Journal of Contemporary Medicine

YEAR: 2024 VOLUME: 14 ISSUE: 3

JOURNAL OF CONTEMPORARY MEDICINE

e-ISSN 2667-7180

Formerly Çağdaş Tıp Dergisi

YEAR 2024 VOLUME 14 ISSUE 3

The Owner and Publishing Manager on behalf of the Journal of Contemporary Medicine

Prof. Dr. Resul YILMAZ

Address: Selçuk Üniversitesi, Tıp Fakültesi Çocuk Yoğun Bakım Bilim Dalı Alaeddin Keykubat Yerleşkesi Selçuklu/Konya 42075 Türkiye
Phone: +90 (332) 241 50 00-44513
Fax: +90 (332) 241 21 84
e-mail: cagdastipdergisi @gmail.com
web: http://www.jcontempmed.com

JOURNAL OF CONTEMPORARY MEDICINE

e-ISSN 2667-7180

Formerly Çağdaş Tıp Dergisi

JOURNAL OF CONTEMPORARY MEDICINE

e-ISSN 2667-7180

Formerly Çağdaş Tıp Dergisi

JOURNAL OF CONTEMPORARY MEDICINE

Formerly Çağdaş Tıp Dergisi

INSTRUCTIONS FOR AUTHORS

AIM AND SCOPE

The Journal will not consider manuscripts any that have been published elsewhere, or manuscripts that are being considered for another publication, or are in press. Studies previously announced in the congresses are accepted if this condition is stated. If any part of a manuscript by the same author(s) contains any information that was previously published, a reprint or a copy of the previous article should be submitted to the Editorial Office with an explanation by the authors

A technical review is performed to confirm that all of the required documentation has been submitted and to conduct a preliminary evaluation of the manuscript and supplementary files to assess suitability for the Journal. The manuscript will be returned to the Author in the event of any deficiency.

Journal of Contemporary Medicine operates a blind review process. Contributions deemed suitable are then typically sent to a minimum of two independent expert reviewers in the field of study to assess the scientific quality of the paper. (You can see at the picture below).

The Editor/Editors are responsible for the final decision regarding acceptance or rejection of articles. The Editor's decision is final. If necessary, author(s) may be invited to submit a revised version of the manuscript. This invitation does not imply that the manuscript will be accepted for publication. Revised manuscripts must be sent to the Editorial Office within 4 (four) weeks, otherwise they will be considered as a new application. The corresponding author will be notified of the decision to accept or reject the manuscript for publication.

Statements and suggestions published in manuscripts are the authors' responsibility and do not reflect the opinions of the Editor, Associate Editors and the Editorial Board members.

The manuscript will not be returned to the authors whether the article is accepted or not. Copyright fee is not paid for the articles published in the journal. A copy of the journal will be sent to the corresponding author.

Language of the Journal

The official languages of the Journal are Turkish and English. The manuscripts that are written in Turkish have abstracts in English, which makes the abstracts available to a broader audience.

Authorship Criteria

After accepted for publication, all the authors will be asked to sign "CoyrightTransfer Form" which states the following: " This work is not under active consideration for publication, has not been accepted for publication, nor has it been published, in full or in part (except in abstract form). I confirm that the study has been approved by the ethics committee. " All authors should agree to the conditions outlined in the form.

Journal of Contemporary Medicine has agreed to use the standards of the International Committee of Medical Journal Editors. The author(s) should meet the criteria for authorship according to the "Uniform Requirements for Manuscripts Submitted to Biomedical Journals: Writing and Editing for Biomedical Publication. It is available at www.icmje.org.

Ethical Responsibility

The protocol of clinical research articles must be approved by the Ethics Committee.

In all studies conducted on humans, the "Material and Method" section was approved by the relevant committee or the Helsinki Declaration of Principles (https://www.wma.net/what-we-do/medical-ethics/declaration-of-helsinki/).

It should be stated in the text that all persons included in the study signed the am Informed Consent Form ".

The articles submitted to the Journal of Contemporary Medicine will be deemed to have been conducted in accordance with the Helsinki Declaration of Principles, and have received ethical and legal permissions and will not be held responsible.

If the "Animal" item was used in the study, the authors stated that in the Material and Method section of the article, they protect the animal rights in their studies in accordance with the principles of Guide for the Care and Use of Laboratory Animals (www.nap.edu/catalog/5140.html) and that they have received approval from the ethics committees of their institutions. must specify.

In case reports, Informed Consent a should be obtained from patients regardless of the identity of the patient.

If the article includes the institution (directly or indirectly) providing financial support for the commercial connection or work, the authors; the commercial product used, the drug, the company has no commercial relationship with, or if there is any relationship (consultant, other agreements, etc.), the editor must inform the presentation page.

If Ethics Committee Approval is required in the article; the received document should be sent with the article.

JOURNAL OF CONTEMPORARY MEDICINE

Formerly Çağdaş Tıp Dergisi

The manuscript should be submitted to the Academic Plagiarism Prevention Program by the authors.

It is the authors' responsibility to ensure that the article complies with the ethical rules.

Policy of Screening for Plagiarism

The manuscripts are scanned by the Journal using the iThenticate program for determination of plagiarism and non-ethical situations. Journal of Contemporary Medicine will immediately reject manuscripts leading to plagiarism.

TYPES OF MANUSCRIPT

Manuscripts should be submitted online via www.jcontempmed.com

Original Articles should not exceed 3000 words and should be arranged under the headings of Abstract (not more than 250 words), Introduction, Materials and Methods, Results, Discussion, Conclusion and References.

Case Reports should not exceed 1000 words and 10 references, and should be arranged as follows: Abstract, Introduction, Case Report, Discussion and References. It may be accompanied by only one figure or table.

Letter to the Editor should not exceed 500 words. Short relevant comments on medical and scientific issues, particularly controversies, having no more than five references and one table or figure are encouraged. Where letters refer to an earlier published paper, authors will be offered right of reply.

Reviews are not accepted unless written on the invitation of the Editorial Board.

PREPARATION OF MANUSCRIPTS

All articles submitted to the Journal must comply with the following instructions:

a) Submissions should be doubled-spaced and typed in Arial 10 points.

b) All pages should be numbered consecutively in the top right-hand corner, beginning with the title page.

c) The title page should not include the names and institutions of the authors.

d) The manuscript should be presented in the following order: Title page, Abstract (English, Turkish), Keywords (English, Turkish), Introduction, Materials and Methods, Results, Discussion, Conclusion, Acknowledgements (if present), References, Figure Legends, Tables (each table, complete with title and foot-notes, on a separate page) and Appendices (if present) presented each on a separate page.

Title

The title should be short, easy to understand and must define the contents of the article.

Abstract

Abstract should be in both English and Turkish and should consist "Aim, Materials and Methods, Results and Conclusion". The purpose of the study, the setting for the study, the subjects, the treatment or intervention, principal outcomes measured, the type of statistical analysis and the outcome of the study should be stated in this section (up to 250 words). Abstract should not include reference. No abstract is required for the letters to the Editor.

Keywords

Not more than five keywords in order of importance for indexing purposes should be supplied below the abstract and should be selected from Index Medicus Medical Subject Headings (MeSH), available at www.nlm.nih.gov/meshhome.html.

Text

Authors should use subheadings to divide sections regarding the type of the manuscript as described above. Statistical methods used should be specified in the Materials and Methods section.

References

In the text, references should be cited using Arabic numerals in parenthesis in the order in which they appear. If cited only in tables or figure legends, they should be numbered according to the first identification of the table or figure in the text. Names of the journals should be abbreviated in the style used in Index Medicus. The names of all authors should be cited when there are six or fewer; when seven or more, the first three should be followed by et al. The issue and volume numbers of the referenced journal should be added.

References should be listed in the following form:

Journal article

Teke Z, Kabay B, Aytekin FO et al. Pyrrolidine dithiocarbamate prevents 60 minutes of warm mesenteric ischemia/reperfusion injury in rats. Am J Surg 2007;194(6):255-62.

Supplement

Solca M. Acute pain management: Unmet needs and new advances in pain management. Eur J Anaesthesiol 2002; 19(Suppl 25): 3-10.

JOURNAL OF CONTEMPORARY MEDICINE

Formerly Çağdaş Tıp Dergisi

Online article not yet published in an issue

Butterly SJ, Pillans P, Horn B, Miles R, Sturtevant J. Off-label use of rituximab in a tertiary Queensland hospital. Intern Med J doi: 10.1111/j.1445-5994.2009.01988.x

Book

Sample1: Murray PR, Rosenthal KS, Kobayashi GS, Pfaller MA. Medical microbiology. 4th ed. St. Louis: Mosby; 2002.

Sample 2: Sümbüloğlu K, Akdağ B. Regresyon Yöntemleri ve Korelasyon Analizi. Hatiboğlu Yayınevi: Ankara; 2007.

Chapter in a book

Meltzer PS, Kallioniemi A, Trent JM. Chromosome alterations in human solid tumors. I n: Vogelstein B, Kinzler KW, editors. The genetic basis of human cancer. New York: McGraw-Hill; 2002. p. 93113.

Journal article on the Internet

Abood S. Quality improvement initiative in nursing homes: The ANA acts in an advisory role. Am J Nurs [serial on the Internet] 2002 [cited 12 Aug 2002]; 102. Available from: www.nursingworld.org/AJN/2002/june/wawatch.htm

Website

Cancer-pain.org [homepage on the Internet]. New York: Association of Cancer Online Resources [updated 16 May 2002; cited 9 Jul 2002]. Available from: www.cancer-pain.org

An organization as an author

The Intensive Care Society of Australia and New Zealand. Mechanical ventilation strategy in ARDS: Guidelines. Int Care J Aust 1996;164:282-4.

Acknowledgements

The source of financial grants and the contribution of colleagues or institutions should be acknowledged.

Tables

Tables should be complementary, but not duplicate information contained in the text. Tables should be numbered consecutively in Arabic numbers, with a descriptive, self-explanatory title above the table. All abbreviations should be explained in a footnote. Footnotes should be designated by symbols in the following order: *,†, ‡, §, ¶.

Figures

All illustrations (including line drawings and photographs) are classified as figures. Figures must be added to the system as separate .jpg or .gif files (approximately 500x400 pixels, 8 cm in width and at least 300 dpi resolution). Figures should be numbered consecutively in Arabic numbers and should be cited in parenthesis in consecutive order in the text.

Figure Legends

Legends should be self-explanatory and positioned on a separate page. The legend should incorporate definitions of any symbols used and all abbreviations and units of measurements should be explained. A letter should be provided stating copyright authorization if figures have been reproduced from another source.

Measurements and Abbreviations

All measurements must be given in metric system (Système International d'Unités, SI). Example: mg/kg, µg/kg, mL, mL/kg, mL/kg/h, mL/kg/min, L/min, mmHg, etc. Statistics and measurements should always be given in numerals, except where the number begins a sentence. When a number does not refer to a unit of measurement, it is spelt out, except where the number is greater than nine.

Abbreviations that are used should be defined in parenthesis where the full word is first mentioned. Some common abbreviations can be used, such as iv, im, po, and sc.

Drugs should be referred to by their generic names, rather than brand names.

Editorial Correspondence

Prof. Dr. Resul YILMAZ
Selçuk Üniversitesi, Tıp Fakültesi
Çocuk Yoğun Bakım Bilim Dalı
Alaeddin Keykubat Yerleşkesi Selçuklu/Konya 42075 Türkiye
Phone: +90 (332) 241 50 00-44513
Faks: +90 (332) 241 21 84

Journal of Contemporary Medicine

(Çağdaş Tıp Dergisi)
http://www.jcontempmed.com
e-posta: cagdastipdergisi@gmail.com

Checklist for Manuscripts

Review guide for authors and instructions for submitting manuscripts through the electronic submission, website at

http://www.jcontempmed.com

JOURNAL OF CONTEMPORARY MEDICINE

Formerly Çağdaş Tıp Dergisi

CONTENTS

YEAR 2024 VOLUME 14 ISSUE 3 e-ISSN 2667-7180

ORIGINAL ARTICLES

Case Report

JOURNAL OF
CONTEMPORARY MEDICINE

DOI:10.16899/jcm.1408942
J Contemp Med 2024;14(3):109-116

Original Article / Orijinal Araştırma

Effect of Erythrocyte Suspension Transfusion on Thiol-Disulfide Homeostasis in Critically ill Children

Eritrosit Süspansiyonu Transfüzyonunun Kritik Hasta Çocuklarda Tiyol-Disülfid Homeostazı Üzerindeki Etkisi

Resul YILMAZ[1], Beyza KOÇ[2], Alaaddin YORULMAZ[3], Fikret AKYÜREK[4]

[1]Department of Pediatrics, Division of Pediatric Critical Care, Selcuk University School of Medicine, Konya, Turkey
[2]Department of Pediatrics, Kulu State Hospital, Konya, Turkey
[3]Department of Pediatrics, Selçuk University Medical School, Konya, Turkey
[4]Biochemistry, Selçuk University Medical School, Konya, Turkey

Abstract

Aim: Our study aimed to investigate the potential relation between dynamic thiol homeostasis and blood transfusion in the pediatric intensive care unit.

Material and Method: Blood samples were collected from pediatric intensive care patients before and after erythrocyte suspension transfusion and from donor blood additionally to measure thiol levels. The study involved 30 patients, including nine females, and a total of 90 blood samples from patients and donors were analyzed.

Results: Prior to transfusion, Total Thiol (TT) and Native Thiol (NT) were 414.77±156.14 (µmol/L) and 272.63±115.75 (µmol/L), respectively, and post-transfusion, they were found to decrease to 398.07±187.38 (µmol/L) and 258.97±136.2 (µmol/L), respectively. However, no statistically significant difference was observed between pre- and post-transfusion values. In post-transfusion blood samples, there was a significant increase in Disulfide/TT and Disulfide/NT ratios, indicating an increase in oxidation (34.79±92.34 and 51.89±68.51, respectively), yet no statistical difference was noted.

Conclusion: Transfusions administered in the Pediatric Intensive Care Unit were associated with a decrease in total and native thiol levels, indicative of increased oxidative stress, despite the lack of statistically significant differences. To mitigate the potential negative impact on patients with high oxidative properties after transfusions, strengthening the antioxidant defense system is recommended. Research should be planned to develop suitable strategies for enhancing the antioxidant defense system and ensuring patients' resilience to this condition.

Keywords: Children, erythrocyte suspension transfusion, pediatric intensive care, dynamic thiol homeostasis

Öz

Amaç: Çocuk yoğun bakım ünitesinde kan transfüzyonu ile dinamik thiol homeostasisi arasında bir bağlantı olup olmadığını araştırmak.

Gereç ve Yöntem: Çocuk yoğun bakım ünitesinde yatan hastalarda kan transfüzyonundan önce ve sonra ek olarak donör kanından thiol düzeylerini ölçmek için kan örnekleri alındı. Dokuzu kız toplam 30 hastanın ve ek olarak donörlerin 90 kan örneğinde araştırma yapıldı.

Bulgular: Transfüzyondan önceki Total tiyol (TT) ve Nativ tiyol (NT) sırasıyla 414,77±156,14 (µmol/L) ve 272,63±115,75 (µmol/L) idi, transfüzyon sonrasında ise yine sırasıyla 398,07±187,38(µmol/L) ve 258,97±136,2(µmol/L) transfüzyon öncesine göre azalmış olarak bulundu. Ancak, transfüzyon öncesi ve sonrası arasında istatistiksel olarak anlamlı bir fark gösterilemedi. Transfüzyondan sonraki kan örneklerinde ise oksidasyonun artışına delalet eden Disülfid/TT ve Disülfid/NT oranlarında önemli bir artış oldu, (sırasıyla 34,79±92,34 ve 51,89±68,51) yine, istatistiksel olarak bir fark gösterilemedi.

Sonuç: Çocuk Yoğun Bakım ünitesinde uygulanan kan transfüzyonları, istatistiksel olarak anlamlı fark olmasa da artmış oksidatif stresi gösteren total ve nativ tiyolde azalma ve disülfid oranlarında artış ile ilişkilendirildi. Oksidatif özelliği fazla olan ES ile transfüzyon sonrası hastaların bu durumdan olumsuz etkilenmemesi için antioksidan savunma sisteminin güçlendirilmesi düşünülmeli ve uygun stratejilerin geliştirilmesi için araştırmalar planlanmalıdır.

Anahtar Kelimeler: Çocuklar, eritrosit süspansiyonu transfüzyonu, pediatrik yoğun bakım, dinamik tiyol homeostazisi

Corresponding *(İletişim)*: Resul YILMAZ, Department of Pediatrics, Division of Pediatric Critical Care, Selcuk University School of Medicine, Konya, TURKEY
E-mail *(E-posta)*: drresul@gmail.com
Received *(Geliş Tarihi)*: 23.12.2023 **Accepted *(Kabul Tarihi)*:** 20.03.2024

INTRODUCTION

Pediatric patients with critical illness commonly experience a high incidence of anemia both upon admission and throughout their stay in the pediatric intensive care unit (PICU). Anemia develops in approximately 95% of intensive care patients before the third day of admission.[1] Around 17% of all PICU patients receive transfusions, and it has been reported that almost 50% of patients with stays exceeding 48 hours in the PICU receive blood products.[2,3] However, the administration of erythrocyte suspension transfusion should be carefully considered when the benefits outweigh the risks.

While transfusion-related infections (TRIs) initially garnered attention in studies on transfusion safety, other factors such as immunomodulation and blood age have also become noteworthy. The risk assessment of transfusion has necessitated exploration into the benefits of this procedure.[4].

Oxidative stress is a key factor in various physiological and pathological events. Despite erythrocytes containing an extensive antioxidant defense system, oxidative stress contributes to oxidative membrane protein and lipid damage, normal cell aging, and shortened cell lifespan.[5,6] Due to its association with worse prognosis in critically ill patients, oxidative stress measurements have become clinically significant in intensive care patients.[7, 8]

To protect cell organelles and membranes from the harmful effects of free radicals, cells possess various enzymatic and non-enzymatic antioxidant defense systems. The antioxidant defense system includes substances such as transferrin, ceruloplasmin, lactoferrin, albumin, haptoglobins, hemopexin, bilirubin, carotenoids, glutathione, vitamin C, vitamin E, uric acid, and acute-phase proteins (C3, antiproteases, CRP, and serum amyloid A).[9] Oxidative stress, on the other hand, manifests itself through an increase in reactive oxygen species like hydroxyl radicals, superoxide radicals, and hydrogen peroxide during cellular metabolism.[10]

Studies have shown that during the storage process of erythrocyte suspension, iron is released from transferrin, leading to an increase in non-transferrin-bound iron (NTBI) levels (toxic form). It is reported that NTBI levels reach their maximum on the 35th day of storage. This increase in oxidative stress during storage is speculated to contribute to the elevated frequency of diseases like premature retinopathy and necrotizing enterocolitis in newborns receiving erythrocyte suspension.[11-13] The increased burden of free iron is also suggested to harm the recipient's lungs, increasing the risk of chronic lung disease.[13]

Hemoglobin (Hb) in erythrocyte suspension is generally well preserved with a range of antioxidants and other protective molecules. However, when erythrocyte suspensions are stored under cold conditions, the mechanisms that protect the cells lose their effectiveness over time. Hb becomes sensitive to oxidation and is released outside the cell. The increase of extracellular Hb during the storage of erythrocyte suspensions is used as an indicator of the degree of hemolysis.[13,14]

Thiol-Disulfide Balance

Thiols are organic compounds consisting of a sulfur atom and a hydrogen atom attached to a carbon atom, containing a sulfhydryl group.[15] The plasma thiol pool primarily consists of albumin thiols, protein thiols, and low molecular weight thiols. Plasma thiols, which are of great importance in physiological and biological events, can exhibit pro-oxidant or predominantly antioxidant effects.[16,17] Antioxidants containing thiol (-SH) groups in their structures include pyridoxine, methionine, S-adenosylmethionine, N-acetylcysteine (NAC), alpha-lipoic acid, captopril, taurine, and homocysteine. Cysteine, homocysteine, and glutathione (GSH) are found in abundance among plasma thiols.[18] Thiol and disulfide (-S-S-) groups play a crucial role in stabilizing protein configurations, regulating the functions of proteins and enzymes, as well as in carriers and receptors, Na-K transmission, and transcription.[19]

The antioxidant or pro-oxidant effects of -SH groups depend on the level of oxidative stress in the environment, the physiological and biological state, and the levels of sulfur-containing amino acids. Compounds containing -SH groups exhibit their antioxidant effects by inhibiting the impact of free radicals.[18] Dynamic thiol-disulfide homeostasis plays a significant role in various mechanisms such as detoxification, apoptosis, antioxidant protection, signal transmission, and enzyme activity regulation. Furthermore, anomalous thiol-disulfide balance has been linked to a range of illnesses such as cardiovascular disease, cancer, rheumatoid arthritis, diabetes, chronic kidney disease, and multiple sclerosis.[20-22] The development of sepsis is intricately influenced by oxidative stress and the body's antioxidant defense mechanisms.[23-25]

In conducted studies, it is known that the -SH groups in proteinaceous compounds such as cysteine and GSH are oxidized by oxidizing molecules in the environment, leading to reversible -S-S- structures. Subsequently, these formed -S-S- structures are reduced back to -SH groups, thereby maintaining thiol-disulfide homeostasis.[25] N-acetyl cysteine, found as a substrate in GSH synthesis and serving as a source of -SH groups in cells, affects oxygen-derived radicals such as OH-, inhibiting reactive oxygen molecules, preserving protein structure to extend metabolic lifespan, and preventing apoptosis.[26]

Conversely, the interaction of GSH with -S-S- groups results in the formation of oxidized glutathione (GSSG). GSSG, an indicator of oxidative stress, is a compound with harmful effects on the structure and metabolism of -SH-containing proteins and is indicative of the presence of oxidative stress. Consequently, the conversion of -SH groups to -S-S- groups and various oxidized compounds such as oxoacids is an initial indication of oxidation caused by reactive oxygen species in proteins.

This study aims to investigate the dynamic thiol levels in donor erythrocyte suspension and their impact on the dynamic thiol balance in post-transfusion period in critically ill children.

MATERIAL AND METHOD

The study was conducted in the Pediatric Intensive Care Unit of Selçuk University Faculty of Medicine between January 1, 2018, and January 1, 2021, including 30 consecutive patients who met the inclusion criteria. Patients or their parents or legal guardians were included in the study after reading the information and consent forms provided to them and obtaining their signatures.

To determine the thiol levels of the erythrocyte suspension obtained from the blood bank for each patient, 2 ml of plasma was taken from the donor erythrocyte suspension. Additionally, 2 ml of serum was collected from the patient before and after transfusion (6-12 hours). Elective ES transfusions are administered for 4 hours in our Pediatric Intensive Care unit with a dose of 10 ml/kg. For donors, variables such as repeated donation/age/systemic disease may also affect the thiol balance in ES. However, unfortunately these data could not be obtained. No additional blood products other than ES and ES were transfused to the patients included in the study while they were hospitalized in another clinic in our hospital or at another health center where they applied before being transferred to our unit.

These samples were stored at -80°C until the desired number of patients was reached. Subsequently, biochemical measurements were performed at the Department of Biochemistry, Selçuk University Faculty of Medicine.

Determination of Thiol-Disulfide Serum Levels

Serum total thiol (TT) and native thiol (NT) levels were determined using an automatic method developed by Erel and Neselioğlu.[25] Thiol/disulfide homeostasis tests were performed using a new automatic and spectrophotometric method that measures the complete thiol/disulfide status. The principle of the thiol/disulfide measurement method involves the reduction of dynamic disulfide bonds (-S-S-) to functional thiol groups (-SH) by NaBH4. Any remaining NaBH4 residues are completely removed with formaldehyde. This process prevents further reduction of 5,5'-dithiobis-2-nitrobenzoic acid (DTNB) and also eliminates any disulfide bonds resulting from the reaction with DTNB. The modified Ellman reagent is used to measure the total thiol content in the samples. After serum extraction, the test takes approximately 12 minutes to measure all parameters.[25] The disulfide level is calculated as half of the difference between total thiol and native thiol. The disulfide/native thiol ratio (index 1), disulfide/total thiol ratio (index 2), and native thiol/total thiol ratio (index 3) are calculated.

Statistical Analyses

Statistical analysis was conducted using the SPSS package program (SPSS for Windows, Version 17.0, SPSS Inc., USA). Descriptive statistics, percentages, and appropriate data type graphs were generated. The Chi-square test was applied for cross-tabulations. After evaluating the normal distribution of the data with the Kolmogorov-Smirnov test, analysis of variance (ANOVA) was used for comparisons between groups. For data that did not follow a normal distribution, Kruskal-Wallis-Friedman variance analysis was applied to analyze differences between groups. The relationships between parameters were assessed using Pearson correlation coefficient for normally distributed data and Spearman's rank correlation coefficient for non-normally distributed data. In all analyses, p-values less than 0.05 were considered statistically significant.

Ethics

Ethical approval was obtained from the Local Ethics Committee of the Selçuk University Faculty of Medicine (Date: 13-01-2021, Approval number 2021/01).

RESULTS

Of the patients included in the study, 21 (70%) were male and 9 (30%) were female.

Mean age±SD was 34.36±7.66 months (median: 22.80; min-max: 3.6-192 months). When the mean age of the patients was examined according to gender, the mean age of the boys was 40.97±10.60 months (median: 21.66; min-max: 3.6-192 months), while the mean age of the girls was 18.93±3.18 months. (median: 24,000; min-max: 3.6-28.8) months. When the mean age was compared statistically by gender, no significant difference was detected (p: 0.192).

When the diagnoses of the patients included in the study were classified at the time of admission, 10 (33.3%) of the patients had respiratory system diseases, 12 (40%) had infectious diseases, 5 (16.7%) had central nervous system diseases. It was determined that 2 (6.6%) of the patients had gastroenterology system diseases and 1 (3.3%) had urogenital system diseases.

The average values of some hematological parameters (HB, HTC, MCV, RDW and PLT) determined before and after ES transfusion in the study are shown in **Table 1**.

Thiol values in the transfused erythrocyte suspension are given in **Table 2**.

Table 1. Comparison of the average hematological examinations of the patients before and after erythrocyte suspension

	Before Transfusion		After Transfuion		p
	Mean±SD	Median (min-max)	Mean±SD	Median (min-max)	
Hb	7.38±0.82	7.2 (5.7-8.9)	10.91±1.78	10.85 (6.6-15.3)	<0.001
MCV	84.36±5.54	85.6 (71.5-95.7)	84.59±3.79	84.35 (76.4-91.8)	0.464
RDW	16.66±1.71	16.45 (13.1-20.3)	16.05±1.43	16.05 (13.8-19.1)	0.002
Plt	222.7±141.12	204.5 (5-598)	243.83±142.71	237.5 (36-591)	0.365

(Hb: Hemoglobin, MCV: Mean erythrocyte volume, RDW: red cell distribution width, PLT: Platelet

Table 2. Thiol values in erythrocyte suspension

Thiols in donor erythrocyte suspension	Mean±SD	Median (min-max)
Total thiol (µmol/L)	201.68±190.43	136.5 (64-989)
Native thiol (µmol/L)	123.11±104.57	93 (31-518)
Disülfide (µmol/L)	39.29±44.5	28.5 (6-235.5)
Reduced thiol (µmol/L)	62.98±9.08	64.2 (43.1-88.2)
Oxidized thiol (µmol/L)	18.5±4.54	17.9 (5.9-28.5)
Oxidation reduction (µmol/L)	354.66±122.13	358.95 (151.2-777.8)

Comparison of thiol measurement values of patients who underwent ES transfusion before and after transfusion is shown in **Table 3**.

No correlation was found between the amount of transfused erythrocyte suspension and hemoglobin difference. (r=0.312 p: 0.93) The difference in hemoglobin and dynamic thiol values was calculated as the difference in hemoglobin and thiol values after and before transfusion. While the total

Table 3. Comparison of Thiol Levels before and after ES

	Before Transfusion		After Transfusiion		p
	Mean±SD	Median (min-max)	Mean±SD	Median (min-max)	
Total thiol (µmol/L)	414.77±156.14	372.5 (187-815)	398.07±187.38	378.5 (25-801)	0.696
Native thiol (µmol/L)	272.63±115.75	281.5 (52-457)	258.97±136.2	242 (29-479)	0.789
Disülfide (µmol/L)	71.07±51.67	67.25 (1-184)	74.87±55.58	52.25 (5-204)	0.439
Reduced thiol (µmol/L)	66.23±20.68	69.85 (27.8-99.6)	73.08±55.29	68.05 (15-340)	0.447
Oxidized thiol (µmol/L)	16.89±10.35	15.1 (0.2-36.1)	21.45±21.8	17.65 (2-120)	0.166
Oxidation reduction (µmol/L)	772.45±778.86	466 (77-2500)	735.11±927.72	369.95 (35.2-4266.7)	0.673
Disulfide/total thiol (%)	16.88± 10.34	15.07 (0-36)	34.79±92.34	17.63 (2-520)	0.277
Disulfide/native thiol (%)	34.87± 32.97	21.61 (0-130()	51.89±68.51	27.36 (2-284)	0.056
Native thiol/total thiol (%)	66.23±20.68	69.87 (28-100)	73.07±55.29	68.51 (15-340)	0.527

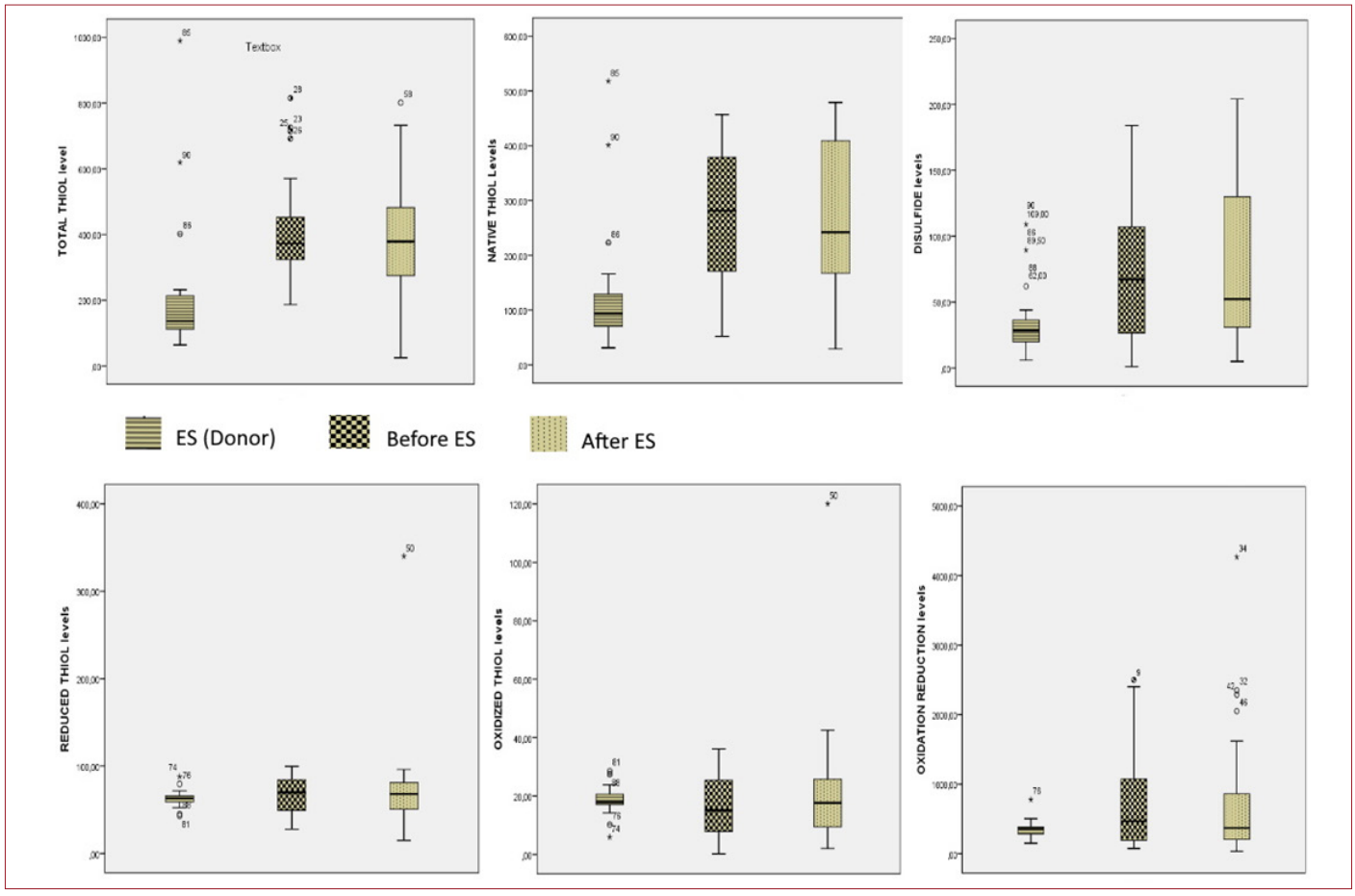

Figure 1. Serum total Thiol, native Thiol, disulfide levels, and reduced Thiol, oxidized thiol, and oxidation reduction levels on three samples: in donor eritrocyte suspension (ES), patients serum before ES and patients serum after ES. Lower and upper margin of each box represents 25th and 75th percentiles, horizontal lines in the middle of the boxes represents median value, and whiskers represent lowest and highest values, circles represent outliers and stars represent extreme values. Transfused donor ES had lower Total Thiol, Native Thiol, and disulfide levels in patients' serum before and after ES transfusion. Oxidized thiol level was found to be higher. However, no statistically significant difference was found. This situation may be associated with the high level of oxidation in the stored blood obtained from the blood center.

thiol difference and native thiol difference show a normal distribution, other dynamic thiol value differences do not show a normal distribution. When the relationship between hemoglobin difference and dynamic thiol value differences was examined, no statistically significant difference was detected (**Table 4**).

Table 4. Correlation between post-transfusion hemoglobin increase and thiol change

		Δtotal_ thiol	UTL	Δdisülfid	Δreduced_ thiol	Δoxidized_ thiol
ΔHb	Correlation	.263*	.254*	.173**	.066**	.062**
	p	.159	.175	.362	.727	.743
	n	30	30	30	30	30

*: Pearson r correlation coefficient. **: Spearman's Rho correlation coefficient. Δ: calculated by subtracting serum thiol values measured before transfusion from serum thiol values after transfusion. In terms of Hb, it is the difference between Hb after and before transfusion
Hb: Hemoglobin, UTL: Undepleted thiol level (UTL=serum native thiol value measured after transfusion – serum native thiol value measured before transfusion).

DISCUSSION

Anemia in children can result from various chronic diseases such as trauma, surgical procedures, anemia due to frequent blood draws, coagulopathy, hemolysis, nutritional deficiencies, and bone marrow depression. Erythrocyte replacement is performed in patients due to a decrease in hemoglobin levels caused by these factors. Given the increased susceptibility to anemia in pediatric intensive care patients, studies on the changes in clinical and laboratory data of patients undergoing erythrocyte replacement become significant.[2]

Transfusion rates and indications for erythrocyte transfusions vary in pediatric intensive care units. In a single-center study by Demaret et al. involving 842 patients, erythrocyte transfusion was administered to 144 (17.1%) patients, with the most common indication being low hemoglobin levels and impaired hemodynamics.[27] Additionally, in several studies, ES transfusion rates during hospitalization in pediatric intensive care units have been reported to range from 49% to 61.7%.[3,28,29] In our study, the ES transfusion rate was determined to be 57.45%. Differences in transfusion rates may be explained by the fact that (1) the studies were conducted in different time periods,(2) the characteristics of included patients, and (3) differences in applied guidelines.

In a study conducted in 2007 in the pediatric intensive care unit on patients with stable general conditions (without active blood loss, cyanotic heart diseases, coronary artery diseases, and severe hypoxemia), the hemoglobin (Hb) thresholds for ES transfusion were compared, with values of 7g/dL and 9.5 g/dL. The study recommended a threshold value of 7 g/dL to prevent unnecessary transfusions.[30] According to the American Association of Blood Banks (AABB) recommendations in 2012 and 2016, the Hb limit for transfusion in hospitalized stable patients is set between 7-8 g/dL, while for patients with a history of cardiovascular disease, it is 8 g/dL.[31,32]

The transfusion guideline for critically ill pediatric patients was last updated in 2018, and, except for specific situations, a hemoglobin level <5 g/dL is recommended.[33] However, both in our study and in the literature, it is frequently observed that transfusions are administered when hemoglobin levels are >7 g/dL. In our study, 40% of the patients (n:12) received transfusion when Hb concentration was between 5-7 g/dL, while 60% (n:18) received transfusion when Hb concentration was between 7-10 g/dL. Most patients who underwent ES transfusion in our study had hemoglobin concentrations between 7-10 g/dL, aligning with similar findings in the literature.[30,34,35]

In the literature, the mean hemoglobin level before ES transfusion ranged from 7.6 to 9.7 g/dL, and the mean hemoglobin level after transfusion ranged from 10.86 to 14.6 g/dL.[3,13,27,28,36] Our study found that the average hemoglobin level before ES transfusion was 7.38±0.82 g/dL, and the average hemoglobin level after transfusion was 10.91±1.78 g/dL, consistent with literature values.

Erythrocytes, despite having high antioxidant properties, require additional antioxidants during storage due to exposure to various factors. Among these factors are agitation, high glucose concentrations, light, and free radicals released by leukocytes.[37,38] When analyzing research on alterations in oxidant and antioxidant parameters during the storage of ES, various changes in erythrocytes become apparent, including adenosine triphosphate and 2,3-diphosphoglycerate (DPG) depletion, loss of flexibility, vesiculation, phospholipid loss, protein oxidation, and lipid membrane peroxidation. These modifications may contribute to adverse clinical outcomes, such as a reduction in oxygen transport.[35] Furthermore, Wardle and colleagues noted an elevation in urinary malondialdehyde levels in preterm newborns following transfusion, suggesting a correlation between transfusion and lipid peroxidation.[39] Another study analyzing levels of TBARS (thiobarbituric acid reactive substances) and protein carbonyls before and after transfusion demonstrated an increase in these levels following ES transfusions, with a positive correlation to mortality. These findings suggest that blood transfusions in critically ill patients may negatively impact patient outcomes.[40]

In the literature, it has been demonstrated that the levels of non-transferrin-bound iron (NTBI), a significant marker of oxidative stress, and malondialdehyde (MDA), a crucial indicator of lipid peroxidation, increase after ES transfusion in premature infants.[13,41] Following ES replacement in premature infants, an increase in free iron load due to ceruloplasmin and transferrin deficiencies leads to catalyzation of the Fenton reaction. This results in an elevated quantity of free radicals in the environment, causing damage to the lungs and retina, and a decrease in total antioxidant status (TAS).[13] However, the high oxygen affinity of fetal hemoglobin in premature infants is thought to play a role in the reduced oxygen distribution to tissues, contributing to retinopathy of prematurity (ROP) and chronic lung disease.[42]

In a study by Ogunro et al., it was shown that on the first day of storage, MDA levels increased by 24.8%, TAS plasma concentration decreased by 27% after 20 days of storage, and the activity of the important antioxidant enzyme glutathione peroxidase decreased by 17.1% after 15 days of storage.[43] During the storage of erythrocyte suspension, the amount of glutathione (GSH), which protects hemoglobin against excessive oxidation, gradually decreased, MDA levels increased outside the cells, and NTBI levels increased.[11] When evaluating NTBI and transferrin levels after transfusing stored fresh (3-7 days) ES and ES stored for 40-42 days, it was shown that NTBI and transferrin levels significantly increased in stored ES compared to fresh ES.[44] The day-by-day increase in MDA levels, the decrease in average TAS levels, and the increase in lactate dehydrogenase (LDH) levels, a marker of oxidative damage, were demonstrated in stored erythrocyte suspensions.[45] In a study by D'Alessandro et al., it was shown that during the storage process, MDA, lactate, and cellular calcium levels increased as the storage period of ES extended.[46] In our study, similar to the literature, patients who received stored RBCs showed a decrease in average TAS levels, an increase in average LDH and calcium levels after transfusion, indicating oxidative stress.

The dynamic balance of thiol-disulfide homeostasis is pivotal in regulating numerous antioxidants, detoxification processes, apoptosis, enzymatic activity, and cellular signaling mechanisms.[19] Thiols engage with all physiological oxidants in the body, serving as a genuine buffering mechanism. This homeostasis is linked to antioxidant mechanisms, as evidenced in inflammatory diseases.[47] Elevated levels of reactive oxygen species (ROS) have been found in infectious diseases such as septic shock, hepatitis, and HIV.[48] Furthermore, heightened antioxidant activity against reactive oxygen species (ROS) molecules has been demonstrated in numerous infectious diseases.[48,49] It is established that oxidative molecules are generated by oxidative enzymes like nicotinamide adenine dinucleotide phosphate oxidase and myeloperoxidase during granulocyte bacterial infections. Consequently, as serum thiol levels decline, there is an increase in disulfide levels.[47] In a study by Aydoğan et al., the decrease in thiol levels in neonatal sepsis was suggested to be an indicator of oxidative stress.[50]

In our study, it was shown that transfused donor ES had lower TT, NT, and disulfide levels in patients' serum before and after ES transfusion. Oxidized thiol level was found to be higher. However, no statistically significant difference was found. This situation may be associated with the high level of oxidation in the stored blood obtained from the blood center.[11-14]

Although the disulfide level in donor ES was lower than the disulfide levels in the patients' serum before and after ES transfusion, disulfide/TT and disulfide/NT levels in the patients' serum were found to be higher after ES transfusion than before (but no statistically significant difference was found). This suggests that oxidation increases in patients with ES transfusion. Although there are rare studies in the literature investigating the relationship between transfusion and thiol homeostasis, it has been shown that oxidative stress increases and antioxidant capacity decreases.[39,40] It has been reported that native thiol levels are low before transfusion in thalassemia patients and increase after transfusion. This increase was interpreted as oxidative stress already being high in thalassemia patients, and oxidative stress being cleared by transfusion, thus increasing native thiol. Undepleted thiol level (UTL) is a term used for thalassemia patients. UTL is calculated by subtracting serum native thiol values measured before transfusion from serum native thiol values after transfusion (UTL = serum native thiol value measured after transfusion – serum native thiol value measured before transfusion). This mathematical difference may arise depending on the oxidation state of the patient before transfusion, oxidative stress and antioxidant capacity in the donor blood.[51] In the thesis study conducted by one of our researchers, it was shown that total oxidative stress and OSI index increased after ES transfusion, which was statistically significant.[52]

When patients were transfused with ES, which has a high oxidation effect, a decrease in the levels of TT and NT, which are protective against oxidation, was detected compared to before ES transfusion. To prevent patients from being affected after transfusion with ES, which has high oxidative properties, it should be considered that it would be appropriate to strengthen the antioxidant defense system, and research should be planned to develop appropriate strategies.

The most important limitation of our study is that it was studied in a single center and with a very limited number of cases. The waiting time for donor blood in blood banks is not recorded. The effects of oxidative stress may be different in children with critical illnesses, and the fact that there are many different diseases that can increase oxidative stress suggests that there may be differences in the results due to this limited sample size. Multicenter studies with large participation and sufficient number of cases are needed.

CONCLUSION

Although there was no statistically significant difference, blood transfusions administered in the Pediatric Intensive Care Unit were associated with increased oxidative stress, as indicated by a decrease in total and native thiol and an increase in disulfide ratios. To prevent negative impacts on patients from transfusions with erythrocyte suspensions that have high oxidative properties, consideration should be given to strengthening the antioxidant defense system. Further research is needed, and plans should be made for the development of appropriate strategies.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Selçuk University Non-interventional Clinical Researches Ethics Committee (Date: 13/01/2021, Decision No: 2021/01).

Informed Consent: All patients signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

REFERENCES

1. Corwin HL, Gettinger A, Pearl RG, et al. The CRIT Study: Anemia and blood transfusion in the critically ill--current clinical practice in the United States. Crit Care Med 2004;32(1):39-52.
2. Armano R, Gauvin F, Ducruet T, Lacroix J. Determinants of red blood cell transfusions in a pediatric critical care unit: a prospective, descriptive epidemiological study. Crit Care Med 2005;33(11):2637-44.
3. Bateman ST, Lacroix J, Boven K, et al. Anemia, blood loss, and blood transfusions in North American children in the intensive care unit. Am J Respir Crit Care Med 2008;178(1):26-33.
4. Shorr AF, Corwin HL. Transfusion in critical care: where do we go from here? Chest 2007;132(4):1105-6.
5. Nagababu E, Rifkind JM. Reaction of hydrogen peroxide with ferrylhemoglobin: superoxide production and heme degradation. Biochemistry 2000;39(40):12503-11.
6. Shiva Shankar Reddy CS, Subramanyam MV, Vani R, Asha Devi S. In vitro models of oxidative stress in rat erythrocytes: effect of antioxidant supplements. Toxicol In Vitro 2007;21(8):1355-64.
7. Motoyama T, Okamoto K, Kukita I, Hamaguchi M, Kinoshita Y, Ogawa H. Possible role of increased oxidant stress in multiple organ failure after systemic inflammatory response syndrome. Crit Care Med 2003;31(4):1048-52.
8. Roth E, Manhart N, Wessner B. Assessing the antioxidative status in critically ill patients. Curr Opin Clin Nutr Metab Care 2004;7(2):161-8.
9. Hadjinikolaou L, Alexiou C, Cohen AS, Standbridge Rde L, McColl AJ, Richmond W. Early changes in plasma antioxidant and lipid peroxidation levels following coronary artery bypass surgery: a complex response. Eur J Cardiothorac Surg 2003;23(6):969-75.
10. Valko M, Rhodes CJ, Moncol J, Izakovic M, Mazur M. Free radicals, metals and antioxidants in oxidative stress-induced cancer. Chem Biol Interact 2006;160(1):1-40.
11. Collard K, White D, Copplestone A. The influence of storage age on iron status, oxidative stress and antioxidant protection in paediatric packed cell units. Blood Transfus 2014;12(2):210-9.
12. Abdullah SM. The effect of repeated blood donations on the iron status of male Saudi blood donors. Blood Transfus 2011;9(2):167-71.
13. Dani C, Martelli E, Bertini G, et al. Effect of blood transfusions on oxidative stress in preterm infants. Arch Dis Child Fetal Neonatal Ed 2004;89(5):F408-11.
14. Klein HG, Anstee DJ. Mollison's blood transfusion in clinical medicine: John Wiley & Sons, 2014.
15. Sen CK, Packer L. Thiol homeostasis and supplements in physical exercise. Am J Clin Nutr 2000;72(2 Suppl):653s-69s.
16. Atmaca G. Antioxidant effects of sulfur-containing amino acids. Yonsei Med J 2004;45(5):776-88.
17. Parcell S. Sulfur in human nutrition and applications in medicine. Altern Med Rev 2002;7(1):22-44.
18. Gurer H, Ercal N. Can antioxidants be beneficial in the treatment of lead poisoning? Free Radic Biol Med 2000;29(10):927-45.
19. Circu ML, Aw TY. Reactive oxygen species, cellular redox systems, and apoptosis. Free Radic Biol Med 2010;48(6):749-62.
20. Matteucci E, Giampietro O. Thiol signalling network with an eye to diabetes. Molecules 2010;15(12):8890-903.
21. Kundi H, Ates I, Kiziltunc E, et al. A novel oxidative stress marker in acute myocardial infarction; thiol/disulphide homeostasis. Am J Emerg Med 2015;33(11):1567-71.
22. Ates I, Kaplan M, Yuksel M, et al. Determination of thiol/disulphide homeostasis in type 1 diabetes mellitus and the factors associated with thiol oxidation. Endocrine 2016;51(1):47-51.
23. Yamaguchi J, Nagase M, Yamamoto Y, et al. Increased oxidative stress and renal injury in patients with sepsis. J Clin Biochem Nutr 2018;63(2):137-43.
24. Yilmaz R, Venkataraman S, Carcillo J, Kagan V, Bayir H. Antioxidant biomarkers in children with sepsis. Critical Care Med 2009;37(12):A210-A.
25. Erel O, Neselioglu S. A novel and automated assay for thiol/disulphide homeostasis. Clin Biochem 2014;47(18):326-32.
26. Gulbahar O, Adisen H, Koca C, Aricioglu A, Gulekon A. Changes in serum carbonyl and malondialdehyde levels following colchicine and vitamin E treatment in Behcet's disease. Methods Find Exp Clin Pharmacol 2007;29(8):521-4.
27. Demaret P, Tucci M, Ducruet T, Trottier H, Lacroix J. Red blood cell transfusion in critically ill children (CME). Transfusion 2014;54(2):365-75.
28. Bağcı M, Özcan PE, Şentürk E, Telci L, Çakar N. Kritik Hastalarda Anemi ve Kan Transfüzyonlarının Değerlendirilmesi. J Turk Soc Intensive Care/Türk Yogun Bakim Dernegi Derg 2014;12(2):45-50.
29. Karam O, Tucci M, Bateman ST, et al. Association between length of storage of red blood cell units and outcome of critically ill children: a prospective observational study. Crit Care 2010;14(2):1-8.
30. Lacroix J, Hébert PC, Hutchison JS, et al. Transfusion strategies for patients in pediatric intensive care units. N Engl J Med 2007;356(16):1609-19.
31. Carson JL, Grossman BJ, Kleinman S, et al. Red blood cell transfusion: a clinical practice guideline from the AABB*. Ann Intern Med 2012;157(1):49-58.
32. Carson JL, Guyatt G, Heddle NM, et al. Clinical practice guidelines from the aabb: red blood cell transfusion thresholds and storage. JAMA 2016;316(19):2025-35.
33. Doctor A, Cholette JM, Remy KE, et al. Recommendations on RBC Transfusion in General Critically Ill Children based on hemoglobin and/or physiologic thresholds from the pediatric critical care transfusion and anemia expertise initiative. Pediatr Crit Care Med 2018;19(9S Suppl 1):S98-s113.
34. Rivers E, Nguyen B, Havstad S, et al. Early goal-directed therapy in the treatment of severe sepsis and septic shock. N Engl J Med 2001;345(19):1368-77.
35. Hébert PC, Tinmouth A, Corwin HL. Controversies in RBC transfusion in the critically ill. Chest 2007;131(5):1583-90.
36. Akyildiz B, Ulgen Tekerek N, Pamukcu O, et al. Comprehensive Analysis of Liberal and Restrictive Transfusion Strategies in Pediatric Intensive Care Unit. J Trop Pediatr 2018;64(2):118-25.
37. Racek J, Herynková R, Holecek V, Faltysová J, Krejcová I. What is the source of free radicals causing hemolysis in stored blood? Physiol Res 2001;50(4):383-8.
38. Ho J, Sibbald WJ, Chin-Yee IH. Effects of storage on efficacy of red cell transfusion: when is it not safe? Crit Care Med 2003;31(12 Suppl):S687-97.
39. Wardle SP, Drury J, Garr R, Weindling AM. Effect of blood transfusion on lipid peroxidation in preterm infants. Arch Dis Child Fetal Neonatal Ed 2002;86(1):F46-8.
40. Rosa SD, Bristot Mde L, Topanotti MF, et al. Effect of red blood cell transfusion on parameters of inflammation and oxidative stress in critically ill patients. Rev Bras Ter Intensiva 2011;23(1):30-5.
41. Hirano K, Morinobu T, Kim H, et al. Blood transfusion increases radical promoting non-transferrin bound iron in preterm infants. Arch Dis Child Fetal Neonatal Ed. 2001;84(3):188-93.

42. Sacks LM, Schaffer DB, Anday EK, Peckham GJ, Delivoria-Papadopoulos M. Retrolental fibroplasia and blood transfusion in very low-birth-weight infants. Pediatrics 1981;68(6):770-4.
43. Ogunro PS, Ogungbamigbe TO, Muhibi MA. The influence of storage period on the antioxidants level of red blood cells and the plasma before transfusion. Afr J Med Med Sci 2010;39(2):99-104.
44. Hod EA, Brittenham GM, Billote GB, et al. Transfusion of human volunteers with older, stored red blood cells produces extravascular hemolysis and circulating non-transferrin-bound iron. Blood 2011;118(25):6675-82.
45. Marjani A. Alterations in plasma lipid peroxidation and total antioxidant status during storage of blood. Pak J Biol Sci 2006;9(13):2520-3.
46. D'Alessandro A, D'Amici GM, Vaglio S, Zolla L. Time-course investigation of SAGM-stored leukocyte-filtered red bood cell concentrates: from metabolism to proteomics. Haematologica 2012;97(1):107-15.
47. Kara SS, Erel O, Demirdag TB, et al. Alteration of thiol-disulphide homeostasis in acute tonsillopharyngitis. Redox Rep 2017;22(5):205-209.
48. Duygu F, Tekin Koruk S, Aksoy N. Serum paraoxonase and arylesterase activities in various forms of hepatitis B virus infection. J Clin Lab Anal 2011;25(5):311-6.
49. Esen R, Aslan M, Kucukoglu ME, et al. Serum paraoxonase activity, total thiols levels, and oxidative status in patients with acute brucellosis. Wien Klin Wochenschr 2015;127(11-12):427-33.
50. Aydogan S, Akduman H, Dilli D, et al. The role of thiol-disulfide homeostasis in neonatal sepsis. J Matern Fetal Neonatal Med 2021;34(10):1522-8.
51. Eren F, Koca Yozgat A, Firat Oğuz E, et al. A New Perspective for Potential Organ Damage Due to Iron-Mediated Oxidation in Thalassemia Major Patients. J Clin Med 2023;12(6).
52. Koç B, Yorulmaz A, Akyürek F, Resul Y. Determining the effects of erythrocyte suspension on total antioxidant status and total oxidative stress values in pediatric intensive care patients. Asian J Transfus Sci 2024.

JOURNAL OF
CONTEMPORARY MEDICINE

DOI:10.16899/jcm.873009
J Contemp Med 2024;14(3):117-121

Original Article / Orijinal Araştırma

Smoking and Real Life Results of Children and Adolescents

Çocuklar ve Ergenlerin Sigara İçme ve Gerçek Yaşam Sonuçları

Ayşegül ERTUĞRUL[1], Eyüp SARI[2], İlknur BOSTANCI[1],

[1]Health Science University Dr. Sami Ulus Maternity and Children Research and Training Hospital, Department of Pediatric Allergy and Clinical Immunology, Ankara, Turkey
[2]Health Science University, Ankara, Turkey

Abstract

Aim: Smoking is a chronic disease and children are the most affected group. In this study, we aimed to question the smoking habits of children and their parents and examine the level of exhaled carbon monoxide (eCO) to evaluate the usefulness of the method in an outpatient allergy clinic.

Material and Method: A questionnare was applied to 29 children who were smoker or exposed to second-hand smoke (SHS) and their parents separately. eCO levels of the participants were measured with CO Smokerlyzer.

Results: The median eCO level of children who smoked was 10 (7-14) ppm and was significantly higher than children exposed to SHS (P <0.001). The children who smoked were significantly older, the more they had friends who smoked. Children who were not exposed to tobacco products had lower rates of hospitalization due to recurrent lower respiratory tract infections, and family history of asthma was lower than children exposed to SHS (p <0.05). All the children were aware of the harmful effects of smoking. 34.5% of the parents were never questioned by their physicians about tobacco and its products and were not informed about smoking.

Conclusion: Using eCO in the clinic is a useful method to predict smoking status in daily practice. Children's attitudes towards smoking and peer relationships and parents' ignorance of smoking and SHS are still an unresolved issue.

Keywords: Carbon monoxide, cigarette, children, nicotine, passive smoker, secondhand smoke, smoking, tobacco

Öz

Amaç: Sigara içmek kronik bir hastalıktır ve çocuklar en çok etkilenen gruptur. Bu çalışmada, alerji polikliniğinde çocukların ve ebeveynlerinin sigara içme alışkanlıklarını sorgulamayı ve ekshale edilen karbon monoksit (eCO) yönteminin yararlılığını değerlendirilmesini amaçladık.

Gereç ve Yöntem: Sigara içen veya ikinci el dumana (SHS) maruz kalan 29 çocuk ve ebeveynlerine ayrı ayrı anket uygulandı. Katılımcıların eCO seviyeleri CO Smokerlyzer ile ölçüldü.

Bulgular: Sigara içen çocukların medyan eCO düzeyi 10 (7-14) ppm idi ve pasif sigaraya maruz kalan çocuklarda anlamlı derecede yüksekti (p <0,001). Sigara içen çocukların yaşı daha büyüktü, ve sigara içen arkadaşları vardı. Tütün ürünlerine maruz kalmayan çocukların tekrarlayan alt solunum yolu enfeksiyonları nedeniyle hastaneye yatış oranları daha düşüktü ve ailede astım öyküsü daha azdı (p <0,05). Bütün çocuklar sigaranın zararlı etkilerinin farkındaydı. Ebeveynlerin% 34,5'i tütün ve ürünleri hakkında hekimleri tarafından hiç sorgulanmamış ve sigara hakkında bilgilendirilmemişti.

Sonuç: Klinikte eCO kullanmak, günlük pratikte sigara içme durumunu tahmin etmek için yararlı bir yöntemdir. Çocukların sigara içmeye ve akran ilişkilerine karşı tutumları ve ebeveynlerin sigara ve pasif sigara konusundaki bilgisizliği hala çözülmemiş bir konudur.

Anahtar Kelimeler: Karbon monoksit, sigara, çocuk, nikotin, pasif içici, ikinci el sigara, sigara, tütün

Corresponding *(İletişim)*: İlknur BOSTANCI, Health Science University Dr. Sami Ulus Maternity and Children Research and Training Hospital, Department of Pediatric Allergy and Clinical Immunology, Ankara, Turkey
E-mail *(E-posta)*: ilknurbirol@hotmail.com
Received *(Geliş Tarihi)*: 02.02.2021 **Accepted *(Kabul Tarihi)*:** 22.03.2024

INTRODUCTION

The use of tobacco and tobacco products is a preventable public health problem that threatens human health. Smoking is a chronic disease and at a high rate starts in childhood. Not only active smoking but also second-hand smoke (SHS) is an important problem all over the world. Children are the group most affected.[1] SHS increases the risk of upper and lower respiratory infections, ear infections, dental caries, asthma attacks, attention deficit-hyperactivity disorder and learning disabilities.[2,3] Exposure to cigarette smoke adversely affects lung and brain development in children.[4,5]

Tobacco exposure can be determined by measurement of nicotine or cotinine in urine, saliva or blood. However, there is limited use in clinical practice due to interpersonal variability and the lack of a rapid test that can be used in the market.[6] Even though carbon monoxide (CO) is not a specific marker for tobacco, studies have shown a significant correlation between exhaled CO (eCO) and the number of cigarettes smoked in the last 24 h and eCO level more than 6 ppm giving an appropriate sensitivity and specificity to detect a smoker in outpatient clinics.[7,8] For active smoking and SHS environmental monitoring, measuring eCO is relatively simple, non-invasive and easy method. Studies have shown the usefulness of eCO, distinguishing between non-smoking and smoking environments.[6]

Questioning about the smoking habits of children and parents in to account is essential to recognize the problem.[9] The objective of the present study was to question the smoking habits of children and their parents and examine the level of eCO to evaluate the usefulness and benefits of the method in an outpatient clinic.

MATERIAL AND METHOD

This was a cross sectional study examining smoking habits of the school aged children who were followed up at the Department of Pediatric Allergy in a tertiary center. 35 patients and their parents were included in our study. Thirty-five participants and their mothers/fathers were included in the study. Three of the participants excluded from the study due to lack of data. Three children who had quitted smoking within the 6 months before the date of the interview were also excluded. eCO level was assessed in a total of 29 pediatric patients and their parents. The children exposed to SHS or active smokers were included in the study. An active smoker was defined as a person who currently smoked at least one cigarette a day. A person was supposed to be exposed to SHS if a household member (at least one of the parents) had regularly smoked cigarettes in their presence. All patients included in the study were under control without medications for the disease they were being followed in the allergy department. Children suffering from any serious internal diseases other than allergic diseases or suffering from acute respiratory infections within the last four weeks were excluded from the study.

Questionnaire

We evaluated the sociodemographic characteristics, smoking habits and attitudes of the children who were smoker or exposed to secondhand smoke and their parents by a questionnaire. The questionnaire was applied to parents and children separately.

Exhaled CO Measurement

eCO levels of the participants were measured with CO Smokerlyzer (Bedfont Scientific, Kent, England). The results were given in part per million (ppm), sensitive to 0–100 ppm of CO.

Ethical Issues

The ethical permission was obtained from the local etic committee of Health Sciences University, Dr Sami Ulus Maternity and Children Training and Research Hospital (73799008/2017). After data collection the participants were informed about the hazards of smoking.

Statistical analysis

All data were analysed by using the statistical program SPSS (Statistical Package for Social Sciences 15; SPSS Inc., Chicago, IL, USA). The Chi-squared test was applied to assess differences in categorical variables. Student's two-tailed t test was used for comparison between two independent groups of normally distributed data and Mann–Whitney U test for non-normally distributed data. Spearman correlation analyses were used to evaluate the relationship between the exhaled CO levels of the children and their parents. A p value of <0.05 was considered to be statistically significant.

RESULTS

Characteristics of the children and the levels of eCO are shown in **Table 1**.

The median eCO level of the children was significantly higher in active smokers than the children exposed to SHS ($p<0.001$). There were no significant differences between eCO levels in the different groups with sex, living place, dental caries, active sports and attention deficit-hyperactivity disorder ($p>0.05$). No significant differences between the eCO levels of the patients were found in terms of the diagnoses in both groups separated as asthma and/or allergic rhinitis and the other allergic diseases ($p>0.05$). The eCO levels of the children with recurrent lower respiratory tract infections were significantly lower ($p=0.009$).

The median eCO level (IQR) was 3 (2-7) ppm for the children and 6.5 (5-9.75) ppm for parents as shown in **Table 2**. The median eCO level of the active smoker children were higher than the median eCO level of active smoker parents. Evaluating the children and parents who were exposed to SHS; the median eCO level of the parents were higher than the children. No significant correlation was found between the eCO measurements of the children exposed to SHS and their active smoker parents in the Spearman's correlation analysis ($r= 0.026$, $p= 0.461$).

Table 1. Characteristics of the children and the levels of exhaled carbon monoxide (eCO)

Characteristics of the patients	Number (%)	eCO level of the patients (ppm) median (IQR)*	p
Total number of the patients	29	3 (2-7)	
Age (year), mean±SD	14±3.5		
Sex			>0.05
Male	21 (72.4)	3 (2-8.5)	
Female	8 (27.6)	1.5 (1-5.25)	
Body mass index (%), median (IQR)		59.5 (28.7-90)	
Maternal smoking at pregnancy			>0.05
Yes	5 (17.2)	3 (2-5.5)	
No	24 (82.8)	2.5 (1.25-8.75)	
Living in big city	26 (89.7)		
Living in town	3 (10.3)		
Diagnosis			>0.05
Asthma and/or Allergic rhinitis	24 (82.8)	3 (2-7.5)	
Other **	5(17.2)	2 (1.5-6.5)	
Smoking status			<0.001
Active smoker	9 (31)	10 (7-14)	
Exposed to SHS	20 (69)	2 (1-3)	
Recurrent lower respiratory tract infections			0.009
Yes	6 (20.6)	1.5 (0.75-2)	
No	23 (79.3)	3 (2-9)	
Dental caries			>0.05
Yes	15 (51.7)	2 (1-5)	
No	14 (48.3)	3 (2-8.25)	
Active sports			>0.05
Yes	6 (20.7)	5.5 (1.75-10.5)	
No	23 (79.3)	3 (2-6)	
Attention deficit-hyperactivity disorder			>0.05
Yes	8(27.6)	3 (2.25-7)	
No	21 (72.4)	2 (1.5-7.5)	

*IQR; Interquartile Range, * *Atopic Dermatitis, Drug Allergy, Urticaria-Angioedema

Table 2. eCO level of the participants

	CO level of the children (ppm) median (IQR)	CO level of the parents (ppm) median (IQR)
All patients n= 29	3 (2-7)	6.5 (5-9.75)
Active smoker	10 (7-14)	7 (5-10)
Exposed to SHS	2 (1-3)	4 (4-4)

Actively smoking children were significantly older, they had more smoking friends, lower hospitalization rates due to recurrent lower respiratory tract infections and lower family history of asthma than the children exposed to SHS (p= 0.008, p=0.006, p=0.027, p= 0.033). The number of the upper respiratory tract infections per year, the number of sinusitis per year and the number of otitis media per year was not statistically different (p> 0.05) between both groups (active smoker children and children exposed to SHS).

Middleton et al 7 demonstrated that breath CO concentration > 6 ppm strongly suggests that an outpatient is a smoker. Only children who actively smoked had eCO levels above 6 ppm in our study. Out of the 9 active smoking children (smoking less than 11 cigarettes daily), 2 had eCO levels below 6 ppm, which is typically regarded as the threshold for active smoking according to literature. Sociodemographic characteristics and smoking patterns of the parents are shown in **Table 3**,**4**.

Table3. Sociodemographic characteristics of the parents

Characteristics of the parents	Number (%)
Age of mother (year), mean±SD	37±4.9
Age of father (year), mean±SD	41±5.7
Number of family members, mean±SD	4.35±1.07
Education levels of the mothers	
Literate	1 (3.4)
Primary-Intermediate-high school	24 (82.8)
University and after	4 (13.8)
Education levels of the fathers	
Literate	6 (20.7)
Primary-Intermediate-high school	19 (65.5)
University and after	4 (13.8)
Employment status of the parents	
Working mother	8 (27.6)
Working father	22(75.9)
Mean income of the families (Turkish lira), median (IQR)	2000 (1500-4000)

Table4. Parents' smoking habits

Parents' smoking habits	Number (%)
Smoking habits of the mother	
Never used	8 (27.6)
Quitted smoking	2 (6.9)
< 11 cigarettes /daily	13 (44.8)
11-20 cigarettes/daily	4 (13.8)
21-30 cigarettes/daily	1 (3.4)
>30 cigarettes/daily	1 (3.4)
Smoking habits of the father	
Never used	1 (3.4)
Quitted smoking	4 (13.8)
< 11 cigarettes /daily	6 (20.7)
11-20 cigarettes/daily	11 (37.9)
21-30 cigarettes/daily	4 (13.8)
>30 cigarettes/daily	3 (10.3)
Smoking in home	22 (75.8)
Smoking in working place	15 (51.7)
Attempted to quit smoking	17 (58.6)
Willingness to quit smoking	18 (62.1)

According to parents' statements, smoking rate at home was 44.8%, but including those who said yes to the question of smoking on the balcony/terrace/toilet of the house, the rate increased to 75.8%. 65.5% of the parents reported that they were informed by their doctors about smoking. 62.1% of parents and 55.5% of children who were current smokers stated that they wanted to quit smoking. The most important obstacle for children to quit smoking was inability of self-control, stress, irritability, friends and school environment. Frequent barriers for parents were stated as flabbiness, irritability and experiences. Other reasons for the parents were self-distrust, habits, stress, unwillingness and smoker spouse.

All children approved in the questionnaire that smoking is harmful to health, smoking may cause cancer, cigarette smoke has harmful side effects on other people and the environment. However, 24.1% of the children reported that smoking relieves stress and makes me feel relaxed, 13.8% of the children reported that smoking makes me happy, 10.3% of the children reported that smoking helps to get acceptance in the groups of friends, 10.3% of the children reported that smokers are attractive.

DISCUSSION

Most of the people start smoking at very young age. Worldwide, surveys indicate that about 7% or just over 24 million children aged 13–15 years smoked cigarettes in 2000– 2017.[10] According to the Global Adult Survey Turkey Report 2012, 16.1% of smokers started smoking under the age of 15 and 58.7% started smoking under the age of 18. In Turkey, despite the tobacco control studies within the frame of tobacco control policies and MPOWER package released by World Health Organization (WHO) smoking rates among young children are approximately two-three times higher than the smoking rate for the worldwide.[11] Therefore, smoking is a very important but ignored health problem that should be questioned in all pediatric outpatient clinics.

Our study population was a representative sample of patients being followed in an allergy department in a tertiary centre with a mean age of 14 years. eCO can be used in adolescents as a predictor of smoking status, environmental tobacco smoke exposure and an indicator of nicotine dependency.[12] In our study the eCO level was significantly higher in smokers than the group exposed to SHS. The level of eCO did not exceed 6 ppm in children who were exposed to SHS. The mean eCO level of the children exposed to SHS was 2.2±1.5 ppm which were similar to the eCO level (2.8±2.6 ppm) of adolescences exposed to SHS reported by Vancelik 12 and higher than determined for the non-smoker subjects (1.8±1.9 ppm) as reported. As shown in previous studies, passive smokers had higher eCO concentration than healthy non-smokers, but this elevation was not always significant.[13] Not establishing healthy control group in to our study was an ethical issue about not including the healthy children in a tobacco study. The eCO level of two smoking patients was found to be under 6 ppm. Besides, some of the patients who were exposed to SHS had eCO levels reaching 6 ppm. One of these patients was working in a hookah café as a waiter. Laranjeira et al.[14] reported that exposure to environmental tobacco smoke is the most likely cause for the increase in eCO levels among non-smoking waiters. The half-life of CO is between 5-6 hours in the body and probably restored to normal after 24-48 hours if one is not exposed to smoking.[7,15] The fact that the time of the last cigarette use is very important for the evaluation. And this handicap explains why two of the active smoker children had lower eCO levels than that considered to be the active smoking limit and explains why no significant correlation was found between the eCO measurements of the children exposed to SHS and their parents' in our group. So it is not possible to predict the severity of SHS exposure of the children by their parents' eCO levels. In our study the time of the last cigarette usage was not recorded and this limited our critics.

eCO is also considered as a biomarker of pulmonary diseases like asthma but asthma control is the most important factor affecting the levels of eCO. Patients who had asthma under control did not show significant differences between the levels of eCO from the healthy controls.[16,17] All of our study population were under control for the allergic diseases they had been followed up. However, it should be kept in mind that the level of eCO may be affected in children with uncontrolled respiratory diseases.

The effects of smoking vary according to the age of exposure. In our study group when considered in terms of recurrent infections (upper respiratory tract infections/otitis media/ sinusitis per year), dental caries and attention deficit-hyperactivity disorder there was no significant differences between active and passive smokers. None of the patients who were hospitalized due to recurrent lower respiratory tract infection were active smoker and also, family history of asthma was fewer in this group. It is considered that hospitalization due to the recurrent lower respiratory tract infections and family history of asthma may have caused a change of attitude in these children about smoking. But the parents of them were unaware of the importance of the SHS exposure and all these children were passive smokers. At this point, by clinicians every hospital visit can be turned into an opportunity to inform parents about hazards of smoking and support and motivate the parents to quit smoking.

The impact of parental smoking has been studied in a wide range of contexts in a large number of studies with a variety of outcomes.[18] In our study no differences could be observed in terms of the presence of household members smoking in the house but the number of smoker friends were significantly higher in the active smoker group. The influence of friend smoking may be more potent on intentions to smoke among young people rather than family smoking. Kim et al.[19] found that, as the number of surrounding cigarette smokers increases, the smoking rate in teenagers increases, and there is a tendency to vary according to social status.

The impact of socioeconomic status and family education on smoking of adolescents is controversial in the literature.[18] In our study 87.2% of the parents were graduated from primary-intermediate- high school with low socioeconomic income. Some of the parents did not accept smoking in the kitchen, on the balcony or in the toilet as smoking at home. And we considered that they didn't have enough information about indoor smoking. Exposure to SHS is still one of the most common indoor pollutants and poses a substantial health risk and disease burden for children worldwide. Public health strategies and complementary educational strategies to reduce exposure to SHS at home is essential.[1]

During outpatient visits for their children, 34.5% of the parents were neither queried about their smoking status nor informed about SHS.. Pediatricians should be trained for tobacco control. Even if smoking status of the patients is questioned, applications are limited by the doctor's experience. As with many other chronic diseases, there should be an action plan for smoking child. Although there are many smoking cessation centres that can guide adults, there are limited or no centers for children to divert.

The creation of the negative image of tobacco and products among young people is required to prevent tobacco use.

CONCLUSION

Utilizing eCO in the clinic is an easy and useful method to predict smoking status and additionally convincing for the children and parents to see the objective results of the of smoking on themselves. It is not possible to predict the influence of SHS on children by using eCO levels of parents. Evaluating the eCO is successful in showing the direct effects of smoking but different measurements are needed to assess the secondary effects observed due to exposure to domestic cigarette smoke.

Ignorance of parents about smoking and SHS is a still unresolved issue. On the other hand, children's attitudes about smoking and their peer relationships are more important than lack of education. Outpatient visits are an opportunity but pediatricians don't pay enough attention on smoking children. Health professionals need guidelines about smoking children for a standard approach.

What is already known

Smoking is a chronic disease and at a high rate starts in childhood. Utilizing eCO in the clinic is an easy and useful method to predict smoking status.

What this study adds

It is not possible to predict the severity of SHS exposure of the children by their parents' eCO levels. Parents need to be educated about smoking but children's attitudes about smoking and their peer relationships are more important than lack of education. Health professionals need guidelines on smoking children for a standard approach.

ETHICAL DECLARATIONS

Ethics Committee Approval: The ethical permission was obtained from the local etic committee of Health Sciences University, Dr Sami Ulus Maternity and Children Training and Research Hospital (73799008/2017).

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

REFERENCES

1. Oberg M, Jaakkola MS, Woodward A, Peruga A, Prüss-Ustün A. Worldwide burden of disease from exposure to second-hand smoke: a retrospective analysis of data from 192 countries. Lancet. 2011;377:139-46.
2. Difranza JR, Aligne CA, Weitzman M. Prenatal and postnatal environmental tobacco smoke exposure and children's health. Pediatrics 2004;113:1007-15.
3. Centers for Disease Control and Prevention. Health Effects od Secondhand Smoke. Available online at https://www.cdc.gov/tobacco/data_statistics/fact_sheets/secondhand_smoke/health_effects/index.htm; accessed June 22, 2019.
4. Moritsugu KP. The 2006 Report of the Surgeon General: the health consequences of involuntary exposure to tobacco smoke. Am J Prev Med. 2007;32:542-3.
5. Maritz GS, Harding R. Life-long programming implications of exposure to tobacco smoking and nicotine before and soon after birth: evidence for altered lung development. Int J Environ Res Public Health. 2011;8:875-98.
6. Apelberg BJ, Hepp LM, Avila-Tang E, et al. Environmental monitoring of secondhand smoke exposure. Tob Control. 2013;22:147-55.
7. Middleton ET, Morice AH. Breath carbon monoxide as an indication of smoking habit. Chest. 2000;117, 758–763.
8. Shie HG, Pan SW, Yu WK, Chen WC, Ho LI, Ko HK. Levels of exhaled carbon monoxide measured during an intervention program predict 1-year smoking cessation: a retrospective observational cohort study. NPJ Prim Care Respir Med. 2017;16:59
9. World Health Organization. Second-hand tobacco smoke and children. Available online at https://www.who.int/ceh/capacity/tobacco1.pdf; accessed June 22, 2019.
10. World Health Organization. WHO Global Report on trends in prevalence of tobacco smoking 2000-2025, second edition. Geneva: World Health Organization;2018. Available online at https://apps.who.int/iris/bitstream/handle/10665/272694/9789241514170-eng.pdf; accessed June 22, 2019.
11. Global Adult Survey Turkey Report 2012. Ministry of Health, Publication No: 948, Ankara 2014. Available online at https://www.who.int/tobacco/surveillance/survey/gats/report_tur_2012.pdf; accessed June 22, 2019.
12. Vançelik S, Beyhun NE, Acemoğlu H. Interactions between exhaled CO, smoking status and nicotine dependency in a sample of Turkish adolescents. Turk J Pediatr. 2009;51:56-64.
13. Deveci SE, Deveci F, Acik Y, Ozan AT. The measurement of exhaled carbon monoxide in healthy smokers and non-smokers. Respir Med. 2004;98:551–6.
14. Larenjeira R, Pillon S, Dunn J. Environmental tobacco smoke exposure among non-smoking waiters: measurement of expired carbon monoxide levels. Sao Paulo Med J. 2000;118:89–92.
15. Sandberg A, Sköld CM, Grunewald J, Eklund A, Wheelock ÅM. Assesing recent smoking status by measuring exhaled carbon monoxide levels. Plos One. 2011;6:e28864
16. Yamaya M, Hosoda M, Ishizuka S, et al. Relation between exhaled carbon monoxide levels and clinical severity of asthma. Clin Exp Allergy. 2001;31(3):417-22.
17. Jesenak M, Banovcin P, Havlicekova Z, Dobrota D, Babusikova E. Factors influencing the levels of exhaled carbon monoxide in asthmatic children. J Asthma. 2014;51:900-6.
18. Ozge C, Toros F, Bayramkaya E, Camdeviren H, Sasmaz T. Which sociodemographic factors are important on smoking behaviour of high school students? The contribution of classification and regression tree methodology in a broad epidemiological survey. Postgrad Med J. 2006;82:532–41.
19. Kim DJ, Kim SJ. Impact of nearby smoking on adolescent smoking behavior in Korea. Medicine (Baltimore). 2018 ;97:e13125.

JOURNAL OF
CONTEMPORARY MEDICINE

DOI:10.16899/jcm.1454025
J Contemp Med 2024;14(3):122-131

Original Article / Orijinal Araştırma

Investigation of the Adjectives in Terminologia Anatomica, in Terms Related to the Nervous System and Sense Organs

Terminologia Anatomica'da Yer Alan Sinir Sistemi ve Duyu Organları ile İlgili Terimlerdeki Sıfatların İncelenmesi

Mücahit AYDIN[1], Hilal IRMAK SAPMAZ[2]

[1]Tokat Gaziosmanpaşa University, Institute of Postgraduate Education, Department of Anatomy, Tokat, Türkiye
[2]Tokat Gaziosmanpaşa University, Faculty of Medicine, Department of Anatomy, Tokat, Türkiye

Abstract

Aim: Effective and correct use of terminology in anatomy education and other medical sciences is very important for healthy communication between scientists. Due to the low number of scientific studies on both medical and anatomical terminology, this study was conducted to help increase the existing knowledge in this field.

Material and Method: Terminologia Anatomica, published by Thieme in 1998, was used in the study.

Results: A total of 2431 terms related to the nervous system and sensory organs were analyzed, and a total of 625 different adjectives within these terms were evaluated in terms of origin, degree and form and classified into classes. A total of 492 different adjectives were included in the 1924 terms under the title of nervous system. There are 133 different adjectives in 507 terms under the title of sense organs. There are a total of 2753 adjectives in both sections we have analyzed, together with the number of repetitions. It was observed that most of these adjectives were of Latin origin, two-shaped and had a gradus positivus degree of comparison.

Conclusion: The data we obtained as a result of this study revealed the distribution and characteristics of adjectives in terms of origin, degree and form within the terminology. We think that our study will contribute to the development of medical terminology and will also help make the anatomy course more understandable and memorable for students.

Keywords: Anatomical terminology, nervous system, sense organs, adjectives

Öz

Amaç: Anatomi eğitiminde ve diğer tıbbi bilimlerde terminolojinin etkili ve doğru şekilde kullanılması bilim insanları arasında sağlıklı iletişim kurulabilmesi için çok önemlidir. Hem tıbbi hem de anatomik terminoloji üzerine yapılan bilimsel çalışmaların sayıca az olması sebebiyle bu alanda var olan bilgi birikiminin arttırılabilmesine yardımcı olmak amacıyla bu çalışma yapılmıştır.

Gereç ve Yöntem: Çalışmamızda Thieme tarafından 1998 yılında yayımlanmış olan Terminologia Anatomica kullanılmıştır.

Bulgular: Sinir sistemi ve duyu organları ile ilgili toplam 2431 terim incelenmiş ve bu terimlerin içerisinde yer alan toplam 625 farklı sıfat köken, derece ve şekil bakımından değerlendirilerek sınıflara ayrılmıştır. Sinir sistemi başlığı altında yer alan 1924 terimin içerisinde toplam 492 farklı sıfat yer almaktadır. Duyu organları başlığı altındaki 507 terim içerisinde 133 farklı sıfat bulunmaktadır. İncelemiş olduğumuz her iki bölüm içerisinde tekrar sayıları ile birlikte toplam 2753 sıfat mevcuttur. Bu sıfatların büyük kısmının Latince kökenli, iki şekilli ve gradus positivus karşılaştırma derecesine sahip olduğu görülmüştür.

Sonuç: Bu çalışma neticesinde elde ettiğimiz veriler, sıfatların terminoloji içerisindeki köken, derece, şekil bakımından dağılımlarını ve özelliklerini ortaya koymuştur. Çalışmamızın tıbbi terminolojinin gelişimine katkıda bulunacağını, ayrıca anatomi dersinin öğrenciler için daha anlaşılır ve ayrıca akılda kalıcı olmasına yardımcı olacağını düşünmekteyiz.

Anahtar Kelimeler: Anatomik terminoloji, sinir sistemi, duyu organları, sıfatlar

Corresponding *(İletişim)*: Mücahit Aydın, Tokat Gaziosmanpaşa University, Institute of Postgraduate Education, Department of Anatomy, Tokat, Türkiye
E-mail *(E-posta)*: mchtydn97@gmail.com
Received *(Geliş Tarihi)*: 16.03.2024 **Accepted *(Kabul Tarihi)*:** 01.05.2024

INTRODUCTION

Anatomy is one of the most basic sciences in medical education. It is very important to learn anatomy well in order to form the basis for other health sciences education. The medical field has a wide and important Anatomy terminology. Understanding and learning the terminology rules is also important to prevent confusion among health workers.[1] Success in learning and practicing anatomy is directly proportional to knowledge of terminology. Terminology learning is intensive at the beginning of health sciences education and is continuous throughout further education and working life.[2]

Terminologia Anatomica (TA) is a list of Latin terms for the structures of the human body and their English equivalents. Common decisions have been reached on the content of the TA through meetings held at various times for many years. Lastly, an updated version was published by the Federative Committee on Anatomical Terminology (FCAT) in 1998 and approved by the International Federation of Associations of Anatomists (IFAA).[3]

Most of the anatomical terminology consists of Latin terms. However, Latin is not used as a spoken language, making it difficult for students to understand the terms. The aim of this study is to classify the adjectives found in the terms for the sensory organs and nervous system in TA according to their linguistic origin, their charms and their degrees in order to facilitate their understanding and to contribute to the field of anatomical terminology.

MATERIAL AND METHOD

In order to identify the adjectives analyzed in this study, Terminologia Anatomica, published in 1998, which is considered to be the most recent and comprehensive of the anatomical term lists, was used. TA contains 7537 anatomical terms.[4] The adjectives in the terms under the title of nervous system and sense organs of the TA are analyzed according to their origins, degrees and the adjectives they have received.

Our study does not require ethics committee approval. This study was derived from the data of the master's thesis titled " Investigation of the Adjustments in Terminologia Anatomica, in Terms Related to the Nervous System and Sense Organs" published in Tokat Gaziosmanpaşa University, Department of Anatomy in 2023.

In order to access the adjective conjugations, roots and meaning information in the tables of these adjectives, Anatomi Sözlüğü, Güncel Tıp Terimleri Sözlüğü, Tıpta Önek ve Sonekler Sözlüğü, Tıbbi Latince, Tıbbi Teminoloji, Yeni Tıp Sözlüğü, Anatomi Terimleri Kılavuzu resources were utilized.[5-11] In addition, Wiktionary (https://www.wiktionary.org)[12] and Health Terms (https://www.saglikterimleri.com)[13] websites were used as online dictionaries and AnatoNomina (http://www.terminologia-anatomica.org/en)[14] website was used to identify the terms of nervous system and sensory organs in TA.

Separate tables were created for each chapter and the adjectives mentioned in each chapter were grouped and analyzed with these tables.

RESULTS

TA has a total of 2431 terms under the title of nervous system and sensory organs. The total number of adjectives in the terms nervous system and sense organs is 625. It was determined that there were 2279 adjectives in the nervous system and 474 adjectives in the terms of sensory organs, for a total of 2753 adjectives in both sections. The classification of adjectives in terms of their linguistic origins, inflections and degrees of comparison are given in **Tables 1** and **2** respectively.

The linguistic origins and repetitions of adjectives in the terms nervous system in **Table 3** and sense organs in **Table 4** are given in alphabetical order.

Latin adjectives are divided into three groups according to the number of charms they take: three-shaped, two-shaped and single-shaped.[15] In our study, it was observed that three-shaped adjectives in nervous system terms were repeated 698 times, two-shaped adjectives 1566 times and one-shaped adjectives 15 times. The three-shaped adjectives in the sense organs adjectives were repeated 13 times in total, the two-shaped adjectives were repeated 330 times in total, and the one-shaped adjectives were repeated 5 times in total.

Table 1. Analyzing the Adjectives in the Nervous System Terms

	Language Origins			Conjugations			Degrees of Comparison		
	LA	GR	LA-GR	Three	Two	Single	Positivus	Comparativus	Superlativus
	386	60	46	177	304	11	483	6	3
Number of Adjectives						492			
Number of Terms						1924			

LA: Latin, GR: Greek

Table 2. Analyzing the Adjectives in the Terms of Sensory Organs

	Language Origins			Conjugations			Degrees of Comparison		
	LA	GR	LA-GR	Three	Two	Single	Positivus	Comparativus	Superlativus
	107	17	9	53	78	2	126	6	1
Number of Adjectives						133			
Number of Terms						507			

LA: Latin, GR: Greek

Table 3. Adjectives in Nervous System Terms

Adjectives	Origin	Repeat Number
Abdominalis, -e	LA	4
Abducens, -entis	LA	2
Accessorius, -a, -um	LA	11
Acusticus, -a, -um	GR	3
Afferens, -entis	LA	1
Affixus, -a, -um	LA	1
Albus, -a, -um	LA	12
Alveolaris, -e	LA	5
Ambiens, -ntis	LA	1
Ambiguus, -a, -um	LA	1
Aminergicus, -a, -um	LA	8
Amygdaloideus, -a, -um	GR	2
Amygdalopiriformis, -e	LA	1
Analis, -e	LA	2
Angularis, -e	LA	1
Anococcygeus, -a, -um	GR, LA	1
Ansiformis, -e	LA	3
Anterior, -ius	LA	89
Anterodorsalis, -e	LA	1
Anterolateralis, -e	LA	8
Anteromedialis, -e	LA	4
Anteroventralis, -e	LA	1
Anuloolivaris, -e	LA	1
Aorticorenalis, -e	GR	1
Aorticus, -a, -um	GR	2
Arcuatus, -a, -um	LA	9
Articularis, -e	LA	2
Ascendens, -entis	LA	1
Auricularis, -e	LA	4
Auriculotemporalis, -e	LA	2
Autonomicus, -a, -um	GR	8
Basalis, -e	LA	10
Basilaris, -e	LA	3
Brevis, -e	LA	3
Bulbopontinus, -a, -um	LA, GR	1
Bulboreticulospinalis, -e	LA	2
Caeruleospinalis, -e	LA	1
Caeruleus, -a, -um	LA	3
Calcarinus, -a, -um	LA	1
Callosus, -a, -um	LA	4
Cardiacus, -a, -um	GR	9
Carotici/cus, -a, -um	LA	6
Caroticotympanic(i)us, -a, -um	GR	2
Caudalis, -e	LA	4
Caudatolenticularis, -e	LA	1
Caudatus, -a, -um	LA	1
Cavernosus, -a, -um	LA	3
Centralis, -e	LA	26
Cerebellaris, -e	LA	12
Cerebelloolivaris, -e	LA	2
Cervicalis, -e	LA	17
Cervicothoracicus, -a, -um	GR	1
Choroideus, -a, -um	LA	14
Ciliaris, -e	LA	8
Cinereus, -a, -um	LA	2
Coccygeus, -a, -um	GR	4
Cochlear, -e, -is	LA	11

Table 3. Adjectives in Nervous System Terms (Continued)

Adjectives	Origin	Repeat Number
Coeliacus, -a, -um	GR	3
Collateralis, -e	LA	6
Commissuralis, -e	LA	27
Communicans, -tis	LA	21
Communis, -e	LA	6
Corticomesencephalicus, -a, -um	LA, GR	1
Corticonuclearis, -e	LA	5
Corticopontinus, -a, -um	LA	2
Corticoreticularis, -e	LA	4
Corticorubralis, -e	LA	1
Corticospinalis, -e	LA	6
Corticotectalis, -e	LA	1
Corticothalamicus, -a, -um	LA	2
Cranialis, -e	LA	8
Craniocervicalis, -e	GR, LA	1
Craniospinalis, -e	GR	1
Cuneatus, -a, -um	LA	7
Cuneiformis, -e	LA	2
Cuneocerebellaris, -e	LA	1
Cuneospinalis, -e	LA	1
Curvatura, -ae	LA	2
Cutaneus, -a, -um	LA	30
Deferentialis, -e	LA	1
Dentalis, -e	LA	4
Dentatus, -a, -um	LA	9
Diagonalis, -e	GR	2
Digastricus, -a, -um	GR	1
Dopaminergicus, -a, -um	LA	8
Dorsalis, -e	LA	42
Dorsolateralis, -e	LA	1
Dorsomedialis, -e	LA	4
Dura, -ae	LA	5
Efferens, -entis	LA	1
Emboliformis, -e	LA	1
Encephalicus, -a, -um	GR	3
Endolemniscalis, -e	GR, LA	1
Endopeduncularis, -e	GR	1
Entericus, -a, -um	GR	1
Epithalamicus, -a, -um	GR	5
Equinus, -a, -um	LA	1
Ethmoidalis, -e	GR	2
Externus, a, um	LA	16
Facialis, -e	LA	4
Fasciolaris, -e	LA	1
Fastigiospinalis, -e	LA	1
Fastigium, -ii	LA	1
Femoralis, -e	LA	3
Fimbriodentatus, -a, -um	LA	1
Flocculonodularis, -e	LA	1
Fornix, -icis	LA	4
Frontopontinus, -a, -um	LA	2
Ganglionaris, -e	LA	11
Gelatinosus, -a, -um	LA	4
Geniculatus, -a, -um	LA	6
Geniculocalcarinus, -a, -um	LA	1
Genitalis, -e	LA	1
Genitofemoralis, -e	LA	1

Table 3. Adjectives in Nervous System Terms (Continued)

Adjectives	Origin	Repeat Number
Gigantocellularis, -e	GR	2
Gingivalis, -e	LA	3
Globosus, -a, -um	LA	1
Glossopharyngeus, -a, -um	GR	3
Gracilis, -e	LA	6
Gracilispinalis, -e	LA	1
Granulosus, -a, -um	LA	1
Griseus, -a, -um	LA	16
Habenularis, -e	LA	6
Habenulointerpeduncularis, -e	LA	1
Hepaticus, -a, -um	GR	2
Hippocampalis, -e	GR	1
Horizontalis, -e	LA	3
Hypogastricus, -a, -um	GR	3
Hypoglossalis, -e	GR	1
Hypoglossus, -a, -um	GR	5
Hypothalamicus, -a, -um	GR	8
Hypothalamohypophysialis, -e	GR	1
Hypothalamospinales, -e	LA	4
Iliohypogastricus, -a, -um	GR	1
Ilioinguinalis, -e	GR, LA	1
Iliopubicus, -a, -um	GR, LA	1
Imus, -a, -um	LA	1
Incertus, -a, -um	LA	2
Inferior, -ius	LA	58
Inferolateralis, -e	LA	1
Inferomedialis, -e	LA	2
Infraclavicularis, -e	LA	1
Infrapatellaris, -e	LA	1
Infratrochlearis, -e	LA	1
Infundibularis, -e	LA	2
Innominatus, -a, -um	LA	1
Insularis, -e	LA	1
Intercalatus, -a, -um	LA	1
Intercostalis, -e	LA	1
Intercostobrachialis, -e	LA	1
Intercruralis, -e	LA	1
Interfascicularis, -e	LA	3
Interganglionaris, -e	LA	1
Intergeniculatus, -a, -um	LA	1
Interlobaris, e	LA	2
Intermediolateralis, -e	LA	1
Intermediomedialis, -e	LA	1
Intermedius, -a, -um	LA	21
Intermesentericus, -a, -um	LA, GR	1
Internus, -a, -um	LA	17
Interosseus, -a, -um	LA	3
Interpeduncularis, a, -um	LA	3
Interpolaris, -e	LA	1
Interpositospinalis, -e	LA	1
Interstitialis, -e	LA	6
Interthalamicus, -a, -um	LA	2
Interventricularis, -e	LA	2
Intrabiventralis, -e	LA	1
Intralaminaris, -e	LA	1
Intraparietalis, -e	LA	1
Intraparotideus, -a, -um	LA, GR	1

Table 3. Adjectives in Nervous System Terms (Continued)

Adjectives	Origin	Repeat Number
Intrathalamicus, -a, -um	LA	1
Jugularis, -e	LA	1
Juxtarestiformis, -e	LA	2
Koniocellularis, -e	GR, LA	1
Labialis, -e	LA	4
Lacrimalis, -e	LA	2
Lacunosus, -a, -um	LA	1
Laryngopharyngealis, -e	GR	1
Lateralis, -e	LA	113
Lenticularis, -e	LA	5
Lienalis, -e	LA	1
Limitans, -ntis	LA	2
Linearis, -e	LA	3
Lingualis, -e	LA	6
Longitudinalis, -e	LA	14
Longus, -a, -um	LA	1
Lumbalis, -e	LA	6
Lumbosacralis, -e	LA	3
Lunatus,-a, -um	LA	1
Lunogracilis, -e	GR, LA	1
Magnocellularis, -e	LA	8
Magnus, -a, -um	LA	6
Major, -us	LA	6
Mamillothalamicus, -a, -um	LA, GR	2
Linearis, -e	LA	3
Lingualis, -e	LA	6
Longitudinalis, -e	LA	14
Longus, -a, -um	LA	1
Lumbalis, -e	LA	6
Lumbosacralis, -e	LA	3
Lunatus,-a, -um	LA	1
Lunogracilis, -e	GR, LA	1
Magnocellularis, -e	LA	8
Magnus, -a, -um	LA	6
Major, -us	LA	6
Mamillothalamicus, -a, -um	LA, GR	2
Mammarius, -a, -um	LA	2
Mammillaris, -e	LA	3
Mammillotegmentalis, -e	LA	1
Mandibularis, -e	LA	7
Marginalis, -e	LA	5
Medialis, -e	LA	84
Medianus, -a, -um	LA	16
Mediodorsalis, -e	LA	1
Medioventralis, -e	LA	1
Medius, -a, -um	LA	10
Medullaris, -e	LA	18
Medulloreticulospinalis, -e	LA	1
Mesencephalicus, -a, -um	LA	3
Mesentericus, -a,-um	GR	4
Minor, -us	LA	8
Mixtus, -a, -um	LA	1
Molecularis, -e	LA	5
Motorius, -a, -um	LA	4
Multiformis, -e	LA	2
Muscularis, -e	LA	23
Musculocutaneus, -a, -um	LA	1

Table 3. Adjectives in Nervous System Terms (Continued)

Adjectives	Origin	Repeat Number
Myentericus, -a, -um	GR	1
Nasalis, -e	LA	9
Nasociliaris, -e	LA	3
Nasopalatinus, -a, -um	LA	1
Niger, -a, -um	LA	2
Obscurus, -a, -um	LA	2
Obturatorius, -a, -um	LA	3
Occipitalis, -e	LA	13
Occipitofrontalis, -e	LA	2
Occipitopontinus, -a, -um	LA	2
Occipitotectalis, -e	LA	1
Occipitotemporalis, -e	LA	6
Oculomotorius, -a, -um	LA	6
Oesophagealis, -e	LA	4
Olfactorius, -a, -um	LA	20
Olivaris, -e	LA	10
Olivocerebellaris, -e	LA	1
Olivocochlearis, -e	LA	1
Olivospinalis, -e	LA	2
Opercularis, -e	LA	1
Opticus, -a, -um	GR	8
Oralis, -e	LA	1
Orbitalis, -e	LA	4
Oticus, -a, -um	GR	3
Ovaricus, -a, -um	LA	1
Palatinus, -a, -um	LA	3
Pallidus, -a, -um	LA	8
Palmaris, -e	LA	1
Palpebralis, -e	LA	2
Pancreaticus, -a, -um	GR	1
Parabigeminalis, -e	GR, LA	1
Parabrachialis, -e	GR	4
Paracentralis, -e	GR	6
Paracommissuralis, -e	GR, LA	1
Parafascicularis, -e	LA, GR	1
Paraflocculares, -e	LA	2
Paragigantocellularis, -e	LA	2
Parahippocampalis, -e	GR	2
Paralemniscalis, -e	GR, LA	1
Paramedianus, -a, -um	LA	5
Paranigralis, -e	GR, LA	1
Paraolfactorus, -a, -um	GR, LA	3
Parapeduncularis, -e	GR, LA	1
Parasolitarius, -a, -um	GR, LA	1
Parasympathicus, -a, -um	GR	11
Parataenialis, -e	GR, LA	1
Paraterminalis, -e	GR, LA	1
Paraventricularis, -e	GR, LA	4
Paraventriculohypophysialis, -e	GR, LA	2
Parietalis, -e	LA	5
Parietooccipitalis, -e .	LA	4
Parietopontinus, -a, -um	LA	2
Parvocellularis, -e	LA	8
Peduncularis, -e	LA	4
Pedunculopontinus, -a, -um	LA	1
Pellucidus, -a, -um	LA	1
Pelvicus, -a, -um	LA	5

Table 3. Adjectives in Nervous System Terms (Continued)

Adjectives	Origin	Repeat Number
Perforans, -ntis	LA	1
Perforatus, -a, -um	LA	2
Periamygdaloideus, -a, -um	GR	1
Periarterialis, -e	GR, LA	1
Pericallosus, -a, -um	GR	1
Pericardiacus, -a, -um	LA	1
Pericentralis , -e	GR, LA	1
Pericuneatus, -a, -um	GR, LA	2
Perihypoglossalis, -e	GR	1
Perinealis, -e	GR	2
Periolivaris, -e	GR, LA	1
Peripeduncularis, -e	GR, LA	1
Periventricularis, -e	LA	7
Perizonalis, -e	GR, LA	1
Peroneus, -a, -um	LA	4
Petrosus, -a, -um	LA	6
Pharyngeus, -a, -um	GR	5
Phrenicoabdominalis, -e	LA	1
Phrenicus, -a, -um	LA	4
Pialis, -e	LA	1
Pigmentosus, -a, -um	LA	1
Pinealis, -e	LA	3
Piriformis, -e	LA	1
Plantaris, -e	LA	6
Pontocerebellaris, -e	LA	4
Pontoreticulospinalis, -e	LA	2
Postcentralis, -e	LA	3
Postcommissuralis, -e	LA	1
Posterior, -ius	LA	105
Posterolateralis, -e	LA	9
Posteromedialis, -e	LA	4
Postganglionicus, -a, -um	LA	1
Postpyramidalis, -e	LA, GR	1
Postremus, -a, -um	LA	2
Prebiventralis, -e	LA	1
Precentralis, -e	LA	3
Precommissuralis, -e	LA	3
Precuneus, -i	LA	2
Preganglionicus, -a, -um	LA	1
Pregeniculatus, -a, -um	LA	1
Premamillaris, -e	LA	2
Preoccipitalis, -e .	LA	2
Preolivaris, -e	LA	1
Preopticus, -a, -um	LA, GR	6
Prepyramidalis, -e	LA, GR	1
Presacralis, -e	LA	1
Pretectalis, -e	LA	4
Primus, -a, -um	LA	2
Principalis, -e	LA	4
Profundus, -a, -um	LA	9
Projectio, -onis	LA	1
Proprius, -a, -um	LA	13
Prostaticus, -a, -um	GR	1
Pterygopalatinus, -a, -um	LA	5
Pudendus, -a, -um	LA	2
Pulmonalis, -e	LA	4
Pulvinaris, -e	LA	6

Table 3. Adjectives in Nervous System Terms (Continued)

Adjectives	Origin	Repeat Number
Pyloricus, -a, -um	GR	1
Pyramidalis,-e	GR	5
Quadrangularis, -e	LA	2
Quadratus, -a, -um	LA	1
Quadrigeminalis, -e	LA	1
Quadrigeminus, -a, -um	LA	2
Quartus, -a, um	LA	7
Radiatus, -a, -um	LA	1
Radicularis, -e	LA	1
Raphespinalis, -e	GR, LA	4
Rectalis, -e	LA	4
Recurrens, -entis	LA	3
Renalis, -e	LA	4
Restiformis, -e	LA	4
Reticularis, -e	LA	20
Reticulospinalis, -e	LA	2
Retinohypothalamicus, -a, -um	LA, GR	1
Retroambiguus, -a, -um	LA	1
Retrobulbaris, -e	LA	1
Retrochiasmaticus, -a, -um	LA, GR	1
Retrofacialis, -e	LA	1
Retroflexus, -a, -um	LA	1
Retrolentiformis, -e	LA	1
Retroolivaris, -e	LA	2
Retroposterolateralis, -e	LA	1
Retrorubralis, -e	LA	1
Retrotrigeminalis, -e	LA	1
Reuniens, -ntis	LA	1
Rhinalis, -e	GR	1
Rhomboideus, -a, -um	GR	2
Rostralis, -e	LA	5
Rostrodorsalis, -e	LA	1
Ruber, -bra, -brum	LA	1
Rubrobulbaris, -e	LA	1
Rubronuclearis, -e	LA	1
Rubroolivaris, -e	LA	4
Rubropontinus, -a, um	LA	1
Rubrospinalis, -e	LA	4
Sacralis, -e	LA	5
Sacrococcygeus, -a, -um	LA	1
Salivatorius, -a, -um	LA	2
Saphenus, -a, -um	GR	1
Scrotalis, -i	LA	2
Secundarius, -a, -um	LA	1
Secundus, -a, -um	LA	2
Semilunaris, -e	LA	5
Sensorius, -a, -um	LA	12
Separans, -ntis	LA	1
Septomarginalis, -e	LA	1
Simplex, -icis	LA	1
Solitariospinalis, -e	LA	1
Solitarius, -a, -um	LA	11
Somaticus, -a, -um	GR	1
Spinalis, -e	LA	25
Spinobulbar, -es	LA	2
Spinocerebellaris, -e	LA	5
Spinocervicalis	LA	1

Table 3. Adjectives in Nervous System Terms (Continued)

Adjectives	Origin	Repeat Number
Spinocuneatus, -a, -um	LA	1
Spinogracilis, -e	LA	1
Spinohypothalamicus, -a, -um	LA, GR	3
Spinomesencephalicus, -a, -um	LA, GR	3
Spinoolivaris, -e	LA	4
Spinoperiaqueductales, -us	LA, GR	3
Spinoreticularis, -e	LA	4
Spinotectalis, -e	LA	4
Spinothalamicus, -a, -um	LA	5
Spinovestibularis, -e	LA	2
Spiralis, -e	LA	1
Splanchnicus, -a, -um	GR	7
Stapedius, -a, -um	LA	1
Stylohyoideus, -a, -um	GR	1
Subbrachialis, -e	LA	1
Subcaeruleus, -a, -um	LA	1
Subcallosus, -a, -um	LA	2
Subclavius, -a, -um	LA	3
Subcommissuralis, -e	LA	1
Subcostalis, -e	LA	1
Subcuneiformis, -e	LA	2
Subfornicalis, -e	LA	3
Subhypoglossalis, -e	LA, GR	1
Sublenticularis, -e	LA	1
Sublentiformis, -e	LA	1
Sublingualis, -e	LA	4
Submandibularis, -e	LA	4
Submucosus, -a, -um	LA	1
Subparabrachialis, -e	LA, GR	1
Subparietalis, -e	LA	2
Subscapularis, -e	LA	1
Subserosus, -a, -um	LA	1
Subthalamicus, -a, -um	GR	3
Subtrigeminalis, -e	LA	1
Sulcomarginalis, -e	LA	1
Superficialis, -e	LA	6
Superior, -ius	LA	63
Superolateralis, -e	LA	1
Suprachiasmaticus, -a, -um	LA, GR	1
Supraclavicularis, -e	LA	5
Supragenicularis, -a, -um	LA	1
Supralemniscalis, -e	LA	1
Supramammillaris, -e	LA	1
Supramarginalis, -e	LA	1
Supraopticohypophysialis, -e	LA, GR	2
Supraopticus, -a, -um	LA, GR	4
Supraorbitalis, -e	LA	1
Suprarenalis, -a, -um	LA	1
Suprascapularis, -e	LA	1
Supraspinalis, -e	LA	1
Supratrochlearis, -e	LA	1
Suralis, -e	LA	1
Sympathicus, -i	GR	11
Tangentiales, -e	LA	1
Tectobulbaris, -e	LA	4
Tectoolivaris, -e	LA	2
Tectopontinae, -us	LA	4

Table 3. Adjectives in Nervous System Terms (Continued)

Adjectives	Origin	Repeat Number
Tectoreticularis, e	LA	1
Tectospinalis, -e	LA	4
Tegmentalis, -e	LA	13
Telencephalicus, -a, -um	GR	7
Temporalis, -e	LA	9
Terminalis, -e	LA	12
Terminatio, -ones	LA	1
Tertius, -a, -um	LA	5
Testicularis, -e	LA	1
Thalamoparietalis, -e	LA	1
Thoracicus, -a, -um	LA	10
Thoracodorsalis, -e	GR, LA	1
Thyrohyoideus, -a, -um	GR	1
Tonsillaris, -e	LA	2
Transversarius, -a, -um	LA	8
Transversus, -a, -um	LA	8
Trapezoideus, -a, -um	GR	5
Triangularis, -e	LA	3
Trigeminalis, e	LA	9
Trigeminospinalis, -e	LA	1
Trigeminothalamicus, -a, -um	LA	3
Trigeminus, -a, -um	LA	5
Trochlearis, -e	LA	3
Tubarius, -a, -um	LA	1
Tympanicus, -a, -um	GR	11
Ulnaris, -e	LA	3
Uncinatus, -a, -um	LA	2
Uretericus, -a, -um	LA	1
Uterovaginalis, -e	LA	1
Utricularis, -e	GR	1
Utriculoampullaris, -e	GR, LA	1
Vagalis, -e	LA	4
Vagoauricularis, -e	LA	1
Vagomeningeus, -a, -um	LA	1
Vagus, -a, -um	LA	4
Vascularis, -e	LA	1
Vasculosus, -a, -um	LA	2
Ventralis, -e	LA	34
Ventrobasalis, -e	LA	1
Ventromedialis, -e	LA	2
Ventroposterior, -ius	LA	1
Verticalis, -e	LA	2
Vesicalis, -e	LA	1
Vestibularis, -e	LA	12
Vestibulospinalis, -e	LA	3
Visceralis, -e	LA	3
Zonalis, -e	LA	1
Zygomaticus, -a, -um	GR	3

LA: Latin, GR: Greek

Table 4. Adjectives in Sensory Organs Terms

Adjectives	Origin	Repeat Number
Accessorius, -a, -um	LA	2
Acusticus, -a, -um	GR	9
Adiposus, -a, -um	GR	3
Ampullaris, -e	LA	5
Anterior, -ius	LA	25
Anularis, -e	LA	1
Aquosus, -a, -um	LA	1
Arteriosus, -a, -um	GR	2
Auricularis, -e	LA	16
Basalis, -e	LA	2
Basilaris, -e	LA	2
Brevis, -e	LA	1
Bulbus, -i	LA	11
Caecus, -a, -um	LA	2
Caroticus, -a, -um	LA	1
Centralis, -e	LA	3
Choroidocapillaris, -e	LA, GR	1
Ciliaris, -e	LA	10
Circularis, -e	LA	1
Cochleariformis, -e	LA	1
Cochlearis, -e	LA	20
Communis, -e	LA	5
Conjunctivalis, -e	LA	2
Corneoscleralis, -e	LA, GR	1
Cribrosus, -a, -um	LA	5
Cupularis, -e	GR	2
Ellipticus, -a, -um	LA	1
Endolymphaticus, -a, -um	GR	3
Episcleralis, -e	GR	2
Epitympanicus, -a, -um	GR	1
Excretorius, -a, -um	LA	1
Externus, -a, -um	LA	13
Facialis, -e	LA	2
Fibrocartilagineus, -a, -um	LA	1
Flaccidus, -a, -um	LA	1
Foraminosus, -a, -um	LA	1
Fuscus, -a, -um	LA	1
Ganglionicus, -a, -um	LA	1
Hyaloideus, -a, -um	GR	3
Incudialis, -e	LA	1
Incudomalleolaris, -e	LA	1
Incudostapedialis, -e	LA	1
Inferior, -ius	LA	14
Internus, -a, -um	LA	13
Intertragicus, -a, -um	LA, GR	1
Intervaginalis, -e	LA	1
Intracranialis, -e	LA	1
Intralaminaris, -e	LA	1
Intraocularis, -e	LA	3

Table 4. Adjectives in Sensory Organs Terms (Continued)

Adjectives	Origin	Repeat Number
Iridicus, -a, -um	LA	1
Iridocornealis, -e	GR, LA	2
Jugularis, -e	LA	1
Labyrinthicus, -a, -um	LA, GR	3
Lacrimalis, -e	LA	14
Lateralis, -e	LA	13
Lenticularis, -e	LA	1
Leptomeningicus, -a, -um	GR, LA	1
Levator, -oris	LA	1
Limitans, -ntis	LA	4
Longitudinalis, -e	LA	2
Longus, -a, -um	LA	1
Luteus, -a, -um	LA	1
Macularis, -e	LA	6
Major, -us	LA	3
Mastoideus, -a, -um	GR	4
Media, -ae	LA	4
Medialis, -e	LA	5
Membranaceus, -a, -um	LA	11
Meridionalis, -e	LA	1
Minor, -us	LA	3
Nasalis, -e	LA	4
Nasolacrimalis, -e	LA	1
Nervosus, -a, -um	LA	2
Obliquus, -a, -um	LA	3
Olfactorius, -a, -um	LA	3
Opticus, -a, -um	GR	5
Palpebralis, -e	LA	1
Palpebronasalis, -e	LA	1
Perichoroideus, -a, -um	GR, LA	1
Perilymphaticus, -a, -um	GR	1
Pigmentosus, -a, -um	LA	2
Pneumaticus, -a,- um	GR	1
Posterior, -ius	LA	25
Postlaminaris, -e	LA	1
Postremus, -a, -um	LA	1
Prelaminaris, -e	LA	1
Profundus, -a, -um	LA	1
Proprius, -a, -um	LA	3
Pupillaris, -e	LA	4
Pyramidalis,-e	GR	2
Radialis, -e	LA	1
Reticularis, -e	LA	1
Retrozonulare	LA	1
Reuniens, -ntis	LA	1
Saccularis, -e	LA	2
Sanguineus, -a, -um	LA	3
Secundarius, -a, -um	LA	2
Semicircularis, -e	LA	10

Table 4. Adjectives in Sensory Organs Terms (Continued)

Adjectives	Origin	Repeat Number
Semilunaris, -e	LA	1
Serratus, -a, -um	LA	1
Simplex, -icis	LA	2
Singularis, -e	LA	1
Sphericus, -a, -um	GR	1
Spiralis, -e	LA	17
Stapedialis, -e	LA	3
Reuniens, -ntis	LA	1
Saccularis, -e	LA	2
Sanguineus, -a, -um	LA	3
Secundarius, -a, -um	LA	2
Semicircularis, -e	LA	10
Semilunaris, -e	LA	1
Serratus, -a, -um	LA	1
Simplex, -icis	LA	2
Singularis, -e	LA	1
Sphericus, -a, -um	GR	1
Spiralis, -e	LA	17
Stapedialis, -e	LA	3
Styloideus, -a, -um	GR	1
Subarachnoidalis, -e	LA	1
Superficialis, -e	LA	1
Superior, -ius	LA	20
Supratragicus, -a, -um	LA	1
Suspensorium, -a, -um	LA	1
Tarsalis, -e	LA	1
Tectorius, -a, -um	LA	1
Tegmentalis, -e	LA	1
Temporalis, -e	LA	4
Tendineus, -a, -um	LA	1
Terminalis, -e	LA	2
Trabecularis, -e	LA	1
Transversus, -a, -um	LA	2
Triangularis, -e	LA	2
Tubarius, -a, -um	LA	1
Tympanicus, -a, -um	GR	5
Tympanostapedialis, -e	GR, LA	1
Utricularis, -e	GR	5
Utriculosaccularis, -e	GR, LA	1
Uvealis, -e	LA	1
Vascularis, -e	LA	1
Vasculosus, -a, -um	LA	3
Verticalis, -e	LA	1
Vestibularis, -e	LA	11
Vestibulocochlearis, -e	LA	3
Vitreus, -a, -um	LA	5
Zonularis, -e	LA	2

LA: Latin, GR: Greek

Latin adjectives are classified into 3 groups: gradus positivus (degree of positivity), gradus comparativus (degree of comparison) and gradus superlativus (degree of superiority). Gradus positivus indicates the existence of only one quality, while gradus comparativus indicates a comparison between two objects. Gradus superlativus denotes the most superior among many objects.[9] Among the terms of the nervous system, gradus positivus adjectives were repeated 1938 times, gradus comparatus adjectives 329 times, gradus superlativus adjectives 12 times. Among the terms for sense organs, gradus positivus adjectives are repeated 383 times, gradus comparativus adjectives 90 times and gradus superlativus adjectives only 1 time.

DISCUSSION

Anatomical terminology, which enables the learning, development and progress of anatomy, is absolutely necessary for mutual communication between contributors to medical science. Understanding the rules of Latin grammar in terminology education is a facilitating factor in learning terms. Students learn the meaning, formation and usage features of terms with grammar rules. Thus, they have the chance to learn the terminology as a whole in a long-term and permanent way.[16] The use of Latin terminology needs to continue to be a common medical language, even though students have difficulty understanding and learning it.[17]

Many clinicians and anatomists use the terminology in their own way. However, it is the terms in the TA list that should be used and taught in medical education. Synonyms and obsolete terms in the terminology cast a shadow on teaching processes and scientific studies, and prevent correct communication between anatomists, leading to misunderstandings in scientific language.[18]

Latin-based terminology is indispensable not only for anatomy but for all medical sciences. Most of the anatomical terminology is of Latin and Greek origin. Terminology should not be seen only for educational or scientific study purposes. Above all, it serves a fundamental function for diagnosis, treatment and recognition of the human body. Therefore, terminology is also important for following scientific research and developing diagnostic and therapeutic techniques. Authors should follow the latest updated version of the TA in any training, translation and publishing activities.[19]

TA is a very valuable list but thinking only terms in the TA prevents us from recognizing some of the Latin terms used in real life. It is known that nomenclature such as zygapophysial joint is difficult to use in written and spoken language. It has been reported that facet joint discourse is used much more frequently instead of this nomenclature. This is not only seen in the clinic. It is known that many different uses that are not included in the TA are taught to students during medical education. Even if these uses and eponyms are not taught to students during their education, they are definitely encountered by students during clinical practice. Some suggestions are provided to expand the use of TA and it is stated that by implementing these suggestions, more widespread use of TA can be ensured.[20]

The history of anatomical terminology goes back more than 2500 years to ancient times. Some of the anatomical terms are colloquial and have not changed since ancient times. The medical terminology that exists today is based on the medical books of Hippocrates called "Corpus Hippocraticum". Hippocrates (460-370 BC) used the terms "acromion", "bronchus" and "peritoneum". In Rome, Aurus Cornelius Celcus (25 BC-50 AD) used the terms "cartilago", "patella" and "sutura". Rufus of Ephesus (late 1st century AD) wrote a book entitled "On the Naming of the Parts of the Body", which is recognized as the earliest treatise on anatomical terms. Cladius Galenos of Pergamon (129/130-199/200) introduced new terms such as "aponeurosis", "pylorus", "tarsus" and "thymus". Herophilos (3rd century BC), who was in Alexandria and regularly performed dissections there, introduced terms such as "duodenum", "prostata" and "pancreas" into medical terminology. From Aristotle (4th century BC), terms such as "meninx", "arteria", "trachea", "neuron", "ischium" have remained until today.[10,19,21]

Andreas Vesalius (Andreas van Wesel) (1514-1564) published the first comprehensive anatomy book in 1543, "De fabrica corporis humani libri septem", which included descriptions of the human body. With this book, some of the Greek and Arabic terms used until then were replaced by Latin terms. Jacobus Sylvius (1478-1555) used the terms created by Hippocrates and Galenos for bones, but created new terms such as "pectoralis, intercostalis" for muscles, vessels and nerves. Subsequently, between the 17th and 19th centuries, many new synonyms for the same anatomical structures were derived. As a result of the increasing number of synonyms in the following years, the number of terms reached approximately 50 000 by the end of the 19th century. But all of these terms referred to only 5000-6000 different structures.[19,22]

In 1895, the Anatomische Gesellschaft announced the first Latin list of anatomical terminology in an attempt to put an end to this term confusion. This list was later named Basiliensia Nomina Anatomica (BNA). Jenaiensia Nomina Anatomica (JNA) and Parisiensia Nomina Anatomica (PNA) were published in 1935 and 1955 respectively. In 1989, at a meeting in Brazil, the IFAA decided to establish a new anatomical terminology committee called FCAT. As a result of the work of this committee, the current TA list was published in 1998.[19]

Latin was used as a living language for 2500 years. But today, like many other languages, it has taken its place in history. Nevertheless, it is the basis of many of the languages that are widely used today (French, Spanish, Italian). Modern doctors do not need to know and learn Latin as a spoken and written language. This is because the Latin in medical terminology only requires that the terms are written and read correctly. Medical terms consist only of adjectives, nouns and numerical words. In Latin, adjectives (nomina

adjectiva) are used with nouns. Adjectives, which are not conjugated in Turkish and used with nouns without change, have different uses in Latin in terms of genus, number and case. The use of nouns and adjectives together is different in Latin than in Turkish. While in Turkish it is used as an adjective followed by a noun, in Latin it is the other way around. In Latin there is a grammatical rule called noun-adjective concordance (attributum). In order to understand the rules of medical terminology, it is necessary to know the properties of adjectives.[9] Looking at the literature, it was observed that in a study analyzing medical terminology, the adjectives in the movement system terms in the TA were evaluated in terms of origin, degree and shape.[23]

CONCLUSION

The importance of terminology for the development of medical sciences and anatomy cannot be ignored, as indicated by existing studies. Although the number of studies on terminology in our country is increasing day by day, it is insufficient. It is important to know and use the current terminology list for the development of medical sciences. We believe that our study, in which we analyzed the adjectives in the terms of the nervous system and sense organs, which are among the parts of the TA, will enlighten the subject of medical terminology and contribute to the existing body of knowledge.

ETHICAL DECLARATIONS

Ethics Committee Approval: Our study does not require ethics committee approval.

Informed Consent: Our study does not require informed consent.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

Note: This study was derived from the data of the master's thesis titled " Investigation of the Adjustments in Terminologia Anatomica, in Terms Related to the Nervous System and Sense Organs" published in Tokat Gaziosmanpaşa University, Department of Anatomy in 2023.

REFERENCES

1. Turan D. Eponyms in medical terminology. Eponyms in the German-Turkish language pair. Journal of Literature and Humanities 2022; 68(1): 103-10.
2. Babacan S, Işıklar S, Kafa İM, Coşkun İ. The thoughts of the students and the employees on medical terminology. Uludağ Üniv Tıp Fak Derg 2016;42(2,3):89-92.
3. Greathouse DG, Halle JS, Dalley AF. Terminologia anatomica:revised anatomical terminology. J Orthop Sports Phys Ther 2004;34(7):363-67.
4. Unur E, Ertekin T, Acer N, Cinar S, Ozcelik O, Çay M. Names which originate from plants within terminologia anatomica. J Turgut Ozal Med Cent 2016;23(4):488-91.
5. Erimoğlu C. Anatomi Terimleri Kılavuzu. 2nd ed. Matematik Araştırma Enstitüsü Baskı Atölyesi:İstanbul;1978.
6. Güler Ç. Anatomi Sözlüğü. Palme Yayınları: Ankara; 2012.
7. Güler Ç. Tıpta Önek ve Sonekler Sözlüğü. Palme Yayıncılık: Ankara; 2012.
8. Güler Ç. Yeni Tıp Sözlüğü. 1st ed. Palme Yayınevi: İstanbul; 2012.
9. Mesut R. Tıbbi Latince. 2nd ed. Nobel Tıp Kitabevleri: İstanbul; 2011.
10. Mesut R, Çıkmaz S. Tıbbi Terminoloji. 3rd ed. Nobel Tıp Kitabevleri: İstanbul; 2017.
11. Yıldırım M. Güncel Tıp Terimleri Sözlüğü. 2nd ed. Nobel Tıp Kitabevleri: İstanbul; 2017.
12. Wiktionary.org [homepage on the Internet]. [cited 17 March 2023] Avaliable from: www.wiktionary.org
13. Saglikterimleri.com [homepage on the Internet]. [cited 13 January 2023] Avaliable from: www.saglikterimleri.com
14. Terminologia-anatomica.org [homepage on the Internet]. [cited 14 December 2022] Avaliable from: www.terminologia-anatomica.org/en
15. Toprak M, Akkın SM. Genel Anatomi Terminolojisi ve Kullanım Özellikleri. İstanbul Üniversitesi Basımevi ve Film Merkezi: İstanbul; 1993.
16. Cankur NŞ. Language in medical education: I importance, development and future. Uludağ Üniv Tıp Fak Derg 2002;28(1):29-32.
17. Kavaklı A, Öğetürk M, Kuş İ, Pekmez H, Türkoğlu A, Sarsılmaz M. Tıp öğrencisi bakış açısıyla latince terminoloji. Tıp Eğitimi Dünyası 2003;10(10):2-6.
18. Chmielewski PP. New Terminologia Anatomica highlights the importance of clinical anatomy. Folia Morphol (Warsz) 2020;79(1):15-20.
19. Kachlik D, Baca V, Bozdechova I, Cech P, Musil V. Anatomical terminology and nomenclature: past, present and highlights. Surg Radiol Anat 2008;30(6):459-66.
20. Hirsch BE. Does the terminologia anatomica really matter? Clin Anat 2011;24(4):503-04.
21. Terzioğlu A. Tıbbî terminolojinin tarihine ve esaslarına kısa bir bakış. Belleten 1986;50(198):637-45.
22. Fabry P, Baud R, Lovis C. Towards a multilingual version of terminologia anatomica. Stud Health Technol Inform 2005;116:665-70.
23. Esersoy S, Unur E. Investigation of the adjustments in terminologia anatomica, in terms related to the movement system. Sağlık Bilimleri Derg 2020;29(3):192-204.

JOURNAL OF
CONTEMPORARY MEDICINE

DOI:10.16899/jcm.1456626
J Contemp Med 2024;14(3):132-136

Original Article / Orijinal Araştırma

Effect of Using Oxygen Concentrators on Oxygen Saturation after COVID-19 Infection

COVID-19 Enfeksiyonu Sonrası Oksijen Konsantratörü Kullanımının Oksijen Satürasyonu Üzerine Etkisi

Zuhal YAVUZ DAĞLI[1], Duygu YENGİL TACİ[2], İzzet FİDANCI[3]

[1]Department of Pulmonology, Ankara Training and Research Hospital, Ankara, Turkey
[2]Department of Family Medicine, Ankara Training and Research Hospital, Ankara, Turkey
[3]Department of Family Medicine, Faculty of Medicine, Hacettepe University, Ankara, Turkey

Abstract

Aim: The study was planned to evaluate the effect of oxygen concentrator use on oxygen saturations after COVID-19 infection.

Material and Method: The study included 42 patients who used oxygen concentrators and 66 patients who did not use concentrators and applied to Ankara Training and Research Hospital Pulmonology Outpatient Clinic between January 1, and April 8, 2021 after COVID-19 infection. Patients received a sociodemographic data questionnaire and a COVID-19 infection severity questionnaire, which were completed through face-to-face interviews. Patients' oxygen saturation levels were also measured and recorded at the time of interview.

Results: Those using oxygen concentrators were older and had less education (p=0.001; p=0.03, respectively). Patients who complained of shortness of breath during infection were mostly in the oxygen concentrator group, while those who had headaches and diarrhoea were mostly in the group that did not require concentrators. The group using oxygen concentrators had longer hospital stays due to COVID-19 infection (p=0.001). Patients using oxygen concentrators had higher rates of pulmonary involvement and lower oxygen saturation levels (p=0.001).

Conclusion: Patients who complained of dyspnea at the time of their COVID-19 diagnosis were more likely to require a concentrator at a later stage. Other factors influencing the need for concentrators include advanced age and education level. Patients using an oxygen concentrator had lower oxygen saturation levels, but the mean value was higher.

Keywords: COVID-19, hypoxia, oxygen therapy

Öz

Amaç: Çalışma, COVID-19 enfeksiyonu sonrası oksijen konsantaratörü kullanımının oksijen satürasyonlarına etkisini değerlendirmek için planlanmıştır.

Gereç ve Yöntem: Ankara Eğitim ve Araştırma Hastanesi Göğüs Hastalıkları polikliniğine 01.01.2021-08.04.2021 tarihleri arasında COVID-19 enfeksiyonu sonrasında başvuran, oksijen konsantratörü kullanan 42 hasta ile konsantratör kullanmayan 66 hasta çalışmaya dahil edildi. Katılımcılara; sosyodemografik veri formu ile COVID-19 enfeksiyonu şiddetini belirlemeyi amaçlayan sorulardan oluşan anket formu yüz yüze uygulandı ve hastaların o anki oksijen satürasyonları ölçülerek kaydedildi.

Bulgular: Oksijen konsantratörü kullananların ileri yaşta ve eğitim seviyesinin düşük olduğu görüldü (sırasıyla p=0.001; p=0.03). Enfeksiyon döneminde nefes darlığı şikayeti olan hastaların daha çok oksijen konsantratörü kullanan grupta olduğu; baş ağrısı ve ishal semptomları yaşayan hastaların ise konsantratör ihtiyacı olmayan grupta istatistiksel anlamlı olarak daha çok olduğu görüldü. COVID-19 enfeksiyonuna bağlı hastanede yatış süresi oksijen konsantratörü kullanan grupta daha yüksek bulundu (p=0.001). Oksijen konsantratörü kullanan hastalarda akciğer tutulumunun daha fazla ve oksijen satürasyonlarının daha düşük olduğu görüldü (p=0.001).

Sonuç: Çalışmamızda oksijen konsantratörü kullanan hastaların hastanede yatış süresi ve akciğer tutulumu daha fazlaydı. COVID-19 tanısı sırasında nefes darlığı şikayeti olan hastaların ilerleyen süreçte konsantratöre daha çok ihtiyaç duyduğu görüldü. İleri yaş ve eğitim seviyesi de konsantratör ihtiyacını etkilemekteydi.

Anahtar Kelimeler: COVID-19, hipoksi, terapi

Corresponding *(İletişim)*: İzzet Fidancı, Department of Family Medicine, Faculty of Medicine, Hacettepe University, Ankara, Turkey
E-mail *(E-posta)*: izzetfidanci@gmail.com
Received *(Geliş Tarihi)*: 21.03.2024 **Accepted *(Kabul Tarihi)*:** 01.05.2024

INTRODUCTION

The novel coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was first identified in Wuhan, China, in December 2019. It quickly spread worldwide and evolved into a pandemic.[1-3] The leading cause of infection-related morbidity and mortality is viral pneumonia, which causes acute respiratory distress syndrome.[4] Progressive hypoxia due to lung damage and multiple organ dysfunctions are the main causes of mortality in critically ill COVID-19 patients.[5] The infection has a broad clinical severity spectrum; most patients have significant arterial hypoxemia but no symptoms of associated respiratory distress at hospital presentation. Some patients may not even feel short of breath, which is known as silent or 'happy' hypoxemia.[6]

Concerns have arisen regarding lung damage caused by COVID-19 infection in recovered patients. Follow-up chest CT scans of patients discharged after COVID-19 pneumonia have revealed persistent lung abnormalities, including ground-glass opacity.[7]

Patients with severe COVID-19 infection may develop chronic hypoxemic respiratory failure because of lung damage.[8] In patients hospitalised for COVID-19, the decrease in the diffusing capacity for carbon monoxide (DLCO) was found to be 52% at 4 months after discharge and 29% at 6 months after discharge.[9-11] Although studies have shown decreasing radiographic abnormalities and increasing DLCO after COVID-19 pneumonia over time, more research is needed for the small number of patients who have persistent lung dysfunction and hypoxemia. Long-term oxygen therapy (LTOT) is usually required for chronic obstructive pulmonary disease, idiopathic pulmonary fibrosis and pulmonary vascular disease.[12-15] During the COVID-19 pandemic, patients in need of oxygen therapy were discharged on LTOT in order to reduce the length of hospital stays and overcrowding in hospitals.

This study aimed to examine the long-term effects of oxygen concentrators on oxygen levels in patients who developed COVID-19 pneumonia and were discharged on oxygen therapy.

MATERIAL AND METHOD

The study was designed as descriptive and analytical. The study received permission from the Republic of Türkiye Ministry of Health COVID-19 Scientific Research Review Committee. Ethical approval was obtained from the University of Health Sciences Ankara Training and Research Hospital, Clinical Research Ethics Committee on December 30, 2020. Written informed consent was obtained from patients who volunteered to participate.

The study included 42 patients aged ≥18 years who presented to the Ankara Training and Research Hospital Pulmonology Outpatient Clinic for follow-up between 01.01.2021 and 08.04.2021 and who had been hospitalised in our hospital for COVID-19 and discharged on an oxygen concentrator; and 66 patients aged ≥18 years who recovered from COVID-19, did not use an oxygen concentrator and presented to the pulmonology outpatient clinic for any reason. Sample calculations could not be made due to restrictions and curfews during the pandemic period. All patients who applied to our health institution and met the inclusion criteria were included in the study if they agreed. Participants received a sociodemographic data questionnaire and a questionnaire for determining the severity of COVID-19 infection, which were completed through face-to-face interviews. The sociodemographic data questionnaire included the following: age, sex, marital status, education level, occupation, smoking status, chronic diseases, medications used, other household members, symptoms experienced during COVID-19 infection, ongoing symptoms, previous stay at a hospital or intensive care unit for COVID-19 and the use of an oxygen concentrator (if yes, how many hours per day they received oxygen supplementation). The results of any chest X-ray or tomography imaging performed during infection were extracted from the electronic health system and recorded, and the oxygen saturation level of the patients was measured and recorded by the same researcher using a calibrated finger-type pulse oximeter device. During the study, all pandemic hygiene rules determined by the Ministry of Health were applied.

Statistical Analysis

Statistical analysis was performed using the IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp. software suite. Continuous variables were analysed for normality of distribution using the Kolmogorov–Smirnov test. In comparisons between groups, categorical variables were analysed using the Chi-squared test and Fisher's exact test, and continuous variables were analysed using the Mann–Whitney U test. For all statistical data, statistical significance was set at $p<0.05$.

RESULTS

The study included 108 patients, with 42 (38.9%) using an oxygen concentrator due to COVID-19 infection and 66 (61.1%) not using an oxygen concentrator. Of the participants, 53 (49.1%) were females, 55 (50.9%) were males, and the mean age was 58.03±13.62 years (22–86 years). An examination of the relationship between using an oxygen concentrator and certain sociodemographic characteristics revealed that there was no significant relationship between using an oxygen concentrator and the presence of chronic disease, regular medication use, or regular smoking, but patients in the concentrator group were found to be older and had statistically significantly lower levels of education ($p=0.001$; $p=0.03$, respectively) (**Table 1**).

Table 1. Correlation between using an oxygen concentrator and sociodemographic characteristics

Sociodemographic characteristics	Oxygen concentrator		p
	Yes (n=42)	No (n=66)	
Age			
Med (min - max)	65 (38-86)	57 (22-75)	0.001*
Gender			
Female / Male	21 / 21	32 / 34	1.0**
Education			
İlliterate	11	7	
Primary school	24	31	
Middle school	2	7	0.03**
High school	4	10	
University	1	11	
Working ststus			
Working	4	18	
Not working	21	26	0.08**
Retired	17	22	
Marital Status			
Married / Single	34 / 8	58 / 8	0.32**
Who lives at home			
Spouse	12	18	
Spouse and child	21	39	0.72**
Alone	1	1	
Other	8	8	
Disease			
Yes / No	34 / 8	48 / 18	0.33**
Medication use			
Yes / No	34 / 8	45 / 21	0.14**
Smoking			
Yes / No	1 /41	6 / 60	0.24**

* Mann Whitney U test, ** Chi Square.

The analysis of the correlation between symptoms experienced during COVID-19 infection and the use of an oxygen concentrator revealed that patients with dyspnea were mostly in the group that used an oxygen concentrator (p=0.002), whereas patients with headache and diarrhea were mostly in the group that did not require a concentrator (p=0.009; p=0.04, respectively) (**Table 2**).

The length of hospital stay for COVID-19 infection was found to be significantly higher in the group using an oxygen concentrator, with an average of 15 days (p=0.001). Patients who used an oxygen concentrator had higher rates of pulmonary involvement and lower oxygen saturation levels (p=0.001) (**Table 3**).

DISCUSSION

The use of aggressive oxygen therapy in the treatment of COVID-19 pneumonia is critical for disease recovery and mortality reduction.[5] Medical oxygen is a life-support therapy that is widely used in various diseases. Oxygen concentrators, a source of medical oxygen prescribed by physicians, are electrical, compact, easy-to-use and portable devices that produce oxygen from ambient air. It is an oxygen source that is preferred for use at home by patients receiving LTOT.[16] Home ventilatory support devices, such as oxygen concentrators, are widely used by patients with chronic respiratory failure and have been prescribed for COVID-19-related respiratory failure after the pandemic. The use of home ventilatory support devices has increased since

Table 2. Correlation between COVID-19 symptoms and the use of an oxygen concentrator

Symptoms	Oxygen concentrator		p
	Yes (n=42)	No (n=66)	
Fever			
Yes / No	23 / 19	31 / 15	0.43*
Dyspnea			
Yes / No	36 / 6	38 / 28	0.002*
Weakness-fatigue			
Yes / No	32 / 10	45 /21	0.37*
Muscle-joint pain			
Yes / No	21 / 21	40 / 26	0.27*
Sore throat			
Yes / No	4 / 38	3 / 63	0.42+
Dry cough			
Yes / No	19 / 23	24 / 42	0.35*
Phlegm cough			
Yes / No	2 / 40	5 / 61	0.70+
Postnasal drip			
Yes / No	0 / 42	1 / 65	1.0+
Visual impairment			
Yes / No	0 / 42	1 / 65	1.0+
Abdominal pain			
Yes / No	0 / 42	0 / 66	1.0+
Anorexia			
Yes /No	10 / 32	16 / 50	0.95*
Nasal discharge			
Yes / No	2 / 40	2 / 64	0.64+
Taste loss			
Yes / No	12 / 30	21 / 45	0.72*
Loss of smell			
Yes / No	10 / 32	24 / 42	0.17*
Sneeze			
Yes / No	0 / 42	0 / 66	1.0+
Headache			
Yes / No	4 / 38	21 / 45	0.009+
Nausea-vomiting			
Yes / No	4 / 38	14 / 52	0.18+
Diarrhea			
Yes / No	1 / 41	10 / 56	0.04+
Chest-back pain			
Yes / No	12 / 30	30 / 36	0.07*
Eye redness			
Yes / No	0 / 42	0 / 66	1.0+

+ Fisher's Exact Test, *Chi Square test.

Table 3. Correlation between using an oxygen concentrator and some parameters of COVID-19 infection

COVID-19	Oxygen concentrator		p
	Yes (n=42)	No (n=66)	
Hospitalization			
Yes / No	42 / 0	32 / 28	0.001+
Hospitalization			
Day	15 (3-36)	5.5 (0-55)	0.001*
SpO2	93.5 (70-99)	97 (92-99)	0.001*
PCR			
+ / -	40 / 2	57 / 9	0.19+
CT			
+ /- / none	42 / 0 / 0	44 / 9 / 13	0.001*

* Mann Whitney U test, + Fisher's Exact Test. SpO2: Peripheral capillary oxygen saturation. PCR: Polymerase Chain Reaction. CT: Computed Tomography

the COVID-19 pandemic.[17-19] Studies have shown that LTOT increases survival by improving lung function in patients with chronic respiratory failure. LTOT also improves the quality of life and reduces the frequency of recurrence and hospitalisation.[20-23]

Our study evaluated follow-up measurements of oxygen saturation levels in patients who were discharged on oxygen concentrators after developing respiratory failure from COVID-19 pneumonia. Patients who used a concentrator had lower oxygen saturation levels (mean SpO2 = 93.5), longer hospital stays (15 days) and more pulmonary involvement (100%). A study from China that analysed the data of 1099 patients hospitalised for COVID-19 reported an average hospital stay of 12.8 days. The same study reported that the incidence of pneumonia was higher in severe COVID-19 cases than in non-severe cases (89.5% vs. 99.4%), which is consistent with our study.[24]

The use of oxygen concentrators had no significant correlation with the presence of chronic diseases; however, patients who used oxygen concentrators were older and had significantly lower levels of education. Studies have shown that COVID-19 has a more severe course in elderly patients and in those with chronic diseases, and age is regarded to be the leading risk factor for critical illness.[25-27] In our study, patients requiring oxygen concentrators had a higher percentage of comorbidities, but the difference was not significant. This may be because of the small sample size. Guan et al.[24] found that patients with severe COVID-19 infection were 7 years older on average than those without severe infection. Our findings are consistent with the findings of previous studies in that the mean age of patients who used oxygen concentrators was 8 years older than the other group.

Dyspnoea is the most common symptom of severe COVID-19 infection and is often accompanied by hypoxia. Most patients develop progressive respiratory failure immediately after the onset of dyspnoea and hypoxemia.[26,28,29] Our study found that patients who complained of dyspnoea during COVID-19 infection were mostly in the group that used oxygen concentrators, while patients who complained of headaches and diarrhoea were mostly in the group that did not require a concentrator.

CONCLUSIONS

Patients who used an oxygen concentrator had lower oxygen saturation levels, but the mean value was higher (SpO2=93.5). This result shows that LTOT at home helped reverse lung damage and relieve hypoxemia in most patients. The use of oxygen concentrators in the treatment of COVID-19-related respiratory failure appears to be a good option that shortens the length of hospital stay in patients and reduces the burden on hospitals. Based on follow-up measurements of oxygen saturation values in the outpatient clinic, it is predicted that patients' requirements for oxygen therapy will not last long and are not likely to evolve into a chronic use. This situation should be taken into consideration for possible future pandemics. More extensive studies are needed on this subject.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study received permission from the Republic of Türkiye Ministry of Health COVID-19 Scientific Research Review Committee. Ethical approval was obtained from the University of Health Sciences Ankara Training and Research Hospital, Clinical Research Ethics Committee on December 30, 2020 (Desicion no: 519/2020).

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

REFERENCES

1. Habas K, Nganwuchu C, Shahzad F, et al. Resolution of coronavirus disease 2019 (COVID-19). Expert Rev Anti Infect Ther 2020;18(12):1201-11.
2. Wiersinga WJ, Rhodes A, Cheng AC, Peacock SJ, Prescott HC. Pathophysiology, transmission, diagnosis, and treatment of Coronavirus disease 2019 (COVID-19): A Review. JAMA. 2020;324(8):782-93
3. Rostami A, Sepidarkish M, Leeflang M, et al. SARS-CoV-2 seroprevalence worldwide: a systematic review and meta-analysis. Clin Microbiol Infect 2021;27(3):331-40.
4. Yalçın A. COVID-19 sürecinde yoğun bakım yönetimi. Med Res Rep. 2020;3(2):66-85.
5. Jiang B, Wei H. Oxygen therapy strategies and techniques to treat hypoxia in COVID-19 patients. Eur Rev Med Pharmacol Sci 2020;24(19):10239-46.
6. Dhont S, Derom E, Van Braeckel E, Depuydt P, Lambrecht BN. The pathophysiology of 'happy' hypoxemia in COVID-19. Respir Res 2020;21(1):198.
7. Mo X, Jian W, Su Z, et al. Abnormal pulmonary function in COVID-19 patients at time of hospital discharge. Eur Respir J 2020;55(6):2001217.
8. Endeman H, van der Zee P, van Genderen ME, van den Akker JPC, Gommers D. Progressive respiratory failure in COVID-19: a hypothesis. Lancet Infect Dis 2020;20(11):1365.
9. Bellan M, Soddu D, Balbo PE, et al. Respiratory and psychophysical sequelae among patients with COVID-19 four months after hospital discharge. JAMA Netw Open 2021;4(2):e2036142.
10. Ekbom E, Frithiof R, Emilsson Öİ, et al. Impaired diffusing capacity for carbon monoxide is common in critically ill Covid-19 patients at four months post-discharge. Respir Med 2021;182:106394.
11. Huang C, Huang L, Wang Y, et al. 6-month consequences of COVID-19 in patients discharged from hospital: a cohort study. Lancet 2021;397(10270):220-32.
12. Truffaut L, Demey L, Bruyneel AV, et al. Post-discharge critical COVID-19 lung function related to severity of radiologic lung involvement at admission. Respir Res 2021;22(1):29.
13. Balbi M, Conti C, Imeri G, et al. Post-discharge chest CT findings and pulmonary function tests in severe COVID-19 patients. Eur J Radiol 2021;138:109676.

14. Steinbeis F, Thibeault C, Doellinger F, et al. Severity of respiratory failure and computed chest tomography in acute COVID-19 correlates with pulmonary function and respiratory symptoms after infection with SARS-CoV-2: An observational longitudinal study over 12 months. Respir Med 2022;191:106709.
15. Sundh J, Palm A, Wahlberg J, Runold M, Ekström M. Impact of covid-19 on long-term oxygen therapy 2020: A nationwide study in Sweden. PLoS One 2022;17(4):e0266367.
16. Ismail J, Bansal A. Medical oxygen: A lifesaving drug during the COVID-19 pandemic-source and distribution. Indian J Pediatr 2022;89(6):607-15.
17. Arora A, Hasan MMF. Flexible oxygen concentrators for medical applications. Sci Rep 2021;11(1):14317.
18. Zorlu D. Is the use of home-type respiratory support devices effective? J DEU Med 2021;35(2):201-17.
19. Nowadly CD, Portillo DJ, Davis ML, Hood RL, De Lorenzo RA. The use of portable oxygen concentrators in low-resource settings: A Systematic Review. Prehosp Disaster Med 2022;37:247-54.
20. Kvale PA, Conway WA, Coates EO. Nocturnal Oxygen Therapy Trial Group. Continuous or Nocturnal Oxygen Therapy in Hypoxemic Chronic Obstructive Lung Disease: A Clinical Trial. Ann Intern Med 1980;93(6):391-8.
21. Ringbaek TJ, Viskum K, Lange P. Does long-term oxygen therapy reduce hospitalisation in hypoxaemic chronic obstructive pulmonary disease? Eur Respir J 2002;20(1):38-42.
22. Stuart Harris C, Bishop J, Clark TJH, et al. Medical Research Council Working Party. Long term domiciliary oxygen therapy in chronic hypoxic cor pulmonale complicating chronic bronchitis and emphysema. Report of the Medical Research Council Working Party. Lancet 1981;1(8222):681-6.
23. Düzenli H, Doğan ÖT, Berk S, Özşahin SL, Akkurt İ. Kronik solunum yetmezliği olan olgularda uzun süreli oksijen tedavisinin yaşam süresi üzerine etkisi. Tuberk Toraks 2008;56(2):179-86.
24. Guan W, Ni Z, Hu Y, et al. Clinical characteristics of coronavirus disease 2019 in China. N Engl J Med 2020;382(18):1708-20.
25. Alsharif W, Qurashi A. Effectiveness of COVID-19 diagnosis and management tools: A review. Radiography (Lond) 2021;27(2):682-7.
26. Berlin DA, Gulick RM, Martinez FJ. Severe Covid-19. N Engl J Med 2020:17;383(25):2451-60.
27. Williamson EJ, Walker AJ, Bhaskaran K, et al. Factors associated with COVID-19-related death using Open SAFELY. Nature 2020;584(7821):430-6.
28. Zhou F, Yu T, Du R, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. Lancet 2020;395(10229):1054-62.
29. Wang D, Hu B, Hu C, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. JAMA. 2020;323(11):1061-9.

JOURNAL OF
CONTEMPORARY MEDICINE

DOI:10.16899/jcm.1470332
J Contemp Med 2024;14(3):137-142

Original Article / Orijinal Araştırma

The Association Between Six-Minute Walk Test and One Minute Sit to Stand Test in Patients with Acute Exacerbations Of COPD

Akut Alevlenmesi Olan KOAH Hastalarında Altı Dakika Yürüme Testi ile Bir Dakika Otur Kalk Testi Arasındaki İlişki

Zeynep Pelin DÜNDAR[1], Nihan KAFA[2], Neslihan DURUTÜRK[3], Hülya VATANSEV[4], Adil ZAMANİ[4]

[1]Necmettin Erbakan University, Nezahat Kelesoglu Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Konya, Turkey
[2]Gazi University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Ankara, Turkey
[3]Baskent University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Ankara, Turkey
[4]Necmettin Erbakan University, Department of Chest Diseases, Meram Faculty of Medicine, Konya, Turkey

Abstract

Aim: Acute exacerbations of chronic obstructive pulmonary disease (AECOPD) are a major complication of COPD and a leading cause of hospitalization, detrimentally affecting functional exercise capacity. The 6-minute walk test (6MWT) is a reliable measure of exercise capacity in chronic lung diseases. Conversely, the 1-minute sit-to-stand test (1STST) offers a simpler assessment of physical function. The aim was to demonstrate the association of functional exercise capacity assessed by 1STST and 6MWT in COPD patients with acute exacerbation.

Material and Method: Thirty-seven hospitalised patients with an acute exacerbation of COPD (91% male, age: 66.9±7.3, BMI: 27.1±6.2) were assessed using lung function testing (spirometer), functional exercise capacity (6-minute walk test and 1-minute sit and stand test) and dyspnoea perception (Modified Medical Research Council scale). Parameters such as heart rate, oxygen saturation, and perceived dyspnea (via the modified Borg scale) were monitored during tests.

Results: The results showed a significant correlation between 6MWT and 1STST performance (r=0.656, p<0.001). Notably, end-tidal oxygen saturation differed between tests, with the 6MWT showing higher end-tidal dyspnea scores. During recovery, 1STST induced increased heart rate and decreased oxygen saturation. Both 6MWT and 1STST were negatively associated with age and MMRC. Positive correlations were observed between 6MWT and FEV1(L) and PEF(L).

Conclusion: Similar to the 6MWT, the 1STS test may be used to evaluate how well patients with AECOPD perform during functional exercise. We propose that the 1STST is a suitable alternative to the 6MWT for the assessment of functional exercise performance during hospitalization in AECOPD patients.

Keywords: Acute exacerbations, chronic obstructive pulmonary disease, six-minute walk test, 1-minute sit to stand test, exercise capacity.

Öz

Amaç: Akut alevlenme dönemleri, Kronik obstrüktif akciğer hastaları (KOAH) için önemli bir komplikasyon ve hastaneye yatışın önde gelen nedenlerinden biridir. Bu durum fonksiyonel egzersiz kapasitesini olumsuz yönde etkiler. Altı dakika yürüme testi (6DYT) kronik akciğer hastalıklarında egzersiz kapasitesinin değerlendirilmesinde kullanılan güvenilir bir testtir. Öte yandan, 1 dakika otur-kalk testi fiziksel fonksiyonun daha basit bir değerlendirmesini sunar. Bu çalışmada akut alevlenen KOAH hastalarında, fonksiyonel egzersiz kapasitesinin değerlendirilmesinde kullanılan 6DYT ve 1 dakika otur kalk testinin arasındaki ilişkinin gösterilmesi amaçlanmıştır.

Gereç ve Yöntem: Hastanede yatan 37 akut alevlenen KOAH hastasına (%91 erkek, yaş:66.9±7.3, Bki: 27.1±6.2) solunum fonksiyon testi (spirometre), fonksiyonel egzersiz kapasitesi (altı dakika yürüme testi ve 1 dakika otur kalk testi), dispne algısı (Modifiye Medical Research Council) ölçeği ile değerlendirildi. Testler sırasında kalp hızı, oksijen satürasyonu ve algılanan dispne parametreleri (modifiye Borg ölçeği) izlendi.

Bulgular: 6DYT ile 1 dakika otur kalk testinin performansı arasında anlamlı bir korelasyon bulunmuştur (r=0.656, p<0.001). Özellikle, test sonu oksijen satürasyonu testler arasında farklılık göstermiştir ve test sonu bulgularında 6DYT daha yüksek dispne algısına sebep olmuştur. Toparlanma sırasında, 1 dakika otur kalk testinin vital bulgularında kalp hızında daha fazla artış ve oksijen satürasyonunda daha fazla düşüş görülmüştür. Hem 6DYT hem de 1 dakika otur kalk testi yaş ve MMRC parametreleri ile negatif ilişkiliydi. 6DYT ile FEV1(L) ve PEF(L) arasında pozitif korelasyon gözlenmiştir.

Sonuç: Altı-DYT gibi, 1 dakika otur kalk testi de akut alevlenen KOAH hastalarının fonksiyonel egzersizin değerlendirilmesi sırasında kullanılabilir. Akut alevlenen KOAH hastalarında hastanede yatış sırasında fonksiyonel egzersiz performansının değerlendirilmesi için 1 dakika otur kalk testini 6DYT'nin yerine uygun bir alternatif olarak öneriyoruz.

Anahtar Kelimeler: Akut alevlenme, Kronik obstrüktif akciğer hastalığı, 6-dakika yürüme testi, 1 dakika otur kalk testi, egzersiz kapasitesi

Corresponding *(İletişim)*: Zeynep Pelin Dündar, Necmettin Erbakan University, Nezahat Kelesoğlu Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Konya, Turkey
E-mail *(E-posta)*: zpdundar@erbakan.edu.tr
Received *(Geliş Tarihi)*: 18.04.2024 **Accepted *(Kabul Tarihi)*:** 13.05.2024

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a heterogeneous lung disease characterized by airflow obstruction, poor pulmonary gas exchange and hyperinflation. [1] Acute exacerbation of Chronic Obstructive Pulmonary Disease (AECOPD), a serious complication of COPD and the most common cause of hospital admission, has many adverse effects such as worsening quality of life, accelerated disease progression, increased hospitalizations, morbidity and mortality. [1,2] Acute exacerbation of COPD leads to acute reductions in lung function and acute increase in symptoms and a consequent decrease in skeletal muscle function and functional exercise capacity.[3] Several tests are used to assess the functional exercise capacity of patients with lung disease. The 6-minute walk test (6MWT) is a valid and reliable measure of exercise capacity in patients with chronic lung disease. The 6MWT for COPD is a simple, inexpensive and standardized test.[4] However, as the 6MWT requires familiarization and is time consuming, many more practical alternative tests have been proposed. One of these alternative tests is the one-minute sit to stand test (1STST). [5] The 1STST requires less space and time than the 6MWT and is similarly a self-paced test that can be influenced by the patient's motivation. In contrast to the 6MWT, more specific muscle groups are involved in this test.[6] Although the 1STST is an appropriate test for patients with stable COPD, little is known about its psychometric properties clinical implications for patients with AECOPD.[7] Previous studies have investigated whether the 6MWT and the 1STST can be used as alternatives to each other in patients with stable COPD and in people with advanced lung disease, and have also compared the cardiorespiratory responses of the two tests.[6,8-10] In the literature, no data evaluating studies in AECOPD patients were found. This research was therefore created to examine the association between functional exercise capacity as measured by the 6MWT and 1STST in patients with acute exacerbation of COPD.

MATERIAL AND METHOD

The study was carried out with the permission of Necmettin Erbakan University Meram Faculty of Medicine Pharmaceutical and Non-medical Device Ethics Committee (Date: 01.07.2022, Decision No: 157). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki. An informed consent form was signed by all patients.

Patients

Patients with AECOPD hospitalized in Necmettin Erbakan University Meram Medical Faculty Chest Diseases Department between August 2022 and May 2023 were included in our study.

Inclusion Criteria

- Patients who were hospitalized due to acute exacerbation of COPD
- Patients of all genders, ranging in age from 18 to 75 years, were included.

Exclusion Criteria

- Patients with orthopedic or neurological problems that may prevent assessment,
- Patients with malignancy,
- Patients with advanced heart problems such as acute coronary syndrome, stable angina pectoris, severe arrhythmias, decompensated heart failure,
- Those who wanted to leave the study voluntarily were excluded.

Thirty-seven COPD patients (3 female, 34 male) with acute exacerbating chronic obstructive pulmonary disease and hospitalized from Necmettin Erbakan University were included in the study.

Study Design

The patients were evaluated on the day they were admitted to the hospital. Exercise tests and respiratory functions of the patients were evaluated on the first day. Dyspnea, fatigue and leg fatigue were assessed using the modified Borg scale[11] before (pre-test), immediately after (end-test) and 1 minute after (recovery phase) the 6MWT and 1STST. We utilized the empirical model as previously explained to calculate the BODE index: The patients were given points ranging from 0 (lowest value) to 3 (maximum value) for each threshold value of FEV_1, distance walked in six minutes, and score on the modified Medical Research Council (MMRC) dyspnea scale. The options for body mass index were 0 or 1. The points for each characteristic were summed together to create a BODE index for each patient that varied from 0 to 10.[12]

Pulmonary Functions

Pulmonary function test measurements (EasyOne Pro Lab, Switzerland) were performed according to American Thoracic Society (ATS) and European Respiratory Society (ERS) criteria.[13] Pulmonary function tests measure forced vital capacity (FVC), which is the volume of air during a forced and rapid expiration, the volume of air inhaled in the first second of a forced expiration (FEV_1), the ratio of forced expiratory volume to forced vital capacity in the first second (FEV_1/FVC), peak expiratory flow rate (PEF) and forced vital capacity in mid-expiration ($FEF_{25-75\%}$). The test was performed in an upright sitting position on a chair and repeated until the test was successful.[14]

Dyspnea

The Modified Medical Research Council (MMRC) dyspnea scale is used to evaluate shortness of breath during activities of daily living. It is a scale scored between 0-4 with the value that best describes the perception of dyspnea out of five statements about dyspnea. As the person's breathlessness worsens, the score increases. It can be assessed either individually or through questioning by the interviewer.[15]

Six-Minute Walk Test

Exercise capacity was evaluated using the six-minute walk test (6MWT) according to the ATS criteria.[16] The test was conducted in a 30-meter long corridor. Heart rate, oxygen saturation, blood pressure, respiratory frequency, dyspnea, fatigue and quadriceps

fatigue perception were recorded before and after the test. Heart rate and oxygen saturation were measured with finger pulse oximetry device (Choicemed MD300C15D, Germany). Dyspnea, fatigue and fatigue perception of the quadriceps femoris muscle were evaluated with the Modified Borg scale.[11] The six-minute walking distance was calculated in meters and recorded.[4]

Sit to Stand Test

The 1STST was performed with a 46 cm standard-height chair without an armrest. The patient was allowed to sit upright in the chair. The patient sat with knees and hips flexed to 90°, feet flat on the floor at hip-width, and hands resting on hips. Each time the person rose from the chair was validated to check whether the full sit-stand-sit sequence was achieved. The number of sit and stand for 1 minute was determined manually. Heart rate, oxygen saturation and dyspnea values were recorded before and after the test.[17]

Statistical Analysis

Statistical analysis was performed using SPSS version 26.0 (SPSS, Chicago, IL, USA). Normality of the data was tested by Kolmogorov Smirnov test. Data are expressed as mean (±SD) or median (minimum-maximum). Paired Samples t-test (for normally distributed data) and Wilcoxon test (for non-normally distributed data) were used to compare results and distances between the two tests. Correlations between the 6MWT distance and number of 1 STST and demographic/clinical characteristics were calculated using Pearson correlation coefficients under parametric conditions and Spearman correlation coefficients under nonparametric conditions. Bland-Altman plot was used to evaluate the agreement between 6MWT distance and 1STST test. We calculated the sample size considering a minimum acceptable correlation coefficient of 0.65. Assuming an alpha error of 0.05 and 95% power, a minimum of 24 AECOPD patients were sufficient for the model. The statistical significance level for all analyses was defined as $p<0.05$.

RESULTS

Thirty-seven patients with acute exacerbation of COPD who agreed to be included in the study and met the inclusion criteria participated in the study (**Figure 1**). Demographic characteristics, pulmonary functions, BODE index (total score) values, the distance of the six-minute walking test, the number of one-minute sit-stand tests and the percentage of the distance of the six-minute walking test of the patients are presented in **Table 1**. The comorbidities present in the patients were diabetes mellitus (11 patients), hypertension (11 patients), coronary artery disease (3 patients), stroke (1 patient) and hepatitis (one patient). Nine of the patients reported that they were still active smokers. Acute exacerbated COPD was mild in 5% of patients (GOLD I), moderate in 38% (GOLD II), severe in 22% (GOLD III) and very severe in 35% (GOLD IV). Most patients (73%) were "at high risk and with high symptom burden" (GOLD D). All patients completed both exercise tests without any problems.

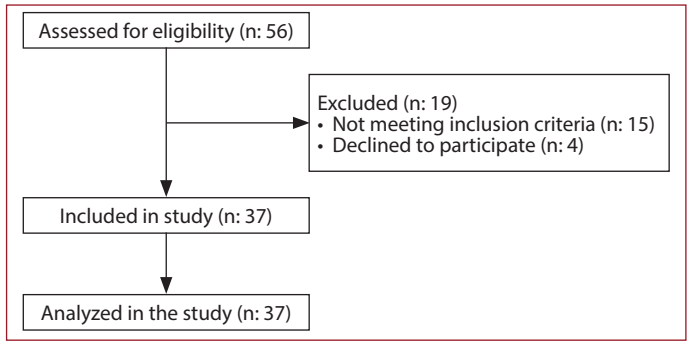

Figure 1. Consort flow chart

Table 1. Baseline clinical characteristics of participants (n:37)

	Mean±SD	Min-Max
Age (years)	66.9±7.3	46-79
Weight (kg)	73.3±17.0	35-108
Height (cm)	164.4±6.3	150-179
BMI (kg/m²)	27.1±6.2	13.3-38.7
Length of hospitalization (day)	9.1±4.5	3-30
Duration of disease (year)	10.3±8.2	1-28
Hospital admissions in last year (n)	4.1±3.3	0-12
Emergency visit in last year (n)	2.9±3.7	0-15
Smoking (pack-years)	52.4±43.8	12-200
FEV_1 (L)	1.1±0.6	0.3-3.4
FEV_1 (%)	44.0±21.6	13-95
FVC (L)	1.8±0.8	0.4-4.5
FVC (%)	54.1±23.7	15-113
FEV_1/FVC (%)	63.0±15.9	29.4-100
$FEF_{2575\%}$ (L)	0.8±0.7	0.1-3.4
$FEF_{2575\%}$ (%)	38.2±31.6	7-162
PEF (L)	3.3±1.5	1.5-8.4
MMRC (1-4)	3.0±0.6	2-4
BODE index	5.9±2.0	1-9
GOLD stage (I-IV)	2.8±0.9	1-4
6MWT (m)	205.5±108.6	28-420
6MWT (% predicted)	38.6±19.2	5.1-78.6
1STST (n)	15.6±6.3	3-27

BMI, body mass index; L:litres; cm: centimetre; kg: kilogram; m:metre; FEV_1: Forced expiratory volume in 1 s; FVC: forced vital capacity; FEV_1/FVC: ratio of forced expiratory volume to forced vital capacity in the first second; $FEF_{2575\%}$: forced mid-expiratory flow rate; PEF: peak expiratory flow rate, MMRC: Modified Medical Research Council dyspnea scale, 6MWT: Six-minute walk test, 1STST: One minute sit to stand test.

The before-test, end-of-test and recovery mean values of heart rate, oxygen saturation and dyspnea perception for both exercise tests are shown in **Table 2**. There was a significant difference between heart rate and dyspnea values among the baseline physiologic parameters ($p<0.05$). End-of-test heart rates were similar in both tests and there was no significant difference ($p>0.05$). There was a significant difference between the tests in end-of-test oxygen saturation ($p<0.05$). Oxygen saturation was much lower at the end of 6MWT compared to 1STST. In terms of end-test dyspnea scores, 6MWT scores were higher than 1STST scores. There was a significant difference between heart rate and oxygen saturation values in the recovery phase ($p<0.05$). In the recovery phase, heart rate was much higher and oxygen saturation was lower in the 1STST.

Table 2. Cardiorespiratory parameters

	6MWT (Mean±SD)	1STST (Mean±SD)	p
δHeart rate (beats/min)			
Baseline	86.2±16.2	90.6±15.6	**0.012***
End	106.2±16.8	106.8±16.5	0.812
Recovery	93.1±16.0	100±14.2	**0.003***
γOxygen saturation (%)			
Baseline	93.1±3.2	92.4±3.4	0.352
End	88.3±6.8	91.4±3.8	**0.001***
Recovery	92.9±3.0	91.8±3.3	**0.043***
δDyspnea (Borg scale; 0-10)			
Baseline	1.7±1.3	2.1±1.2	**0.0**42*
End	5.7±1.9	5.0±1.6	**0.038***
Recovery	4.5±1.9	3.9±1.6	0.103

γ: Wilcoxon signed rank test,δ: paired sample t test, 6MWT: six-minute walk test, 1STST: one minute sit to stand test, *p<0.05

The relationships between clinical variables and 6MWT and 1STST are shown in **Table 3**. 6MWT and 1STST test were statistically significantly associated (r=0.656, p<0.001, **Table 3**). Both 6MWT and 1STST were significantly negatively associated with age and MMRC (p<0.05). 6MWT was significantly negatively associated with smoking pack-years (p<0.05). There were significant positive correlations between 6MWT and FEV_1(L) and PEF (L) (p<0.05). No statistically significant correlations were found between the 6MWT and 1STS tests; height, weight, BMI, resting and activity Borg scale, and except for pulmonary function parameters. The agreement between 6MWT and 1STST is shown in Bland-Altman plots (**Figure 2**). The mean difference between the 6MWT distance and the number of 1STST was -189.9, and the limits of agreement were -83.4 and -292.4.

Table 3. Correlation between clinical variables and 6MWT and 1STST

	6MWT		1STST	
	r	p	r	p
Age (years)	-0.443	**0.006**	-0.377	**0.021**
Weight (kg)	0.006	0.970	-0.148	0.382
Height (cm)	0.177	0.294	-0.081	0.632
BMI (kg/cm²)	-0.056	0.740	-0.130	0.442
Smoking (packxyears)	-0.353	**0.044**	-0.169	0.348
Resting Borg Scale (1-10)	-0.223	0.186	-0.143	0.398
Activity Borg scale (1-10)	-0.198	0.239	-0.40	0.815
MMRC (1-4)	-0.663	**<0.001**	-0.427	**0.008**
FEV_1 (L)	0.377	**0.021**	0.119	0.482
FEV_1 (%)	0.185	0.272	-0.023	0.891
FVC (L)	0.277	0.097	-0.046	0.785
FVC (%)	0.160	0.344	-0.087	0.607
FEV_1/FVC (%)	0.097	0.567	0.073	0.670
$FEF_{2575\%}$ (L)	0.218	0.195	-0.044	0.795
$FEF_{2575\%}$ (%)	0.101	0.551	-0.085	0.617
PEF (L)	0.342	**0.038**	0.008	0.960
6MWD (m)			0.656	**<0.001**
1STST (n)	0.656	**<0.001**		

*Pearson and spearman correlation coefficients, BMI, body mass index; L: litres; FEV_1: Forced expiratory volume in 1 s; FVC: forced vital capacity; FEV_1/FVC: ratio of forced expiratory volume to forced vital capacity in the first second; $FEF_{2575\%}$: forced mid-expiratory flow rate; PEF: peak expiratory flow rate, MMRC: Modified Medical Research Council dyspnea scale, 6MWT: Six-minute walk test, 1STST: One minute sit to stand test.p<0.05

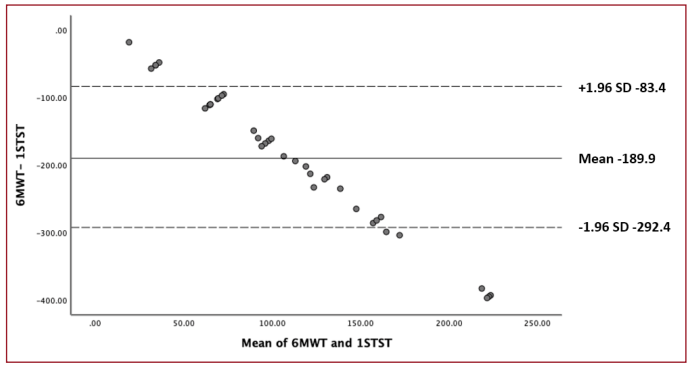

Figure 2. Bland-Altman plot of the difference between 6-minute walk test (6MWT) and 1-minute sit-to-stand test (1STST) plotted against the mean of 6MWT and 1STST.

DISCUSSION

The number of published studies measuring functional status in COPD has increased rapidly in recent years but such studies in patients with AECOPD are limited. This study demonstrated a significant relationship between functional exercise capacity as assessed by the 6MWT and the 1STST in patients with AECOPD. A relationship was observed between the number of 1STST repeated and distance walked in the 6MWT. However, the physiological parameters differed significantly between the tests. Among the physiological parameters at baseline, there was a significant difference between heart rate and dyspnea scores. At the end of the test, the 6MWT, oxygen saturation was lower and the perception of dyspnea was higher compared to the 1STST. During the recovery phase, heart rate was much higher and oxygen saturation was lower in the 1STST. We also found that MMRC was the main factor influencing the results of both tests.

The present study shows that there is a statistically significant relationship between the distance walked in the 6MWT and the number of repetitions of the 1STST. In patients with exacerbation of COPD, the acute increase in respiratory load during exacerbations causes breathlessness even when engaging in low-intensity activities, which lowers their functional exercise tolerance.[3] The current findings are similar to previous studies in patients with stable COPD which found strong correlations between the 6MWT and the 1STST,[6,8,10,18] as well as a study in patients with acute exacerbations of COPD.[7] The significant correlation between the distance walked and the number of repetitions means that both tests are measuring functional exercise performance and that the statistical power of the correlations is high.

In this study, the baseline physiological parameters of heart rate and dyspnea were significantly different in both tests. Previous studies have shown that the baseline physiological parameters of the tests are similar.[8,10] These studies were carried out in patients with stable COPD. We believe that the fact that our patients were in the acute exacerbation phase may be the reason for the different result in our study.

The current study confirmed a significant decrease in end of the test oxygen saturation between the tests. The oxygen saturation was lower at the end of the 6MWT compared to the 1STST. Our patients received supplemental oxygen during both tests as they were in the acute exacerbation phase. In previous studies, patients were both stable COPD and it was unclear whether they received supplemental oxygen during testing. However, to our knowledge, only a few studies have been conducted on the assessment of oxygen desaturation with 1STST in patients with acute exacerbations of COPD.[7] Conflicting results have been reported in the literature on the decrease in SpO_2 during 1STST. On the one hand, studies reported no significant change in SpO_2 during 1STST,[11,12] while on the other hand, results of previous studies showed less desaturation during 1STST, similar to our study.[6,7,18] The most likely reason for this is that the 6MWT lasts longer than the 1 STST and therefore people with chronic lung disease are exposed to increased ventilatory demand, dynamic hyperinflation and a greater V/Q mismatch for a longer period of time.[19]

In this study, 6MWT scores were higher than 1STST scores in terms of end-test dyspnea scores expressed on the modified Borg scale. In similar previous studies, dyspnea scores were similar in both tests.[6,8,17] Dyspnea scores may have differed between the two tests due to the longer duration of the 6MWT test and the fact that patients were in the acute exacerbation phase. Patients with acute exacerbations of COPD have severe dyspnea even at rest and increased exertion during testing may result in higher dyspnea scores.

In the present study, both walking tests elicited heart rate responses but recovery heart rates were higher for the 1STST compared to the 6MWT. In a study of stable COPD patients, a greater increase in heart rate was observed after the 6MWT compared with the 1STST, and cardiorespiratory work was greater after the 6MWT. In this study, the higher heart rate after the 6MWT was explained by the longer duration of the test.[6] In the present study, we believe that the fact that our patients were in the acute exacerbation period may be the reason why the heart rate was higher at 1STST than at 6MWT. It is possible that many factors such as hypoxaemia, dynamic hyperinflation, systemic inflammation and drug therapy present in COPD patients during the acute exacerbation period may affect the autonomic cardiac response to exercise and lead to adverse results in disease prognosis.[20] Therefore, we suggest that COPD patients with acute exacerbations may have a higher heart rate in the recovery phase after the 1STST test. Studies are needed to investigate the physiological effects of this change in 1STST recovery parameters in COPD patients with acute exacerbations.

As shown in the present study, MMRC was significantly negatively associated with both 6MWT and 1STST. Dyspnea in patients with COPD is one of the strongest correlates of impaired exercise performance. In COPD patients experiencing an acute exacerbation, the degree of dyspnea worsens as the patient's need for ventilation grows until it reaches the ventilator's maximum capacity.[21] When we look at other studies, 6MWT walking distance in AECOPD patients showed a strong correlation with MMRC,[22] in another study, a correlation was found between MMRC and 30 seconds sit to stand test and 5 repetitions of sit to stand test in stable COPD patients.[23] Exacerbations cause respiratory issues to worsen, which is compounded by a history of persistent immobility. The finding of a relationship between MMRC and the tests might point to people with worsened COPD who are becoming more immobile and experiencing more dyspnea.

The present study showed a significant positive correlation between the 6-min walk test and the lung function parameters FEV_1 (L) and PEF (L) in AECOPD patients. However, there was no statistically significant correlation between the other parameters of lung function test. In contrast to our study, previous studies have found no correlation between 6MWT and 1STST and FEV_1 in stable COPD patients.[6,24] While another study carried out in patients with stable COPD found a correlation between the FVC and the 6MWT test.[8] Although it is thought that FEV_1 is not a good predictor of functional status in COPD patients and that field tests are not complementary in assessing lung function[25] our study has shown a result in the opposite direction. We think that the different result is due to the fact that the patients were in the acute exacerbation phase. Unfortunately, there are no studies that examined patients with an acute exacerbation of COPD that we can use to make comparisons with the results of our study. Therefore, more studies are needed on this topic in AECOPD patients.

6MWT and 1STST were not found to be statistically significantly associated with height, weight, BMI, resting and activity Borg scales. Age was correlated with 1STST and 6MWT, consistent with previous studies.[24] It is important to recognize that the 1STST and 6MWT have different movement requirements, and the factors limiting performance may differ between the tests. There may also be differences in height between individuals, which can affect patient performance when the test is performed in a standardized chair.

Limitations

One of the limitations of our study is that we did not have the opportunity to measure peripheral muscle strengths that may affect functional performance. The fact that the majority of our patients were male meant that the gender-related responses could not be determined.

CONCLUSION

Due to the more sensitive clinical condition of patients with AECOPD, the 1STS test can be used to assess functional exercise capacity like the 6MWT. During hospitalization, the 1STS test

can be used to assess exercise capacity in a simpler and less stressful way than the 6MWT, depending on the patient's condition. Our study may contribute to the evolving knowledge of functional testing in patients with acute exacerbations of COPD and may have important clinical implications. We propose that the 1STST is a suitable alternative to the 6MWT for the assessment of functional exercise performance during hospitalization in AECOPD patients.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Necmettin Erbakan University Meram Faculty of Medicine Pharmaceutical and Non-medical Device Ethics Committee (Date: 01.07.2022, Decision No: 157).

Informed Consent: All patients signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

Acknowledgment: The authors would like to thank Gazi University Academic Writing Research and Application Centre for English editing their contribution and support.

REFERENCES

1. Troosters T, Janssens W, Demeyer H, Rabinovich RA. Pulmonary rehabilitation and physical interventions. Eur Respir Rev. 2023;32(168): 220222.
2. Lu HY, Chen CF, Lee DL, Tsai YJ, Lin PC. Effects of early pulmonary rehabilitation on hospitalized patients with acute exacerbation of chronic obstructive pulmonary disease: a systematic review and meta-analysis. Int J Chron Obstruct Pulmon Dis. 2023;18:881-93.
3. Machado A, Barusso M, De Brandt J, et al. Impact of acute exacerbations of COPD on patients' health status beyond pulmonary function: A scoping review. Pulmonology. 2023;29(6):518-34.
4. A. T. S. Committee on Proficiency Standards for Clinical Pulmonary Function Laboratories. ATS statement: guidelines for the six-minute walk test. Am J Respir Crit Care Med. 2002;166(1):111-7.
5. Singh SJ, Puhan MA, Andrianopoulos V, et al. An official systematic review of the European Respiratory Society/American Thoracic Society: measurement properties of field walking tests in chronic respiratory disease. Eur Respir J. 2014;44(6):1447-78.
6. Reychler G, Boucard E, Peran L, et al. One minute sit-to-stand test is an alternative to 6MWT to measure functional exercise performance in COPD patients. Clin Respir J. 2018;12(3):1247-56.
7. McDonald O, Perraton L, Osadnik C. Validity and clinical applicability of the 60-second sit-to-stand test in people with acute exacerbations of COPD. Respir Med. 2023:107264.
8. Meriem M, Cherif J, Toujani S, Ouahchi Y, Hmida AB, Beji M. Sit-to-stand test and 6-min walking test correlation in patients with chronic obstructive pulmonary disease. Ann Thorac Med. 2015;10(4):269-73.
9. Watson K, Winship P, Cavalheri V, et al. In adults with advanced lung disease, the 1-minute sit-to-stand test underestimates exertional desaturation compared with the 6-minute walk test: an observational study. J Physiother. 2023;69(2):108-13.
10. Ozalevli S, Ozden A, Itil O, Akkoclu A. Comparison of the sit-to-stand test with 6 min walk test in patients with chronic obstructive pulmonary disease. Respir Med. 2007;101(2):286-93.
11. Mahler DA, Wells CK. Evaluation of clinical methods for rating dyspnea. Chest. 1988;93(3):580-6.
12. Celli BR, Cote CG, Marin JM, et al. The body-mass index, airflow obstruction, dyspnea, and exercise capacity index in chronic obstructive pulmonary disease. N Engl J Med. 2004;350(10):1005-12.
13. Miller MR, Crapo R, Hankinson J, et al. General considerations for lung function testing. Eur Respir J. 2005;26(1):153-61.
14. Pellegrino R, Viegi G, Brusasco V, et al. Interpretative strategies for lung function tests. Eur Respir J. 2005;26(5):948-68.
15. Bestall JC, Paul EA, Garrod R, Garnham R, Jones PW, Wedzicha JA. Usefulness of the Medical Research Council (MRC) dyspnoea scale as a measure of disability in patients with chronic obstructive pulmonary disease. Thorax. 1999;54(7):581-6.
16. Holland AE, Spruit MA, Troosters T, et al. An official European Respiratory Society/American Thoracic Society technical standard: field walking tests in chronic respiratory disease. Eur Respir J. 2014;44(6):1428-46.
17. Vaidya T, de Bisschop C, Beaumont M, et al. Is the 1-minute sit-to-stand test a good tool for the evaluation of the impact of pulmonary rehabilitation? Determination of the minimal important difference in COPD. Int J Chron Obstruct Pulmon Dis. 2016;11:2609-16.
18. Crook S, Büsching G, Schultz K, et al. A multicentre validation of the 1-min sit-to-stand test in patients with COPD. Eur Respir J. 2017;49(3):1601871.
19. Marin JM, Carrizo SJ, Gascon M, Sanchez A, Gallego B, Celli BR. Inspiratory capacity, dynamic hyperinflation, breathlessness, and exercise performance during the 6-minute-walk test in chronic obstructive pulmonary disease. Am J Respir Crit Care Med. 2001;163(6):1395-9.
20. Nasis I, Kortianou E, Vasilopoulou M, et al. Hemodynamic effects of high intensity interval training in COPD patients exhibiting exercise-induced dynamic hyperinflation. Respir Physiol Neurobiol. 2015;217:8-16.
21. Foglio K, Carone M, Pagani M, Bianchi L, Jones PW, Ambrosino N. Physiological and symptom determinants of exercise performance in patients with chronic airway obstruction. Respir Med. 2000;94(3):256-63.
22. Quadflieg K, Machado A, Haesevoets S, et al. Physical tests are poorly related to patient-reported outcome measures during severe acute exacerbations of COPD. J Clin Med. 2021;11(1):150.
23. Zhang Q, Li YX, Li XL, et al. A comparative study of the five-repetition sit-to-stand test and the 30-second sit-to-stand test to assess exercise tolerance in COPD patients. Int J Chron Obstruct Pulmon Dis. 2018;13:2833-9.
24. Fernandes AL, Neves I, Luis G, et al. Is the 1-Minute Sit-To-Stand Test a Good Tool to Evaluate Exertional Oxygen Desaturation in Chronic Obstructive Pulmonary Disease? Diagnostics (Basel). 2021;11(2):159.
25. Casanova C, Cote C, Marin JM, et al. Distance and oxygen desaturation during the 6-min walk test as predictors of long-term mortality in patients with COPD. Chest. 2008;134(4):746-52.

JOURNAL OF
CONTEMPORARY MEDICINE

DOI:10.16899/jcm.1402142
J Contemp Med 2024;14(3):143-151

Original Article / Orijinal Araştırma

Saudi Physiotherapists' Attitudes, Knowledge, Behaviors, and Barriers Towards Evidence-Based Practice

Suudi Fizyoterapistlerin Kanıta Dayalı Uygulamaya Yönelik Tutumları, Bilgileri, Davranışları ve Engelleri

Amr Abdel-aziem[1,2], Osama Abdelraouf[3], Khaled AlQurashi[4], Nashwa Hamed[1], Muhsen Alsufiany[1], Maher Mahdi[5], Sobhy Aly[2,6]

[1]Department of Physical Therapy, College of Applied Medical Science, Taif University, Taif, Saudi Arabia
[2]Department of Biomechanics, Faculty of Physical Therapy, Cairo University, Giza, Egypt
[3]Department of Physical Therapy Program, Batterjee Medical College, Jeddah, Saudi Arabia
[4]King Fahad Hospital, Jeddah, Saudi Arabia
[5]Department of Foreign Languages, College of Arts, Taif University, Taif, Saudi Arabia
[6]Department of Medical Rehabilitation Sciences-Physiotherapy Program, College of Applied Medical Sciences, Najran University, Najran, Saudi Arabia

Abstract

Aim: This study investigated the attitudes, knowledge, behaviors and barriers of Saudi physiotherapists regarding EBP throughout Saudi Arabia.

Material and Method: A sample of 323 physiotherapists, represented all regions of Saudi Arabia, completed an EBP questionnaire, which was designed to cover the 6-domain of EBP; Attitudes, interest, attention to literature, information availability, educational background, and its barriers.

Results: About 91.5% of the participants reported that EBP is essential, literature helps practice 74.6%, EBP enhances patient care 79.6%, reimbursement rate 81.4%, and aids in decision-making 75.2%. A 62.2% showed that EBP does not consider the patient preferences, or constraints of the clinical practice 70.0%. A 79.9% were interested in enhancing their abilities, and to use evidence more frequently in daily work 74.0%. Whereas 71.3% disagree that their workplace encouraged the EBP usage, and 43.6% having access to databases at work and 66.6% at home. Fifty-one percent had not learned the EBP's fundamentals, 60.4% had not attended training sessions on finding research, and 74.9% were not confident in their capacity to evaluate professional literature. However, 62.2% were able to find pertinent research to address clinical concerns.

Conclusion: The Saudi physiotherapists have a generally positive attitude toward EBP. However, it places an unreasonable demand on physiotherapists, does not consider the clinical setting limitations or patient preferences. Their attention to literature was relatively low and need support from their workplaces. The lack of time was the primary barrier to EBP.

Keywords: Attitudes, barriers, evidence-based practice, literature, rehabilitation

Öz

Amaç: Bu çalışma, Suudi Arabistan genelinde Suudi fizyoterapistlerin Kanıta Dayalı Uygulama (KDU) ile ilgili tutum, bilgi, davranış ve engellerini araştırdı.

Gereç ve Yöntem: Suudi Arabistan'ın tüm bölgelerini temsil eden 323 fizyoterapistten oluşan bir örneklem, KDU'nın tutumlar, ilgi, literatüre dikkat, bilgi bulunabilirliği, eğitim geçmişi ve engelleri alt gruplarında 6 alanını kapsayacak şekilde tasarlanmış bir KDU anketini doldurdu.

Bulgular: Katılımcıların yaklaşık %91,5'i KDU'nın gerekli olduğunu, %74,6'sı literatürün uygulamaya yardımcı olduğunu, %79,6'sı KDU'nın hasta bakımını iyileştirdiğini, %81,4'ü geri ödeme oranını ve %75,2'si karar vermeye yardımcı olduğunu bildirdi. %62,2'lik bir oran, KDU'nın hasta tercihlerini veya %70,0'ı klinik uygulamanın kısıtlamalarını dikkate almadığını gösterdi. %79,9'u yeteneklerini geliştirmekle ve %74,0'ı günlük işlerinde kanıtları daha sık kullanmakla ilgilendi. %71,3'ü işyerlerinin KDU kullanımını teşvik ettiğine katılmadığını, veri tabanlarına erişime %43,6'sı iş yerinden, %66,6'sı ise evinden sahip olduğunu belirtti. Yüzde elli biri KDU'nın temellerini öğrenmemişti, %60,4'ü araştırma bulma konusunda eğitim oturumlarına katılmamıştı ve %74,9'u mesleki literatürü değerlendirme kapasitelerine güvenmiyordu. Ancak %62,2'si klinik kaygıları giderecek uygun araştırmaları bulabildi.

Sonuç: Suudi fizyoterapistlerin KDU'ya karşı genel olarak olumlu bir tutumu var. Ancak KDU fizyoterapistlerden makul olmayan bir talepte bulunur, klinik ortamın sınırlamalarını veya hasta tercihlerini dikkate almaz. Literatüre olan ilgileri nispeten düşüktü ve işyerlerinin desteğine ihtiyaç duyuyorlardı. Zaman eksikliği KDU'nın önündeki birincil engeldi.

Anahtar Kelimeler: Tutumlar, engeller, kanıta dayalı uygulama, literatür, rehabilitasyon

Corresponding *(İletişim)*: Amr Abdel-aziem, Department of Physical Therapy, College of Applied Medical Science, Taif University, Taif, Saudi Arabia
E-mail *(E-posta)*: amralmaz@yahoo.com
Received *(Geliş Tarihi)*: 08.12.2023 **Accepted *(Kabul Tarihi)*:** 14.05.2024

INTRODUCTION

Decision-making in health care settings currently requires the implementation of evidence-based practice (EBP). The decision-making model entails combining clinical expertise with the top validated research findings and taking into account patient preferences.[1] In fact, the assessment of EBP related outcomes became important for evaluating the quality of services provided by different health care systems.[2] The use of EBP can result in an intervention that is cost-effective, safe, and beneficial.[3] These reasons have caused EBP to become significantly more important in clinical practice.[4] EBP is divided into five steps,[5] applying this process requires evaluating evidence sources using critical thinking, then incorporating the evidence into patient care utilizing decision-making abilities.[6]

It's crucial to assess a change in an EBP by comparing the outcomes before and after its implementation to see whether it leads to better practice. This approach remains briefly addressed in the literature.[7] For instance, two recent studies revealed that Saudi primary healthcare workers only sometimes used EBP.[8,9] Another study revealed low awareness and knowledge of physiotherapists towards EBP application.[10] The attitudes of physiotherapists toward EBP have also been found to be influenced by cohort effects. For instance, it has been demonstrated that work experience reduces physiotherapists' perceptions of the relevance of EBP when measured against levels from their graduation,[11] and it has been demonstrated that prior research expertise and a positive outlook on future research indicate a positive outlook toward the application of EBP.[12]

Saudi Arabia offers very few physiotherapy programs, especially at the postgraduate level. Furthermore, there hasn't been much discussion of the EBP notion in Saudi Arabia's research community.[10] In fact, there aren't recent Saudi studies that have acknowledged the necessity of integrating EBP into medical and physiotherapy curricula.[13,14] Whereas, increasing the awareness of the importance of research would help the physiotherapists to need less time and resource when implementing EBP.[15]

According to the World Confederation for Physical Therapy (WCPT), physiotherapists must possess certain competencies in order to use EBP, including the ability to critically examine research articles, find evidence, and assess their practices after implementation.[16] Thus, educating physiotherapists in EBP and research techniques will offer a chance to maintain the profession's familiarity with current findings. It has been reported that teaching students about EBP can increase their knowledge and confidence when it comes to employing research terms.[17] Therefore, continuous evaluation of the perception and barriers of EBP was very important to realize the required curriculum modifications to identify the knowledge gap which in turn improves services provided to patients.[10,18]

However, few studies have been conducted on the physiotherapists perception and use of EBP in Saudi Arabia,[10,19,20] but so far there has been no study examined the 6-domain of physiotherapy EBP which were established by previously validated questionnaire created by Simmons College, USA,21 and updated by Bernhardsson and Larsson.[22] Also, there is no study evaluated the physiotherapy EBP on all thirteen regions of Saudi Arabia.[23] According to recent studies, there is a large difference in Saudi physiotherapists' knowledge, attitudes, and adoption of EBP.[10,20]

These studies had a diverse population because they enrolled physiotherapists working in outpatient settings,[20] or working in clinical or academic setting.[10] Another study looked at Saudi physiotherapists who only work at public hospitals in the Eastern region of Saudi Arabia.[24] While the clinical practice guidelines availability, information accessibility, and attention literature, were not fully taken into account in most of the previous studies. The aforementioned studies show that they did not include all 6-domain of EBP, nor were they applied throughout Saudi Arabia. So, this study examined the attitude, beliefs, motivation, attention to literature, availability of information, educational background and barriers of Saudi physiotherapists regarding EBP.

MATERIAL AND METHOD

Participants

The Directorate of Health Affairs-Taif: Research and Studies Department (KACST, KSA: HAP-02-T-067) approved this cross-sectional study with approval number (ID: 319) which was adhered to the Declaration of Helsinki. The target population was graduated physiotherapists across Saudi Arabia who are registered with the Saudi Commission for Health Specialties (SCHS). The study included a total of 323 therapists, of both genders, it was a little more than the sample size estimated by the G*Power 3.1 software (University of Düsseldorf, Germany), which was 317 individuals based on = 0.05, power = 0.95, and effect size = 0.25. The undergraduate and internship physiotherapy students were excluded.

Procedures

This study adopted the Jette et al.[21] and Bernhardsson and Larsson questionnaire,[22] which were said to have adequate test-retest reliability and strong face and content validity. Physiotherapists in several nations have been polled using this questionnaire.[21,25–28] The 6- domain were covered in the following order: EBP-related attitudes and beliefs (questionnaire items 1-9), interest in and motivation to engage in EBP (items 10 and 11), availability of information (items 15-20), educational background, knowledge and skills related to accessing and interpreting information (items 21-27), and perceived barriers to using evidence in practice (survey item 28). The majority of the items covering attitudes and beliefs, education, knowledge, and abilities pertinent to EBP were assessed using a 5-point Likert scale with the

anchors "strongly disagree" and "strongly agree." There were several questions about information access that required "yes/no" answers.

Between November 2022 and March 2023, a 5-month period was used to conduct the survey. It was delivered straight to the workplace, by email and WhatsApp, or both. A 446 physiotherapists were invited to participate. They were given 2 weeks to complete the questionnaires. A reminder with the same response timeline was given to participants who did not respond within this time frame. The non-responders received a second notification after 2 weeks. A final notification was delivered 2 weeks later. Only 357 respondents provided their response, 28 participants were excluded due to incomplete questionnaire information. Moreover, some participants were excluded; 5 internship students, 1 not physiotherapist (**Figure**). The final accepted participations were 323 with a response rate 72.4%.

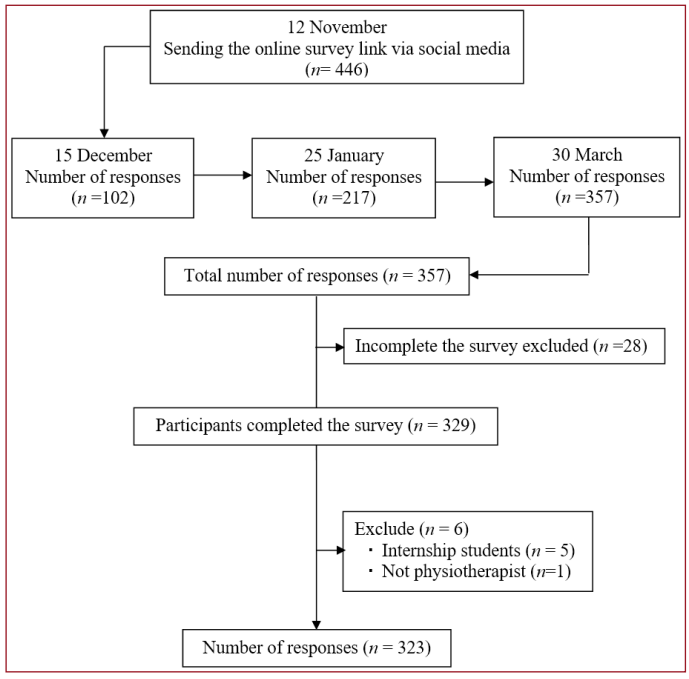

Figure 1. Flow diagram of the study

Data analysis

Using Windows-compatible SPSS software, version 20.0, the data were descriptively analyzed. The frequencies of responses were shown in tabular formats, which show the frequency and significance of each item. To ascertain the factors that influence physiotherapy EBP, the Chi-square test was performed. The significance level was calculated using a 95% confidence interval. With a 5-point Lickert scale and a positive response set (i.e., agreement with the statement suggested positive regard for EBP), the "strongly agree" and "agree" categories, as well as the "neutral," "strongly disagree," and "disagree" categories, were combined for those items so that responses fell into one of two categories: "agree" or "disagree." For questions with a negative answer set, the "neutral" category was combined with the "agree" and "strongly agree" categories.

The "do not know" option was coupled with the "no" category for the items that had a "yes/no/do not know" choice set because it was thought that not knowing if, for instance, a workplace had Internet connection would be just as detrimental to a respondent as not having access. The lowest category (<2) was set apart from the higher categories of items that were categorized according to the frequency with which articles were read or databases were accessed/month because it was thought that the lowest level of access indicated a lack of attention to the literature, which was inconsistent with the goals of EBP. For items intended to measure the level of understanding of research words, the categories "understand entirely" and "understand slightly" were combined, producing a two-category response: "understand at least somewhat" or "do not understand".

RESULTS

In all, 323 physiotherapists (160 male and 163 female) participated in the study, without significant difference between both genders (p= 0.867). About 85% have batecholar degree of physiotherapy, and 89.9% working in urban areas. Sixty percent aged (20-29 years), 23.50% (30-39 years) and 2.40% (40-49 years). Twenty-eight percent have a license (less than 3 years ago), 45.5% (3-5 years ago), 8.7% (6-10 years ago), 1.6% (11-15 years ago) and 1.6% (16-20 years ago). Nearly 70% of physiotherapists were keen to join more than one training course/year, 50% treated 5-10 patients/day, 57.3% need more than 75 minutes to provide patient care 66.6% of their patients were orthopedic cases, and the majority of their patients were adults 62.2%.

Attitudes and beliefs

The majority of physiotherapists said they agreed that EBP is essential 91.5%, literature is helpful in practice 74.6%, and that it enhances patient care 79.6%. The reimbursement rate increases by incorporating EBP into their practice 81.4%, evidences help in decision making 75.2%, and 42% of the participants stated there wasn't enough strong evidence to support certain areas of their practice. They frequently selected "neutral" response more than other responses when asked if the adoption of EBP places an unreasonable demand on physiotherapists 36.5%, with total agreement 70.9%. EBP does not take into account the limitations of clinical practice setting 46.3%, with total agreement 70.0%, or takes into account patient preferences 37.2%, with total disagreement 62.2%, as shown in **Table 1**.

Interest in and motivation to engage in EBP

Seventy-four percent of the participants agreed that they needed to utilize evidence more frequently in their daily practices, and 79.9% were interested in learning or enhancing the skills required to execute EBP (**Table 2**).

Attention to literature

Only 37% of the participants read one article monthly, or none at all, 41.2% said they typically read between 2 and 5 articles/month, 43.7% used expert literature 2-5 times/month when making clinical decisions, and 48% conduct one database search every month on average, as shown in **Table 3**.

Availability of information

About 63.2% of the participants incorporated patient preferences with practice guidelines, and 71.3% disagreed that their workplaces encourage the application of evidence in practice (**Table 4a**). Whereas 83% of the participants claimed the availability of the practical guidelines of their practice, while 66.6% more participants reported having access to pertinent databases at home and 43.6% at work, as shown **Table 4b**.

Educational background and required skills

Fifty-one percent of the participants disagreed that their academic preparation included learning the principles of EBP, and 60.4% had not attended training sessions on how to discover research that was pertinent to their field of practice. Also, 58.8% disagreed that they had expertise about using databases like MEDLINE and Pedro, 86.4% reported not having received any training in the critical evaluation of research literature, and 74.9% expressed lack of confidence in their capacity to examine professional literature. However, 62.2% expressed confidence in their ability to locate pertinent research to address their clinical problems (**Table 5a**). The participants' knowledge of the terms such as relative risk, absolute risk, systematic review, odds ratio, meta-analysis, confidence interval, and publication bias were 55.4%, 54.8%, 55.7%, 63.5%, 70.9%, 88.6%, and 70.0%, respectively, as shown **Table 5b**.

Table 1. Attitudes and beliefs of physiotherapist toward EBP

Items		Number (%)					p-value
		Strongly disagree	Disagree	Neutral	Agree	Strongly agree	
Q1.	Application of EBP is necessary in the practice of physiotherapy	0 (0.0)	10 (3.10)	23 (7.12)	162 (50.15)	128 (41.34)	0.001
Q2.	Literature and research findings are useful in my day-to-day practice	0 (0.0)	9 (2.78)	73 (22.60)	163 (50.46)	78 (24.16)	0.001
Q3.	EBP places an unreasonable demand on physiotherapists.	14 (4.33)	80 (24.77)	118 (36.53)	89 (27.55)	22 (6.81)	0.001
Q4.	EBP improves the quality of patient care.	0 (0.0)	0 (0.0)	66 (20.43)	125 (38.70)	132 (40.87)	0.001
Q5.	EBP does not consider the limitations of my clinical practice setting.	14 (4.33)	63 (19.50)	149 (46.13)	81 (25.08)	16 (4.33)	0.001
Q6.	The physiotherapy reimbursement rate will increase if I incorporate EBP into my practice.	0 (0.0)	9 (2.79)	51 (15.79)	168 (52.01)	95 (29.41)	0.001
Q7.	Strong evidence is lacking to support most of the interventions I use with my patients.	9 (2.79)	86 (26.63)	94 (29.10)	115 (35.60)	19 (5.88)	0.001
Q8.	EBP helps me make decisions about patient care.	0 (0.0)	12 (3.72)	68 (21.05)	166 (51.39)	77 (23.84)	0.001
Q9.	EBP does consider patient preferences.	9 (2.79)	72 (22.29)	120 (37.15)	112 (34.67)	10 (3.10)	0.001

P < 0.05 means significant difference

Table 2. Interest in and motivation to EBP

Items		Number (%)					p-value
		Strongly disagree	Disagree	Neutral	Agree	Strongly agree	
Q10.	I need to increase the use of evidence in my daily practice.	0(0.0)	18(5.57)	66(20.43)	168(52.01)	71(21.98)	0.001
Q11.	I am interested in learning or improving the skills necessary to incorporate EBP into my practice.	0(0.0)	0(0.0)	65(20.12)	172(53.25)	86(26.63)	0.001

P < 0.05 means significant difference

Table 3. Attention to literature

Items		Number (%)					P-value
		≤ 1	2-5	6-10	11-15	> 16	
Q12.	Number of scientific articles related to my clinical work that I read, per month	118 (36.53)	133 (41.18)	46 (14.24)	20 (6.19)	6 (1.86)	0.001
Q13.	Number of uses of professional literature and research findings in the process of clinical decision making.	101 (31.27)	141 (43.65)	54 (16.72)	15 (4.64)	12 (3.72)	0.001
Q14.	Number of use of databases to search for practice-relevant literature/research.	155 (47.99)	118 (36.53)	20 (6.19)	20 (6.19)	10 (3.96)	0.001

P < 0.05 means significant difference

Table 4a. Availability of information to promote EBP

Items		Number (%)					p-value
		Strongly disagree	Disagree	Neutral	Agree	Strongly agree	
Q16.	I can incorporate patient preferences with practice guidelines	8 (2.48)	11 (3.41)	100 (30.96)	185 (57.28)	19 (5.88)	0.001
Q19.	My workplace supports the use of current research in practice.	45 (13.93)	56 (14.34)	139 (43.03)	67 (20.74)	16 (4.95)	0.001

P < 0.05 means significant difference

Table 4b. Availability of information to promote EBP

Items		Number (%)			p-value
		Yes	No	Do not know	
Q15.	Practice guidelines are available for topics related to my practice.	268 (82.97)	55 (17.03)	0 (0.00)	0(0.00)
Q17.	I am able to access relevant databases and the Internet at my workplace.	141 (43.56)	100 (30.96)	82 (25.39)	0.001
Q18.	I am able to access relevant databases and the Internet at home or locations other than my workplace.	215 (66.56)	47 (14.55)	61 (18.89)	0.001

P < 0.05 means significant difference

Table 5a. Education, knowledge, and skills related to EBP

Items		Number (%)					p-value
		Strongly disagree	Disagree	Neutral	Agree	Strongly agree	
Q20.	I learned the foundations for EBP as part of my academic preparation	24 (7.43)	31 (9.60)	110 (34.06)	127 (39.32)	31 (9.60)	0.001
Q21.	I have received formal training in search strategies for finding research relevant to my practice	29 (8.98)	95 (29.41)	71 (21.98)	107 (33.13)	22 (6.81)	0.001
Q22.	I am familiar with the medical search engines (eg, MEDLINE, Pedro database)	44 (13.62)	59 (18.27)	87 (26.93)	144 (44.58)	19 (5.88)	0.001
Q23.	I received formal training in critical appraisal of research literature as part of my academic preparation	83 (25.70)	107 (33.13)	89 (27.55)	35 (10.84)	9 (2.79)	0.001
Q24.	I am confident in my ability to critically review professional literature	40 (12.38)	80 (24.77)	122 (37.77)	71 (21.98)	10 (3.10)	0.001
Q25.	I am confident in my ability to find relevant research to answer my clinical questions	9 (2.79)	28 (8.67)	85 (26.32)	176 (54.49)	25 (7.74)	0.001

P < 0.05 means significant difference

Table 5b. Education, knowledge, and skills related to EBP

	Rank your understanding of;	Understand completely	Understand somewhat	Do not understand	p-value
Q26.	1. Relative risk	59 (18.27)	120 (37.15)	144 (44.58)	0.001
	2. Absolute risk	67 (20.74)	110 (34.06)	146 (45.20)	0.001
	3. Systematic review	107 (33.13)	73 (22.60)	143 (44.27)	0.001
	4. Odds ratio	110 (34.06)	95 (29.41)	118 (36.53)	0.282
	5. Meta-analysis	151 (46.75)	78 (24.15)	94 (29.10)	0.001
	6. Confidence interval	201 (62.23)	85 (26.32)	37 (11.46)	0.001
	7. Publication bias	144 (44.58)	82 (25.39)	97 (30.03)	0.001

P < 0.05 means significant difference

Barriers

The participants said that the biggest barrier to use EBP was a lack of time, 25.4%, lack of research abilities was rated as the second barrier by over 22.9% of the participants, and almost 18.0% identified the third significant barrier as not understanding statistical analysis, as shown in **Table 6**.

Table 6. The greatest barriers to the use of EBP

Items		Number (%)	p-value
Q27-1	1st barrier; Insufficient time	82 (25.39)	0.001
Q27-2	2nd barrier; Lack of research skills	74 (22.91)	0.001
Q27-3	3rd barrier; Lack of understand statistical analysis	58 (17.96)	0.001

P < 0.05 means significant difference

DISCUSSION

In comparison to the previous conducted studies in Saudi Arabia,10,14,19,20,24 this study investigated the 6-domain of the EBP, which makes it more comprehensive than those studies that studied specific domains without paying enough attention to other domains such as attention to literature and information availability. Therefore, the current study's findings can be relied upon more than others in making the necessary decisions to enhance EBP implementation.

Attitudes and beliefs

The current study physiotherapists are largely supportive of EBP. They believied the necessity of EBP, use of literature

in practice, and improvement of patient care. Which was consistent with the previous studies.[10,14,20,21] Furthermore, a recent study[24] was conducted on 118 physiotherapists of Eastern region of Saudi Arabia showed that 90% agreed that EBP is necessary. Another study concluded that 81-95% of the physiotherapists consider research is important in clinical practice, and 95% believed that reading pertinent publications was crucial for their profession, which were slightly higher than the current study (91.5% and 74.6% respectively). Additionally, they found that 81.4% of physiotherapists claimed that physiotherapy practice should be backed by evidence,[10] which was closely similar to the present finding (81.4%). These agreements could be return to consistency of the physiotherapy curriculums have adopted in different educatioanl institutions of Saudi Arabia.

The Colombian physiotherapists responded with low scores in comparison to the current findings, As 61.3% of physiotherapists thought that literature was helpful for practice and 71.6% felt that EBP is vital,[29] whereas the Brazilian physiotherapists reported similar results, 92.2% saw the EBP was essential for their profession. However, their score regarding that the EBP improves patient care was 89% which was higher than the present findings.[30] Furthermore, the use of research findings in practice was deemed beneficial by 78% of Canadian physiotherapists, which was slightly lower than the present study.[25] These differences could be attributed to the difference in education curriculums of these countries. As the EBP is shaped through efficient evidence-based teaching and learning practices.[15]

The current study showed that 70.9% of Saudi physiotherapists saw that applying EBP imposes unreasonable demand, in comparison to 61% of the American physiotherapists.[21] Moreover, 70.0 and 62.2% considered that EBP does not take into account the limitations of clinical practice setting or takes into account patient preferences. The physiotherapists of the Eastern region of Saudi Arabia, recorded better results which were 25%, 19%, and 18% respectively.[24] So, more focus is required to enhance the awareness and knowledge of EBP, where the work workplace setting is crucial for fostering a favorable attitude toward EBP.[20,31] Also, 75.2% of participants agreed that using EBP is essential when deciding how best to treat patients, that was consistent with Saudi physiotherapists of the Eastern region, 80%.[24] However, supporters of EBP typically assert that a clinician's decision regarding the most appropriate intervention includes taking into account the patient's preferences, conditions, and values.[32]

EBP interesting and motivation

Seventy-four percent of the participants need to increase the use evidence in daily practice which was less than the previous study, 84%.[21] In addition, a recent research showed that 88% of the Saudi physiotherapist were interested in incorporating EBP in patient care and thought that doing so would enhance patients' conditions,[24] compared to the present study which showed only 80%. A more recent study showed that the Egyptian physiotherapists agreed that treatment interventions need to be supported by evidence, 95.3%,[15] which was higher than the present result, that could be attributed to implementation of EBP course in their educational curriculum. So that, it was very important to include all regions of the Saudi Arabia in this study, where it will be possible to evaluate the EBP comprehensively, and compare its implementation with other countries, thus develop comprehensive reform policies.

Furthermore, 79.9% of the participants were interested to learn EBP skills which was lesser than the finding of the American study, 85%.[21] This comparison showed that Saudi physiotherapists were less motivated than American physiotherapists to use EBP in their regular practice and develop their abilities. This emphasizes the importance of creating motivation for Saudi physiotherapists that makes them more enthusiastic about EBP. Another study was conducted on 68 Saudi pediatric physiotherapists revealed that almost 78% were motivated to apply EBP in their everyday practice, and 82.3% had reported using the best available scientific evidence in clinical practice,[33] which were slightly higher than the present study, 74% and 79.9% respectively. Whereas, this study was conducted on pediatric physiotherapists without other specialities, and perhaps the small sample size had a positive effect on their responses.

Attention to literature

More than 41% of the participants read 2-5 clinical practice-related publications/month, 43.7% consult the literature 2-5 times/month when making clinical decisions, and 48% conduct one database search/month. These findings were greater than Jette et al.'s findings[21] who stated that 17% read less than two articles/month, and 25% used literature in clinical decision making less than twice a month. The relatively low level of attention to literature is supported by the physiotherapists in England and Australia who preferred peers to academic research when it came to learning about patient management.[34] However, 87.9% of Egyptian physiotherapists believed that it was necessary to update their knowledge by reading relevant articles, and 72.7% believed that practicing physiotherapy effectively requires a comprehension of research techniques.[15] The lack of time, difficulty in understanding the scientific writing and statistical data, and inability to access the scholarly literature are different reasons which could explain the low attention to literature.

Availability of information

Sixty-three percent of the participants considered patient preferences with practice guidelines, which was higher than Egyptian physiotherapists value, 44.9%.[15] However, the physiotherapists in the Eastern region of Saudi Arabia reported only 18%.[24] So, investigating all regions of Saudi Arabia was more reliable than one or two regions. Additionally, 83% stated that practical guidelines were

accessible, which was slightly higher than the previous study, 80%.[21] The American physiotherapists[21] having access to databases at home, 89% greater than at work, 65%. These values were greater than the current results which were 66.6% and 43.6%, respectively. This difference explored that the Saudi health institutions need to change their viewpoint in facilitating difficulties to activate EBP.

Besides, only 25.7% of participants believed that their work supports the use of EBP, which was much lesser than Jette et al.'s finding[21] which was 67%. So, decision-makers should take into account the institutional support to increase the adoption of EBP.[24] This concurs with Shousha et al.15 who reported that increasing resources such as open-access and peer-reviewed publications would assist in the implementation of EBP. Evaluating the availability of information that required to promote EBP and supporting of work places were of the domains that were missed in majority of studies conducted in Saudi Arabia.

Educational background and required skills

About 51% of the participants did not learn the foundations of EBP, which shows the necessity of developing the educational programs as the scientific principles of the EBP model were more easily understood by undergraduate students who had studied it.[35] Also, 60% had not received continuing education on EBP, that was higher than the Egyptian physiotherapists, 45.5%.[15] However, it was less than the findings of the study was conducted 7 years ago in Saudi Arabia, which reported that 70.2% of the universities did not provide the physiotherapy students with official EBP training,[10] which inversely affected the students' satisfaction level of clinical training.[36] So, EBP training is necessary to encourage decision-makers to embrace it more frequently in clinical practice.[37]

The present study showed that 58.8% had knowledge about using databases, and 60.4% had not engaged in educational course for EBP. In contrast, 88% of the Colombian physiotherapists received the basic knowledge about EBP.[29] Accordingly, the undergraduate physiotherapy curriculums need to incorporate the basics of EBP. As there are several chances to expand the scope of EBP and support the health requirements of the local communities, despite the fact that the student enrollment in physiotherapy programs in Saudi Arabia is progressively rising.[38]

Although 62.2% were confident in their ability to locate research, which was similar to American physiotherapists,[21] only 13.6% of the current participants received training in the critical evaluation of research literature, compared to 59% of American physiotherapists, and 55% felt competent to evaluate scholarly literature, which was greater than the current participants, 25.1%. This reflects that the teaching research skill are lacking in the Saudi educational institutions. Moreover, the decision-makers should take into account the development of research skills since these factors may aid to increase the adoption of EBP.[24]

Knowledge of research methodology concepts like relative risk, absolute risk, systematic review, odds ratio, meta-analysis, confidence interval, and publication bias was slightly low, ranging from 54.8% to 70.9%, except for the confidence interval, 88.6%. The Saudi physiotherapists understanding of "systematic reviews" completely was 64.9%,[10] which was higher than the present finding, 55.7%. Whereas these results were higher than Shousha et al.'s findings[15] who reported understanding of terms such as systematic review and randomized controlled trial were 40.2% and 42.3% respectively. This discrepancy can be explained by physiotherapists' inadequate knowledge of EBP[5,39] and their incapacity to evaluate quantitative research designs.[29]

EBP barriers

The recognition of the EBP barriers is essential and should be considered as the first step towards establishment of the problem preventing its implementation.[40] The first barrier of the current study was the insufficient time, 25.4%, it was consistent with most physiotherapy studies,[21,24,25,27,41–43] which may be attributed to that 57.3% the current participants need more than 75 minutes to provide patient care. The second barrier was lack of research skills 22.9%, which was similar to American physiotherapist,[21] where 20% lacked the search skills. The inability to understand statistical analysis was the third barrier, 18.0%, highlighting the importance of incorporating statistics course in the physiotherapy educational curriculums. The second and third barriers were consistent with the finding of The Saudi physiotherapists of Eastern region reported self-efficacy in identifying evidence in the literature and translating research findings into clinical practice were their second and third barrier which was consistent with the present findings.[24]

Da Silva et al.[44] reported that the three main barriers were a lack of time, a challenge understanding statistics, and a lack of support which was consistent with the current findings. However, the Colombian physiotherapists[29] found the deficiency in research skills was their primary barrier, while the Brazilian physiotherapists reported that the most common barrier was to accessing full-text publications.[30]

The paediatric physiotherapists in Saudi Arabia said that their biggest challenges were finding full-text articles and limited time, followed by insufficient management support, lack of enthusiasm for research, and inadequate EBP training,[33] which illustrates that the lack of time is a common between this study and the current research. However, another Saudi study.[10] found that the first barrier was the inadequate teaching during academic training, 43.1% followed by a lack of research abilities and knowledge, 36.4% which was higher than the present findings, which was against the previous reports.[21,25,27,41–43] From the foregoing, it was clear that the barriers to the implication of EBP differ from one region to another in Saudi Arabia, this was one of the motives for conducting this study, in which physiotherapists from all regions of Saudi Arabia participated.

Limitations

One of the strengths of this study was that the details of the participants' practice settings were available which make the results are generalizable to the intended population. However, this study was limited to the following; Firstly, the study included only physiotherapist of Ministry of Health without consideration of private sector due to difficulty in communicating and obtaining personal and professional data. Secondly, a convince sampling technique was adopted, as there was no way to access all physiotherapists in Saudi Arabia. However, the study was strengthened by calculation of the sample size determination. Thirdly, the response bias cannot be assessed because data about non-respondents were not available. In self-report surveys, the response bias can be seen in acquiescence, social desirability, negative affectivity, and extreme response styles.[45] However, when conducting sociological research, self-report surveys should be taken into account because they are the most reliable way to gauge people's attitudes, beliefs, and opinions,[46] which has a fundamental role during conduction of research that evaluates the educational programs.[47] Finally, the current study did not investigate the relationship between age, gender, years of experience, academic degree, geographic region, and physiotherapy EBP, so as not to increase the study size, which evaluated the 6-domain of the EBP, and none was excluded.

CONCLUSION

The Saudi physiotherapists are usually supportive of EBP and express interest in honing their abilities and using more research in clinical settings. However, the EBP places an unreasonable demand on physiotherapists, does not take into account the limitations of clinical practice setting or patient preferences. Their attention to literature was relatively low. So, they need support from their workplaces, training sessions for finding research, building knowledge for using databases and regulation of workloads to enhance the EBP implementation. The limited time was the primary barrier to implement the EBP, lack of research skills was the second barrier, and third barrier was the inability to understand statistical analysis.

Clinical Implications

- Workplaces supports such as access to relevant databases, training courses, and regulation of workloads will assist in implementation of EBP.
- For distinctive patient care, the physiotherapy educational curriculums should include intensive research methodology and statistics courses.
- Physiotherapists should be updated with the recent research findings, this requires increased organizational responsibility to alert them to the latest research evidence.
- It is imperative that the EBP's barriers be addressed as soon as possible.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Directorate of Health Affairs-Taif: Research and Studies Department Ethics Committee (Date: 26.01.2020, Decision No: KACST, KSA: HAP-02-T-067).

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

Acknowledgment: The author thanks all physiotherapists for their participation.

REFERENCES

1. Maher CG, Sherrington C, Elkins M, Herbert RD, Moseley AM. Challenges for evidence-based physical therapy: Accessing and interpreting high-quality evidence on therapy. Phys Ther. 2004;84(7):644-54.
2. Newhouse RP. Instruments to assess organizational readiness for evidence-based practice. J Nurs Adm. 2010;40:404–7.
3. Lee C, Hunsley J. Evidence-based practice: Separating science from pseudoscience. Can J Psychiatry. 2015;60:534-40.
4. Wilson A, Howitt S, Holloway A, Williams A, Higgins D. Factors affecting paramedicine students' learning about evidence-based practice: A phenomenographic study. BMC Med Educ. 2021;21:45.
5. AlKetbi H, Hegazy F, Alnaqbi A, Shousha T. Evidence-based practice by physiotherapists in UAE: Investigating behavior, attitudes, awareness, knowledge and barriers. PLoS One. 2021;16(6):e0253215.
6. Schmidt NA, Brown J. Evidenced-Based Practice for Nurses: Appraisal and Application of Research. 4th ed. Jones & Bartlett; 2017.
7. Gawlinski A. Evidence-based practice changes: Measuring the outcome. AACN Adv Crit Care. 2007;18(3):320-2.
8. Alqahtani N, Oh KM, Kitsantas P, Rodan M. Nurses' evidence-based practice knowledge, attitudes and implementation: A cross-sectional study. J Clin Nurs. 2020;29(1-2):274–83.
9. Alkhatib AH, Ibrahim EA, Ameenuddin M, Ibrahim IA. Nurses' knowledge, perception, and attitude towards Evidence-Based Practice at King Abdullah Medical City-Saudi Arabia. Am J Nurs Res. 2021;9(1):1-7.
10. Alshehri MA, Ahmed Alalawi A, Alhasan H, Stokes E. Physiotherapists' behaviour, attitudes, awareness, knowledge and barriers in relation to evidence-based practice implementation in Saudi Arabia: a cross-sectional study. Int J Evid Based Healthc. 2017:127-41.
11. McEvoy M, Luker J, Fryer C, Lewis L. Changes in physiotherapists' perceptions of evidence-based practice after a year in the workforce: A mixed-methods study. PLoS One. 2020;15:e0244190.
12. Grimmer-Somers K, Lekkas P, Nyland L, Young A, Kumar S. Perspectives on research evidence and clinical practice: A survey of Australian physiotherapists. Physiother Res Int. 2007;12:147-61.
13. Bindawas S. Physical therapy entry-level education and post-professional training in Saudi Arabia: a comparison of perceptions of physical therapists from five regions. J Phys Ther Sci. 2014;26:1377–82.
14. Amin T, Kaliyadan F, Al Qattan E, Majed M, Al Khanjaf H, Mirza M. Knowledge, attitudes and barriers related to participation of medical students in research in three Arab Universities. Educ Med J. 2012;4:43–56.

15. Shousha T, Javed A, Bekhet A, et al. Investigating behavior, attitudes, knowledge, awareness and barriers to the implementation of evidence-based practice by physiotherapists in Egypt: A cross sectional study. Heliyon. 2023;9(12):e22951.
16. Bury T. Evidence based practice: an overview. WCPT Keynotes. 2003:1-3.
17. Perraton L, Machotka Z, Grimmer K, Gibbs C, Mahar C, Kennedy K. Embedding evidence-based practice education into a post-graduate physiotherapy program: eight years of pre-post course evaluations. Physiother Res Int. 2017;22(2).
18. AlMutair A. Quality of nursing care in Saudi Arabia: needs for improvement. J Nurs Care. 2015;4(6):309.
19. Alqahtani M, Kashoo F, Ahmad F. Current scenario of evidence-based practice and rationale of preferred approach in stroke rehabilitation among physiotherapists in Saudi Arabia: A cross-sectional survey. Saudi J Heal Sci. 2018;7(1):53-64.
20. Hasani F, MacDermid JC, Tang A, Kho M, Alghadir AH, Anwer S. Knowledge, attitude and implementation of evidence-based practice among physiotherapists working in the Kingdom of Saudi Arabia: A cross-sectional survey. Healthc. 2020;8:354.
21. Jette DU, Bacon K, Batty C et al. Evidence-based practice: beliefs, attitudes, knowledge, and behaviors of physical therapists. Phys Ther. 2003;(83):786–805.
22. Bernhardsson S, Larsson MEH. Measuring evidence-based practice in physical therapy: Translation, adaptation, further development, validation, and reliability test of a questionnaire. Phys Ther. 2013;93(6):819-32.
23. Ministry of Health. Health statistical year book, Saudi Arabia. https://www.moh.gov.sa/en/Ministry/Statistics/book/Documents/Statistical-Yearbook-2022.pdf. Published 2022.
24. Alsaadi S. Beliefs, attitudes, and behaviors of Saudi physiotherapists toward evidence-based practice: A multicenter, cross-sectional study. Saudi J Med Med Sci. 2022;10(3):227-35.
25. Salbach NM, Jaglal SB, Korner-Bitensky N, Rappolt S, Davis D. Practitioner and organizational barriers to evidence-based practice of physical therapists for people with stroke. Phys Ther. 2007;87:1284–303.
26. Akinbo S, Odebiyi D, Okunola T AO. Evidence-based practice: knowledge, attitudes and beliefs of physical therapists in Nigeria. Int J Med Inf. 2009;4:169 –72.
27. Iles R, Davidson M. Evidence based practice: a survey of physiotherapists' current practice. Physiother Res Int. 2006;11:93–103.
28. Nilsagrd Y, Lohse G. Evidence-based physiotherapy: A survey of knowledge, behaviour, attitudes and prerequisites. Adv Physiother. 2010;12:179–86.
29. Ramírez-Vélez R, Correa-Bautista JE, Muñoz-Rodríguez DI, et al. Evidence-based practice: beliefs, attitudes, knowledge, and skills among Colombian physical therapists. Colomb Med. 2015;46(1):33–40.
30. Silva TM, Costa L, Costa LO. Evidence-Based Practice: a survey regarding behavior, knowledge, skills, resources, opinions and perceived barriers of Brazilian physical therapists from Sa˜o Paulo state. Braz J Phys Ther. 2015;19(4):294–303.
31. Castellini G, Corbetta D, Cecchetto S, Gianola S. Twenty-five years after the introduction of Evidence-based Medicine: knowledge, use, attitudes and barriers among physiotherapists in Italy - a cross-sectional study. BMJ Open. 2020;10(6):e037133-e.
32. Guyatt GH, Haynes RB, Jaeschke RZ, et al. Users' guides to the medical literature: XXV. Evidence-based medicine: Principles for applying the users' guides to patient care. J Am Med Assoc. 2000;284:1290–6.
33. Alghadier M, Elnaggar RK, Alasraj MI, Khan N, Almeiman A, Albesher R. Evidence-Based Physiotherapy Practice in Paediatric Subdiscipline: A Cross-Sectional Study in Saudi Arabia. Healthc. 2022;10(11):1-14.
34. Turner P, Whitfield TW. Physiotherapists' use of evidence based practice: a cross-national study. Physiother Res Int. 1997;2:17–29.
35. Manspeaker SA, Lunen BL Van, Turocy PS, Pribesh S, Hankemeier D. Student knowledge, attitudes, and use of evidence-based concepts following an educational intervention. Athl Train Educ J. 2011;6(2):88–98.
36. Alghamdi AN, Alzahrani SS, Abdel-aziem AA. Students learning and teaching satisfaction. J Contemp Med. 2017;7(1):23-35.
37. Stander J, Grimmer K, Brink Y. Training programmes to improve evidence uptake and utilisation by physiotherapists: a systematic scoping review. BMC Med Educ. 2018;18(1):14.
38. Alghadir A, Zafar H, Iqbal ZA, Anwer S. Physical therapy education in Saudi Arabia. J Phys Ther Sci. 2015;27(5):1621-3.
39. Scurlock-Evans L, Upton P, Upton D. Evidence-based practice in physiotherapy: a systematic review of barriers, enablers and interventions. Physiotherapy. 2014;100(3):208–19.
40. McKenna HP, Ashton S, Keeney S. Barriers to evidencebased practice in primary care. J Adv Nurs. 2004;45:178–89.
41. Ely JW, Osheroff JA, Ebell MH, et al. Obstacles to answering doctors' questions about patient care with evidence: Qualitative study. Br Med J. 2002;324:710–3.
42. Retsas A. Barriers to using research evidence in nursing practice. J Adv Nurs. 2000;21:599–606.
43. Heiwe S, Kajermo KN T-LR, Guidetti S, Samuelsson M, Andersson I, Wengström Y. Evidence-based practice: attitudes, knowledge and behaviour among allied health care professionals. Int J Qual Heal Care. 2011;23(2):198-209.
44. Mota da Silva T, da Cunha Menezes Costa L, Garcia AN, Costa LOP. What do physical therapists think about evidence-based practice? A systematic review. Man Ther. 2015;20(3):388-401.
45. Lanyon R, Goodstein L. Personality Assessment. 3rd editio. New York: Wiley; 1997.
46. Korb K. Self-report questionnaires: can they collect accurate information? J Educ Found. 2011;1:5–12.
47. Gonyea R. Self-reported data in institutional research: Review and recommendations. New Dir Inst Res. 2005;127:73-89.

JOURNAL OF
CONTEMPORARY MEDICINE

DOI:10.16899/jcm.1466346
J Contemp Med 2024;14(3):152-157

Original Article / Orijinal Araştırma

The Evaluation of Burn Knowledge and Burn Management Skills of Resident Doctors of Emergency Medicine, General Surgery and Plastic Surgery

Acil Tıp, Genel Cerrahi ve Plastik Cerrahi Asistanlarının Yanık Bilgisi ve Yönetim Becerisinin Değerlendirilmesi

Zafer DOLU[1], Ömer JARADAT[1], Yavuz KATIRCI[2], Hacı Mehmet ÇALIŞKAN[3], Burak ŞAHİN[1], Ahmet Burak ERDEM[4]

[1]Kirsehir Training and Research Hospital, Clinic of Emergency Medicine, Kirsehir, Turkey
[2]University of Health Sciences Turkey, Gulhane Training and Research Hospital, Clinic of Emergency Medicine, Ankara, Turkey
[3]Kirsehir Ahi Evran University, School of Medicine, Department of Emergency Medicine, Kirsehir, Turkey
[4] University of Health Sciences Turkey, Ankara Etlik City Hospital, Clinic of Emergency Medicine, Ankara, Turkey

Abstract

Aim: Our study aimed to assess the abilities of emergency medicine, general surgery, and plastic surgery resident doctors in diagnosing, treating, and managing burn patients.

Material and Method: We conducted a survey study between 04.05.2015 and 04.08.2015 at university hospitals and training and research hospitals in Ankara. We collected information on the age, gender, experience, and hospital of the doctors, as well as their training and approaches to treating burn cases. We evaluated their knowledge in various areas, including clinical approaches to 2nd and 3rd-degree burn cases, escharotomy localizations, intubation indications, bulla treatment, referral and hospitalization indications, identification of inhalation burns, and fluid resuscitation.

Results: The average age of the participants was 29.3±2.4 years, and 65.7% were male. We found that doctors who had received advanced burn life support training had better approaches to burn cases. We also observed a positive correlation between age and approaches to cases, escharotomy localizations, and referral indications. Additionally, there was a positive correlation between the duration of residency and approaches to burn cases, clinical application to 2nd and 3rd-degree burn cases, escharotomy localization, intubation indications, indications of bulla treatment, referring indications, hospitalization indications, and approaches to inhalation burn.

Conclusion: Our study revealed that doctors' knowledge about assisting burn patients was insufficient in the early stages of their training. However, this improved as the duration of their residency increased. We believe that burn training and advanced life support courses can facilitate the diagnosis and treatment of burn patients more effectively.

Keywords: Burn, medical training, emergency medicine, general surgery, plastic surgery

Öz

Amaç: Biz bu çalışmada Ankara'daki acil tıp, genel cerrahi ve plastik cerrahi kliniklerindeki asistan doktorların, anket soruları ile yanık bilgilerini ve yönetim becerilerini değerlendirmeyi amaçladık.

Gereç ve Yöntem: Bu çalışma 04.05.2015- 04.08.2015 tarihleri arasında Ankara'daki üniversite ve eğitim ve araştırma hastanelerinde anket çalışması olarak yapıldı. Hekimlerin yaş, cinsiyet, hekimlik süresi, asistanlık süresi, çalıştıkları hastane, aldıkları eğitimler ve vakalara yaklaşımları belirlendi. Hekimlerin 2. ve 3. derece yanık vakalarındaki klinik uygulamalar, eskaratomi alanı, entübasyon endikasyonu, büllere müdahale, sevk ve yatış endikasyonları, inhalasyon yanığını tanıma, yanıkta sıvı resusitasyonu konusundaki bilgileri değerlendirildi.

Bulgular: Katılımcıların yaş ortalaması 29.3±2.4 yıl ve %65.7'si erkekti. İleri Yanık Yaşam Desteği eğitimi alan hekimlerin vakalara yaklaşım ve klinik bilgilerinin daha iyi olduğu saptandı. Yaş ile vakalara yaklaşım, eskaratomi lokalizasyonu ve sevk endikasyonu bilgisi arasında pozitif yönlü korelasyon saptandı. Asistanlık süresiyle; yanık vakalarına yaklaşım, 2. ve 3. derece yanık vakalarında klinik uygulama, eskarotomi lokalizasyonu, entübasyon endikasyonları, bül tedavi endikasyonları, sevk endikasyonları, yatış endikasyonları ve inhalasyon yanıklarına yaklaşım arasında pozitif yönlü korelasyon saptandı.

Sonuç: Çalışmamız hekimlerin yanık müdahalesi konusunda bilgilerinin yeterli olmadığını göstermiştir. Verilecek yanık eğitimleri ve ileri yanık desteği kursları ile yanık hastalarında tanı ve tedavi süreci daha başarılı bir şekilde gerçekleştirilecektir.

Anahtar Kelimeler: Yanık, tıp eğitimi, acil tıp, genel cerrahi, plastik cerrahi

Corresponding *(İletişim)*: Ömer Jaradat, Kırşehir Training and Research Hospital, Department of Emergency Medicine, Kırşehir, Turkiye
E-mail *(E-posta)*: dromerjaradat@gmail.com
Received *(Geliş Tarihi)*: 17.04.2024 **Accepted *(Kabul Tarihi)*:** 29.05.2024

INTRODUCTION

Burn is described as a kind of physical injury resulting from tissue contact with materials with higher or lower temperatures than the tissue's own temperature, such as burning chemicals, electrical current, and radioactive beams. Burns are commonly observed traumas in developed and developing countries.[1,2] According to the parameters of the World Health Organization (WHO), every year around the world, 2.5 million people are affected by burns, and 300.000 people die of reasons based on the burn and associated with burns.[3]

Almost half of the burn cases are pediatric patients.[4] The most common causes of burns include scalding, flame, electrical, and chemical burns, respectively. These burns usually affect the upper and lower extremities, with second-degree burns being the most common. About half of all burn cases can be treated with dressings, while others may require surgery. Unfortunately, burns have a mortality rate of around 6-7%, with sepsis and inhalation burns being the most common causes of death.[5] It is essential to avoid unconscious interventions by families, such as applying yogurt or toothpaste, as these can significantly increase the risk of mortality and morbidity.[5,6]

Medical contact with patients with burns starts in the emergency department (ED). Most patients can be treated by doctors in primary and secondary care hospitals' EDs. The age of the patients, the width and the depth of the burn, the reason for the burn, and the intervention in the first few hours affect the prognosis of the burn at a large scale.[5,7] ED doctors must know the surface of the burn area, referring criteria, airway control, intubation indications, fluid resuscitation, and emergency interventions for the burn. They must apply their knowledge to the patients in the best way.

In our country, in some hospitals, patients with burns are primarily given medical interventions by ED doctors, and then the treatment is continued by general surgery and plastic surgery doctors. In some other hospitals, the treatment is carried out by the clinic doctor (general surgeon/plastic surgeon), who has continued the treatment since the first intervention with the patient. The knowledge and competence of the medical staff to intervene in the burn significantly affects the mortality and morbidity of the patients.[1,6,7]

In this study, we used a survey to evaluate the burn knowledge and burn management skills of emergency medicine, general surgery, and plastic surgery residents who had trained in Ankara.

MATERIAL AND METHOD

This prospective study was performed in Ankara Training and Research Hospital on 29.04.2015, dated 4886, numbered ethics committee approval of Ankara Training and Research Hospital. The study was conducted according to the last version of the "Helsinki Declaration" and "Good Clinical Practice Instruction." The study was carried out by the emergency medicine, general surgery, and plastic surgery residents of Ankara Training and Research Hospital, Ankara Training and Research Hospital, Keçiören Training and Research Hospital, Atatürk Training and Research Hospital, Dışkapı Training and Research Hospital, Gazi University School of Medicine, Hacettepe University School of Medicine, and Ankara University School of Medicine between the dates 04.05.2015 – 04.08.2015.

Other residents, besides those in emergency medicine, general surgery, and plastic surgery, were excluded from the study. Only the volunteer residents were included because the study was based on voluntariness. A total of 166 residents participated in the study. Of these, 90 were emergency medicine residents, 41 were general surgery residents, and 35 were plastic surgery residents. The residents were given a survey that had three parts. The first part of the survey included a demographic area that questions age, gender, the duration of their professional life as a doctor and as a resident, the hospital where they work, and the residency training they had; the second part included 2 cases in order to assess the doctors' case evaluation; the third part includes 10 test questions to evaluate the knowledge level of the doctors. The questions in the third part were associated with their clinical practice of 2nd and 3rd-degree burn cases, emergency interventions for 2nd and 3rd-degree burns, escharotomy field, intubation indications, interventions to bullas, referring criteria, hospitalization indications, recognition of inhalation burn, given fluid and the follow-up of the given fluid.

The case questions were evaluated by eight specialists (4 emergency medicine specialists, three general surgery specialists, and one plastic and reconstructive surgery specialist) concerned about burns and working at three training and research hospitals with burn centers and burn units. The accurate calculations of the burn percent in the cases were determined by the agreement of those specialists. For total body surface (TBS), average value and standard deviation (SD) were calculated. The average predicted percent was calculated by experts as %28.37±2.55 and %14.87±1.72 for the first and second cases, respectively. In order to gain the correct percent, three values below and above in the SD were considered. Therefore, acceptable values were 21-36% for the 1st and 10-20% for the second cases. Calculations on evaluating essential fluid needs in the cases were performed with the doctors' estimated percent. The fluid need was based on the Parkland formula.[8]

The parameters were analyzed by SPSS for Windows version 23.0. SD was used to express the average descriptive statistics of continuous variables; numbers and percentages were used to express categorical variables. The distributions of the variables were assessed with the Kolmogorov-

Simirnov test. Mann Whitney U and Kruskal Wallis tests were utilized in the analyses of numerical non- parametric parameters. The chi-square test was used in the analysis of categorical parameters. The Spearman Correlation test was used to evaluate the association of permanent parameters. $p < 0.05$ was accepted to be statistically significant.

RESULTS

Our study involved 166 doctors aged 25-37 years, with an average age of 29.3±2.4 years. Of the total number of doctors included in the study, 106 (65.7%) were male, while 57 (34.3%) were female. On average, the doctors had been practicing medicine for 48.3±25.9 months, with a range of 10-144 months, and had completed their residency programs for an average of 29.3±15.2 months, with a range of 7-66 months. Out of the participating doctors, 90 (54.2%) were emergency medicine residents, 41 (24.7%) were general surgery residents, and 35 (21.1%) were plastic surgery residents. Sixty percent (100) of the doctors worked at training and research hospitals, while the rest (39.8%) worked at university hospitals. Moreover, 14.5% (24) of the doctors had received ABLS (Advanced Burn Life Support) or burn management training. In comparison, 50.6% (84) had taken ACLS / ATLS / APLS (Advanced Cardiac/Trauma/ Pediatric Life Support) or any other life support course (**Table 1**).

Table 2 compares the average values of the doctors' correct answer percentages to the questions that evaluate their burn management skills with regard to their branches and the type of hospital they work in. Correct answer percentages for burn management skills were similar in every three branches (**Table 2**). Calculating the fluid need concerning burn area and knowledge levels in diagnosing inhalation burn was better in training and research hospitals than in university hospitals. The comparison of training and research hospitals and university hospitals regarding other criteria was similar.

Regarding the level of competence in burn management knowledge concerning the residents' training, it was seen that the ones who had ABLS training had better levels of knowledge at all steps (**Table 3**). When examining the presence or absence of ACLS/ATLS/APLS training, the doctors who received those training appeared to perform primary interventions more effectively upon initial assessment, calculating the essential fluid need and its follow-up, specific intubation indications, intervention to bullas, and indications of hospitalizations. However, the doctors were trained to perform similarly in calculating burn percentages, escharotomy, referring indication, and identifying inhalation burns (**Table 3**).

Table 4 shows the correlation between a doctor's age and duration of professional life as a doctor and a resident and his/her correct response percentages at burn management steps. There was a positive, meaningful correlation between the duration of residency and other burn management skills, apart from primary must interventions at first impression. However, this correlation was identified as weak (**Table 4**).

Table 1. Demographic data

	Mean±SD / n(%)
Age (year)	29.3±2.4
Gender	
Male	109 (65.7)
Female	57 (34.3)
Duration of work as a doctor (months)	48.3±25.9
Duration of work as a resident doctor(months)	29.3±15.2
Proficiency	
Emergency medicine	90 (54.2)
General surgery	41 (24.7)
Plastic and reconstructive surgery	35 (21.1)
Hospital type	
Training and Research Hospital	100 (60.2)
University Hospital	66 (39.8)
Attended Education	
ABLS	24 (14.5)
ACLS/ATLS/APLS	84 (50.6)

* SD: Standard deviation

Table 2. The knowledge of burn management according to proficiency and hospital type

	Total	Proficiency of the doctor				Hospital type		
		Emergency medicine	General surgery	Plastic and reconstructive surgery	p	Training and Research Hospital	University Hospital	p
Things to do at the first look	70.8	69.0	71.5	74.5	0.543	71.96	69.00	0.383
Calculation of total burn area	48.2	43.3	51.2	57.1	0.346	67.5	32.5	0.965
Calculation of the need of fluid	48.8	47.8	46.3	54.3	0.756	72.8	27.2	0.001
IV fluid selection	66.3	58.9	73.2	77.1	0.086	62.7	37.3	0.359
IV fluid follow up	79.5	82.2	75.6	77.1	0.634	62.1	37.9	0.329
Escharatomy	44.7	42.2	45.7	50.0	0.576	45.75	43.18	0.653
Intubation indication	76.7	75.9	76.3	79.5	0.659	77.80	75.15	0.361
Management of bullas	76.8	75.9	76.7	79.5	0.658	77.80	75.41	0.367
Referring indication	70.6	67.3	73.1	76.2	0.061	72.05	68.39	0.524
Hospitalization indication	58.7	58.7	56.6	61.1	0.733	61.20	54.85	0.150
Diagnosis of inhalation burn	72.8	71.3	73.9	75.5	0.462	75.71	68.39	0.022

Table 3. The knowledge of management of burn according to taking the ABLS, ACLS, ATLS and APLS training programs

	ABLS training program			ACLS/ATLS/APLS training programs		
	No	Yes	p	No	Yes	p
Things to do at the first look	67.7	88.8	<0.001	65.98	75.48	0.015
Calculation of total burn area	41.5	87.5	<0.001	42.7	53.6	0.160
Calculation of the need of fluid	40.8	95.8	<0.001	34.1	63.1	<0.001
IV fluid selection	62.7	87.5	0.017	62.2	70.2	0.273
IV fluid follow up	76.8	95.8	0.032	70.7	88.1	0.006
Escharatomy	37.5	87.5	<0.001	39.02	50.30	0.065
Intubation indication	75.0	87.0	<0.001	73.41	80.00	0.022
Management of bullas	75.1	87.0	<0.001	73.62	80.00	0.023
Referring indication	67.5	88.7	<0.001	68.89	72.26	0.161
Hospitalization indication	53.8	87.5	<0.001	51.95	65.24	0.005
Diagnosis of inhalation burn	69.9	89.9	<0.001	70.10	75.44	0.191

Table 4. The correlation of burn management knowledge with the age, duration of duration of professional life as a doctor and as a resident

	Age		Duration of professional life as a resident		Duration of professional life as a doctor	
	r	p	r	p	r	p
Things to do at the first look	-0.032	0.687	0.087	0.263	-0.196	0.011
Escharatomy	0.273	<0.001	0.202	0.009	0.110	0.159
Intubation indication	0.026	0.735	0.200	0.010	-0.012	0.875
Management of bullas	0.025	0.748	0.201	0.009	-0.013	0.866
Referring indication	0.192	0.013	0.271	<0.001	0.098	0.211
Hospitalization indication	0.192	0.064	0.222	0.004	0.087	0.265
Diagnosis of inhalation burn	0.192	0.359	0.203	0.009	0.031	0.689

DISCUSSION

Burn cases are a group of diseases that can affect people of any age, but 50% of cases are observed in childhood and can lead to severe morbidity and mortality. A recent study found that emergency medicine residents, as well as general surgery and plastic surgery residents, who are often the first medical professionals to encounter burn patients, may have insufficient knowledge in the early stages of their residency. However, their level of knowledge increases with the duration of their residency training. The study also revealed that ABLS training provides crucial information about the appropriate intervention for burn patients, while ACLS/ATLS/APLS training covers some related topics.

According to numerous studies, proper fluid therapy, escharotomy, intubation, and other interventions significantly reduce burn mortality rates.[9] However, incompetency of the staff in burn management skills was reported in some earlier studies.[10,11] In their study, Baartmas et al. evaluated TBS and fluid need in children; exaggerations in TBS were observed; for that reason, the given fluid amount was identified to be miscalculated in 71.4% of the patients.[12] In their study, Breederveld et al. indicated that the patients' TBS was miscalculated, and, therefore, the fluid was given inaccurately, which meant that patient management was incompletely performed (10). Smith et al. indicated that TBS was miscalculated at a severe rate, such as 50%.[11] Freiburg et al. reported that burns smaller than 20 % were expressed as 4.3 % of a more significant rate; burns larger than 20% were stated as 4.9% of a more significant rate.[13] Another study showed that only one-fourth of the doctors calculated the appropriate TBS amount and got started with the appropriate fluid amount Similar to earlier studies, our study also detected TBS miscalculations at a rate of 51.8 % and fluid need miscalculations at a rate of 51.2%.

When the extremity circulation of burn patients is imperiled, an escharotomy is done to the extremity. If the eschar resulting from the burns around the neck and chest restricts breathing mechanically, an escharotomy is done. Escharotomy areas are the anterior axil line, bottom elevation line on the chest wall anterior or second and third elevation level, and medial and lateral longitudinal lines of extremities

In our study, doctors' knowledge of the necessity of escharotomy and localization was 44.7%. No similar study that displays the knowledge level of escharotomy could be found.

In severe inhalation burns, findings that develop the necessity of intubation are severe and continuous cough, respiratory tract obstructions, and deep or full-thickness burns around the neck. Severe burns in the mouth and nose can cause swelling in the oropharynx, mental impairment, clouded consciousness (often from drug and alcohol abuse), difficulty breathing, hypoxia, and hypercapnia.[15] In our study, the proper response level to specific intubation indications was an average of 76%. After an extensive search, no studies were found that have examined doctors' knowledge of intubation indications in burn cases.

In the treatment of bullas, a consensus could not be provided. Some researchers argue that bullas should not be removed. Some others argue that bulla should be removed from their skin. Also, some argue that the fluid in the bullas should be aspired and the skin should be kept with medical dressing. A generally accepted rule is that if bullas are smaller than 6-8 cm and have not been ruptured, they should not be touched. The inside of the bigger ones can be emptied or cleaned after being ruptured. The bullas in the palm and the plantar are not generally ruptured.[16-18] The average knowledge level of the doctors included in the study about bulla treatment was 76.8%.

Clinical conditions of burn patients sometimes necessitate hospitalization and intensive unit care. Intensive unit care departments exist in very few centers, especially for burn patients. Patients who need to be hospitalized in intensive unit care are more frequently referred to those centers. However, patients with mild symptoms and patients who should be followed in the clinic may also need to be referred to those burn centers. The average level of physician knowledge of correct referral indications was 70.6% in our study. Baartmas et al. expressed that 86.3-89.2% of the referring criteria of the children are met.[12] Carter et al. reported an 88% accuracy in adult referring criteria.[19]

To the best of our knowledge, no study comparing resident doctors' knowledge about burns at tertiary healthcare services (between training and research hospitals and university hospitals) has been identified in the literature. In our study, doctors' burn management skills and knowledge levels do not show differences based on their branches. However, their knowledge level about calculating the essential fluid needed and diagnosing inhalation burns was higher in teaching and research hospitals.

Fathuldeen AA et al. assessed the knowledge of burn first aid among healthcare workers (specialists, consultants, and residents) and found that education level, specialty, professional experience, and participation in burn management courses did not significantly affect the burn management skills of physicians.[20] Also, Breederveld et al. stated that staff training about burns was better in some areas of case management. However, when all the categories were evaluated, there was no difference between the ones who had training and those who did not.[10] The training was reported to decrease the period of fluid treatment, referring criteria, and period of acceptance to a burn center.[21-23] Rogers et al. stated that staff that had ABLS training had a more practical approach toward burn patients.[24] In our study, the doctors with ABLS training had a better approach to the cases, better burn management skills, and higher levels of knowledge at every step. The fundamentals of critical care are conveyed during ABLS training. For that reason, having the training is identified to create an apparent difference. Van Olden et al., in their two studies, stated that ATLS training would positively affect the burn patients' survival rate.[25,26] Rogers et al. expressed that courses such as ABLS and ATLS had similar results.[24] Smith et al. stated that doctors who had training in ACLS and essential life support had a better approach to patients with severe conditions.[27] In his study, Ramakrishnan emphasized that doctors practicing on pediatric burn patients should get APLS training.[28] In our study, doctors who had training in ACLS/ATLS/APLS or any life support course were seen to have more competency at doing the necessary intervention at first impression, calculating the essential fluid need and its follow-up, specific intubation indications, interventions to bullas and hospitalization indications. However, despite their training, doctors showed similar results in calculating burn percent, escharotomy, referring indication, and inhalation. ACLS/ATLS/APLS training provided competency in common training subjects associated with some steps of burn management, but they had deficiencies only particular to burn management.

Doctors who had ABLS training displayed significantly different levels of knowledge at all steps, showing the benefits of special training in burns. This finding agrees with Lam NN et al.'s statement that physicians who had previously attended training courses had significantly higher knowledge levels than others.[29]

In our study, there were positively significant correlations between other burn management skills except for the duration of residency and interventions done at a first impression. However, those correlations were weak. Despite Fathuldeen AA et al. and Lam NN et al. state that working experience did not significantly affect knowledge level, in our study, there is a relationship between prolonging the residency period and having higher competency in burn management.[20,29] That is because residents can practice what they have learned in primary burn education by treating, following up, and managing patients.

CONCLUSION

Based on the data obtained from the study, it was found that the residents needed to be adequately trained to handle burn patients in the initial stages of their practice. However, their level of expertise increased as they gained more experience. Moreover, it was observed that ABLS Training makes an apparent difference in burn management. Doctors working at healthcare centers where burn admissions are frequent should undergo ABLS training, which contributes significantly to decreased mortality and morbidity in burn patients. Furthermore, obtaining ACLS/ATLS/APLS training can benefit residents when dealing with burn patients. Hence, we suggest that it would be advantageous to complete the training earlier to enhance the knowledge base concerning burns. Additionally, diagnosis and therapy in patients with burns will be achieved more successfully, owing to burn training and advanced life support courses, which will be provided.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Ankara Training and Research Hospital Ethics Committee (Date: 29.04.2015, Decision No: 4886).

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

REFERENCES

1. Church D, Elsayed S, Reid O, Winston B, Lindsay R. Burn wound infections. Clin Microbiol Rev 2006;19(2):403-34.
2. Jeschke M, Williams FN, Gauglitz GG and Hemdon DN. Burns. In: Townsend Jr, Beauchamp D, Evers BM, Mattox KL, editors. Sabiston Text Book of Surgery: The Biological Basis of Modern Surgical Practice. Philadelphia: Saunders Elsevier; 2012. p. 521-47.
3. Latha B, Babu M. The involvement of free radicals in burn injury: a review. Burns 2001;27(4):309-17.
4. Doğan F, Çoruh A, Kemaloğlu AC, Günay GK. Çocuk hastalarda yanık travması ve koruyucu önlemler. Erciyes Tıp Derg 2011; 33(1):35-8.
5. Coban YK, Erkilic A, Analay H. Our 18-month experience at a new burn center in Gaziantep, Turkey. Ulus Travma Acil Cerrahi Derg 2010;16(4):353-6.
6. Engin C, Çakar KS. An epidemiyologic evaluation of outpatient burn cases. Ulusal Travma Derg 1996;2(2):208-11.
7. Sarı O, Onar T, Aydoğan Ü. Wound and burn management in primary care. Smyrna Tıp Derg 2011;1:53-8.
8. Baker RH, Akhavani MA, Jallali N. Resuscitation of thermal injuries in the United Kingdom and Ireland. J Plast Reconstr Aesthet Surg 2007;60(6):682-5.
9. Klein MB, Hayden D, Elson C, et al. The association between fluid administration and outcome following major burn: a multicenter study. Ann Surg 2007;245(4):622-8.
10. Breederveld RS, Nieuwenhuis MK, Tuinebreijer WE, Aardenburg B. Effect of training in the Emergency Management of Severe Burns on the knowledge and performance of emergency care workers as measured by an online simulated burn incident. Burns 2011;37(2):281-7.
11. Smith JJ, Malyon AD, Scerri GV, Burge TS. A comparison of serial halving and the rule of nines as a pre-hospital assessment tool in burns. Br J Plast Surg 2005;58(7):957-67.
12. Baartmans MG, van Baar ME, Boxma H, Dokter J, Tibboel D, Nieuwenhuis MK. Accuracy of burn size assessment prior to arrival in Dutch burn centres and its consequences in children: a nationwide evaluation. Injury 2012;43(9):1451-6.
13. Freiburg C, Igneri P, Sartorelli K, Rogers F. Effects of differences in percent total body surface area estimation on fluid resuscitation of transferred burn patients. J Burn Care Res 2007;28(1):42-8.
14. Lavrentieva A, Kontakiotis T, Lazaridis L, et al. Inflammatory markers in patients with severe burn injury. What is the best indicator of sepsis? Burns 2007;33(2):189-94.
15. DeKoning EP. Thermal Burns. In: Tintinalli JE, Stapczynski J, Ma O, Yealy DM, Meckler GD, Cline DM, editors. Tintinalli's Emergency Medicine: A Comprehensive Study Guide. New York: McGraw-Hill Education; 2016. p. 1398-405.
16. Tompkins D, Rossi LA; Nursing Committee of the International Society for Burn, Care of out patient burns. Burns 2004;30(8):A7-9.
17. Herndon DN. Total Burn Care. 2nd ed. London: WB Saunders; 2002.
18. Mertens DM, Jenkins ME, Warden GD. Outpatient burn management. Nurs Clin North Am 1997;32(2):343-64.
19. Carter JE, Neff LP, Holmes JH 4th. Adherence to burn center referral criteria: are patients appropriately being referred? J Burn Care Res 2010;31(1):26-30.
20. Fathuldeen AA, Alduheim MA, Alqahtani AS, et al. Knowledge and Practice of Burn Management Among Physicians Using Burn Manikin in Ha'il, Kingdom of Saudi Arabia. Cureus 2023;15(3):e36196.
21. Saffle JR, Davis B, Williams P. Recent outcomes in the treatment of burn injury in the United States: a report from the American Burn Association Patient Registry. J Burn Care Rehabil 1995;16(3 Pt 1): 219–89.
22. Parks J, Foster T, Hickerson W. Burn care in emergency departments: A 3-year review. J Burn Care Res 2008; 29(Suppl 2):155.
23. Bjur AJ, Blayney C, Zierler B, Whitney JD, Gibran NS. Prehospital burn resuscitation. J Burn Care Res 2009; 30(Suppl 2): 89.
24. Rogers AD, Allorto NL, Wallis LA, Rode H. The Emergency Management of Severe Burns course in South Africa. S Afr J Surg 2013;51(1):38.
25. van Olden GD, Meeuwis JD, Bolhuis HW, Boxma H, Goris RJ. Clinical impact of advanced trauma life support. Am J Emerg Med. 2004;22(7):522-5.
26. van Olden GD, Meeuwis JD, Bolhuis HW, Boxma H, Goris RJ. Advanced trauma life support study: quality of diagnostic and therapeutic procedures. J Trauma 2004;57(2):381-4.
27. Smith KK, Gilcreast D, Pierce K. Evaluation of staff's retention of ACLS and BLS skills. Resuscitation 2008;78(1):59-65.
28. Ramakrishnan KM. Advanced pediatric life support in burn injuries. Indian J Burns 2013;21(1):8.
29. Lam NN, Huong HTX, Tuan CA. Knowledge on emergency management for burn and mass burn injuries amongst physicians working in emergency and trauma departments. Ann Burns Fire Disasters 2018;31(2):138-43.

JOURNAL OF
CONTEMPORARY MEDICINE

DOI:10.16899/jcm.1478881
J Contemp Med 2024;14(3):158-159

Case Report / Olgu sunumu

Oral Retinoid Treatment in a Newborn with Lamellar Ichthyosis

Lamellar İktiyozisli Yenidoğanda Oral Retinoid Tedavisi

Hanife Merve Akca

Karamanoglu Mehmet Bey University, Department of Dermatology, Karaman, Turkey

Abstract

Ichthyosis is a heterogeneous group of conification disorders characterized by hyperkeratosis involving the skin. One form of ichthyosis, lamellar ichthyosis (LI), is autosomal recessively inherited with an incidence of 1/300,000. The diagnosis is based on clinical findings, skin biopsy and genetic analysis. Treatment includes moisturizing the skin, reducing fluid loss and keratolytics. Oral retinoids have been found to be very successful in the treatment of LI. In this case, a premature newborn diagnosed with LI is presented because of its rarity and good response to oral retinoid treatment.

Keywords: Ichthyosis, lamellar ichthyosis, oral retinoids

Öz

İktiyozis, deriyi tutan hiperkeratoz ile karakterize heterojen bir grup konifikasyon bozukluğudur. İktiyozisin bir formu olan lamellar iktiyozis (LI), 1/300.000 insidans ile otozomal resesif kalıtılır. Tanı klinik bulgulara, deri biyopsisine ve genetik analize dayanır. Tedavi, cildin nemlendirilmesini, sıvı kaybının azaltılmasını ve keratolitikleri içerir. Oral retinoidler LI tedavisinde çok başarılı bulunmuştur. Bu olguda, nadir görülmesi ve oral retinoid tedavisine iyi yanıt vermesi nedeniyle LI tanısı konulan bir prematüre yenidoğan sunulmuştur.

Anahtar Kelimeler: İktiyozis, lamellar iktiyozis, oral retinoidler

INTRODUCTION

Ichthyosis is a group of clinically and etiologically heterogeneous cornification disorders characterized by diffuse crusting of the skin. It may be congenital or acquired. Congenital forms include lamellar ichthyosis (LI), non bullous congenital ichthyosiform erythroderma, and "harlequin ichthyosis".[1] In this case report, we present a patient with Harlequin ichthyosis who had severe skin involvement at birth and was treated with oral acitretin.

CASE REPORT

Male baby was born via spontaneous vaginal delivery from the 3rd pregnancy of a 21-year-old mother. His birth weight was 2720 gr (%75-90 Percentile) at term (34 weeks). Postnatal follow-up was performed in the neonatal intensive care unit. Dermatologic examination revealed a membrane-covered appearance, fissures between the membranes and occasional bleeding in the form of leakage. There were pseudocontracture in the fingers and toes, fish mouth appearance and ectropion was due to loss of skin elasticity (**Figure 1**). There were marked contractures at the extremity ends, especially in the fingers. Other system examinations were normal. Routine blood tests, cranial and abdominal ultrasonographic evaluation were normal. Echocardiographic findings were normal. Skin care was applied with sterile vaseline and oral feeding was started on the 2nd day. In collaboration with pediatric specialists, it was decided to start oral acitretin treatment. Family consent was obtained and 1 mg/kg oral acitretin was started. Retinoid treatment was planned to be continued by decreasing the dose in a six-month period. Weekly biochemistry tests were continued in terms of treatment side effects. Calcipotriol and vaseline were started for topical skin care. Topical retinoic acid and 10% topical urea were applied for thick plaque lesions. Fusidic acid was applied for areas with suspected infection. Fever and elevated C-reactive protein (CRP) were not detected during follow-up. The membranes on the skin of the patient, which were present at birth, started to fall off on postnatal day 10 (**Figure 2**). Informed consent was obtained from the family for this case.

Corresponding *(İletişim)*: Hanife Merve Sivas, Karamanoglu Mehmet Bey University, Department of Dermatology, Karaman, Turkey
E-mail *(E-posta)*: kayameyve@hotmail.com
Received *(Geliş Tarihi)*: 06.05.2024 **Accepted *(Kabul Tarihi)*:** 17.05.2024

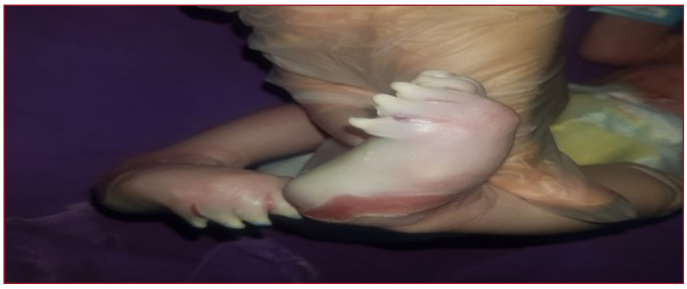

Figure 1. Membrane structure on the skin and rudimentary fingers after birth

Figure 2. Large, thick hyperkeratotic squames separated by erythematous fissures in a 34-week premature neonate with lamellar ichthyosis.

DISCUSSION

"Ichth" means fish in Latin. Ichthyosis refers to a group of cornification disorders characterized by skin lesions covered with fish scale-like squames. During neonatal period, ichthyosis may be observed in two different clinical forms including collodion baby and Harlequin ichthyosis.[2] In Harlequin ichthyosis, the skin is covered with plaques and deep cracks like hard armor. There is ectropion and eclabium and flattening in the ears and nose. Hair and nails are not yet developed. Adhesions and necrosis of the fingertips can be observed on the hands and feet. Limited joint movements may be observed due to the hard skin structure.[3] Failure to ensure skin integrity can disrupt the skin's barrier function and may result in infection, heat and fluid loss. Bacterial infections, heat loss and dehydration may develop because the skin cannot fulfill its functional barrier function and maintain its integrity. In the past years, two siblings of collodion babies who died as a result of hypernatremic dehydration have been reported.[4] Erythroderma is very little or absent in classic LI. There may be findings ranging from mild increased striation on the palms and soles of the feet to keratoderma. Lips and mucous membranes are not affected, but nearby skin areas may be involved. Ectrapion is almost always seen and is a diagnostic finding. Eclabion, hypohidrosis and alopecia may accompany other findings.[5] In our patient, parchment-like, lamellar peeling was present on whole body including palms and soles at birth. No oral mucosa involvement and erythroderma were observed and diagnosis of lamellar ichthyosis was made via clinical findings. During treatment, moisturization of the skin, prevention of fluid loss and keratolytic agents are used as a principle.[2] Lotions, creams, ointments and oils are used for skin moisturization and creams containing 5% lactic or glycolic acid, 10-40% urea and 0.1% retinoic acid are used for keratolytic treatment. Ophthalmologic care is also required for ectrapion in patients with ichthyosis.[2] The patient who was evaluated by dermatology and ophthalmology consultant physicians was started on eau distillate and vaseline for skin moisturization, artificial tears and antibiotic eye drops for the eyes. He was monitored with fluid and electrolyte therapy appropriate for her weight and age. Systemic retinoic acid (0.5-1 mg/kg/day) treatment has been reported to provide dramatic benefit in severe forms of ichthyosis including LI and congenital ichthyosiform erythroderma.[6]

CONCLUSION

Lamellar ichthyosis is a dramatic picture for the family and the physician, which may progress with fatal complications. It should be kept in mind that a successful neonatal intensive care process with a multidisciplinary approach and retinoic acid treatment may lead to long-term survival.

ETHICAL DECLARATIONS

Informed Consent: All patients signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: No financial support was received from any organisation in this study.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

Note: This case was presented as a poster presentation at the 27th National Dermatology Congress (October 16 - 20, 2018, Antalya) (PS-086).

REFERENCES

1. Fischer J, Bourrat E. Genetics of inherited ichthyoses and related diseases. Acta Derm Venereol. 2020;100(7):186-96.
2. Morelli JG. Disorders of keratinization. in: Kliegman RM, Behrman RE, Jenson HB, Stanton BF (eds). Nelson Textbook of Pediatrics. 18th edPhiladelphia: WB Sounders Company; 2007:2708-14.
3. Tekin M, Konca Ç, Kahramaner Z, Erdemir A. Harlequin iktiyozis: aynı ailede üçüncü olgu. Türk Ped Arş. 2014;49:269-71.
4. Soyuer U, Kurtoğlu S, Aktaş E, Hasanoğlu E. Hypernatremia in two collodion babies. Turk J Pediatr. 1989; 31: 173-5.
5. Shibata A, Akiyama M. Epidemiology, medical genetics, diagnosis and treatment of harlequin ichthyosis in Japan. Pediatr Int. 2015;57:516–22.
6. Lilly E, Bunick CG. Congenital ichthyosis: a practical clinical guide on current treatments and future perspectives. Clin Cosmet Investig Dermatol. 2023 ;11(16):2473-9.