 4–12 قدمًا (1 – 3.5 مترًا تقريبًا).
3. الوقوف على رجل واحدة	اسمح بمحاولتين للشخص وسجل الأوقات. قم بتسجيل عدد الثواني التي يمكن للشخص أن يتحملها بحد أقصى 20 ثانية. توقف عن حساب الوقت عندما يبعد الشخص يديه عن وركيه أو يضع قدمه لأسفل. تأكد من أن الشخص ينظر إلى هدف غير متحرك أمامه 4–12 قدمًا (1– 3.5 مترًا تقريبًا). كرر على الجانب الآخر.
4. تصحيح الخطوة التعويضية – الأمامية	قف أمام الشخص واضعًا يديك على كتفيه واطلب منه أن يميل إلى الأمام (تأكد من وجود مساحة له لأخذ خطوة للأمام). اطلب من الشخص أن يميل للأمام حتى يصبح كتفاه ووركاه أمام أصابع قدميه. بعد أن تشعر بثقل جسم الشخص بين يديك، أبعد يديك عنه فجأة. يجب أن ينتج عن الاختبار خطوة للأمام. ملاحظة: كن مستعدًا لالتقاط الشخص ومنعه من السقوط.
5. تصحيح الخطوة التعويضية – الخلفية	قف خلف الشخص واضعًا يديك على لوحي كتفيه واطلب منه أن يميل للخلف (تأكد من وجود مساحة له لأخذ خطوة للخلف) اطلب من الشخص أن يميل حتى يصبح كتفاه ووركاه خلف كعبيه. بعد أن تشعر بثقل جسم الشخص بين يديك، أبعد يديك عنه فجأة. يجب أن ينتج عن الاختبار خطوة للخلف. ملاحظة: كن مستعدًا لالتقاط الشخص ومنعه من السقوط.

6. تصحيح الخطوة التعويضية – الجانبية	قف بجانب الشخص، وضع إحدى يديك على جانب حوضه، واجعله يميل جسمه بالكامل على يديك. دع الجسم يميل حتى يصبح خط منتصف الحوض أعلى القدم اليمنى (أو اليسرى) ثم اتركه فجأة. ملاحظة: كن مستعدًا لالتقاط الشخص ومنعه من السقوط.
7. الوقوف (القدمان متلاصقتان)؛ العينان مفتوحتان، سطح صلب	سجّل الوقت الذي كان فيه الشخص قادرًا على الوقوف وقدماه متلاصقتان حتى 30 ثانية كحد أقصى. تأكد من أن الشخص ينظر إلى هدف غير متحرك أمامه على بعد 4–12 قدمًا (1– 3.5 مترًا تقريبًا).
8. الوقوف (القدمان متلاصقتان)؛ العينان مغلقتان، سطح اسفنجي	استخدم سطحًا اسفنجيًا متوسط الكثافة، بسمك 4 بوصات. ساعد الشخص على الصعود عليه. سجّل الوقت الذي تمكن فيه الشخص من الوقوف في كل حالة بحد أقصى 30 ثانية. اطلب من الشخص النزول من السطح الاسفنجي بين المحاولات. اقلب السطحَ الاسفنجيَّ بين كل محاولة للتأكد من عودته لشكله.
9. سطح مائل، العينان مغلقتان	ساعد الشخص على الصعود للسطح المائل. بمجرد أن يغلق الشخص عينيه، ابدأ بحساب الوقت وسجل الوقت. لاحظ إذا كان هناك تأرجح مفرط.
10. التغيير في سرعة المشي	اسمح للشخص بأخذ 3–5 خطوات بالسرعة المعتادة، ثم قل "بسرعة". بعد 3–5 خطوات سريعة، قل "بطيء". اسمح ب 3–5 خطوات بطيئة قبل أن يتوقف الشخص عن المشي.
11.المشي مع التفاف الرأس – أفقيًا	اسمح للشخص بالوصول إلى السرعة المعتادة، وأعطِ الأوامر "يمينًا أو يسارًا" كل 3–5 خطوات. سجل إذا رأيت مشكلة في أي من الاتجاهين. إذا كان الشخص لديه مشاكل شديدة ومعيقة في الرقبة اسمح بحركات من الرأس والجذع.

12.المشي مع الدوران حول نقطة الارتكاز	اشرح الدوران حول نقطة الارتكاز للشخص. بمجرد أن يسير الشخص بالسرعة المعتادة، قل در وتوقف". احسب عدد الخطوات من "در" حتى يصبح الشخص ثابتًا. يمكن تحديد اختلال التوازن من خلال أخذ قاعدة دعم واسعة عند الوقوف، أو أخذ خطوات إضافية أو بحركة الجذع.
13.المشي مع تخطي العقبات	ضع الصندوق (9 بوصات أو ارتفاع 23 سم) على بعد 10 أقدام (3 متر تقريبًا) من مكان بدء الشخص بالمشي. استخدام صندوقي أحذية ملتصقين معًا يعمل بصورة جيدة لعمل هذه الأداة.
14.القيام والمشي الموقوت مع المهمة المزدوجة	استخدم وقت اختبار القيام والمشي الموقوت لتحديد تأثير المهمة المزدوجة. يجب أن يسير الشخص مسافة 3 أمتار. **اختبار القيام والمشي الموقوت:** اجعل الشخص يجلس ويسند ظهره على الكرسي. يحسب الوقت للشخص من اللحظة التي تقول فيها " انطلق" حتى يعود للجلوس. توقف عن التوقيت عندما يضع الشخص أردافه على قاعدة الكرسي ويكون ظهره مستندًا عليه. يجب أن يكون الكرسي صلبًا بدون أذرع للاستناد عليها. **اختبار القيام والمشي الموقوت مع المهمة المزدوجة:** أثناء الجلوس، حدد مدى السرعة والدقة التي يمكن للشخص أن يعد تنازليًا بمقدار ثلاثة أرقام بدءًا من رقم بين 100–90. ثم اطلب من الشخص أن يعد من رقم مختلف وبعد بضعة أرقام تقول "انطلق". احسب وقت الشخص من اللحظة التي تقول فيها "انطلق" حتى عودته إلى وضعية الجلوس. سجل أن المهمة المزدوجة تؤثر على العد أو المشي إذا تباطأت السرعة (> 10٪) من اختبار القيام والمشي الموقوت و/ أو ظهور علامات جديدة لاختلال التوازن.

Appendix 8.6: A-BBS

Appendix

مقياس بيرج للتوزان - الاصدار العربي - (A-BBS)

الأدوات المطلوبة :
كرسيين واحد له سنادات والأخر لا يوجد له سنادات - ساعة للوقت
قلم رصاص وورقة – مسطرة - جسم صلب أو وزن خفيف
الزمن : وقت التقييم من ١٥ إلى ٢٠ دقيقة

- عدد النقاط ١٤ نقطة من ٠ إلى ٤ درجة كل نقطة حسب تنفيذها (٥ مستويات للإجابة)
- يرجى شرح كل خطوة / أو إعطاء تعليمات كما هو مكتوب. عند التسجيل ، الرجاء تسجيل فئة أدنى ردا على ذلك ينطبق على كل بند.

	(النقاط من ٠-٤ لكل سؤال)	النقاط
١- الوقوف من وضع الجلوس : حاول عدم استخدام يديك للاعتماد أو (المساندة).	(٤) قادر على الوقوف بدون استخدام اليدين والثبات بدون مساندة . (٣) قادر على الوقوف بشكل ثابت باستخدام الأيدي. (٢) قادر على الوقوف باستخدام الأيدي بعد عدة محاولات. (١) يحتاج إلى مساعدة بسيطة للوقوف أو الثبات . (٠) يحتاج إلى مساعدة متوسطة أو قصوى للوقوف .	
٢- الوقوف بدون مساعدة . توصيات : الرجاء الوقوف لمدة دقيقتين دون أن تمسك أي شيء للثبات. (ملحوظة) إذا كان الشخص قادر على الوقوف ٢ لمدة دقيقتين دون مساعدة ، تسجل الدرجة كاملة أو أعلى درجة للجلوس دون مساعدة (وتنقل لسؤال رقم ٤) .	(٤) قادر على الوقوف بأمان لمدة دقيقتين . (٣) قادر على الوقوف لمدة دقيقتين مع المراقبة. (٢) قادر على الوقوف لمدة ٣٠ ثانية دون مساعدة. (١) يحتاج إلى عدة محاولات للوقوف لمدة ٣٠ ثانية دون مساعدة. (٠) غير قادر على الوقوف لمدة ٣٠ ثانية بدون مساعدة .	
٣- الجلوس مع عدم سند الظهر ولكن القدم مسنودة على الأرض أو مقعد توجيهات : يرجى الجلوس مكتوفي الأيدي لمدة ٢ دقيقة.	(٤) قادر على الجلوس في امن وأمان لمدة دقيقتين. (٣) قادر على الجلوس لمدة دقيقتين تحت الملاحظة. (٢) قادر على الجلوس لمدة ٣٠ ثانية. (١) قادر على الجلوس لمدة ١٠ ثوان . (٠) غير قادر على الجلوس دون دعم أو مساعدة لمدة ١٠ ثوان.	
٤- الجلوس من وضع الوقوف . توجيهات : أرجو الجلوس .	(٤) يجلس بأمان مع استخدامه البسيط للأيدي . (٣) التحكم بالنزول باستخدام اليدين. (٢) يستخدم ساقه من الخلف ضد كرسي للسيطرة على النزول. (١) يجلس بشكل ثابت ولكنه غير متحكم في نزوله . (٠) يحتاج لمساعدة في الجلوس .	
٥- عمليات النقل أو الحركة . توجيهات: ترتيب الكراسي لنقل محوري . تسأل الشخص إلى التحرك بطريقة واحدة تجاه كرسي به سنادات لمساندة الذراعين وأخر بدون سنادات (من الممكن استخدام كرسيين أو كرسي وسرير) .	(٤) قادر على الانتقال بأمان مع استخدام بسيط للأيدى . (٣) قادر على الانتقال بأمان وحاجة للاستخدام اللابدى. (٢) قادر على التنقل تحت الملاحظة أو التوجيه اللفظي . (١) يحتاج إلى شخص واحد للمساعدة . (٠) يحتاج إلى شخصين للملاحظة أو للمساعدة ليكون بأمان.	
٦- الوقوف بدون مساندة أو مساعدة مع غمض العينين . توجيهات : الرجاء تغمض عينيك ، والوقوف بثبات لمدة ١٠ ثانية.	(٤) قادر على الوقوف لمدة ١٠ ثوان بأمان. (٣) قادر على الوقوف لمدة ١٠ ثوان مع الملاحظة. (٢) قادر على الوقوف لمدة٣ ثوان. (١) غير قادر على الوقوف مع الاحتفاظ مغمض العينين ٣ ثوان ولكنه يبقى ثابتا. (٠) في حاجة إلى مساعدة للحفاظ علية من السقوط.	
٧- الوقوف بدون مساندة مع ضم الساقين توجيهات: ضع قدميك معا والوقوف من دون أن تمسك .	(٤) قادر على ضم القدمين بدون مساعدة " والوقوف دقيقة بأمان . (٣) قادر على ضم القدمين بدون مساعدة ، والوقوف دقيقة مع الإشراف أو الملاحظة . (٢) القدرة على ضم القدمين بدون مساعدة ولكنه غير قادر على الثبات لمدة ٣٠ ثانية.	

	(١) يحتاج إلى مساعدة لثبات وضعة ولكن قادر على الوقوف لمدة ١٥ ثانية مثلما قديه . (٠) يحتاج إلى مساعدة لثبات وضعة وغير قادر على الاستمرار لمدة ١٥ ثانية .	
٨. الوصول للأمام مع مد الذراع أثناء الوقوف. توجيهات : ارفع ذراعك إلى ٩٠ أفرد أصابعك والوصول إلى الأمام بقدر ما تستطيع. (مدرب يضع مسطرة في نهاية الأصابع عندما يكون الذراع ٩٠ درجة. الأصابع لا يتبغي أن تلمس المسطرة أثناء الوصل إلى الأمام. المسافة المسجلة هي تلك المسافة التي يصل إليها الإصبع بينما الشخص في أكثر الأوضاع انحناء الأمام .	(٤) يمكن أن تصل إلى الأمام بثقة لمسافة اطول من ٢٥ سنتيمترا. (٣) يمكن أن تصل إلى الأمام بأمان لمسافة اطول من ١٢ سم. (٢) يمكن أن تصل إلى الأمام لمسافة اطول من ٥ سم بأمان. (١) قادر للوصول إلى الأمام لكنه يحتاج ملاحظة. (٠) يفقد توازنه بينما يحاول ويحتاج إلى مساعدة خارجية.	
٩. التقاط شيئا من الأرض من وضع الوقوف . توجيهات : التقاط الحذاء / النعال التي وضعت أمام قدميك.	(٤) قادر على التقاط الحذاء أو الشبشب بسهولة وأمان . (٣) قادر على التقاط شبشب لكنه يحتاج الإشراف. (٢) غير قادر على الالتقاط ولكن يقترب من ٢-٥ سم من النعال ويحتفظ بتوازنه بدون مساعدة. (١) غير قادر على الالتقاط ويحتاج إلى ملاحظة أثناء المحاولة. (٠) غير قادر على المحاولة / ويحتاج مساعدة للحفاظ علية من فقدان التوازن أو السقوط .	
١٠. اللف للنظر للوراء على يسار ويمين كتفة أثناء الوقوف . توجيهات : اتجه مباشرة إلى النظر خلفك على نحو كتفيه الأيسر وتكرر كتفية الأيمن . من الممكن يحمل الباحث شيئا خلف الشخص مباشرة للنظر إلية مما يشجع على التقاطه أفضل .	(٤) ينظر وراءه من كلا الجانبين مع التحكم الجيد بتوازن الجسم. (٣) ينظر وراء جانب واحد فقط والجانب الأخر يظهر أقل تحكما بالتوازن (٢) يلف بجانب واحد ، بل يحافظ على توازنه. (١) يحتاج إلى ملاحظة أثناء دورانه. (٠) يحتاج إلى مساعدة للحفاظ علية من فقدان التوازن أو السقوط .	
١١. يلف أو يدور ٣٦٠ درجة . توجيهات: يلف حول نفسه في دائرة كاملة. ويقف. ثم يلف دائرة كاملة في الاتجاه الأخر.	(٤) قادر على لفة أو دوران ٣٦٠ درجة بأمان في ٤ ثوان أو أقل. (٣) قادر على لفة ٣٦٠ درجة بأمان بجانب واحد فقط في ٤ ثوان أو أقل. (٢) قادر على لفة أو دوران ٣٦٠ درجة بأمان ولكن ببطء. (١) يحتاج إلى ملاحظة دقيقة وتوجيهات لفظية. (0) يحتاج مساعدة أثناء الدوران.	
١٢. وضع الأقدام بالتناوب على الأرض أو الكرسي أثناء الوقوف بدون مساندة . توجيهات : ضع القدم على درجة بالتناوب مع الأخرى . حتى تكون كل قدم قد لمست الدرجة أو الكرسي ٤ مرات.	(٤) قادر على الوقوف بدون مساعدة وامن وإكمال ٨ خطوات في ٢٠ ثانية. (٣) قادر على الوقوف بدون مساعدة ، وإكمال ٨ خطوات في اكثر من ٢٠ ثانية . (٢) قادر على إكمال ٤ خطوات دون معونة وملاحظة. (١) قادر على إكمال اكثر من ٢ خطوات ويحتاج مساعدة ضئيلة. (٠) يحتاج إلي مساعدة لتجنب السقوط وغير قادر علي المحاولة .	
١٣. الوقوف بدون مساندة وقدم واحدة للأمام . توجيهات : (ضع إحدى القدمين إمام الأخرى مباشرة إن لم تستطيع أن تضعها مباشرة أمامها حاول أن تباعد بين القدمين بمسافة كافية بحيث يكون كعب القدم الأمامية بعيدا عن أصابع القدم الأخرى) .	(٤) قادر على وضع القدم بثبات واحدة أمام الأخرى ، ويصمدا ٣٠ ثانية. (٣) قادر على وضع مقدمة قدمه عن الأخرى بشكل ثابت ، ويصمد ٣٠ ثانية. (٢) قادرا على اتخاذ خطوة صغيرة بدون مساعدة ، ويصمد ٣٠ ثانية. (١) يحتاج إلى مساعدة ولكن الخطوة يمكن أن تصمد ١٥ ثانية. (٠) يفقد التوازن مع الخطوة أو الوقوف .	
١٤. الوقوف على ساق واحدة . توجيهات : الوقوف على ساق واحدة تبعا لقدراته طالما يمكنه دون أن يمسك .	(٤) قادر على رفع الساق بدون مساعدة وتصمد اكثر من ١٠ ثانية . (٣) قادر على رفع الساق بدون مساعدة ويصمد ٥-١٠ ثانية. (٢) قادر على رفع الساق وبدون مساعدة أو يصمد اكثر من ٣ ثوان.	

	(١) يحاول رفع الساق وغير قادر على الاستمرار ٣ ثوان لكنة يظل واقفا بـــــــــــــــــــــــــــدون مســـــــــــــــــــــــــــــاعدة. (٠)غير قادر على المحاولة أو يحتاج مساعدة لمنع السقوط .	
مجموع الدرجات (الحد الأقصى = ٥٦) . مدى العرضه للسقوط	٢٠-٠٠ درجة عرضة كبيرة للسقوط ٤٠-٢١ درجة عرضة متوسطة للسقوط ٥٦ -٤١ درجة عرضة قليلة للسقوط	

Appendix 8.7: A-DGI

مؤشر المشي الديناميكي

الاسم : ---------- التاريخ :-----/-----/-----

النتيجة :----------/24 احتمالية السقوط (<20) ___ نعم ___ لا

1. المشي على سطح مستوى :

الأمر: "امش بسرعتك الطبيعية من هنا إلى الإشارة القادمة (مسافة 20 قدم)".

الدرجات : اختر أقل درجة ملائمة.

(3) طبيعي : يمشي 20 قدم بدون استخدام أدوات مساعدة، بسرعة جيدة، لا دليل على عدم التوازن، بنسق مشي طبيعي.

(2) اختلال بسيط : يمشي 20 قدم، يستخدم أداة مساعدة، بسرعة أبطأ، انحرافات بسيطة في المشي.

(1) اختلال متوسط : يمشي 20 قدم، بسرعة بطيئة، بنسق مشي غير طبيعي، دليل على عدم التوازن.

(0) اختلال شديد: لا يستطيع أن يمشي 20 قدم بدون مساعدة، انحراف شديد في لمشي أو عدم توازن.

2. التغيير في سرعة المشي :

الأمر : " ابدأ المشي بسرعتك الطبيعية (لمسافة 5 قدم). عندما أقول لك " انطلق " امش بأسرع ما يمكنك (لمسافة 5 قدم). عندما أقول لك " تمهل " امش ببطأ ما يمكنك ".

الدرجات : اختر أقل درجة ملائمة.

(3) طبيعي: يستطيع أن يغير سرعة المشي بسلاسة دون فقدان التوازن أو انحرافات في المشي. يُظهر فرقاً واضحاً في سرعات المشي بين العادية و السريعة و البطيئة.

(2) اختلال بسيط : يستطيع تغيير السرعة و لكن يُظهر انحرافات بسيطة في المشي، أو لا يُظهر انحرافات في المشي لكنه لا يستطيع أن يغير سرعته بشكل واضح، أو يستخدم أداة مساعدة.

(1) اختلال متوسط : يقوم بتعديلات بسيطة على سرعة المشي، أو يُغيّر السرعة ولكن مع انحرافات واضحة في المشي، أو يُغيّر السرعة ولكن يفقد التوازن لكن يستعيده و يتابع المشي.

(0) اختلال شديد: لا يستطيع أن يُغيّر سرعته أو يفقد التوازن و يضطر أن يُمسك بالحائط أو أن يسنده أحد.

3. المشي مع دوران أفقي في الرأس :

الأمر : " ابدأ المشي بسرعتك الطبيعية. عندما أخبرك أن تنظر إلى اليمين استمر في المشي بخط مستقيم لكن أدر رأسك إلى ناحية اليمين. ابق على هذا النحو حتى أخبرك أن تنظر إلى اليسار، عندها استمر في المشي بخط مستقيم لكن أدر رأسك إلى ناحية اليسار. ابق على هذا النحو حتى أخبرك أن تنظر إلى الأمام، عندها استمر في المشي بخط مستقيم لكن أعد رأسك إلى المنتصف " .

الدرجات : اختر أقل درجة ملائمة.

(3) طبيعي : يؤدي حركات الرأس بسلاسة دون تغيير في سرعة المشي.

(2) اختلال بسيط : يؤدي حركات الرأس بسلاسة مع تغيير بسيط في سرعة المشي، مع عدم انتظام بسيط في مسار المشي أو يستخدم أداة مساعدة.

(1) اختلال متوسط : يؤدي حركات الرأس مع تغيير متوسط في السرعة ،يُبطئ سرعته . يترنَّح لكن يعتدل. يستطيع أن يستمر في المشي.

(0) اختلال شديد: يؤدي المهمة مع عدم انتظام شديد في المشي. يترنح خارج 15 إنش** من المسار. يفقد توازنه. يتوقف. يمد يده للوصول إلى لحائط.

4. المشي مع حركة عمودية بالرأس :

الأمر : " ابدأ المشي بسرعتك الطبيعية. عندما أخبرك أن تنظر إلى الأعلى استمر في المشي بخط مستقيم لكن ارفع رأسك إلى الأعلى باتجاه السقف. ابق على هذا النحو حتى أخبرك أن تنظر إلى الأسفل، عندها استمر في المشي بخط مستقيم لكن اخفض رأسك للأسفل. ابق على هذا النحو حتى أخبرك أن تنظر إلى الأمام، عندها استمر في المشي بخط مستقيم لكن أعد رأسك إلى المنتصف " .

الدرجات : اختر أقل درجة ملائمة.

(3) طبيعي : يؤدي حركات الرأس بسلاسة دون تغيير في سرعة المشي.

(2) اختلال بسيط : يؤدي حركات الرأس بسلاسة مع تغيير بسيط في سرعة المشي، مع عدم انتظام بسيط في مسار المشي أو يستخدم أداة مساعدة.

(1) اختلال متوسط : يؤدي حركات الرأس مع تغيير متوسط في السرعة. يُبطئ سرعته . يترنَّح لكن يعتدل. يستطيع أن يستمر في المشي.

(0) اختلال شديد: يؤدي المهمة مع عدم انتظام شديد في المشي. يترنح خارج 15 إنش من المسار. يفقد توازنه. يتوقف. يمد يده للوصول إلى لحائط.

5. المشي مع دوران محوري:

الأمر : "ابدأ المشي بسرعتك الطبيعية. عندما أخبرك أن تدور و تتوقف، دُر بأسرع مايمكنك مواجهاً الجهة المعاكسة لك و توقف".

الدرجات : اختر أقل درجة ملائمة.

(3) طبيعي : يدور محورياً بشكل آمن خلال 3 ثوانٍ و يتوقف بسرعة دون أن يفقد توازنه.

(2) اختلال بسيط : يدور محورياً بشكل آمن خلال اكثر من 3 ثوانٍ و يتوقف دون أن يفقد توازنه.

(1) اختلال متوسط : يدورُ ببطء، يحتاج إلى إرشادات لفظية و يحتاج إلى عدة خطوات ليحافظ على توازنه بعد الدوران و الوقوف.

(0) اختلال شديد: لا يمكنه الدوران بشكل آمن. يحتاج إلى مساعدة ليدور و يتوقف.

6. الخطو فوق عائق:

الأمر : "ابدأ المشي بسرعتك الطبيعية. عندما تصل إلى العائق اخطُ فوقه ، لا تلتفت حوله، وأكمل المشي".

الدرجات : اختر أقل درجة ملائمة.

(3) طبيعي : يستطيع أن يخطو فوق العائق دون تغيير سرعة المشي.

(2) اختلال بسيط : يستطيع أن يخطو فوق العائق لكن يجب أن يُبطئ سرعته و يُعدّل خطواته حتى يجتاز بشكل آمن.

(1) اختلال متوسط : يستطيع أن يخطو فوق الصندوق لكن يجب أن يتوقف، ثم يخطو مجدداً. قد يحتاج إلى إرشاد لفظي.

(0) اختلال شديد: لا يستطيع أن يؤدّي دون مساعدة.

7. المشي حول العوائق :

الأمر : " ابدأ المشي بسرعتك الطبيعية. عندما تصل إلى القمع الأول (على بُعد 6 قدم) امشِ عن يمينه. عندما تصل إلى القمع الثاني (على بُعد 6 قدم من القمع الأول) امشِ عن يساره".

الدرجات : اختر أقل درجة ملائمة.

(3) طبيعي : يستطيع أن يمشي حول القمعين بشكل آمن دون تغيير سرعة المشي. لا دليل على عدم التوازن.

(2) اختلال بسيط : يستطيع أن يخطو حول القمعين لكن يجب أن يُبطئ سرعته و يُعدّل خطواته كي يجتاز القمعين.

(1) اختلال متوسط : يستطيع أن يجتاز القمعين لكن يجب أن يُبطئ سرعته بشكل ملحوظ لينجز المهمة، أو يحتاج إلى إرشاد لفظي.

(0) اختلال شديد: غير قادر على ا جتياز القعين. يصطدم بأحد أو كلا القعين، أو يحتاج إلى مساعدة جسدية.

8. الدرج :

الأمر : "اصعد هذه الدرجات كما تفعل في منزلك (مثلاً : استخدم الدرابزين عند الضرورة). عند أعلى الدرج دُر و انزل الدرجات".

الدرجات : اختر أقل درجة ملائمة.

(3) طبيعي : تناوب الخطوات. دون استخدام الدرابزين.

(2) اختلال بسيط : تناوب الخطوات. يجب أن يستخدم الدرابزين.

(1) اختلال متوسط : قدمين للدرجة. يجب أن يستخدم الدرابزين.

(0) اختلال شديد: لا يستطيع التنفيذ بشكل آمن.

النتيجة النهائية : _____

*** 20 قدم = 6 أمتار**

**** 15 إنش = 38 سم**

Appendix 8.8: GROC

LifeConnections Health Center
Nurturing health through the human connection
Services delivered by North First Street Medical Group

GLOBAL RATING OF CHANGE SCALE (GROC)

Thank you for the opportunity to assist in your rehabilitation. The following rating scale allows us to review the overall outcome of your condition with physical therapy intervention. It allows us to review your physical therapy outcome, which helps guide our treatment to better serve our patients in the future. The Global Rating of Change (GROC) has been well documented and extensively used in research as an outcome measure as well as to compare outcome measures.

Please rate the overall condition of your injured body part or region *FROM THE TIME THAT YOU BEGAN TREATMENT UNTIL NOW* (Check only one):

☐ A very great deal worse (-7)	☐ About the same (0)	☐ A very great deal better (7)
☐ A great deal worse (-6)		☐ A great deal better (6)
☐ Quite a bit worse (-5)		☐ Quite a bit better (5)
☐ Moderately worse (-4)		☐ Moderately better (4)
☐ Somewhat worse (-3)		☐ Somewhat better (3)
☐ A little bit worse (-2)		☐ A little bit better (2)
☐ A tiny bit worse (-1)		☐ A tiny bit better (1)

From: Jaeschke R, Singer J, Guyatt GH. Measurement of health status. Ascertaining the minimal clinically important difference. Control Clin Trials 1989: 407-15.

· 3571 North First Street, Suite 200 · San Jose, CA 95134 ·
· Phone: 424.2000 · Fax: 408.321.8710 ·
www.ciscolifeconnections.com

Appendix 8.9: Approval of the backward English translation from the main developer of the test

From: Fay Horak <horakf@ohsu.edu>
Sent: Saturday, September 26, 2020 4:40:08 PM
To: انهى اليوسف ID 439204063 <439204063@student.ksu.edu.sa>
Subject: Re: Arabic version and the back translation of the Mini-BESTest

Thanks for the reminder.
It is really excellent so I approve the translation. However, we no longer suggest Temper foam as it is difficult to get and expensive so Airex foam 2 inches thick works fine.

Arabic Abstract

المستخلص العربي:

خلفية البحث. يعد اختبار تقييم أنظمة التوازن المصغر مقياسًا وظيفيًا شاملًا لقياس التوازن الحركي والساكن، ومع ذلك لا توجد منه نسخة عربية مقررة.

الأهداف. هدفت الدراسة إلى ترجمة اختبار تقييم أنظمة التوازن المصغر، وتكيفه الثقافي مع اللغة العربية، والتحقق من خصائصه السيكومترية على مرضى اضطرابات التوازن العصبي.

نوع الدراسة. دراسة مقطعية واختبار الخصائص السيكومترية.

الطريقة. تُرجم اختبار تقييم أنظمة التوازن المصغر واختبر تكيفه مع اللغة العربية وفقًا للمعايير المعمول بها. تم التحقق من الخصائص السيكومترية للنسخة العربية من الاختبار على(56) مشتركًا ومشتركة يعانون من اضطرابات التوازن العصبي وهم (38 رجلًا و18 امرأة) تتراوح أعمارهم بين 18-71 عامًا.

تم قياس الصدق البنائي مع النسخة العربية من اختبار(بيرج) للتوازن، والنسخة العربية من اختبار مؤشر المشي الديناميكي باستخدام ارتباط (بيرسون)، والاتساق الداخلي باستخدام (ألفا كرونباخ)، والثبات بطريقة إعادة الاختبار باستخدام معامل الارتباط الداخلي (ICC) وارتباط (بيرسون). كذلك تم قياس الثبات المطلق عن طريق حساب الخطأ في القياس باستخدام الخطأ القياسي في القياس (SEM)، والحد الأدنى من التغير مع مجال الثقة 95% (MDC_{95})، و(البلاند ألتمان). كما تم قياس الاستجابة باستخدام منحى خصائص تشغيل المُستَقبِل (ROC) كما تم قياس تأثير القمة والقاع.

النتائج. تُرجِم الاختبار من دون أي صعوبات مع التأكد من شموليته وملاءمته. ارتبطت النسخة العربية من اختبار تقييم أنظمة التوازن المصغر إحصائيًا وإيجابيًا مع مجموع النسخة العربية من اختبار بيرج للتوازن (r=0.80)ومع النسخة العربية من مؤشر المشي الديناميكي (rho=0.95)، والمقاييس الفرعية ارتبطت بروابط ضعيفة إلى مرتفعة (0.38-0.81). وكذلك أظهرت اتساقاً

داخليًا ممتازًا(α =0.96) ، وثباتًا باستخدام طريقة إعادة الاختبار للمجموع(ICC=0.95، r=0.92)وللمقاييس الفرعية (ICC=0.94-0.81 و r=0.90-0.68) .

. كما أن الخطأ القياسي في القياس (SEM= 1.19)، والحد الأدنى من التغير(MDC_{95}=3.29). أكد تحليل بلاند ألتمان عدم وجود أخطاءٍ في القياس ولا تحيزٍ نسبيٍ، المساحة تحت المنحى (AUC=0.85) عند نقطة الفصل 21.5 مع الحساسية =75% والنوعية =75%. أما تأثير القاع فلا يوجد، ولكن وُجِد تأثير القمة في مقياسيين فرعيين من الاختبار.

الاستنتاج. أظهرت النسخة العربية لاختبار تقييم أنظمة التوازن المصغر خصائص سيكومترية ممتازة، وهذا مشابه للدراسات السابقة، مما يؤكد أهمية استخدامه في البحوث والممارسات السريرية مع المرضى العرب.

الكلمات الدّالة. التوازن، اختبار تقييم أنظمة التوازن المصغر، الخصائص السيكومترية، اضطرابات التوازن العصبي.

المملكة العربية السعودية

وزارة التعليم

جامعة الملك سعود

كلية العلوم الطبية التطبيقية

قسم علوم التأهيل الصحي

النسخة العربية من اختبار تقييم أنظمة التوازن المصغر: التكيف الثقافي وتحليل الخصائص السيكو مترية لدى مرضى اضطرابات التوازن العصبي

قُدمت هذه الرسالة إستكمالًا لمتطلبات الحصول على درجة الماجستير في العلاج الطبيعي

أعدتها الطالبة:

نهى إبراهيم اليوسف

بكالوريس علاج طبيعي

تحت إشراف:

د/ عفاف أحمد شاهين

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