Original Article

Validity and reliability of "Persian Weaning Tool" in mechanically ventilated patients

Fatemeh Bazrafshan, Alireza Irajpour[1], Saeed Abbasi[2], Behzad Mahaki[3]

Student Research Center, School of Nursing and Midwifery, [1]Nursing and Midwifery Care Research Centre, Department of Critical Care Nursing, Faculty of Nursing and Midwifery, Social Determinants of Health Research Centre, [2]Department of Anesthesiology and Critical Care Research Center, [3]Department of Biostatistics, Faculty of Health, Isfahan University of Medical Sciences, Isfahan, Iran

Abstract

Background: "Persian Weaning Tool (PWT)" is the only specific, national protocol designed to assess patients' readiness for weaning from mechanical ventilation in Iran. This study was developed to determine the validity and reliability of this protocol.

Materials and Methods: This is a psychometric study conducted on 31 patients connected to mechanical ventilation were ready from weaning according to anesthesiologist's diagnosis and was selected through convenient sampling. The patients selected from Intensive Care Units (ICUs) of Al-Zahra Hospital in Isfahan. The sheet data collection includes demographic data, PWT; Burn's Wean Assessment Program (BWAP), and Morganroth's scale. To determine the inter-rater reliability between researcher and his partner, Pearson correlation and paired *t*-test were used. To assess the criterion validity of the PWT in relation to Burn's and Morganroth's weaning scales (as criteria), Pearson correlation and McNemar tests were used. To specify a minimum acceptable score of the PWT for weaning from mechanical ventilation, receiver operating characteristic curve was used.

Results: The results showed that there was statistically significant correlation between score of PWT and BWAP ($r = 0.370$ with $P < 0.05$) and there were no statistically significant differences between these tools in terms of identification of patients' readiness for weaning ($P = 0.453$). There was statistically significant correlation between PWT score obtained by researcher and his colleague ($r = 0.928$), and the reliability of this tool was approved. The PWTs cut of point was calculated as 57 (sensitivity = 0.679, specificity = 1).

Conclusions: The reliability and validity of the PWT were confirmed for this study's sample size. Consequently, the findings of this study can be used to measure the PWTs effectiveness and applicability in ICUs.

Key Words: Intensive Care Units, mechanical ventilation, reliability, Persian weaning tool, validity

Address for correspondence:
Dr. Alireza Irajpour, Nursing and Midwifery Care Research Centre, Department of Critical Care Nursing, Faculty of Nursing and Midwifery, Isfahan University of Medical Sciences, Isfahan, Iran. E-mail: irajpour@nm.mui.ac.ir

Received: 22.02.2016, **Accepted:** 25.05.2016

INTRODUCTION

Mechanical ventilation is a common method used in the treatment of patients transferred to Intensive Care Unit (ICU).[1] Over 90% of critically ill patients require mechanical ventilation and getting a patient off a ventilator comprises 40% of the duration of

Access this article online	
Quick Response Code:	Website: www.advbiores.net
	DOI: 10.4103/2277-9175.188488

How to cite this article: Bazrafshan F, Irajpour A, Abbasi S, Mahaki B. Validity and reliability of "Persian Weaning Tool" in mechanically ventilated patients. Adv Biomed Res 2016;5:157.

mechanical ventilation.[2] Mechanical ventilation can have negative effects on the cardiovascular, respiratory, gastrointestinal, and musculoskeletal systems along with water and electrolyte status and mental state of the patients.[3-6] Moreover, long-term use of mechanical ventilation increases care costs; thus, patients should be weaned from mechanical ventilator as soon as possible.[7] Several studies have shown that daily screening based on weaning protocols may shorten the duration of mechanical ventilation and hospitalization in ICU and reduce costs and rates of weaning failure.[8,9] Nurses are able to wean patients from mechanical ventilator safely; therefore, physicians have more opportunities to perform tasks cannot be delegated to nonmedical teams.[10] In addition, performing based on interprofessional approaches and building relationships between members of health teams provide higher quality care for patients.[11-12] Nonetheless, no definite indicator has been developed yet for weaning patients from mechanical ventilator. In Iran, there is little research on this area and no native protocol exists to determine patients' readiness for being weaned from mechanical ventilators; thus, anesthesiologists wean patients by measuring a number of parameters.[5,7] For these reasons, weaning process may be started with a delay or patients become weaned prematurely which leads to further complications.[8,13] In a qualitative study with Delphi multitriangulation design, Irajpour *et al*. developed the Persian weaning tool (PWT). By reviewing related literature, they noticed that there is no comprehensive tool to determine patients' readiness for being weaned from mechanical ventilation. Given that there is no local research on the determination of reliability and validity of the PWT and that the tool must be reliable and valid to be used for Iranian patients, the present study aimed at evaluating some psychometric properties of the mentioned tool.

MATERIALS AND METHODS

The present methodological study was conducted to evaluate some of the psychometric properties of the PWT used in ICUs. The study population consisted of all patients transferred to ICUs of Isfahan's Al-Zahra Hospital in 2015. Based on the formula used in reliability studies (with level of significance 95%, statistical power 80%, the minimum acceptable reliability 85%, and durability expected 90% and 2 repeated measurements) a sample size of 31 was determined.

$$n = 1 + \frac{2\left(Z_{1-\frac{\alpha}{2}} + Z_{1-\beta}\right)^2 K}{\left(\ln C_0\right)^2 (K-1)}$$

$K = 2$

$\infty = 0.05 \rightarrow$ level of significance 95%

$\beta = 0.2 \rightarrow$ statistical power 80%

The samples were selected using the convenience sampling method. The inclusion criteria were being mechanically ventilated for >48 h[14] and <14 days,[15] lack of chronic cardiovascular or other underlying diseases, level of consciousness higher than 9 (based on Glasgow Coma Scale), not being in the middle of weaning process and patients' or patients' families' willingness to participate in the study. Dead or spontaneously extubated patients or those who needed surgery were excluded from the study. The required data were collected by a two-part questionnaire: (1) The first part included demographic characteristics, the cause of being mechanically ventilated, underlying diseases and consciousness level at the beginning of the study; (2) and the second part consisted of Burn's Wean Assessment Program (BWAP), Morganroth's criteria for weaning from prolonged mechanical ventilation, and the PWT [Figure 1].

Instruments

Burn's Wean Assessment Program

The BWAP was developed in 1999 by Burn *et al*. In the BWAP, every positive answer has 1 point, and the overall score is the sum of all positive answers. This scale includes 26 items: 12 items for assessing general criteria and 14 for assessing respiratory functions. Each item has three options. The BWAP checklist requires the assignment of 1 of 3 responses (yes, no, or not assessed). A yes response indicates that the factor meets the established threshold definition. A no response means that the factor does not meet the established threshold definition, and the response not assessed is used when not enough data are available. When a patient's score is over 17, she/he is ready for being weaned from the ventilator. Yazdannik *et al*. confirmed the BWAPs content validity, in a study conducted by a group of experts including three ICU nurses, four nursing faculty members, and three anesthesiologists.[13] In a study conducted on 40 ICU patients in Thailand, Plang-Wan determined reliability of the BWAP and reported a Cronbach's alpha of 0.92.[16] Yazdannik *et al*. conducted a pilot study on five patients and reported a Cronbach's alpha of 0.85 for the BWAP.[13]

Morganroth's criteria for weaning from prolonged mechanical ventilation

Morganroth *et al*. developed a set of standard criteria for weaning from mechanical ventilation in 1984. This scale includes two parts: (1) The first part examines patients' overall status through 21 items; (2) and the

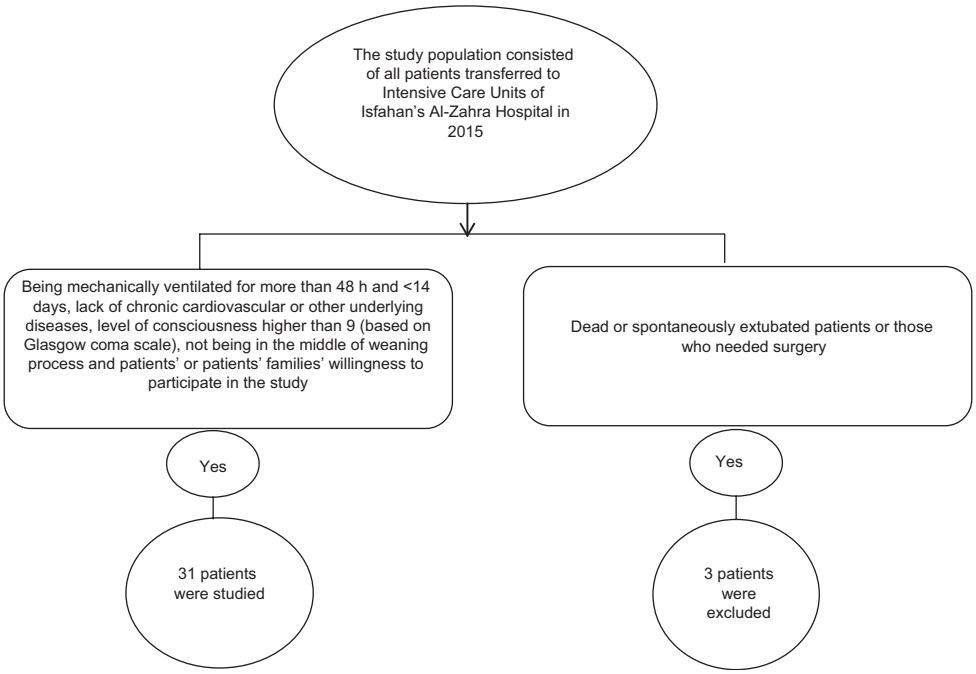

Figure 1: Sampling flowchart

second part examines issues related to mechanical ventilation through 6 items. Based on the descriptions provided in the scale, each item has a specific score, and the total score is the sum of scores obtained in the two mentioned parts. The highest possible score in this scale is 75 and scores <55 indicate an increase in the probability of successful weaning. Morganroth reported a sensitivity of 93% and a specificity of 86% for the scale.[17] The applicability of this scale has been examined in several studies.[18]

The Persian weaning tool

This tool has three areas which include respiration status (9 items), cardiovascular status (4 items), and general status (13 items) of the patients. Each item is scored either 1 (for the critical conditions in which the patients need immediate intervention), 2 (for the conditions in which the patient need care), or 3 (for patients with appropriate condition regarding the related item). The PWT has also a "not applicable" option used when there is no definite answer for an item. The lowest and the highest possible scores in this scale are 26 and 75, respectively (scores higher than 50 indicate patients' readiness for weaning).

When a patient was ready to be weaned from mechanical ventilation, the researcher and his partner collected the required information. The researcher completed all three research tools and his partner completed only the PWT. Finally, the patients were weaned from the ventilator under the supervision of a physician. To access the external validity intraclass correlation coefficient (ICC) index was calculated. To determine the inter-rater reliability between researcher and his partner, Pearson correlation and paired *t*-test were used. To assess the criterion validity of the PWT in relation to Burn's and Morganroth's weaning scales (as criteria), Pearson correlation and McNemar tests were used. To specify a minimum acceptable score of the PWT for weaning from mechanical ventilation, receiver operating characteristic (ROC) curve was used. All statistical analyses were performed using the SPSS-20 (that produced by The International Business Machines Corporation (IBM). It is an American multinational technology and consulting corporation, with corporate headquarters in Armonk, New York) software ($P < 0.05$).

RESULTS

The results showed that 58.1% of the examined patients were male and 41.9% were female. The average age of participants was 51.42 years, the average duration of mechanical ventilation was 6.97 days, and the average consciousness level of the patients when being mechanically ventilated was 14.13. Most of the patients were mechanically ventilated due to medical reasons. The average scores of BWAP, Morganroth's criteria, and PWT were 17.65, 13.94, and 57.48, respectively. The clinical conditions of the patients are presented in Table 1. During the study, two patients died and one patient were extubated spontaneously that were excluded and three other patients were replaced them. From 31 weaning, six of which were failed and patients were connected to ventilator again, and PWT was predicted five of unsuccessful weaning correctly.

The results showed a significant relationship between PWT scores and BWAP scores (r = 0.370; P = 0.040). However, no significant relationship was found between PWT scores and Morganroth's scale scores (r = 0.209; P = 0.260). PWT scores given by the researcher were significantly correlated with PWT scores given by his partner (r = 0.928; P < 0.001). All results that were presented above reported based on Pearson's correlation test [Table 2]. Moreover, paired t-test results showed no significant difference between the mentioned two sets of scores (researcher and his partner) P = 0.189.

The external validity was proved (ICCs = 0.962 with 95% confidence interval = 0.921, 0.981). ROC curve was calculated to determine the minimum acceptable PWT score for weaning from mechanical ventilation; accordingly, a cutoff point of 57, sensitivity of 0.679, specificity of 0.804, and area of under the curve 0.804 (asymptotic 95% confidence interval = 0.643, 0.964) were obtained [Figure 2]. After determination of the cutoff point, the samples were grouped based on their readiness or unreadiness specified in the BWAP and the PWT and then McNemar's test was conducted. The results showed no significant difference in the determination of patients' readiness/unreadiness for being weaned from mechanical ventilator between the PWT and the BWAP (P = 0.453). Nonetheless, a significant difference was observed in the determination of patients' readiness/unreadiness for being weaned from ventilator between the PWT and Morganroth's scale (P = 0.031).

Table 1: Patients' clinical condition

Patients' clinical condition	*n*	Percentage
Cause of mechanical ventilation		
Multiple trauma	8	25.8
Surgery	6	19.4
Head injury	3	7.9
Internal injury	10	32.3
Neuromuscular injury	4	12.9

Patients' clinical condition	Mean	Maximum-minimum	SD
Length of mechanical ventilation (day)	6.97	13-3	2.938
GCS*	14.13	15-13	0.763
BWAP**	17.65	19-15	1.018
Morganroth's criteria	13.94	18-11	1.482
PWT[i]	57.48	63-53	2.488

*Glasgow coma scale, **Burn's Wean Assessment Program, [i]Persian weaning tool. SD: Standard deviation

Table 2: Correlation* between Persian weaning tool with Burn's Wean Assessment Program, Morganroth's criteria and Persian weaning tool scores given by partner

Tools	PWT scores given by the researcher	
	Correlation coefficient	*P*
BWAP**	0.37	0.040[i]
Morganroth's criteria	0.209	0.260[i]
PWT scores given by partner	0.928	0.000[i]

*Results are reported based on Pearson correlation, **Burn's Wean Assessment Program, [i]Significant (P<0.05). PWT: Persian weaning tool

DISCUSSION

The present study was conducted to determine some of the PWTs psychometric characteristics. The results showed a significant relationship between PWT and BWAP score. Given the sample size and the P value (P < 0.05), that correlation indicated criterion validity of the PWT. However, no significant relationship was found between PWT and Morganroth's scale scores. The results of McNemar's test showed no significant difference in the determination of patients' readiness/unreadiness for being weaned from mechanical ventilator between the PWT and the BWAP (P = 0.453) indicating criterion validity of the PWT based on the BWAP. Nonetheless, a significant difference was observed in the determination of patients' readiness/unreadiness for being weaned from ventilator between the PWT and Morganroth's scale. Accordingly, all examined patients were ready for being weaned based on Morganroth's scale, whereas six patients were still unready for that process based on the PWT. The average of Morganroth's scale scores was almost 14. In Morganroth's scale, scores <55 indicate an increase in the likelihood of successful weaning. Thus, there was a great difference between the obtained average score (i.e., 14) and the determined cutoff point (i.e., 55). On the other hand, the average of BWAP scores was 17.65 which were very close to the determined cutoff point (i.e., 17). This contradiction caused a lower correlation between scores of Morganroth's scale and scores of the PWT, which could be due to the differences in parameters and scoring procedure between Morganroth's scale

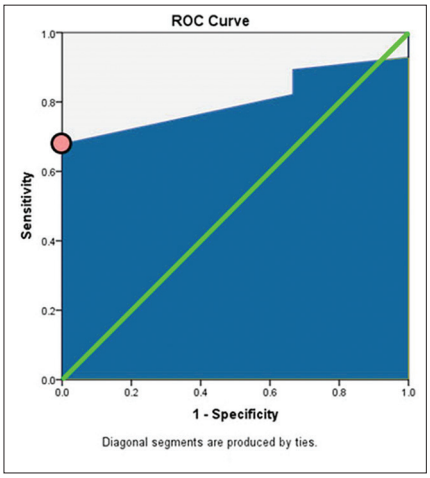

Figure 2: Determining the cutoff point of Persian weaning tool by receiver operating characteristic curve

and the other two tools. In the BWAP, there is a "not assessed" option for each item. Similarly, in the PWT, there is an "inapplicable" option for each item. Selection of these options in the BWAP and PWT negatively impacts the overall score. However, Morganroth's scale does not have such options and not assessed or inapplicable cases do not receive any score resulting in lower overall cores. Moreover, in Morganroth's scale, there are conditions that score was not assigned to it. Bagheri *et al*. conducted a study in 2012, to determine reliability and validity of the weight satisfaction scale. In that study, the body shape questionnaire was simultaneously completed by the samples to determine the scale's validity. In testing validity, scores of the weight satisfaction scale were highly correlated with scores of the body shape questionnaire ($r = 0.72$; $P < 0.05$).[19]

The results also showed that PWT scores given by the researcher were significantly correlated with PWT scores given by his partner ($r = 0.923$; $P > 0.001$) indicating a high level of agreement between the two observers and inter-rater reliability of the PWT. In 2013, Dalvandi and Bahrampouri examined reliability and validity of the Iranian prehospital stroke scale. To determine the scale's reliability, they used inter-rater reliability and found a correlation coefficient of 0.96.[20]

Using ROC curve and based on the BWAPs cutoff point, the minimum acceptable PWT score of 57 was determined for weaning from mechanical ventilation. In 2013, Dehghan and Habibi conducted a study to validate a questionnaire used for heat strain evaluation in women. They calculated a ROC curve based on the standard oral temperature and found a cutoff point of 17 for the examined questionnaire.[21]

CONCLUSIONS

According to the findings of the present study, both reliability and validity of the PWT were confirmed for this study's sample size. The results also showed a minimum acceptable PWT score of 57 for weaning from mechanical ventilation which was determined based on the BWAP. Consequently, the findings of this study can be used to measure the PWTs effectiveness and applicability in ICUs. However, further studies with greater sample sizes are required to examine other psychometric characteristics of the PWT.

Acknowledgments

This article was derived from a master thesis of Fatemeh Bazrafshan with project number: 394217, Isfahan University of Medical Sciences, Isfahan, Iran. We appreciate from Clinical Research Development Center of Al-Zahra, for their help in this project.

Hereby, the authors of this study (code: 394217) express their gratitude to the authorities of Isfahan University of Medical Sciences and all officials and hospital personnel in Al-Zahra Hospital's ICUs.

Financial support and sponsorship

Isfahan University of Medical Sciences.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Danckers M, Grosu H, Jean R, Cruz RB, Fidellaga A, Han Q, *et al.* Nurse-driven, protocol-directed weaning from mechanical ventilation improves clinical outcomes and is well accepted by intensive care unit physicians. J Crit Care 2013;28:433-41.
2. Lavelle C, Dowling M. The factors which influence nurses when weaning patients from mechanical ventilation: Findings from a qualitative study. Intensive Crit Care Nurs 2011;27:244-52.
3. Arabi A, Tavakol KH. Respiratory Care and Mechanical Ventilation. Isfahan: University of Medical Sciences Press; 2008. p. 88-9.
4. Irajpour A, Khodaee M, Yazdannik A, Abbasi S. Developing a readiness assessment tool for weaning patients under mechanical ventilation. Iran J Nurs Midwifery Res 2014;19:273-8.
5. Hosseini M, Ramezani J. Evaluation of APACHE II system in prediction of the separation from mechanical ventilation. J Sci Health 2007;3:2-7.
6. Curuvilla J. Essential of Critical Care Nursing. New Delhi: Jaypee Brother's Medcal Publishers; 2007. p. 231.
7. Jalalian HR, Aslani J, Panahi Z. Factors affecting the duration of mechanical ventilation device isolation of patients in intensive care units. Kowsar Med J 2009;13:163-4.
8. Blackwood B, Alderdice F, Burns K, Cardwell C, Lavery G, O'Halloran P. Use of weaning protocols for reducing duration of mechanical ventilation incritically ill adultpatients: Cochrane systematic review and meta-analysis. Br Med J 2011;10:1-2.
9. Tonnelier JM, Prat G, Le Gal G, Gut-Gobert C, Renault A, Boles J, *et al*. Impact of a nurses' protocol-directed weaning procedure on outcomes in patients undergoing mechanical ventilation for longer than 48 hours: A prospective cohort study with a matched historical control group. Br Med J 2005;9:83-9.
10. Sole M, Klein D, Moseley M. Introduction to Critical Care Nursing. 5th ed. Saunders Elsevier; 2009. p. 105.
11. Alavi M, Irajpour A, Abdoli S, SaberiZafarghandi MB. Clients as mediators of interprofessional collaboration in mental health services in Iran. J. Interprof. Care 2012;26:36-42.
12. Irajpour A, Ghaljaei F, Alavi M. Concept of Collaboration from the Islamic Perspective: The View Points for Health Providers. J. Relig. Health 2015;54:1800-9.
13. Yazdannik A, Salmani F, Irajpour A, Abbasi S. Application of Burn's wean assessment program on the duration of mechanical ventilation among patients in intensive care units: A clinical trial. Iran J Nurs Midwifery Res 2012;17:520-3.
14. McLean SE, Jensen LA, Schroeder DG, Gibney NR, Skjodt NM. Improving adherence to a mechanical ventilation weaning protocol critically ill adults: Outcomes after an implementation program. Am J Crit Care 2006;15:299.
15. Roh JH, Synn A, Lim CM, Suh HJ, Hong SB, Huh JW, *et al.* A weaning protocol administered by critical care nurses for the weaning of patients from mechanical ventilation. J Crit Care 2012;27:549-55.
16. Plang-Wan R. The Effect Providing Information and Instilling Reassurance on Uncertainty in Weaning from Mechanical Ventilation. Master Thesis of Nursing Science (Adult Nursing), Faculty of Graduate Studies, Mahidol University; 2004.

17. Morganroth ML, Morganroth JL, Nett LM, Petty TL. Criteria for weaning from prolonged mechanical ventilation. Arch Intern Med 1984;144:1012-6.
18. Mergoni M, Iacovelli W, Giovanelli L, Barantani D, Grattagliano C. Evaluation of traditional parameters and the Morganroth system to monitor the weaning process in patients treated with long-term mechanical ventilation. Minerva Anestesiol 1990;56:1265-7.
19. Bagheri M, Sadrzadeh Y, Dorosti Motlagh A, Eshraghiyan M, Kazemiyan E, Agaee Negad M. The reliability and validity of body image assessment for obesity tool to measure the satisfaction of pre-pregnancy weight in pregnant women. Iran J Diabetes Lipid Disord 2013;11:400.
20. Dalvandi A, Bahrampouri S. The validity and reliability of Iranian pre-hospital diagnosis of stroke tools. 6th International and the First National Iranian Stroke Congress, Tabriz, University of Medical Sciences; 2013.
21. Dehghan H, Habibi P, Meraci M, Habibi A. Validation of a Questionnaire for Heat Strain Evaluation in Women. Isfahan: School of Health, Isfahan University of Medical Sciences; 2014.