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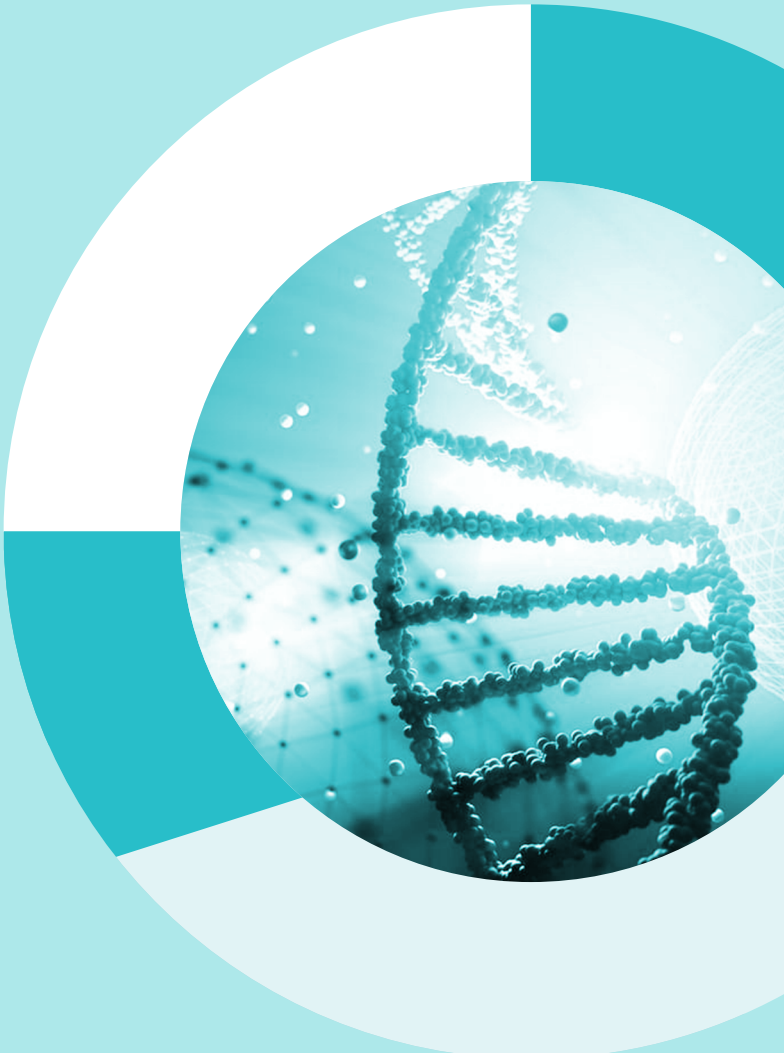

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CONTENTS

REVIEW

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The Use of Additive Manufacturing Technologies in Restorative Dentistry

Tağmaç Özberk[1], İzgen Karakaya[2]

[1]Department of Restorative Dentistry, Near East University Faculty of Dentistry, Nicosia, North Cyprus
[2]Department of Restorative Dentistry, European University of Lefke Faculty of Dentistry, Lefke, North Cyprus

Abstract

In today's era, as in many other industries, there has been a rapid trend towards digitalization in dentistry with the use of computer-aided design and computer-aided manufacturing (CAD/CAM) technologies becoming increasingly common. In dentistry, three different concepts are used to produce a physical prototype: additive, subtractive and hybrid. Additive manufacturing techniques, which serve on the basis of CAD/CAM technology, have been shown to be an alternative to subtractive methods with the various advantages they offer, and for this reason, their use in the dental industry has increased rapidly. It is predicted that additive manufacturing technologies, which have found a wide range of uses in various dental applications, will become the main method for digital manufacturing in dentistry in the future. In this review, it was aimed to examine the CAM methods which are commonly used in dentistry; to evaluate the advantages and disadvantages of these methods systematically; to examine the functioning processes of additive manufacturing technologies which are used in dentistry; and to evaluate the uses and developments of these additive manufacturing techniques in restorative dentistry. For this purpose, a literature scan was conducted using MeSH terms related to the subject ("manufacturing, fabrication techniques", "CAD/CAM, restorations", "digital dentistry", "additive, subtractive systems", "additive manufacturing in restorative dentistry") in medical databases (Medline- PubMed, Embase).

Keywords: 3D printing, additive manufacturing, CAD/CAM, digital dentistry, subtractive manufacturing

INTRODUCTION

Computer-aided design and computer-aided manufacturing (CAD/CAM) applications have proliferated in dentistry as a result of rising technological advancements in this field (Figure 1, 2). These applications are popular due to benefits such as enabling the creation and use of new materials, requiring less labor, being cost-effective, and having control over quality.[1] The concept of using CAD/CAM methodologies to complete indirect restorations made of a material with superior biological and mechanical qualities in a single session and to deliver them to the patient marked the beginning of indirect restoration applications.[2] In CAD/CAM applications, there are three different manufacturing strategies: subtractive, additive, and hybrid.[3-5] Due to its ability to generate more complex, sophisticated structures with reduced material waste, additive manufacturing is now being employed as a substitute for subtractive methods in dentistry.[6,7]

The aim of this article was to give information about three-dimensional (3D) printing technologies which are used in dentistry and to examine the application areas of these technologies in the field of restorative dentistry.

CAD/CAM Technologies

All CAD/CAM systems, past and present, essentially provide services based on three functional components.[8] The first part scans the area which the dentist has prepared either intraorally or extraorally and gathers data about the pertinent region. The restoration can be planned and developed in three dimensions on a computer thanks to the second component, CAD. The final element, CAM, makes it possible to produce the restoration which has been virtually prepared.[9] In general, CAD/CAM systems are split into "*Open*" and "*Closed*" systems based on their ability to share digital data.[10] All CAD/CAM processes, including data

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ORCID IDs of the authors: T.Ö. 0000-0001-5969-2484; İ.K. 0000-0002-4448-556X.

Address for Correspondence: Tağmaç Özberk
E-mail: tagmac.ozberk@neu.edu.tr
ORCID ID: orcid.org/0000-0001-5969-2484

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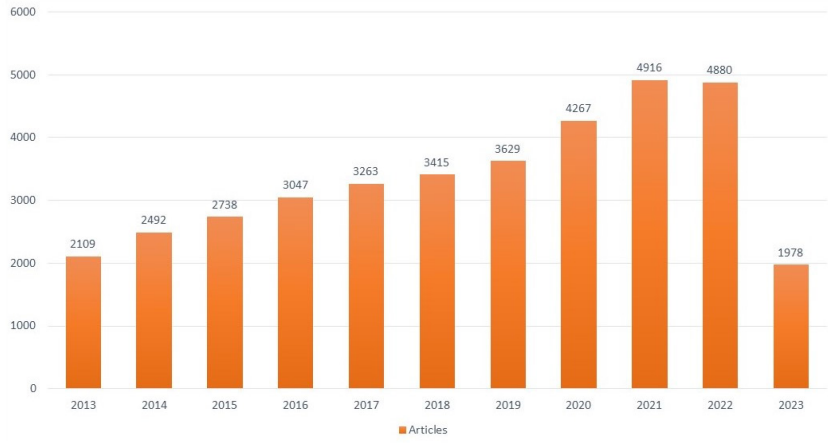

Figure 1. Year-wise (2013-2023) literature production in the dentistry field on additive manufacturing technology.

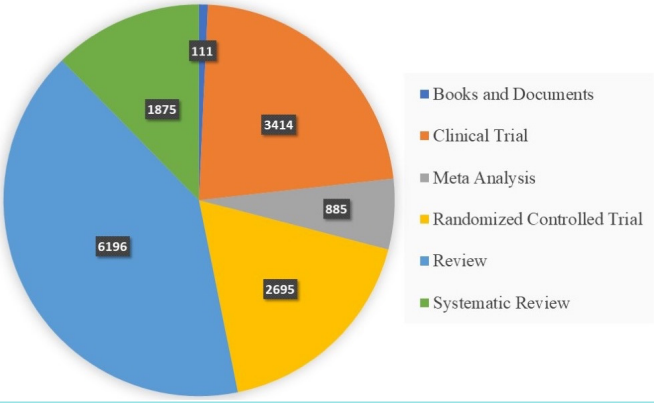

Figure 2. The ratio of the types of articles published on additive manufacturing technology in the field of dentistry.

collection, virtual design, and restoration manufacturing, are included in closed systems; however, data sharing between these systems and other software and hardware is not possible. Closed systems have this drawback, while open systems enable the original digital data produced on a particular device to be read and processed by many CAD software and CAM machines.[9]

Subtractive Manufacturing Technologies

The premise behind the subtractive manufacturing process is that the final product is milled from pre-fabricated disks or blocks composed of certain materials.[11,12] This method has certain drawbacks even though it can successfully achieve a final restoration. 90% of the block is used, and 10% is wasted with no chance of recycling.[13,14] In addition, the milling components used in this system are exposed to heavy abrasion,[15] the production system is insufficient for the production of complex shapes,[4] and also shrinkage and fractures can be seen in the material.[16] Due to the existing disadvantages of this method and the rapid developments in additive manufacturing, the use of additive manufacturing techniques in dentistry has been brought to the fore and studies on this subject have gained importance today.

Additive Manufacturing Technologies

Systems that enable the fabrication of a 3D-designed object by integrating layers on layers with computer assistance are known as additive manufacturing systems. Additionally, the American Society for Testing and Materials describes additive manufacturing as "*the process of combining materials by layering (adding layer upon layer) to produce objects from computer data of a 3D model, in contrast to subtractive manufacturing methods.*"[5,17]

In addition to being known as 3D printing, additive fabrication, fast prototyping, rapid manufacturing, freeform manufacturing, layered manufacturing, and solid freeform fabrication, additive manufacturing technology has become a common practice in dentistry today.[18]

In contrast to subtractive manufacturing, which creates solid materials by milling, additive manufacturing involves layering powder or liquid based ingredients to create solid objects.[12,19] While other techniques use inkjet printing nozzles to spray the binder or solvent onto the powdered ceramic or polymer, some methods use thermal energy from optically directed laser or electron beams to melt or sinter metal or plastic powders together.[12,20]

Two different types of materials, build materials and support materials, are typically deposited in an additive manufacturing device. The support material is not a component of the finished product, but it is required to support the build material placed in voids and overhangs.[21] Despite the fact that many different additive manufacturing processes build and combine layers in a variety of ways, each methodology essentially comprises three steps.[22]

These are;

1. Creating a 3D design in a computing environment and converting it into a traditional additive manufacturing programming language or current additive manufacturing file format.

2. Transmitting the generated design file to a device that uses additive manufacturing technology to make adjustments such as positioning, adjustment and sizing of the object to be produced.

3. Layer-by-layer manufacturing of the designed object.

Vat Polymerization Techniques

Vat photopolymerization is an additive manufacturing process which uses light-activated polymerization to selectively polymerize a liquid photopolymer in a vat. Vat polymerization is a process used in additive manufacturing technologies such as stereolithography (SLA), digital light processing (DLP), continuous liquid interface production, and multiphoton polymerization (MPP).[22]

Stereolithography: SLA is based on the concept of photopolymerization, where monomers form polymeric structures through photons supplied from a ultraviolet (UV) light source.[20,23] It is the process of producing geometric cross-sections imported into software on a light-cured resin surface by means of a laser light source controlled by mirrors.[22]

Digital light processing: DLP is based on the principle of layer-by-layer production by the selective curing of a light-cured resin by a light source, similar to SLA. DLP is also called dynamic mask photolithography because it is very similar to SLA. In contrast to SLA, the light source simultaneously polymerizes the resin in each layer of the object being produced. In addition, this technology uses a production direction opposite to SLA.[21]

Continuous liquid interface production: The working principle is very similar to conventional DLP. The difference is that it uses an oxygen-permeable film to inhibit polymerization on the surface close to the UV source and consequently eliminates the need for an intermediate coating step for each layer.[21]

Multiphoton polymerization: The term "multiphoton" recognizes that the simultaneous absorption of three or more photons can occur (although with very low probability) and photopolymerization will be achieved. With the production of powerful and high-tech lasers, this technique has become feasible. However, the production time and the size of the object which can be produced are still not at the desired level (production size is limited to 30x30 µm).[24] In contrast to traditional SLA, MPP is the process of producing the entire desired object at one time by MPP without using the layer-on-layer technique. Thus, complex structures which cannot be produced in SLA can be produced.[21]

Material Extrusion Methods

Material extrusion is an additive manufacturing technique in which material is selectively distributed through a nozzle.

Fused deposition modeling: This is the most commonly used printer technology for model manufacturing. In this technique, the production employs the method of forming layers with melted thermoplastic filaments.[25] Wax, metals and ceramics are the main materials used in this technique.

Inkjet Printers

In this technique, production is carried out by selective deposition of droplets of photopolymer or thermoplastic materials.[26]

Thermal inkjet printing: The term thermal inkjet printer refers to the spraying of liquid phase materials and/or inks consisting of material dissolved or dispersed in a fixed amount of solvent material in the chamber from the nozzle in the form of droplets which depend on the pressure of air bubbles which form due to the increase in temperature. The piezoelectric effect can also be used to eliminate the need for solvent.[21]

Inkjet-based lithography: Also known as polyjet photopolymerization or multijet modeling, this technique combines the advantages of lithographic methods such as high resolution and good surface quality with the advantages of inkjet methods such as high production speed and large volume object production.[21] In this technique, photopolymerizing resin droplets are sprayed onto a platform by hundreds of nozzles and the layer formed is polymerized with a UV light source.[27]

Aerosol Jet Printers

Aerosol jet printers were patented and commercialized (Optomec Inc.) in 2004. In this technique, droplets of the material used in production with a diameter not exceeding 1-5 µm are sprayed with ultrasonic energy (1.6-2.4 MHz) or pneumatic atomization.[21]

3D Printers

3D printers (3DP) utilize a technology similar to inkjet printers and they provide object production by spraying particles of the powdered base material in the production platform onto a binder molecule surface.[11]

Powder Bed Fusion

This method melts and fuses powdered particles onto a production platform using thermal energy produced by a laser or electron source.[28] There are now three different powder bed fusion (PBF) technology types: electron beam melting (EBM), selective laser melting (SLM), and selective laser sintering (SLS). There are differences between these three PBF techniques in terms of factors such as melting temperature, energy source, energy power, thermal conductivity, room conditions, temperature to be reached, layer thickness, structure orientation, and particles.[19]

Selective laser sintering: This technique uses laser energy from carbon dioxide (CO_2) and neodymium-doped yttrium aluminum garnet lasers to fuse plastic, ceramic or glass particles.

Selective laser melting: The SLM technique can be considered a variation derived from SLS as the same steps are applied in both techniques, but the main difference is that SLM completely melts the powdered particles with the powerful laser beam to create fully dense metallic models.[29] The most common laser used in SLM technology is the CO_2 laser.[19,30]

Electron beam melting: Selective EBM is an additive manufacturing technique used in the production of metal components. This technology, which was first marketed in 2006, produces an object by melting a metal layer by layer using electron beams in a high vacuum.[29] EBM has the ability to process brittle materials which generally cannot be processed by SLM.[31]

Rapid Freeze Prototyping

Rapid freeze prototyping produces dental restorations using ice molds instead of traditional wax molds. This technique is a new and environmentally friendly solid free-forming process which can selectively deposit a water layer and then rapidly freeze it, producing a 3D ice model based on a CAD model.[11]

Laser Engineered Net Shaping

Laser engineered net shaping is also called laser metal deposition or laser coating. The powder is completely melted by a powerful laser beam, similar to the SLM technique, but in this technique, the powdered particles to be melted are sprayed by a nozzle.

4D Printers

Unlike 3DP, which manufacture static materials which maintain the same shape and properties throughout their lifetime, 4D printers (4DP) aim to manufacture dynamic models whose properties and functions can change depending on external stimuli such as heat, pH, humidity, light, pressure, touch-shear and electromagnetic radiation.[5,21] The manufacturing of these dynamic models is carried out by digital modelling designed with special software which can calculate the shape and dimensional changes which may occur.[5,32]

Hybrid Manufacturing Technologies

Hybrid systems combine the versatility of additive manufacturing with the advantages of subtractive manufacturing.[33] There are a limited number of CAD/CAM systems which incorporate both additive and subtractive manufacturing approaches. Commercial examples of these manufacturing approaches are Procera (Nobel Bio-Care, Gothenburg, Sweden) and Wol-Ceram (Wol-Dent, Ludwigshafen, Germany).[3] In addition, although laminated object manufacturing is classified within additive manufacturing systems, it is actually a system which works with a hybrid approach, but since the additive manufacturing part is highly dominant, it is usually mentioned among the additive manufacturing techniques.[11]

Additive Manufacturing Technologies in Restorative Dentistry

The use of additive manufacturing techniques in dental applications is increasing day by day. These technologies are preferred in many applications especially in the prosthetic (temporary or permanent crown/bridge, framework, model production, etc.), surgical, endodontic, restorative (guide formation) and orthodontic (model and personal appliance production) fields.[7,34,35] In addition, additive manufacturing techniques are emerging as a preferred technology in regenerative applications (especially in scaffold production) in parallel with the development of dental materials and innovations in tissue engineering.[25,36,37]

Digital Wax-up and Guide Design in Anterior Restorations

In cases regarding the high aesthetic expectations of patients in the anterior region, the deficiencies in patient-doctor communication, and patient concerns about the appearance to be obtained at the end of the procedure, mock-ups, wax-ups and guide applications may be preferred in order to create appropriate forms, sizes, contact relationships and to ensure that the patient and dentist are on the same page before direct restorative procedures are started.[38]

In digital technology, the ability to instantly transfer intraoral scans to the computer environment and to superimpose these data with the patient's facial photographs or 3D facial scans by means of CAM design software has made digital wax-up applications frequently preferred in the design step of the planned restorations (Figure 3).[39]

This development provides very fast feedback on any changes in the design plan instead of the traditional intraoral mock-up or wax-up methods used on the model in aesthetic services such as smile design.[40] In addition to wax-ups created in digital format, dentists and technicians can use natural shapes from digital libraries and adapt them in a very short time, unlike traditional wax-ups. Thus, the digital wax-up can be readjusted easily and efficiently, and the proposed design can be created without compromising aesthetics and/or periodontal health.[39]

The introduction of 3D printing technology in this field has brought many advantages. Thanks to additive manufacturing technologies, a model can be obtained from digitally prepared wax-up designs and consultation with the patient can take place, and if desired, silicone mock-ups can be prepared on this model (Figure 4).[38]

Recently, this technology has enabled the development of 3D printed rigid preparation guides with a new design which makes it possible to overcome some of the limitations of silicone indexes and improves the ability to visualize the teeth. Furthermore, in the multidisciplinary treatment protocol of aesthetic anterior restorations, it has become possible to 3D print crown lengthening guides which can be used in the periodontal surgery step in order to improve facial aesthetics by restoring the harmony between hard and soft tissues.[38,39]

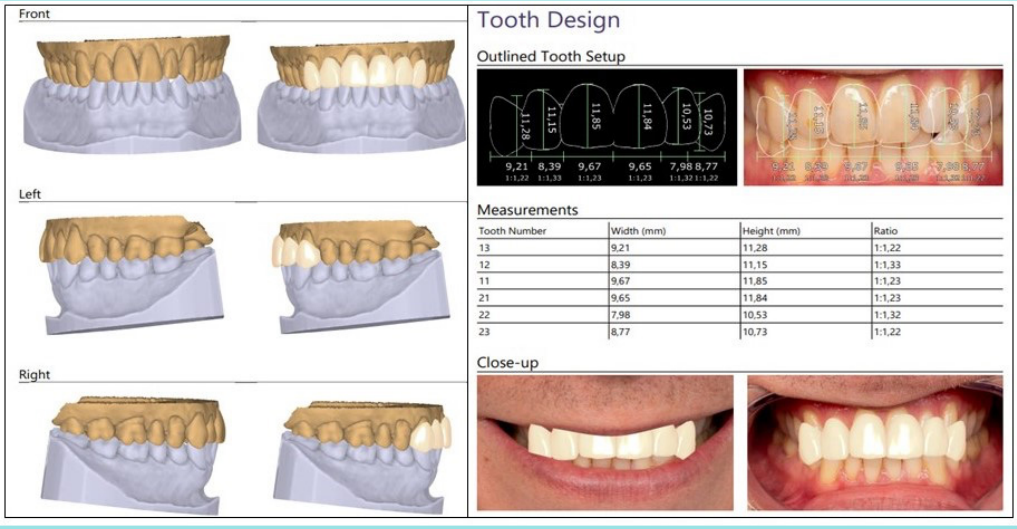

Figure 3. Digital wax-up design in the anterior region using CAM design software.

CAM: Computer-aided manufacturing.

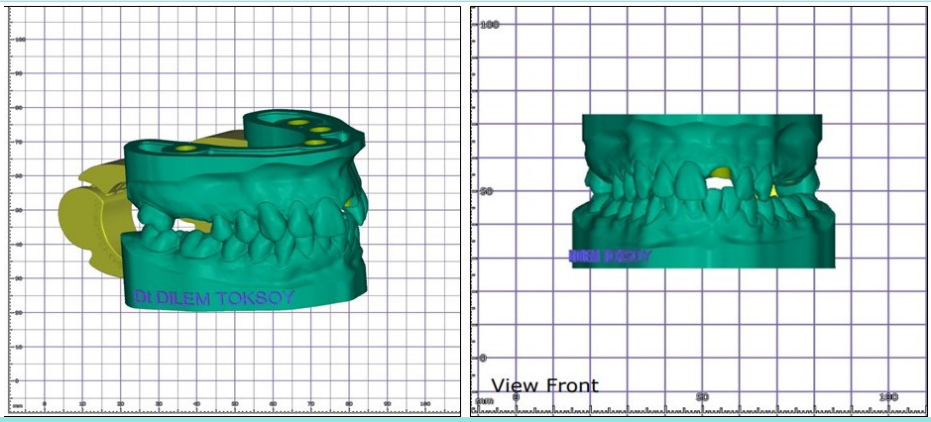

Figure 4. 3D printed model design.
3D: Three-dimensional.

Additionally, after the periodontal and surgical procedures are performed, resin shells produced with 3D printing technologies can be adapted to the patient's mouth as post-operative mock-ups and the patient can have precise information about the final restoration shape.[39]

Indirect Temporary Dental Restorations

Temporary dental restorations, which are important not only for the protection of pulpal and periodontal tissues but also for oral function and aesthetics, have recently started to be produced with CAD/CAM technology as an alternative to conventional methods.[23] Most commercially available dental CAD/CAM systems utilize the milling method in which temporary crowns are mechanically shaped from a resin block.[12] While the strength and accuracy of temporary crowns are higher than those fabricated with the conventional direct technique because the resin block is polymerized with a high degree of conversion in this fabrication technique; the range of motion of the fabrication device and the size of the milling burs are the main disadvantages as they limit the shape which can be milled.[4,41] In order to eliminate such disadvantages of subtractive methods, additive manufacturing techniques have also been used in the production of temporary dental restorations.[23,42,43] Temporary dental restorations produced with additive technologies are becoming the preferred choice of many clinicians because they have sufficient mechanical strength, exhibit superior internal/marginal fit, and can be easily produced with SLA-based 3DP.[44] However, additional research is needed on the biocompatibility and long-term outcomes of the polymers used in additive manufacturing (Figure 5).[22]

Fabrication of Indirect Dental Restorations

Nowadays, 3D printed hybrid composite resins developed by different brands are available for use in permanent restorations. In the indirect fabrication of permanent restorations with additive manufacturing technology, firstly, the relevant tooth is prepared in accordance with the minimum thickness values for the restoration reported by the manufacturer and after scanning with an intraoral scanner, the virtual design of the restoration is made and sent to the relevant production unit in STL format (Figure 6). After the manufacturing and post-manufacturing processes are carried out, the restoration is cemented onto the abutment tooth with the appropriate adhesive system and luting cement in accordance with the manufacturer's instructions.[45]

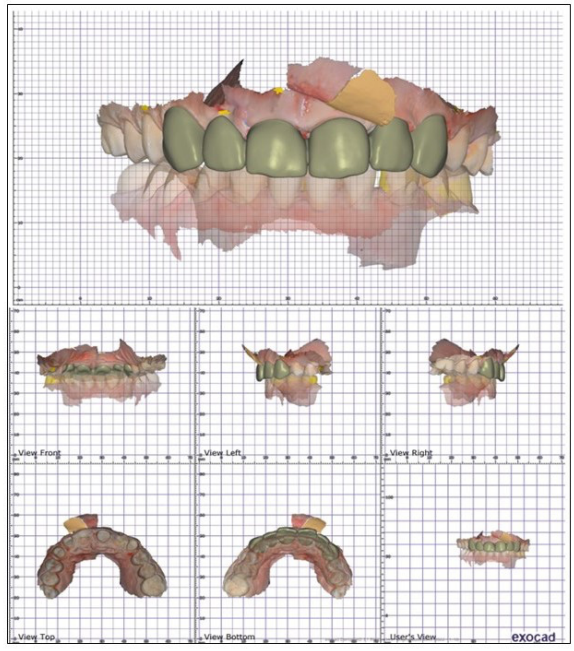

Figure 5. Anterior temporary restoration designed for manufacturing on a 3D printer.
3D: Three-dimensional.

Although the additive manufacturing of hybrid composite resins seems promising in terms of the advantages they offer to the laboratory, clinicians and patients, more studies are needed to compare these materials with those materials used in conventional and subtractive methods.[46] The 3D printed hybrid composite resins of some of the different brands available on the market for use in permanent restorations are shown in Table 1.

Regenerative Applications and Tissue Engineering

As dental tissues have complex structures, anisotropic mechanical properties and heterogeneous cell distribution, it is difficult to mimic their complex 3D structures by using conventional techniques. Recently, the 3D bio-printing of dental and craniofacial tissues has been proposed

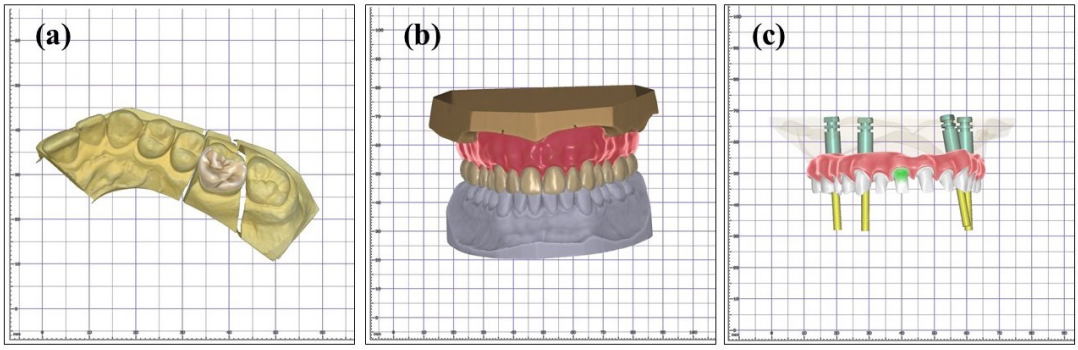

Figure 6. Onlay restoration designed for fabrication with 3D printable hybrid composite resins (a), total prosthesis designed for fabrication with 3D printable hybrid composite resins (b), implant supported prosthesis designed for fabrication with 3D printable hybrid composite resins (c).

3D: Three-dimensional.

Table 1. Commercial names of 3D printable hybrid composite resins available on the dental market and the composition, flexural strength, indications, shades and manufacturing technologies of these materials

Name	Composition	Flexural strength	Indications	Shades	Manufacturing technology	Manufacturer
Varseosmile Crown^{plus}	Silanized dental glass, methyl benzoylformate, diphenyl(2,4,6-trimethylbenzoyl) phosphine oxide, 4.4'-isopropylidiphenol, ethoxylated and 2-methylprop-2enoic acid, inorganic fillers	116-150 MPa	Single crowns, inlays, onlays, and veneers	A1, A2, A3, B1, B3, C2, D3, BL	DLP	BEGO GmbH & Co. Bremen, Germany
SprintRay Crown	Silanized dental glass, methyl benzoylformate, diphenyl(2,4,6-trimethylbenzoyl) phosphine oxide, 4.4'-isopropylidiphenol, ethoxylated and 2-methylprop-2enoic acid, inorganic fillers	>100 MPa	Single crowns, inlays, onlays, and veneers	A1, A2, A3, B1, B3, C2, D3	DLP	BEGO GmbH & Co. Bremen, Germany
SprintRay Ceramic Crown	Oligomers, monomers, photoinitiators, additives	136 MPa	Single crowns, inlays, onlays, and veneers, artificial teeth for dental prostheses	A1, A2, A3, B1, B3, C2, D3, BL	DLP	SprintRay Inc., Los Angeles, USA
Saremco Print-Crowntec	Bisphenol a polyethylene glycol diether dimetaacrylate, BiSemA, methyl benzoylformate, diphenyl(2,4,6-trimethylbenzoyl) phosphine oxide	>135 MPa	Single crowns, inlays, onlays, and veneers, artificial teeth for dental prostheses	A1, A2, A3, B1, BL	DLP	Saremco Dental AG, Rebstein, Switzerland
Formlabs Permanent Crown Resin	Silanized dental glass, methyl benzoylformate, diphenyl(2,4,6-trimethylbenzoyl) phosphine oxide, 4.4'-isopropylidiphenol, ethoxylated and 2-methylprop-2enoic acid, inorganic fillers	116 MPa	Single crowns, inlays, onlays, and veneers	A2, A3, B1, C2	SLA	Formlabs GmbH, Berlin, Germany
Flexcera Smile Ultra^{+}	Acrylates, methylacrylates, methacrylated oligomers and monomers, photo initiators, colorants/dyes, fillers and absorbers	Unspecified	Single crowns, inlays, onlays, and veneers, artificial teeth for dental prostheses	A1, A2, A3, A3.5, B1, BL	DLP	EnvisionTEC GmbH, Gladbeck, Germany
Irix® Plus	Acrylate monomers, Inorganic fillers, photoinitiator, stabilizers	>100 MPa	Single crowns, up to 3-unit bridges, inlays, onlays, and veneers	A1, A2, A3, A3.5, B1, N, multicoloured	SLA	DWS, Thiene (VI), Italy
Irix® Max	Acrylate monomers, Inorganic fillers, photoinitiator, stabilizers	>80 MPa	Single crowns, up to 3-unit bridges, inlays, onlays, and veneers	A1, A2, A3, A3.5, B1, N, multicoloured	SLA	DWS, Thiene (VI), Italy

Data was collected from the manufactures' websites and brochures. 3D: Three-dimensional, DLP: Digital light processing, SLA: Stereolithography.

to overcome the challenges of mimicking complex and 3D functional biological tissues.[36,47] Technological advances show that 3D bio-printing shows great promise for future generations in the fabrication of whole teeth and other oral tissues.[36] Microscale technologies have great potential for *in vitro* and *in vivo* improvements of tooth-like structures, as they can produce microstructures, provide open canals, promote vascularization, improve diffusion, help regulate cell activity and facilitate efficient approaches.[48] The "*microscale technology approach*" developed for the control of activities at the cellular level can be realized by soft lithography or photolithography.[36,49]

Soft lithography is a technique where patterned silicon materials such as poly (dimethylsiloxane) are used as master casting templates for molding elastomeric materials.[49] Photolithography is an another technique used to create micro-scale features in scaffolds.

There is increasing consensus that 3D micro-channels created by these techniques can help promote cell metabolism and play an important role in achieving a reliable technique for tooth regeneration.[36,50] Even after achieving the advanced technology for the regeneration of dental structures, the major challenges of the application of these technologies in dental clinical practice are their high cost, difficulties in public accessibility, and the ethical debates about which source of cell (patient or donor) and type of cell (adult or fetal) should be chosen for regeneration.[36]

Study Limitations

Although there are case reports and *in vivo* studies on the clinical use of these technologies for surgical, orthodontic, endodontic, and prosthodontic applications in the literature, there are few studies on their restorative applications, owing to the limitations of the materials used with additive manufacturing technologies.

Conclusion

Additive manufacturing technologies, which have become widespread in many fields due to their success in manufacturing complex structures, have started to attract interest in regenerative and restorative dental applications as an alternative to conventional and subtractive methods. This technology, which is employed in many areas of dentistry, has raised hopes for the total regeneration of dental tissues, particularly with the ability to create dynamic models with 4DP.

MAIN POINTS

- Additive manufacturing technologies avoid a great deal of material waste compared to subtractive manufacturing technologies.
- Integration of additive manufacturing technologies into the field of dentistry is becoming more widespread day by day with the continuous development of 3D printers and their compatible resins.
- In restorative dentistry, additive manufacturing technologies are utilized in digital wax-up and guide preparations, the fabrication of indirect temporary/permanent dental restorations, as well as regenerative and tissue engineering applications.

ETHICS

Authorship Contributions

Surgical and Medical Practices: T.Ö., Concept: T.Ö., İ.K., Design: T.Ö., İ.K., Data Collection and/or Processing: T.Ö., Analysis and/or Interpretation: T.Ö., Literature Search: T.Ö., Writing: T.Ö.

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RESEARCH ARTICLE

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Acute Kidney Injury in Very Preterm Infants: A Cohort Study in a Level III NICU

Nilüfer Güzoğlu[1], Ümit Ayşe Tandırcıoğlu[2], Ayşe Bulut[2], Banu Çelikel Acar[3], Didem Aliefendioğlu[4]

[1]Department of Pediatrics, Eastern Mediterranean University, Dr. Fazıl Küçük Faculty of Medicine, Famagusta, North Cyprus
[2]Department of Pediatrics, Division of Pediatric Neonatology, Kırıkkale University Faculty of Medicine, Kırıkkale, Türkiye
[3]Department of Pediatrics, Division of Pediatric Nephrology, University of Health Sciences Türkiye, Ankara City Hospital, Ankara, Türkiye
[4]Clinic of Pediatrics, Division of Pediatric Neonatology, Güven Hospital, Ankara, Türkiye

Abstract

BACKGROUND/AIMS: Acute kidney injury (AKI) is not rare among preterm infants in neonatal intensive care units (NICU). It raises mortality and morbidity in NICUs and also chronic kidney disease in the long term. The aim of this study was to define the incidence of clinical characteristics and the course of AKI in very preterm infants.

MATERIALS AND METHODS: A retrospective cohort study was conducted in a level III NICU in a university hospital. All very preterm infants born in the same hospital during the study period were included in this study. Patient data were taken from the medical records. AKI diagnosis was made using the neonatal-modified Kidney Disease Improving Global Outcomes (KDIGO) criteria.

RESULTS: AKI was diagnosed in 20 very preterm infants (42%). The median time of AKI diagnosis was 4.5 days of life (between 2-12 days). While there were 8 infants with AKI when the diagnosis was made based on the serum creatinine (Cr) level being over 1.5, the diagnosis of AKI increased to 20 with the use of the KDIGO criteria. Need for resuscitation in the birth room, patent ductus arteriosus, the number of cases of apnea, desaturation episodes, sepsis, hypotension, inotropic support, and sepsis rates were significantly higher in the AKI group. Days hospitalized among survivors were longer and mortality was higher in the AKI group than in the non-AKI group ($p=0.042$, $p<0.0001$ respectively).

CONCLUSION: The neonatal KDIGO criteria are beneficial and also informative in diagnosing and staging AKI. Close follow-up of urine output and Cr levels especially in the first days is essential in very preterm infants.

Keywords: Acute kidney injury, preterm, creatinine

INTRODUCTION

Acute kidney injury (AKI) is a significant issue in patients who are admitted to neonatal intensive care units (NICU). The AKI prevalence is reported to be 40-70% of sick newborns admitted to the NICU.[1]

AKI is reported as an independent risk factor for both morbidity and mortality during hospitalization.[2] It may also disrupt the function and structure of the kidneys in the long term. While it was assumed that patients with AKI were completely healed, several recent studies have highlighted it to be an independent risk factor in the development of chronic kidney disease.[3] Therefore, being familiar with the first signs of injury and managing preventive strategies in order to stop its progress is vital.

There are different classification systems used to define AKI by measuring serum creatinine (Cr) levels, glomerular filtration rates and urine output. Recently, neonatal AKI criteria, which is a modified version of Kidney Disease Improving Global Outcomes (KDIGO)-AKI, have been used by clinicians in NICUs.[4,5]

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ORCID IDs of the authors: N.G. 0000-0003-1241-5134; Ü.A.T. 0000-0002-1743-8194; A.B.; B.Ç.A. 0000-0002-1808-3655; D.A. 0000-0001-6314-3461.

Address for Correspondence: Nilüfer Güzoğlu
E-mail: nguzoglu@gmail.com
ORCID ID: orcid.org/0000-0003-1241-5134

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This study aimed to define the incidence of clinical characteristics and the course of AKI in very preterm babies in our NICU. We used the neonatal-modified KDIGO criteria to define and stage neonatal AKI (Table 1).

MATERIALS AND METHODS

This retrospective cohort study was conducted with very preterm infants who were admitted to a level III NICU in a university hospital. This study was conducted between December, 2015 and December, 2016. All very preterm infants (gestational age less than 32 weeks) who were followed from the first hours of life were included in this study. Patients with multiple congenital anomalies, congenital heart disease except for patent ductus arteriosus (PDA), kidney, and urinary tract malformations were excluded. Those infants who survived less than 48 hours and those who were accepted after their first day of life were also excluded.

Infants diagnosed with AKI during their follow-up were defined as the AKI-group. The non-AKI group consisted of very preterm infants who did not develop AKI during the same period. Maternal characteristics including age, preeclampsia, hypertension, diabetes, urinary tract infection, HELLP syndrome, and the patients' clinical characteristics including delivery type, gender, gestational age, Apgar scores at 5 min, birth-weight, respiratory support, daily weight and fluid volume, urine output, medications, laboratory results, the presence of hemodynamically significant PDA, sepsis, duration of hospital stay, and mortality were obtained from the medical records.

AKI diagnosis and staging were determined based on the neonatal KDIGO criteria as shown in Table 1. The KDIGO stage was determined by considering the values of either the lowest urine output or the highest serum Cr level in the follow-up of the patients. This study was approved by the Ethics Committee of Malatya Turgut Özal University Non-interventional Clinical Research Ethics Committee (approval number: 2022/128, date: 09.08.2022).

Statistical Analysis

Statistical analyses were carried out by IBM SPSS Statistics V22.0. The demographic characteristics of the patients were compared between the AKI and non-AKI groups. For the evaluation of the study values such as medians, minimums, and maximums, we used descriptive statistical methods. The chi-square test was used to compare qualitative data. The Mann-Whitney U test was used to compare differences in quantitative variables with non-normal distributions for two groups.

RESULTS

During the study period, 52 infants born very prematurely were admitted to the NICU within their first hours of life. After excluding neonates based on the exclusion criteria, 44 were included in this study. AKI was diagnosed in 20 with an estimated prevalence of 42% in the study population according to the modified KDIGO criteria. Of the 20 patients diagnosed with AKI; 11 were stage 1 (55%), 6 were stage 2 (30%), and 3 were stage 3 (15%). The median time of AKI diagnosis was 4.5 days of life (between 2-12 days).

There was a significant difference in serum Cr levels between those patients with AKI (1.42±0.6) and the non-AKI (0.63±0.1) group ($p<0.0001$). With serum Cr levels higher than 1.5 mg/dL, 8 preterm infants were diagnosed as AKI, which increased to 20 when using the KDIGO criteria. Two patients were diagnosed based only on their urine output criteria. The mean serum Cr level was 1.2±0.3 in stage 1, 1.19±0.45 in stage 2 and 2.5±0.6 in stage 3 infants.

The gestational week was significantly lower ($p=0.011$) and the male ratio was higher in the AKI group ($p=0.01$). The median birth weight was lower in the AKI group, however, there was no statistically significant difference. The maternal characteristics of the AKI group and the demographic characteristics of both groups are shown in Tables 2, 3.

In the AKI group, the need for resuscitation in the birth room was higher. No difference was noticed between the groups in terms of initial urine output or fluid loads. However, there was a significant difference in the number of cases of apnea, desaturation episodes, sepsis, hypotension, inotropic support, and sepsis (Table 4).

The length of stay among survivors was significantly longer in the AKI group (median: 47 days) than in the non-AKI group (median: 28 days) ($p=0.042$) (Table 4).

Table 1. Modified neonatal acute kidney injury criteria[5]

	Serum creatinine	Urine output
Stage 1	≥0.3 rise within 48 h or ≥1.5-1.9 × rise from baseline (previous lowest value) within 7 days	≤1 mL/kg/h for 24 h
Stage 2	2.0-2.9 times baseline	≤0.5 mL/kg/h for 24 h
Stage 3	≥3 × rise from baseline or serum creatinine ≥2.5 mg/dL or renal replacement therapy initiation	≤0.3 mL/kg/h for 24 h

Table 2. Demographic characteristic

Variables, med (min.-max.)	AKI (n=20)	Non-AKI (n=24)	p
Mother's age	27 (16-39)	24 (17-37)	0.795
Delivery type (C/S) n (%)	16 (84)	24 (96)	0.17
Gestational week	28 (24-32)	30 (25-32)	0.011*
Birth weight	1,205 (580-1,890)	1,435 (600-1,860)	0.141
5-min Apgar score	8 (4-10)	8 (6-10)	0.044*
Male gender n (%)	16 (80)	10 (42)	0.01*

AKI: Acute kidney injury, C/S: Cesarean birth, *Statistically significant, min.: Minimum, max.: Maximum.

Table 3. Maternal characteristics of patients with AKI

Variables, n (%)	AKI, (n=20)	Non-AKI, (n=24)
Gestational hypertension or preeclampsia	4 (21)	2 (8)
Urinary tract infection	5 (26)	4 (16)
HELLP syndrome	-	3 (12)
Placental abruption	2 (10)	2 (8)
Hyperemesis gravidarum	-	1 (4)

AKI: Acute kidney injury.

Table 4. Clinical conditions and comorbidities in the newborns			
Variables, n (%)	**AKI (n=20)**	**Non-AKI (n=24)**	**p**
Intubated in the delivery room	1 (4)	13 (65)	0.000*
Respiratory distress syndrome	20 (83)	16 (80)	0.539
Patent ductus arteriosus	11 (44)	15 (79)	0.02*
Birth asphyxia	0	6 (32)	0.002*
Desaturation attacks	9 (38)	17 (85)	0.002*
Apnea attacks	9 (38)	19 (95)	0.000*
Hypotension-shock	4 (17)	16 (80)	0.000*
Sepsis	8 (33)	19 (95)	0.000*
Invasive mechanical ventilation	5 (21%)	7 (35%)	0.29
Inotropes	5 (21%)	90 (72%)	0.000*
Nephrotoxic medicine			
NSAID	5 (21)	4 (21)	0.622
Vancomycin	4 (17)	13 (68)	0.001*
Furosemide	1 (4)	13 (65)	0.000*
Amphotericin B	0	2 (10)	0.20
Length of stay	28 (7-86)	47 (17-136)	0.042*

AKI: Acute kidney injury, NSAID: Non-steroidal anti-inflammatory drugs, *Statistically significant.

The AKI group mortality was significantly higher (65% vs. 2%, p<0.0001), with an odds ratio (OR) of 3.5 (1.8-7.0).

DISCUSSION

AKI is common in preterm babies admitted to the NICU as reported in the literature. Carmody et al.[6] showed that the AKI incidence in very low birth weight infants was 40%. Weintraub et al.[7] reported an AKI incidence of 30.3% at less than 30 gestational weeks. In a prospective study from Saudi Arabia, AKI incidence was 56% in infants who were admitted to level 2 and 3 NICUs.[8] In a multi-center study, which included 24 NICUs, the incidence of AKI was 29.9%, and this rate increased to 47.9% for those infants born at less than 29 gestational weeks.[9] In our study, we found that the AKI incidence in very preterm infants was 45.4%.

Although there was no difference in terms of gender in some studies,[6,9,10] male gender was significantly higher in the AKI group in our study. In our study, the gestational week was significantly lower in those infants with AKI. The study by Hingorani et al.[2] showed an inverse relation between severe AKI incidence and the gestational age in an extremely low gestational age neonate group. Additionally, they reported that mean birthweight was lower in those newborns with severe AKI than in those with none/stage 1 AKI.

The AWAKEN study which examined the incidence and outcomes of AKI in newborns found AKI diagnoses most often during the first week after birth.[9] The median day of AKI diagnosis was 4.5 (2-12 days) in this study. Similar to the previous studies, stage 1 frequency was higher than the other stages, and stage 2 and 3 AKI were related to higher mortality.[11,12]

The mean serum Cr level was higher than 1.5 mg/dL only in stage 3. Therefore, diagnosis and early prevention strategies are very crucial in the early period when the Cr levels have not yet increased in most cases. Pantoja-Gómez et al.[12] showed that while most patients' kidney function healed in the first stage, just half of the patients' kidney function healed in the severe stage.

It is well known that a significant cause of neonatal AKI is asphyxia. In our study, there were 6 patients within the AKI group. Alaro et al.[13] reported that full-term neonates with hypoxic ischemic encephalopathy had a 15 times higher risk of AKI. Kaur et al.[14] examined the incidence of AKI among ≥34 gestational week neonates with birth asphyxia. They reported that the incidence was 41.7%.

In our study overall, preterm infants with AKI had more inotropic treatment than those without AKI. Additionally, patent ductus arteriosus, sepsis, apnea, and desaturation attacks were more commonly seen in the AKI group. Moreover, vancomycin usage was higher in the AKI group. However, all patients had treatment after their AKI attack. Different studies reported that gestational age, out-born delivery, the need for high mean airway pressure, non-steroidal anti-inflammatory treatment for patent ductus arteriosus, hypotension, necrotizing enterocolitis, sepsis, hyperbilirubinemia, inborn errors of metabolism, and the need of surgery were associated with AKI.[7,10,15,16]

The number of days of hospitalization in the NICU among the survivors was longer in the AKI group than in the non-AKI group and the mortality rate also was higher in the AKI group in this study (OR: 3.5, 95% confidence interval: 1.8-7.0). It has been stated that neonatal AKI has a more than 4-fold higher risk of death and was related with longer hospitalization (8.8 days), as well as a 4-fold higher risk of death, and increased length of stay (11.7 days) in very low birth weight (VLBW) infants.[6,9] Charlton reported that neonatal infants having AKI in the first postnatal week is associated with a 2.8-fold higher risk of death and 7.3 days longer LOS in hospital.[15] Koralkar et al.[17] indicated that AKI was strongly associated with mortality in a prospective study on VLBW infants.

AKI is not rare among patients in NICUs. Due to its short and long-term outcomes and the significance of early recognition, different neonatal AKI definitions have been suggested. However, in a study with neonatologists and pediatricians from India using an online survey, more than half of the participants were not familiar with the standard neonatal AKI criteria. Additionally, most respondents were unaware of the risk of AKI due to prematurity.[1]

Study Limitations

The fact that this study only examined a small number of cases and was based on a single center are the limitations of this study. However, the fact that the results of this study are very similar when compared with the literature emphasizes the importance of the early diagnosis of AKI in the neonatal period.

Conclusion

In conclusion, delays in diagnosis and inappropriate management of AKI are associated with adverse outcomes, longer hospitalizations, and higher mortality. For the early diagnosis, the first step should be awareness and close monitoring. The neonatal-modified KDIGO criteria are very beneficial and also informative in the follow-up. For very preterm infants, close follow-up of urine output and Cr levels, especially in the first days, is highly recommended.

MAIN POINTS

- AKI is a common issue in premature patients who are admitted to neonatal intensive care units.

- AKI is associated with adverse outcomes during hospitalization, so awareness and close monitoring are essential.
- The neonatal-modified KDIGO criteria are beneficial for the early diagnosis of AKI.

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ETHICS

Ethics Committee Approval: This study was approved by the Ethics Committee of Malatya Turgut Özal University Non-interventional Clinical Research Ethics Committee (approval number: 2022/128, date: 09.08.2022).

Informed Consent: Retrospective study.

Authorship Contributions

Surgical and Medical Practices: Ü.A.T., A.B., D.A., Concept: N.G., B.Ç.A., D.A., Design: N.G., B.Ç.A., D.A., Data Collection and/or Processing: Ü.A.T., A.B., Analysis and/or Interpretation: N.G., Ü.A.T., A.B., Literature Search: N.G., Writing: N.G., B.Ç.A.

DISCLOSURES

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RESEARCH ARTICLE

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Risk Factors of Long PICU Stay for Term-Born Bronchiolitis Patients Less than 3 Years Old

Hakan Tekgüç[1], Serhat Emeksiz[2], Selman Kesici[3], Ebru Azapağası[4]

[1]Department of Pediatric Intensive Care, Dr. Burhan Nalbantoğlu State Hospital, Nicosia, North Cyprus
[2]Department of Pediatric Intensive Care, Ankara Yıldırım Beyazıt University Faculty of Medicine, Ankara, Türkiye
[3]Department of Pediatric Intensive Care, Life Support Center, Hacettepe University Faculty of Medicine, Ankara, Türkiye
[4]Department of Pediatric Intensive Care, Gazi University Faculty of Medicine, Ankara, Türkiye

Abstract

BACKGROUND/AIMS: Bronchiolitis, which is caused by a virus, is the most common lower respiratory infection in children aged <3 years. Several prenatal and postnatal risk factors affect the need for escalated care. To standardize the assessment of these patients, scoring systems based on clinical findings and respiratory examinations have been developed. Our primary aim was to determine the risk factors for longer pediatric intensive care unit (PICU) stays in term-born bronchiolitis patients who needed intensive care before 3-years of age. Our secondary aim was to evaluate the efficacy of the Pediatric Respiratory Severity Score (PRESS) scoring system.

MATERIALS AND METHODS: A prospective observational study was performed on pediatric patients aged ≤3-years who had been admitted to three tertiary-level PICUs in Ankara, during the epidemic season with clinical diagnoses of bronchiolitis. Those patients who were born preterm or who had congenital heart diseases were excluded. PRESS was used to define the clinical severity of bronchiolitis at admission.

RESULTS: Fifty three of the 79 (67.01%) were male and the median age was 6-months. Correlation analysis showed that Pediatric Risk of Mortality III Score (r=0.37), prenatal smoke exposure (r=0.34) and previous hospitalization (r=0.28) were significantly associated with the length of PICU stay. Multiple regression analysis showed that only prenatal smoke exposure was related with longer PICU stays (R-sq: 0.321). PRESS severity levels had no statistically significant effect on PICU or hospital stays.

CONCLUSION: Prenatal smoke exposure is the only independent risk factor for longer stays in intensive care units for term-born bronchiolitis patients under 3 years of age.

Keywords: Bronchiolitis, pediatric intensive care, prenatal smoke exposure, risk factors

INTRODUCTION

The symptoms of bronchiolitis and respiratory distress are triggered by acute inflammation, edema, necrosis of epithelial cells lining the small airways, increased mucus production, and/or bronchospasm. Viral diseases are the leading cause of bronchiolitis.[1]

Previous studies have aimed to evaluate the role of prenatal, perinatal and postnatal conditions in determining the risks of hospitalization for bronchiolitis[2,3] or clinical findings at admission and the need for escalated care.[4] In addition, studies have identified the demographics and epidemiological characteristics of previously healthy term infants who were hospitalized in pediatric intensive care unit (PICUs) because of severe bronchiolitis.[5] However, few studies have yet described the prenatal, perinatal, postnatal factors associated with PICU admission and their outcomes.[6]

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ORCID IDs of the authors: H.T. 0000-0001-6424-6761; S.E. 0000-0003-1026-0386; S.K. 0000-0003-4746-6986; E.A. 0000-0002-0684-8219.

Address for Correspondence: Hakan Tekgüç
E-mail: tekguchakan@gmail.com
ORCID ID: orcid.org/0000-0001-6424-6761

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The diagnosis of acute respiratory diseases and hospital admission due to bronchiolitis are based on clinical observations and laboratory investigations.[7] For these purposes and to standardize the assessments of hospitalizations, several scoring systems based on physical findings and respiratory examination have been developed.[8] The Pediatric Respiratory Severity Score (PRESS) is one of them and it has five components including respiratory rate, wheezing, accessory muscle use, SpO_2, and feeding difficulties.[9] Also PRESS scores are a severity assessment used to categorize patients with respiratory infections into 3 groups: mild (0-1), moderate (2-3), or severe (4-5) based on these five parameters. This scoring system can be a useful and applicable bedside scoring method to assess and triage bronchiolitis patients. However, there is no data on whether it can be used to estimate PICU admission or length of hospital stay for severe patients.

Objectives: Our main objective was to analyze prenatal and postnatal risk factors for longer PICU and hospital stays for term-born bronchiolitis patients less than 3 years of age who applied to our hospital during winter. Our secondary objective was to determine reasons for higher PRESS scores and to evaluate if PRESS scoring could be used to estimate PICU durations for bronchiolitis patients.

MATERIALS AND METHODS

Study design and aspects to be covered: This was a prospective observational study, performed on pediatric patients aged ≤3 years, who were admitted to three tertiary level PICUs in Ankara, Türkiye during one epidemic season (between December, 2017 and April, 2018) with clinical diagnoses of bronchiolitis. The PICU physician decides whether the patient has bronchiolitis in light of their clinic, X-ray, and laboratory parameters. Intensive care unit (ICU) admission criteria were an increased work of breathing despite medical treatment, SO_2 <92 despite oxygen treatment or cyanosis. Those patients who were born preterm (before 37 completed weeks of gestation) or those who had congenital heart diseases were excluded from this study.

A questionnaire investigating the smoking status of the parents, the number of people living in the home, the number of siblings of school age and the living habitat of the family members was conducted. Recent studies have shown that any level of smoking exposure (one or more cigarettes per day) is likely to be associated with progressive and lasting lung damage,[10] so we accepted any level of cigarette smoking of the mother to be sufficient for prenatal smoke exposure and any level of smoking in the household adequate for passive smoke exposure. We collected data on nursery/school attendance for the patients. The PRESS was used to define the clinical severity of bronchiolitis at admission. Besides age, gender and any chronic diseases of the subjects, symptoms at admission were also recorded. Also, initial vital signs, Pediatric Risk of Mortality (PRISM) III Score,[11] blood gas and white cell count, and C-reactive protein at admission were recorded. Respiratory syncytial virus (RSV) and influenza Polymerase Chain Reaction test results were recorded if they were present. Treatment modalities such as high-frequency oxygen (HFO), non-invasive ventilation (NIV) and invasive ventilation were recorded on a daily basis. All patients who needed HFO received 2 Lt/kg air flow and weaning from HFO was performed by decreasing the oxygen concentration. The patients stopped HFO when their oxygen concentration was 30-40% without tachypnea. Those patients who had a saturation over 92% without respiratory distress, ventilatory support, positive inotropes or any organ failure were discharged from the PICU by the attending doctor and were followed up until discharge from the hospital.

Ethical considerations: Ethical approval was obtained from Dr. Sami Ulus Research Hospital Review Board (approval number: E22/03-294, date: 02.03.2022). With the admission of the subject to PICUs, written approval including informed consent about this study was obtained from the family.

Statistical Analysis

Data were expressed as descriptive statistics, percentages or medians as appropriate. We started our empirical analysis by reporting descriptive statistics (Table 1 and the accompanying discussion). Table 2 presents pairwise correlations between all the variables in the analyses. We also report the significant cases of correlation. In the next step, we employed multivariate analysis in order to check for confounding factors. In this observational study (i.e., not experimental), the patients' attributes were not under the control of the researcher. Hence, unlike experimental risk factors, they were not necessarily balanced among the samples. These unbalanced attributes can lead to a bias in the findings if not accounted for. Multivariate analysis allowed us to check for these potential biases. The dependent variables are continuous variables, so we performed Poisson regression analysis and negative binomial regression analysis. We also corrected the standard errors for heteroscedasticity. The analyses were performed using Stata/SE 15.1.

RESULTS

During four months, we recorded 86 patients in our study, however, 2 patients were excluded because of their history of prematurity and one

Table 1. Descriptive analysis

Parameters	Factor	Number of patients	Number (%)	Median (min.-max.)
Age	Months	79		6 (1-36)
PRISM III	Score	79		6 (0-28)
CRP	Mg/dL	79		3 (0.1-97)
PICU stay	Days	79		5 (1-38)
Hospital stay	Days	79		9 (3-64)
Sex	Male	79	53 (67.01)	
PRESS	Severe	79	29 (36.71)	
Risk factors				
	Age less than 6 months	79	45 (56.96)	
	Passive cigarette smoke exposure	79	43 (54.43)	
	Previous hospitalization	79	28 (35.44)	
	School age sibling	79	20 (25.31)	
	Prenatal smoke exposure	79	14 (17.72)	
	RSV positivity	64	27 (42.19)	
	Influenza positivity	63	5 (7.94)	
	Attending nursery	79	2 (2.53)	
	Household over five people	79	15 (18.00)	

PRISM III: Pediatric Risk of Mortality III, CRP: C-reactive protein, PICU: Pediatric intensive care unit, PRESS: Pediatric Respiratory Severity Score, min.: Minimum, max.: Maximum.

patient was excluded because of congenital heart disease. Two patients were excluded because they were over 36 months old. Among the rest, two other patients had missing information on their risk factors. The remaining 79 patients were included. 53 of these 79 (67.01%) were male. Their median age was 6 months and 45 of the 79 (56.96%) patients were equal to or less than 6 months old (Table 1). Their median ICU stay was 5 (2-38) days and their median hospital stay was 9 (3-64) days (Table 1).

Ten patients were intubated (12.05%), nine of these ten patients received NIV treatment either before or after intubation, 66 (83.54%) patients were treated with NIV, 51 (64.56%) of them were treated only with HFO therapy, 6 (7.59%) of them were treated only with continuous positive air pressure with or without pressure support (CPAP ± PS), 9 (11.39%) patients were treated with a combination of CPAP ± PS and HFO therapy. The mean duration for NIV ventilation was 4.75 days [standard deviation (SD): 4.26 days]. Three (3.79%) patients needed neither NIV nor invasive ventilation. We found no correlation between these ventilation support therapies and the risk factors.

All cases in our study had either moderate or severe PRESS severity scores. Although severe cases were hospitalized in the PICU for longer (mean: 9.03, SD: 9.42 days) than moderate cases (mean: 6.60, SD: 7.22 days), this difference was not statistically significant (p=0.189). A similar statistically insignificant relationship was detected for the length of hospital stay (mean: 10.67 vs. 14.58 days, p=0.118).

Univariate analysis showed that PRISM III scores, prenatal smoke exposure and previous hospitalizations were associated significantly with the lengths of PICU and hospital stays (Table 2). Also, there were significant correlations among the explanatory variables such as higher PRISM III scores and higher PRESS scores (correlation r=0.25), passive cigarette smoke exposure and PRISM III scores (r=0.34), passive cigarette smoke exposure and prenatal smoke exposure (r=0.42), previous hospitalization, PRISM III and PRESS scores (r=0.27). Older age was also found to be correlated with higher PRESS scores.

Multiple regression analysis showed that only prenatal smoke exposure was related with longer PICU and hospital stays (Table 3). According to the PRESS scores, severity levels had no statistically significant effect on the lengths of PICU or hospital stays.

Table 2. Pairwise correlations between risk factors, PRESS score and PICU stay duration

Factors	PICU stay	PRISM III	PRESS score	CRP	Age	Male	Passive exposure	Prenatal exposure	School age sibling	Attending nursery	Previous hospitalization
PRISM III	**0.37***										
PRESS score	0.09	**0.25***									
CRP (mg/dL)	0.15	0.11	-0.10								
Age (months)	0.20	0.07	**0.36***	-0.02							
Male	0.04	0.05	**-0.26***	0.10	-0.07						
Passive cigarette smoke exposure	0.08	**0.34***	-0.10	0.15	-0.20	-0.15					
Prenatal smoke exposure	**0.34***	**0.26***	0.15	-0.12	0.04	**-0.24***	**0.42***				
School age sibling	-0.08	0.02	0.19	0.09	-0.02	-0.03	-0.05	-0.04			
Attending nursery	-0.07	-0.04	-0.04	-0.05	-0.15	0.11	-0.01	-0.07	-0.09		
Previous hospitalization	**0.28***	**0.27***	**0.27***	-0.05	0.12	-0.04	0.20	0.21	-0.07	-0.12	
Household over five people	0.16	-0.01	-0.03	-0.06	-0.10	-0.00	**0.25***	**0.28***	-0.13	0.13	0.18

Number of patients: 79, *p<0.05, PICU: Pediatric intensive care unit, PRESS: Pediatric Respiratory Severity Score, CRP: C-reactive protein.

Table 3. Poisson regression analysis of risk factors affecting PICU and hospital stay

	PICU stay				Hospital stay			
	Beta	95% CI		p-value	Beta	95% CI		p-value
PRISM III	0.042	-0.002	0.086	0.063	0.038	-0.003	0.079	0.07
PRESS score severity	0.289	-0.098	0.676	0.144	0.272	-0.115	0.66	0.169
Age younger than six months	0.082	-0.273	0.436	0.652	0.012	-0.282	0.305	0.938
Male	0.269	-0.116	0.654	0.171	0.233	-0.152	0.619	0.235
Passive cigarette smoke exposure	-0.528	-0.981	-0.074	0.023	-0.373	-0.715	-0.031	0.033
Prenatal smoke exposure	**0.816**	**0.325**	**1.306**	**0.001**	**0.528**	**0.057**	**0.998**	**0.028**
School age sibling	-0.21	-0.692	0.272	0.393	-0.292	-0.681	0.098	0.142
Attending nursery	-0.323	-1.28	0.634	0.508	-0.049	-0.742	0.644	0.89
Previous hospitalization	0.309	-0.207	0.826	0.24	0.258	-0.14	0.656	0.204
Household over five people	0.319	-0.174	0.813	0.205	0.32	-0.068	0.708	0.106
No of patients	79				79			
Pseudo R-sq	**0.263**				**0.246**			

p-value <0.05 is accepted as statistically significant, PICU: Pediatric intensive care unit, PRISM III: Pediatric Risk of Mortality III, PRESS: Pediatric Respiratory Severity Score, CI: Confidence interval, R-sq: R-squared.

DISCUSSION

Prenatal smoke exposure is associated with the development of bronchiolitis in term, non-low birth weight infants without a history of cardiac or pulmonary illness.[12] With a similar patient group, we showed that prenatal smoke exposure also correlates with longer PICU stays. Our multivariable model estimates 86% longer PICU stays for a children under 3 years of age with prenatal smoke exposure history if all other parameters are equal. Stevenson et al.[13] showed that maternal cigarette smoking during pregnancy increased the probability of requiring an ICU hospitalization in children hospitalized with bronchiolitis. The same study revealed that children exposed to prenatal smoking alone had a higher risk for PICU admission than those children who had been exposed to passive smoking as well. Our study showed that these patients not only had a higher chance for PICU admission when they had bronchiolitis, but also they would stay for longer in the PICU. All of these clearly show that exposure to prenatal smoking may cause permanent damage to the babies' lungs and predispose them to serious lung infections for the rest of their lives.

A meta-analysis showed that children exposed to passive smoking by any household member had a higher risk of developing bronchiolitis throughout their first two years of life.[14] However, in our study, the coefficient estimate for passive cigarette smoke exposure was unexpectedly negative. Our in-depth analysis shows that this counterintuitive finding was the result of the significant correlation between passive cigarette smoke exposure and prenatal smoke exposure (correlation coefficient: 0.42). When we included passive cigarette smoke exposure in the empirical model without accounting for prenatal smoke exposure, the coefficient estimate for passive cigarette smoke exposure was positive.[1]

Age was associated with higher PRESS scores in our study (correlation coefficient: 0.36). In a previous study including patients with premature-birth, low birthweight and congenital heart diseases, a lower age was found to be a significant risk factor for both intensive care and respiratory support.[15] However, similar to Sala et al.[12], a younger age was not associated with invasive ventilation, longer PICU stay or hospital stay in our study.

In some studies, crowded living environments, defined as 5 or more people living in the household, were associated with increased RSV related bronchiolitis hospitalization.[2,16] However, in the FLIP-2 study, crowded households were not determined to be risk factors for bronchiolitis hospitalization.[17] In our study, households over 5 people were associated with higher rates of prenatal smoke exposure and passive smoke exposure (correlation coefficient: 0.28 and 0.26 respectively). The multivariate model did not show any relationship between crowded households and the length of PICU stay.

Only 2 children were attending nursery/school before hospitalization. In our sample, only 5 (out of 79) patients were older than 24 months. Most of the nurseries in Türkiye for very young children are private and not affordable for the parents of our patients. Therefore, our data was not sufficient to analyze the effects of nursery attendance on the length of bronchiolitis patients' hospital stay.

This study was carried out during the viral infection epidemic season. It has been shown that exposure to RSV was a risk factor for higher rates of hospitalization.[18] We did not test every patient for viral infections. Therefore, we did not include RSV or influenza in the main multivariate analysis. Multivariable analysis including the RSV variable showed that the coefficient estimates of this smaller sample for the main variables of interest were very similar to Table 3 and RSV or influenza positivity were not associated with longer PICU stays.[1]

Our secondary aim was to evaluate the relationship between the risk factors and the PRESS scores and to find out if the PRESS scoring system is useful in estimating the length of PICU stay. Thokngaen and Karoonboonyanan[19] showed that PRESS severity scoring could be helpful in evaluating patients' intensive care needs. We found that the PRESS score was positively correlated with the PRISM 3 scores, age, and previous hospitalizations and negatively correlated with male gender. However, we demonstrated that there was no correlation with higher PRESS scores and longer PICU or hospital stays.

Study Limitations

The number of patients was our most obvious limitation. If we had had more patients, we might have had the chance to comment on the effects of risk factors and/or PRESS scores on respiratory treatment modalities. More patients are needed in future studies in order to understand which patients are at higher risk of invasive ventilation or longer PICU stays. Another obvious limitation in our study was that the patients' family history of asthma and wheezing child were not taken into consideration. Last but not least, all of the patients should have been tested for seasonal viruses and these viral infections should have been included in the regression analysis.

CONCLUSION

In our study, prenatal smoke exposure was the only independent risk factor for longer stays in the intensive care unit and hospital for term-born bronchiolitis patients less than 3 years old who had been hospitalized in a PICU during winter. In contrast with the literature, in our study group, a younger age was not related with longer PICU stays. We also showed that the PRESS scoring system was not useful in estimating the length of PICU or hospital stay.

MAIN POINTS

- Bronchiolitis is a common respiratory infection in children under 3 years of age caused by a virus.
- This study was conducted to determine the risk factors for longer stays in intensive care for term-born bronchiolitis patients under the age of 3 years and to evaluate the efficacy of the PRESS scoring system.
- This study found that prenatal smoke exposure was the only independent risk factor for longer stays in intensive care for term-born bronchiolitis patients under 3 years of age.

ETHICS

Ethics Committee Approval: Ethical approval was obtained from Dr. Sami Ulus Research Hospital Review Board (approval number: E22/03-294, date: 02.03.2022).

Informed Consent: Written approval including informed consent about this study was obtained from the family.

Authorship Contributions

Surgical and Medical Practices: H.T., S.E., S.K., E.A., Concept: H.T., S.E., S.K., E.A., Design: H.T., S.E., S.K., E.A., Data Collection and/or Processing: H.T., S.E., S.K., E.A., Analysis and/or Interpretation: H.T., S.E., S.K., E.A., Literature Search: H.T., S.E., S.K., E.A., Writing: H.T., S.E., S.K., E.A.

DISCLOSURES

Conflict of Interest: No conflict of interest was declared by the authors.

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RESEARCH ARTICLE

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Examining the Effectiveness of Low-Level Laser Treatment Applied to the Upper Back Region in Individuals with Myofascial Pain Syndrome

Ayşegül Akgül Kocabal[1], Osman Hakan Gündüz[2]

[1]Department of Physiotherapy and Rehabilitation, Yavuz Selim Osteopathic and Rehabilitation Hospital, Trabzon, Türkiye
[2]Department of Physical Medicine and Rehabilitation, Marmara University Faculty of Medicine, İstanbul, Türkiye

Abstract

BACKGROUND/AIMS: The aim of this research was to examine the effects of the low-level laser therapy (LLLT) application on pain, emotional state, disability, and range of motion (ROM) in myofascial pain syndrome (MPS).

MATERIALS AND METHODS: Sixty patients diagnosed with MPS and randomly divided into treatment and control groups were included in this study. The study group was given LLLT applications at four points on the upper trapezius, while the control group received placebo LLLT. Pain was evaluated using a visual analogue scale, neck ROM using an inclinometer, pain pressure thresholds using an algometer, emotional state using the Beck Depression Inventory, and disability using the Neck Pain and Disability Scale. The effectiveness of the treatment was evaluated by comparing the pre-treatment, post-treatment and first-month results in each group.

RESULTS: The mean ages were 40.4±8.58 years in the treatment group and 37.6±8.88 years in the control group. A significant decrease was observed in the treatment group in terms of pain at the end of treatment and at the first month ($p=0.040$). Similarly, improvement was observed in both groups in terms of emotional state and disability at the conclusion of treatment and at the first month ($p=0.492$, $p=0.497$). In terms of neck ROM, marked improvement compared to the control group was only observed in left lateral flexion measurements at the conclusion of treatment and at the first month ($p=0.010$). Improvements in pain pressure thresholds were significant in both groups ($p<0.05$).

CONCLUSION: The LLLT application exhibited more positive effects than the placebo in MPS patients.

Keywords: Laser, myofascial pain syndrome, trigger point, trapezius

INTRODUCTION

Myofascial pain syndrome (MPS) is a musculo-skeletal disease with trigger points in at least one muscle or connective tissue and progressing with symptoms such as pain, spasms, sensitivity, movement restriction, weakness, and rarely autonomic dysfunction.[1,2] Although factors such as macro and micro trauma, muscle hypercontraction, physical fatigue, psychological stress, and genetic factors have been proposed, the etiology of MPS is still unclear and it has not been attributed to a single factor.[3] Pain, the most pronounced symptom, may be mild or unbearable, sharp or blunt, and continuous or periodic. Trigger points are decisive in this context and are directly proportional to the level of sensitivity and spread.[4] The upper back region is mostly affected in terms of increased trigger points. It is very common in the M. trapezius. Therefore, patients with MPS suffer from pain pressure sensitivity in this region.[5]

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ORCID IDs of the authors: A.A.K. 0000-0001-5256-632X; O.H.G. 0000-0002-3214-803X.

Address for Correspondence: Ayşegül Akgül Kocabal
E-mail: fzt.aysegul@hotmail.com
ORCID ID: orcid.org/0000-0001-5256-632X

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***The results of this study were presented as a presentation on June in 2009 at the 13th-17th 5th International World Congress of the ISPRM in İstanbul, Türkiye.**

The basic aims in the treatment of MPS are to ameliorate the pain, increase muscle strength, and achieve a full range of motion (ROM) and the appropriate posture of the joint associated with the affected muscle.[6] In addition, since MPS also adversely affects the individual's emotional state and disability status, it is important for treatment to yield psychosocial benefits as well. Studies have reported a higher risk of depression in individuals diagnosed with MPS than in healthy individuals. The relationship between depression level and pain severity is also noteworthy.[7] Since pain leads to restrictions in functional activities, neck disability increases in parallel with the duration of MPS.[8]

Therapeutic methods in MPS include lifestyle modification, medications, stretching exercises, acupuncture, injections, manual therapy, ultrasound, low-level laser therapy (LLLT) applications, electrical stimulation, transcutaneous electrical nerve stimulation (TENS), mesotherapy, massage therapy, and biofeedback.[9,10] Significant progress has been made in the diagnosis and treatment of MPS in recent years. However, no agreed disease management protocol has yet emerged.[11] Light amplification by stimulated emission of radiation (LASER) therapy is a reliable physical therapeutic agent which has been employed for many years. Since the therapeutic LLLT dosage increases tissue temperature by less than 0.5 °C, its effects are not thought to be due to warming alone. Various attempts have been made to explain the analgesic effects of LLLT.[12] Another therapeutic LASER application is the high-intensity laser therapy (HILT) application which is commonly used in the therapeutic protocols of physiotherapy. The main difference between HILT and LLLT is that the more powerful beams (power >500 mW) are irradiated to penetrate deeper, bringing the desired high amount of multi-directional energy to the deep tissues in a short time.[13] Determining the effectiveness of LLLT in MPS and its biopsychosocial effects will make a significant contribution to the existing literature.

The primary aim of this study was to investigate the impacts of LLLT on reducing pain intensity and disability, and on increasing neck ROM and the emotional state in those patients diagnosed with MPS.

MATERIALS AND METHODS

This study was performed with 60 patients (51 women, and nine men) presenting at the Marmara University Faculty of Medicine, Department of Physical Medicine and Rehabilitation, Türkiye. Patients aged 18-50 years and diagnosed with MPS who had pain in their upper back region were enrolled in this study. A total of 4 points were applied. The points which were bilateral and the most painful were selected. When the selected trigger points were palpated, explosive and spontaneous pain occurred. Those patients diagnosed with fibromyalgia syndrome based on ACR criteria, with cervical disc lesion, cervical radiculopathy, or myelopathy, those who had undergone neck or shoulder surgery within the year prior to this study, those using drugs due to psychological problems and pregnant women were excluded from this study (Supplementary Figure 1).

This study was approved by the Ethics Committee of Marmara University Faculty of Medicine (approval number: MAR-YÇ-2007-0214, date: 30.11.2007).

The patient who consented to take part in this study were informed about the research aims and methodology. Written consent was received from all the individuals taking part. The participants' sociodemographic characteristics (sex, body weight, and height) were recorded (Table 1). Data were collected using a visual analogue scale (VAS), the Beck Depression Inventory (BDI), and the Neck Pain and Disability Scale. Joint neck ROM and pain pressure thresholds were also measured.

Study Design/Procedure

Evaluations were performed at the beginning and conclusion of the treatment, and again four weeks following the completion of the treatment. The patients received 10 treatment sessions, five times a week for two weeks. The Ga-Al-As laser, which emits a continuous beam of 830 nm with a power density of 0.9 Joule/cm^2 for 30 seconds, in full contact, at right angles to four points on the upper trapezius in the neck region, was applied to the treatment group for 20 minutes, together with a hot pack for 20 minutes, timed TENS, and stretching exercises. The control group received a placebo laser for 20 minutes, a hot pack for 20 minutes, TENS, and stretching exercises. The placebo laser was applied when machine was turned off. However, the patient believed it was turned on. A home exercise program was designed as three sets of 20 repetitions each and it included isometric neck exercises and joint neck ROM exercises. Each patient was shown the exercise program and asked to apply it every day for a period of one month. The study subjects did not use any analgesics.

Outcome Measurements

Visual analog scale: It measures the intensity of pain. It consists of a 10 cm horizontal line with zero indicating "no pain" and ten indicating "unbearable pain".[14]

Neck range of motion measurement: Measurements were performed using a Chattanooga Baseline Bubble inclinometer. Neck flexion, extension, bidirectional lateral flexion, and rotation were measured using an inclinometer. Flexion was measured with the patient in a seated position and with the inclinometer on the apex of the head in the sagittal plane. The inclinometer was zeroed with the patient's head facing forward. The patient was asked to incline their neck forward without using the trunk, and the value shown on the inclinometer was recorded. Neck extension was performed in the same position, with the patient being asked to lower their head backward. Lateral flexion was also measured with the patient in a sitting position. The inclinometer was installed in the coronal plane. The patient was asked to bring his ear to his shoulder, and the value shown on the inclinometer was recorded. The patient was placed in the supine position for rotation measurements. A thin towel was place beneath the head to keep it central. The inclinometer was placed on the patient's forehead in the transverse plane. The patient was asked to turn their head in both directions, and the value on the inclinometer was recorded.[15]

Pain pressure threshold measurement: Measurements were taken using a pressure algometer. This semi-quantitative method is employed for assessing pressure pain sensitivity in tissues and for locating abnormal sensitivity in sensitive areas, trigger points, muscles, and bones. Pain pressure thresholds were determined using the algometer. The Wagner Instruments (Greenwich, CT, USA) brand pressure algometer used in this study consisted of a metal piston with a 1 cm^2 round disc attached to a dial used to measure pressure in both kilograms and pounds. The operator can hold the dial and apply it to the desired part of the body. The dial was calibrated up to 2.5 kg at 25 g intervals. The pressure resulting from the dial being continually pressed against the skin causes the dial hand to move in a clockwise direction. When the device is removed, the needle continues to point to the last measured

Table 1. Sociodemographic data

Features		Study group, (n=30)	Control group, (n=30)	p
Gender	Female	26	25	1
	Male	4	5	
Marital status	Married	26	20	0.125
	Single	4	10	
Employment	Working	13	15	0.343
	Housewife	15	15	
	Student	2	0	
Education	Illiterate	1	1	0.296
	Elementary	12	7	
	Middle school	5	7	
	High school	4	10	
	University	8	5	
Systemic disease	Yes	0	0	1
	No	30	30	
Smoking status	Smoker	7	9	0.447
	Non-smoker	23	21	

value.[8] Once the procedure had been explained, the patient assumed a sitting position in a chair and was allowed to relax completely. The trigger points on the upper trapezius were first identified and marked, after which the metal rod of the pressure algometer was placed on the marked site in a vertical direction. The compression pressure was gradually increased, and the patient was asked to indicate when they felt pain or discomfort, at which time the pressure was stopped.

Beck Depression Inventory: The BDI was developed by Beck in 1967. The reliability and validity of the Turkish-language version were investigated by Hisli[16]. This inventory consists of the patient's selection of somatic, affective (perceptual), and cognitive (sensory) functions over 21 items. These items are ranked from neutral (scored as 0) to severe (scored as 3). The patient reads the items and selects the most appropriate response. The highest possible score is 63. Scores of 1-13 indicate "no depression", scores of 14-24 indicate "moderate depression", and scores of 25 or more indicate "severe depression."

Neck Pain and Disability Scale: This scale was employed for a functional evaluation of the disability levels in the individuals in this study. The Neck Pain and Disability Scale consists of 20 items. Each item is scored using a 10 cm VAS, values ranging between 0 and 5. Total scores are calculated by adding the different item scores and range between 0 and 100. Higher scores indicate more severe pain and impact. The Turkish validity study of this scale was performed by Bicer et al.[17] in 2004.

Randomization and allocation: The participants were divided into two groups, either into the study group or the control group. Lots were drawn to achieve this with the patients blindly selecting balls of different colors. The ball which was selected by them was opened by the researcher, and the groups were determined. According to a homogeneity test, the two groups were homogeneous (Table 1) ($p>0.05$).

Statistical Analysis

Student's t-test was applied to compare the groups' qualitative characteristics (such as age, weight, and height) when the data was normally distributed, and the chi-square test was used in the comparison of categorical characteristics (such as sex, marital status, occupation, smoking status, pack-year values among smokers, and systemic disease).

The groups' pre-treatment, post-treatment and first-month evaluations were compared with the repeated measures ANOVA test as the data was normally distributed. For intra group analysis (in pairwise comparisons), the paired t-test was used to compare pre-treatment and post-treatment, and also post-treatment and first-month measurements for normally distributed data. During the statistical analysis, two-sided p-values were adopted, and values <0.05 were regarded as statistically significant.

Sample size calculation: In this study, a priori sample size calculation was carried out with the G*Power software 3.1.9.4 program (Heinrich-Heine Universität Düsseldorf, Düsseldorf, Germany). In order to examine changes between repeated measurements over time (before, after, 1st month) in the two groups, it was determined that the number of samples should be at least 24 in total in each group, considering an error of 0.05, a power of 0.80 and an effect size of 0.05. Therefore, a total of 30 participants were included in each group of this study.

RESULTS

Intra-group analysis revealed significantly lower pain severity in both groups immediately after treatment compared to pre-treatment ($p<0.001$ for both). Pain severity also decreased significantly one month after treatment compared to pre-treatment ($p<0.001$). In the control group, a significant decrease was observed in the post-treatment and one-month values compared to pre-treatment ($p<0.01$ for both). Inter-group comparisons revealed significantly lower pain severity on the completion of treatment and after one month in the study group compared to the baseline values ($p=0.01$ and $p=0.04$, respectively) (Table 2).

Intra-group analysis revealed a significant decrease in the risk of depression immediately after the completion of treatment compared to the baseline in both groups ($p<0.001$ for both). The risk of depression also decreased significantly in both groups immediately and one

Table 2. Intra-group and inter-group comparisons of pain severity, emotional state, and disability

Measure	Study group, (n=30) Mean ± SD	Control group, (n=30) Mean ± SD	p
Pain severity			
Pre-treatment	7.16±1.82	6.08±1.71	
Post-treatment	4.04±1.91	4.84±1.95	**0.010***
One month after treatment	2.92±2.21	4.95±2.07	**0.040***
p	**0.0001***	**0.0015***	
Emotional state			
Pre-treatment	14.3±8.35	12.8±7.47	
Post-treatment	10.8±6.35	10.9±6.4	0.385
One month after treatment	9.73±6.62	12.7±8.64	0.492
p	**0.0001***	**0.0001***	
Disability			
Pre-treatment	58.0±14.5	54.5±16.6	
Post-treatment	45.3±16.2	46.5±17.8	0.216
One month after treatment	41.7±19.6	45.1±14.4	0.497
p	**0.0001***	**0.0017***	

Repeated measures ANOVA test, Paired t-test, SD: Standard deviation.

month after treatment compared to pre-treatment values ($p<0.001$). Inter-group comparisons revealed no significant difference in the pre-treatment values or in those immediately or one month after treatment ($p>0.05$ for all) (Table 2).

Intra-group analyses revealed a statistically significant decrease in terms of disability status immediately after treatment compared to pre-treatment ($p<0.001$ for both). Significant decreases were observed in both groups immediately after and one month after treatment compared to the baseline ($p<0.001$ for both). No significant difference was observed between the groups in terms of pre-treatment, immediately post-treatment, or one-month post-treatment values ($p>0.05$) (Table 2).

Intra-group analyses revealed a significant increase between repeated all neck ROM measures (pre-treatment, immediately post-treatment and one-month post-treatment) ($p<0.001$) in both groups (Table 3).

Significant differences were observed between the groups in terms of left lateral flexion values immediately after treatment, and after one month ($p<0.001$ for all). However, no significant differences emerged between the groups in terms of flexion, extension, right lateral flexion, or right and left rotation values ($p>0.05$ for all) (Table 3).

No significant changes were registered in the control group after treatment compared to the baseline in the pain pressure threshold values in the right and left trapezius first and second trigger points ($p>0.05$). In the study group, however, significant increases were observed in the values immediately after treatment and in the first month in the right and left trapezius first and second trigger points compared to the pre-treatment values ($p<0.01$ and $p<0.001$, respectively). The differences between the two groups were statistically significant ($p<0.001$) (Table 4).

DISCUSSION

The findings emerging from this research suggest that LLLT is effective in reducing pain severity in MPS, improving emotional state, reducing disability, and increasing neck ROM. The patients' most important complaint in MPS is pain. A previous study suggested that the application of LLLT in MPS reduced pain complaints when at rest and during activity.[18] In their study of patients with MPS, Kavadar et al. [19] examined VAS and algometric measurement parameters and found that pain complaints and trigger point sensitivity decreased significantly in both groups immediately and one month after ultrasound therapy compared to baseline pre-treatment values, while pain thresholds increased significantly, although the improvement in the treatment group was significantly more. In the present study, the severity of pain decreased significantly in the study group compared to the control group, and the pain thresholds in the study group increased compared to their pre-treatment values. There was also another study which reported a significant decrease in pain when at rest and during activity in a laser group compared to a placebo group.[20]

ROM assessment is an important follow-up parameter in MPS. A previous study involving ultrasound in patients with MPS concluded that the stretch level of the upper trapezius muscle was powerfully correlated with a decrease in neck ROM, pain, and disability caused by MPS and with the pain threshold. Increased tension in the trapezius muscle also increases pain, disability, and the pressure pain threshold. This finding shows that the therapeutic methods applied in the present and other studies increased neck ROM by reducing tension in the trapezius muscle.[21] Another study's results showed significant statistical evidence for the short-term effectiveness of LLLT in the treatment of patients with myofascial neck pain in terms of improvements in pain, pain pressure thresholds, and neck ROM.[22]

Yağcı et al. reported an increase in neck ROM values in individuals with MPS following connective tissue massage and exercise education. Another study involving MPS suggested that dry-needling, kinesiology taping, and dry cupping improved neck ROM.[23] Similarly, in the present study, improvement was observed in almost all neck ROM measurements in both groups. Further studies are now needed to reveal the effects of LLLT on neck ROM in MPS patients.

Table 3. Intragroup and intergroup comparisons of joint range of movement			
ROM	**Study group, (mean ± SD)**	**Control group, (mean ± SD)**	**p**
Flexion			
Pre-treatment	50.3±15.0	50.9±13.7	
Post-treatment	58.4±14.4	56.0±13.7	0.258
One month after treatment	58.1±13.7	58.4±15.1	0.411
p	**<0.001***	**<0.001***	
Extension			
Pre-treatment	45.4±14.5	52.7±18.8	
Post-treatment	53.4±17.1	57.8±16.8	0.265
One month after treatment	54.3±17.4	58.6±18.4	0.989
p	**<0.001***	**<0.001***	
Right lateral flexion			
Pre-treatment	33.0±11.8	32.2±11.0	
Post-treatment	42.5±10.9	38.4±11.8	0.109
One month after treatment	44.1±12.3	37.9±13.5	0.238
p	**<0.001***	**<0.001***	
Left lateral flexion			
Pre-treatment	37.3±9.40	36.6±12.7	
Post-treatment	44.9±9.84	44.8±13.6	0.778
One month after treatment	47.7±11.0	43.5±14.6	**0.010***
p	**<0.001***	**<0.001***	
Right rotation			
Pre-treatment	60.9±18.7	65.4±17.6	
Post-treatment	69.7±17.1	71.4±16.6	0.312
One month after treatment	70.0±20.0	72.6±16.9	0.649
p	**<0.001***	**<0.001***	
Left rotation			
Pre-treatment	69.0±15.5	69.6±16.2	
Post-treatment	74.7±13.9	74.7±12.9	0.808
One month after treatment	76.3±16.1	75.8±13.3	0.818
p	**<0.001***	**<0.001***	

ROM: Range of motion, SD: Standard deviation.

The literature shows that LLLT exhibits long-term effectiveness in overcoming pain and symptoms in patients with MPS.[24] LLLT has been shown to reduce trigger point sensitivity in patients with MPS and to increase the pressure pain threshold at trigger points.[24] In line with the previous literature, LLLT also lowered pain while raising the pressure pain threshold in the current research. However, further studies are needed on this issue.

The trigger point pressure pain threshold in patients with MPS is lower than average. Ilbuldu et al.[25] compared LLLT, dry needling, and placebo laser in patients with trigger points in the upper trapezius. Those authors reported a significant alteration in rest and activity pain and pain thresholds in the group receiving LLLT treatment compared to the other groups.

Another study investigated pain threshold measurements with the application of ultrasound, Kinesio taping, and placebo ultrasound on trigger points and they reported significant decreases in algometry measurements in all three groups after treatment.[26] Similarly, in the present study, pain pressure threshold measurements decreased significantly in the study group compared to the control group. We think that LLLT can be applied to trigger points due to its non-invasive and painless nature, as well as ease of application. However, we also think that it is important to adopt a comprehensive approach including stretching and relaxation exercises, the maintenance of proper posture, and lifestyle changes in order to provide long-term therapeutic efficacy. Various parameters associated with dosage, wavelength, duration of treatment, and application sites should be investigated in future studies on this subject.

Study Limitations

There are two limitations of this study. The first is that the number of studies examining its biopsychosocial effects has been insufficient to interpret the results. Based on this, there is a need for well-conducted clinical trials with a better standardization of the parameters to be used in the treatment of this syndrome. The second limitation is that the placebo effect was not investigated thoroughly. Another group to which no treatment was applied was needed in order to determine this.

Table 4. Intra- and inter-group pain pressure threshold comparisons			
	Study group, (mean ± SD)	**Control group, (mean ± SD)**	**p**
Right M. trapezius 1st trigger point pain pressure threshold			
Pre-treatment	1.94±0.44	1.91±0.49	
Post-treatment	2.14±0.31	1.91±0.47	**<0.001**
One month after treatment	2.25±0.31	1.93±0.44	**<0.001**
p	**<0.001***	0.8664	
Right M. trapezius 2nd trigger point pain threshold			
Pre-treatment	1.92±0.35	1.78±0.50	
Post-treatment	2.08±0.29	1.82±0.08	**<0.001**
One month after treatment	2.25±0.23	2.01±0.26	**<0.001**
p	**<0.001***	0.3727	
Left M. trapezius 1st trigger point pain pressure threshold			
Pre-treatment	2.03±0.15	1.91±0.47	
Post-treatment	2.13±0.29	1.91±0.47	**<0.001**
One month after treatment	2.26±0.33	1.98±0.43	**<0.001**
p	**<0.001***	0.4682	
Left M. trapezius 2nd trigger point pain			
Pre-treatment	1.97±0.45	1.84±0.46	
Post-treatment	2.12±0.36	1.89±0.44	**<0.001**
One month after treatment	2.25±0.27	1.97±0.44	**<0.001**
p	**<0.001***	0.1142	
Repeated measures ANOVA test, Paired t-test, SD: Standard deviation.			

CONCLUSION

Taken as a whole, our results showed that LLLT is effective in reducing trigger point sensitivity. Exercise programs which include the suppression of triggering factors, posture training, and stretching tense and short muscles while strengthening weak muscles can be highly beneficial in achieving long-term therapeutic efficacy. In conclusion, LLLT might be employed as a therapeutic option in patients with MPS. Further studies are now needed on this subject.

MAIN POINTS

- LLLT is more effective than placebo laser at reducing the pain intensity and improving the emotional state of individual with MPS.
- LLLT is more effective than placebo laser at reducing disability and increasing neck ROM in individual with MPS.
- LLLT reduces the trigger point sensitivity and increases the pressure pain threshold in individuals with MPS.

ETHICS

Ethics Committee Approval: This study was approved by the Ethics Committee of Marmara University Faculty of Medicine (approval number: MAR-YÇ-2007-0214, date: 30.11.2007).

Informed Consent: Written consent was received from all the individuals taking part.

Authorship Contributions

Concept: A.A.K., O.H.G., Design: A.A.K., O.H.G., Supervision: A.A.K., Data Collection and/or Processing: A.A.K., Analysis and/or Interpretation: A.A.K., Literature Search: A.A.K., O.H.G., Writing: A.A.K.

DISCLOSURES

Conflict of Interest: No conflict of interest was declared by the authors.

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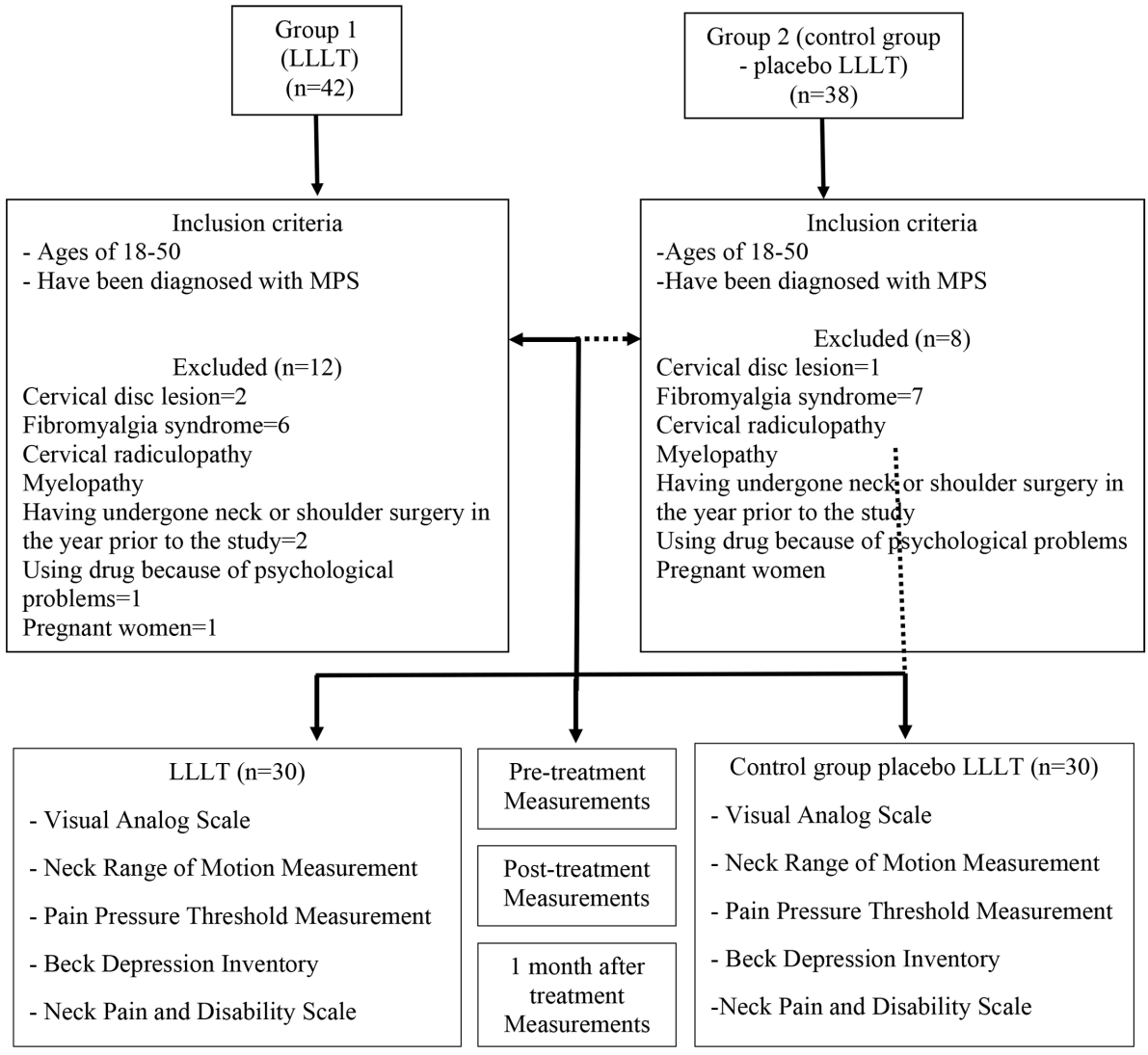

Supplementary Figure 1. The flow diagram.

RESEARCH ARTICLE

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Hypertension Control in North Cyprus and the Feasibility of Life Style Changes

Ersan Berksel[1], Cangül Tuncay[1], Cenk Conkbayır[2], Aslı Aykaç[3]

[1]Cyprus Science University Faculty of Health Sciences, Kyrenia, North Cyprus
[2]Department of Cardiology, Near East University Faculty of Medicine, Nicosia, North Cyprus
[3]Department of Biophysics, Near East University Faculty of Medicine, Nicosia, North Cyprus

Abstract

BACKGROUND/AIMS: Hypertension (HT) is a significant preventable risk factor for cardiovascular disease, stroke, and chronic kidney disease. It is defined as systolic blood pressure ≥140 mmHg, or diastolic blood pressure ≥90 mmHg, or both, and is often linked to obesity. Around 75% of HT cases are directly related to obesity. Effective blood pressure (BP) control in hypertensive patients relies on medical treatment and lifestyle adjustments. However, no prior study in North Cyprus had examined HT control and recommended lifestyle changes.

MATERIALS and METHODS: This study, conducted between May and August, 2022, involved 185 hypertensive patients in North Cyprus. Data collection included height and weight measurements, along with a 14-point questionnaire in order to assess BP values and lifestyle habits. Statistical analysis was performed using IBM® SPSS Statistics Version 18.0.

RESULTS: The results revealed that only 42.7% of participants had controlled their BP and that a significant 83.8% were overweight or obese. Most patients did not adhere to the recommended daily salt intake, engage in regular physical activity, or maintain a healthy diet. Specifically, 76.8% consumed more than the recommended 5-6 grams of salt daily, and 55.1% favored animal-based foods over fruits and vegetables. In terms of physical activity, 88.1% did not engage in activities such as swimming, biking, running, or brisk walking for the recommended 30-45 minutes daily. Furthermore, 28.1% of hypertensive patients smoked. Alcohol consumption was low, with 43.2% reporting that they never consumed it.

CONCLUSION: The majority of hypertensive patients were overweight or obese, lacked BP control, and did not adhere to the recommended lifestyle changes. Notably, maintaining daily salt consumption below 6 grams was statistically associated with effective BP control in Turkish Cypriots. This underscores the importance of lifestyle modifications in HT management.

Keywords: Hypertension, blood pressure, obesity, lifestyle changes

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ORCID IDs of the authors: E.B. 0000-0003-0528-3911; C.T. 0000-0002-4065-7344; C.C. 0000-0002-6594-1915; A.A. 0000-0002-4885-5070.

Address for Correspondence: Cangül Tuncay
E-mail: dytcangultuncay@gmail.com
ORCID ID: orcid.org/0000-0002-4065-7344

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INTRODUCTION

Hypertension (HT) is one of the most important preventable risk factors for cardiovascular disease, stroke, and chronic kidney disease when not detected early and treated appropriately. HT is defined as systolic blood pressure (SBP) ≥140 mmHg, or diastolic blood pressure (DBP) ≥90 mmHg, or both.[1] According to the World Health Organization, one in four adult males and one in five adult females have high blood pressure (BP), and only one in five patients with HT have their BP under control.[2]

Obesity is a major cause of HT. It is estimated that at least 75% of HT cases are directly related to obesity.[3] Therefore, it is essential to develop treatment strategies for obesity management in order to reduce the incidence of obesity-related HT and effectively manage high BP in obese individuals.

Studies indicate that, with the use of anti-hypertensive medication, only one-third of patients reached the targeted BP (SBP lower than 140 mmHg, DBP lower than 90 mmHg). Therefore, relying solely on antihypertensive medicines for BP control is both challenging and not the correct approach.[4,5]

Studies demonstrate that changes in the lifestyles of hypertensive patients are beneficial and effective in reducing cardiovascular risk and controlling BP.[6-9] The recommended lifestyle changes for hypertensive patients include reducing daily salt consumption, decreasing the intake of foods rich in dietary cholesterol and saturated fat from animal sources, minimizing fast food consumption, increasing daily physical activity, reducing alcohol intake, avoiding smoking, and controlling body weight.[10,11]

The aim of this study was to determine the proportion of hypertensive patients whose BP was under control and the proportion of participants who had adopted lifestyle changes accordingly in North Cyprus.

MATERIALS AND METHODS

This study was approved by the Ethics Committee of Cyprus Science University (approval number: 2022/12.002, date: 07.12.2022).

This research was conducted in North Cyprus between May and August, 2022. A total of 185 Turkish Cypriot citizens diagnosed with HT by medical doctors and aged between 18 and 80 years participated in this study. The patients were selected from various clinics and hospitals. Pregnant women, cancer patients, those with advanced heart failure, and those with advanced kidney insufficiency were excluded from this study.

A simple random sampling method was employed. A questionnaire consisting of 14 questions about daily physical activity, daily salt consumption, dietary habits, alcohol consumption, and smoking habits was administered. The reported daily salt consumption by the participants was based on their verbal information during face-to-face interviews regarding salt-rich foods. Specifically, they were asked about the salt content in commonly consumed items such as cheese, halloumi, and olives, as well as the amount of salt added during food preparation and after cooking. Additionally, the questionnaire covered pickles, salty dried nuts, fast food, mustard, ketchup, and bread consumption. The co-author, a dietitian, determined whether the salt intake exceeded 5-6 grams daily. The salt content was assessed based on portion sizes using the Nutrient Compound Scale and the National Nutrient Composition Database "Turkomp".[12] For example, 5 olives contain 0.587 grams of salt, 1 piece of halloumi (30 g) contains 0.78 grams, and 1 piece of white cheese (30 g) contains 0.96 grams. Furthermore, 1 dessertspoon of salt added during cooking corresponds to 5 grams of salt (the amount is calculated based on the number of people consuming the food).

BP measurements for the hypertensive patients were taken after a minimum of 5 minutes of rest in a seated position, at least twice, and the average of these two measurements was recorded. Participants with high BP were re-measured after 5 minutes. The BP readings for hypertensive patients were taken by the same doctor and using the same BP monitor.

Height and weight values were recorded in order to calculate the participants' body mass index (BMI). BMI is calculated by dividing the body weight in kilograms by the height in meters squared. Therefore, the height of the hypertensive patients was measured in meters without shoes, and their weight was measured without jackets and shoes on a scale, with an adjustment of approximately 1 kilogram for clothing. The evaluation categorized BMI as follows: 18.5-24.99 kg/m^2 as normal, 25-29.99 kg/m^2 as overweight, 30-39.99 kg/m^2 as obese, and ≥40 kg/m^2 as severely obese.

Statistical Analysis

The questionnaire forms were administered face-to-face, and for data analysis, the SPSS statistical program (IBM® SPSS Statistics Version 18.0) was utilized. Descriptive statistics included frequency, percentage, mean, average, and standard deviation, as well as minimum and maximum values for data analysis.

RESULTS

Eighty-one of the 185 hypertensive patients were female (43.8%) and 104 (56.2%) were male. In terms of the age distribution of the participants, 3.8% of them were 18-39 years, 37.3% of them were 40-59 years, and 58.9% of them were 60-80 years (Table 1).

Table 2 shows the BP measurement values of the hypertensive patients. 42.7% of them had normal BP, whereas 57.3% of them had higher than the normal BP.

When the implementation rates of lifestyles of the hypertensive patients were analyzed, their BMI was within the normal range (18.5-24.99 kg/m^2) for 16.2%, 46.5% were overweight (25-29.99 kg/m^2), 34.6% of them were obese (30-39.99 kg/m^2), and 2.7% of them were severely obese (≥40 kg/m^2). In other words, 83.8% of the patients had a BMI above the normal range.

Table 1. Distribution of hypertensive patients according to their sociodemographic characteristics

Sociodemographic characteristics	n	%
Gender		
Female	81	43.8
Male	104	56.2
Age group		
18-39	7	3.8
40-59	69	37.3
60-80	109	58.9

Table 2. BP measurement values of the patients

Blood pressure	n	%
Normal blood pressure (blood pressure under control)	79	42.7
Blood pressure higher than normal (blood pressure not under control)	106	57.3

BP: Blood pressure.

In terms of smoking, 24.9% of the participants had quit smoking, 28.1% were current smokers, and 47.0% had never smoked. Regarding alcohol consumption, 43.2% had never consumed alcohol, 44.3% consumed it very rarely, and 12.4% consumed more than two drinks at least twice a week.

When it came to daily salt consumption and dietary habits, the majority of the hypertensive patients consumed more than 5-6 grams. Specifically, 76.8% consumed more than 5-6 grams daily, while 23.2% consumed less than 5-6 grams.

Analyzing nutrition habits, 55.1% consumed foods of animal origin, whereas 44.3% consumed foods rich in fruits and vegetables. As for the daily physical activities of the participants, 88% of them did not engage in additional physical activities such as swimming, biking, running, or brisk walking for 30-45 minutes per day. 1.6% participated in physical activity once a week (Table 3). Additionally, 2.2% engaged in physical activity 2-3 times a week, and 8.1% were physically active on at least 5 days a week.

In this study, we found that especially reducing salt intake would lead to more effective BP control compared to other lifestyle changes ($p<0.05$) (Table 4).

DISCUSSION

HT is one of the most important preventable risk factors for cardiovascular disease, stroke, and chronic kidney disease when not detected early and treated appropriately. HT treatment involves a process which includes medical treatment, lifestyle changes, and lifelong patient training.[13]

When the BP controls of hypertensive patients were evaluated, there was a consistency with previous studies. In a 2017 study conducted with 211 hypertensive patients, 35.8% of the patients had their BP under control, while 70.4% did not.[14] According to another study with 380 hypertensive patients, 45.3% had their BP under control.[15] The results of a cross-sectional study in 2022 showed that 43.2% of the patients had their BP controlled, while 56.8% did not.[16] In our study, 42.7% of the participants had their BP under control, indicating consistency with the previous research.

Within the scope of this study, when evaluating the adaptation of lifestyle changes in hypertensive patients, the majority of the hypertensive patients (83.8%) had a body weight above the normal range. 46.5% of hypertensive patients were overweight, 34.6% were obese, and 2.7% were extremely obese. The prevalence of obesity is not only increasing in North Cyprus but also globally. Approximately 68% of US adults are either overweight or obese.[17] Weight gain is associated with increases in BP and the incidence of HT. It is estimated that at least 75% of the incidence of HT is directly related to obesity.[3]

In our study, 12.4% of hypertensive patients consumed more than two doubles of alcohol at least twice a week, and 44.3% consumed alcohol

Table 3. Lifestyle change application rates of the hypertensive patients

Lifestyle changes	n	%
Body weight control		
BMI 18.5-24.99 kg/m^2 (normal)	30	16.2
BMI 25.0-25.99 kg/m^2 (overweight)	86	46.5
BMI 30.0-39.9 kg/m^2 (obese)	64	34.6
BMI ≥40 kg/m^2 (extremely obese)	5	2.7
Smoking habits		
Quit smoking	46	24.9
Current smoker	52	28.1
Non-smoker	87	47.0
Alcohol consumption		
Sometimes	82	44.3
More than 2 doubles at least 2 days a week	15	8.1
More than 2 doubles per day	8	4.3
Never	80	43.2
Salt consumption		
Less than 5-6 grams per day	43	23.2
More than 5-6 grams per day	142	76.8
Food consumption		
Diet rich in saturated fat and cholesterol	102	55.1
Vegetable/fruit-based diet low in saturated fat and cholesterol	82	44.3
Vegetarian	1	0.5
Physical activity		
30-45 minutes brisk walking, jogging, swimming or cycling once a week	3	1.6
Walking, jogging, swimming or cycling for 30-45 minutes 2-3 days a week	4	2.2
30-45 minutes of brisk walking, running, swimming or cycling at least 5 days a week	15	8.1
Not doing any physical activity	163	88.1

BMI: Body mass index.

occasionally. Alcohol consumption increases the risk of obesity due to its high caloric content and it also raises BP. The pressor effect of alcohol has been established in clinical trials, with an estimated increase in SBP of 1 mmHg per 10 grams of alcohol.[18] 28.1% of hypertensive patients in our study smoked, and 28.9% of them had quit smoking. While there is no study demonstrating a direct reduction in BP from quitting smoking, it is necessary in order to prevent resistance against medical treatment and to reduce cardiovascular disease risks.[19] These results align with a study involving 525 individuals conducted in Türkiye in 2019 regarding smoking and alcohol consumption rates. In that study, 27.6% smoked and 9.3% consumed alcohol. According to a study conducted in South Cyprus in 2022, it was shown that 35.5% of the participants smoked.[20]

It is known that a high sodium intake increases BP. Therefore, hypertensive patients are advised to limit their daily salt intake to no more than 6 grams.[21] Restricting salt intake not only lowers BP but also reduces the risk of HT, with or without weight loss, and it decreases the incidence of cardiovascular events.[22,23] In our study, we determined that daily salt consumption of less than 6 grams a day was statistically associated with effective BP control in Turkish Cypriots. There has been no study conducted on daily salt consumption in North Cyprus. In two

Table 4. Lifestyle changes and BP control							
Blood pressure control / **Lifestyle changes**	**Effective control**		**Ineffective control**		**Total**		**p**
	n	**%**	**n**	**%**	**n**	**%**	
BMI							
<18.5 (underweight)	0	0	0.0	0	0	0.0	0.238
18.5-24.9 (normal)	17	56.7	13	43.3	30	16.2	
25.0-25.9 (overweight)	36	41.9	50	58.1	86	46.5	
30.0-39.9 (obese)	23	35.9	41	64.1	64	34.6	
≥40 (extremely obese)	3	60.0	2	40	5	2.7	
Smoking							
Ex-smoker	19	41.3	27	58.7	46	24.9	0.670
Smoker	20	38.5	32	61.5	52	28.1	
Never smoked	40	46	47	54	87	47.0	
Alcohol							
Rarely	32	39	50	61	82	44.3	0.303
More than 2 times per week (more than 10 cL)	9	60	6	40	15	8.1	
Every day (more than 10 cL)	5	62.5	3	37.5	8	4.3	
Never	33	41.3	47	58.8	80	43.2	
Salt intake							
Daily less than 5-6 gram	32	74.4	11	25.6	43	23.2	0.000*
Daily more than 5-6 gram	47	33.1	95	66.9	142	76.8	
Diet							
Animal based diet rich in saturated fat and cholesterol	42	41.2	60	58.8	102	55.1	0.595
Vegetable based diet rich in low in saturated fat and cholesterol	37	45.1	45	54.9	82	44.3	
Vegetarian	0	0	1	100	1	0.5	
Physical activity							
30-45 minutes, walking 1 day in a week	1	33.3	2	66.7	3	1.6	0.257
30-45 minutes, walking 2-3 days in a week	2	50.0	2	50.0	4	2.2	
30-45 minutes, walking at least 5 days in a week	10	66.7	5	33.3	15	8.1	
No exercise	66	40.5	97	59.5	163	88.1	

*p<0.05 (chi-square test), BP: Blood pressure, BMI: Body mass index.

studies conducted in Türkiye in 2008 and 2012, daily salt consumption was found to be 18 grams and 14.8 grams, respectively.[24,25] When analyzing the daily salt consumption of the patients, the majority reduced their daily salt intake (67.7%), but did not limit it to 5-6 grams. In this study, the proportion of hypertensive patients consuming daily salt of less than 5-6 grams was 23.2%, while those consuming more than 5-6 grams was 76.8%. According to the results of two studies in Türkiye, in one study, 70.5% of the patients reduced their daily salt consumption, whereas in the other study, 67.8% reduced it.[26,27]

In terms of evaluating dietary habits, 55.1% consumed animal origin foods, while 44.3% consumed foods rich in fruits and vegetables. Reducing the intake of trans-unsaturated fatty acids and saturated fatty acids, while increasing the consumption of vegetables, fruits, and whole-grain products improves BP control and aids in maintaining a healthy body weight.[28-30] Vegetables are a good source of potassium, which has a positive effect on BP regulation.[31]

The imbalance between energy intake and expenditure is a key factor contributing to being overweight and obese. Patients should be encouraged to increase their daily physical activity to enhance energy expenditure. In our study, 88% of hypertensive patients did not engage in any physical activity beyond their daily routine, and only 8.1% participated in activities such as biking, swimming, running, or brisk walking for 30-45 minutes at least five days a week. The significant benefits of physical activity include increasing high-density lipoprotein-cholesterol levels, reducing triglyceride levels, improving glycemic control due to increased tissue sensitivity to insulin, as well as reducing BP.[28]

Study Limitations

To address the limitations of this study, it is important to acknowledge certain constraints which may have influenced our findings. Firstly, in this study, obesity assessment was based solely on BMI, which means only those individuals with general obesity were identified. Since waist circumference measurements were not taken, those with abdominal obesity were not identified. Consequently, the ratio of obesity-related HT could not be determined in our study. Secondly, the participants' daily salt consumption was evaluated without measuring 24-hour urinary sodium excretion, leading to an approximation of their consumption as being either above or below 6 grams. Lastly, for those patients who

had previously been diagnosed with HT by their doctors and had their medications adjusted, only their BP levels were measured in order to determine whether it was under control. It was not investigated as to whether they were using their medications in sufficient doses or in a proper manner.

CONCLUSION

Obesity and HT are steadily increasing both in our country and worldwide. There is an association between HT and obesity, with nearly two-thirds of hypertensive patients being obese. Obesity is not only a significant factor in the development of HT but also in controlling BP in those who already have HT. Lowering the prevalence of obesity will also lead to a reduction in the prevalence of HT. The primary focus in combating the development of HT and obesity should be on increasing physical activity and instilling healthy dietary habits. Therefore, new strategies should be developed to combat obesity, and the fight against obesity should begin in childhood.

MAIN POINTS

- In North Cyprus, there had been no study related to hypertension control and lifestyle changes. This was the first study in the literature which investigated the association between lifestyle changes and hypertension among Turkish Cypriots.
- This research found that the majority of hypertensive patients did not have their blood pressure under control and did not adhere to the recommended lifestyle changes.
- 83.8% of hypertensive patients were overweight or obese.
- This study determined that salt consumption of less than 5-6 grams a day is statistically associated with effective blood pressure control in Turkish Cypriots.

ETHICS

Ethics Committee Approval: This study was approved by the Ethics Committee of Cyprus Science University (approval number: 2022/12.002, date: 07.12.2022).

Informed Consent: It wasn't obtained.

Authorship Contributions

Surgical and Medical Practices: E.B., Concept: E.B., A.A., Design: E.B., Data Collection and/or Processing: E.B., Analysis and/or Interpretation: C.T., Literature Search: E.B., C.T., A.A., Writing: E.B., C.T., C.C.

DISCLOSURES

Conflict of Interest: No conflict of interest was declared by the authors.

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RESEARCH ARTICLE

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Family Physicians' Knowledge and Practice of FRAX® in the Management of Osteoporosis in Jeddah, Saudi Arabia

Emad M. Salawati[1], Waleed M. Alqulayti[2]

[1]Department of Family Medicine, King Abdulaziz University Faculty of Medicine, Jeddah, Saudi Arabia
[2]Department of Family Medicine, King Abdulaziz University Hospital, Jeddah, Saudi Arabia

Abstract

BACKGROUND/AIMS: This study intended to assess the awareness and usage of the FRAX tool among family physicians in Jeddah and to identify gaps in screening knowledge.

MATERIALS AND METHODS: A cross-sectional study on 152 family physicians in Jeddah through a convenient sampling method and Google Forms was used to collect data via an online survey. The questionnaire included six items, and respondents were asked to select "Yes" or "No" as their response options. The chi-square test was used to determine significant associations between the variables related to FRAX tool awareness and practice and certain sociodemographic characteristics.

RESULTS: A total of 152 family physicians participated. The results showed moderate awareness (88.20%). Of those aware of FRAX, only 57.20% reported using it in their practice, with the main barriers being a lack of a country-specific model, a busy practice, and not knowing how to use it. Single participants and those attending King Abdulaziz University were more likely to have used FRAX.

CONCLUSION: Osteoporosis is a significant health problem with a rising incidence and economic burden. The FRAX tool is widely used to evaluate fracture risk. However, healthcare professionals still face perceived barriers, such as a lack of knowledge and awareness of a country-specific calculator. Targeted educational interventions and further studies are needed to overcome these barriers and to improve the tool's usage in clinical practice.

Keywords: Osteoporosis, FRAX, primary healthcare, physicians

INTRODUCTION

Osteoporosis is a systemic skeletal disorder of a metabolic nature which is distinguished by low bone density and micro-architectural deterioration. This leads to an increased risk of fractures due to bone fragility, even from minor falls or injuries. Fractures associated with osteoporosis typically occur in the hip, wrist, or spine.[1] It is estimated that osteoporosis impacts more than 200 million individuals across the globe.[2] In Saudi Arabia, the prevalence of osteoporosis is believed to be 58.4% among women aged 50-80 years and 63.6% among healthy men.[3] Despite sufficient sunlight, vitamin D deficiency is widespread among children and adults in Saudi Arabia.[4] This can be attributed in part to genetic variations and the need for clothing to cover the skin, which limits exposure to sunlight.[5]

The operational definition of osteoporosis relies on the assessment of bone mineral density (BMD) using dual-energy X-ray absorptiometry. Recently, there have been refinements in the definition which places emphasis on using measurements taken at the femoral neck as a reference standard.[6] Originally intended for classification in epidemiological studies, the T-score of -2.5 standard deviations (SDs) or lower, as defined by the World Health Organization (WHO), is now commonly used as both a diagnostic and intervention threshold. However, the main challenge in assessing fracture risk is that this

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ORCID IDs of the authors: E.M.S. 0000-0001-6602-3473; W.M.A. 0000-0003-4580-6318.

Address for Correspondence: Emad M. Salawati
E-mail: esalawati@kau.edu.sa
ORCID ID: orcid.org/0000-0001-6602-3473

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threshold has a high specificity but a low sensitivity, meaning that the majority of fragility fractures occur in individuals whose BMD values are above the osteoporosis threshold.[7] Hence, a crucial aspect of patient management involves the capacity to evaluate fracture risk and identify those who are suitable for intervention.

In 2008, the WHO Collaborating Centre located in Sheffield, UK, introduced FRAX®,[8] a computer-based algorithm which calculates an individual's 10-year probability of experiencing hip or major osteoporotic fractures (clinical spine, distal forearm, and proximal humerus). The FRAX tool comprises seven dichotomous clinical risk factors, including prior fragility fracture, parental hip fracture, smoking, systemic glucocorticoid use, excessive alcohol intake, rheumatoid arthritis, and other causes of secondary osteoporosis. These risk factors, along with age, sex, and body mass index, help in estimating an individual's 10-year fracture probability, regardless of their BMD. Although BMD at the femoral neck can be included as an optional input variable, earlier data indicated that BMD measurements have low sensitivity for predicting fractures.[9,10] Consequently, FRAX represented a significant therapeutic advancement outperforming the BMD T-score-based treatment technique. Although FRAX anticipates fractures under conflicting mortality frameworks, it has several limitations which must be considered when interpreting its results, including the fact that the tool does not account for dose responses of specific risk factors and the influence of previous fractures on the calculated absolute fracture risk However, FRAX only considers a binary input for prior fractures.[11-14]

Due to significant variations in fracture probability globally, FRAX models had to be calibrated to the fracture and death epidemiology specific to each country.[15] When FRAX was first launched, only models for eight countries were available. Currently, the FRAX tool is an accessible website which receives approximately three million visits annually, with models for 71 countries in 35 languages, representing over 80% of the world's population, including Saudi Arabia.[16-18]

This study aimed to explore the awareness and practical application of FRAX among family physicians in Jeddah and to identify the physicians' knowledge gaps in osteoporosis screening.

MATERIALS AND METHODS

Ethical statement: The Unit of Biomedical Ethics Research Committee of the King Abdulaziz Faculty of Medicine approved this study (approval number: 236-22, date: 21.04.2022).

Study design and study participants: This cross-sectional study was conducted using a previously validated questionnaire among family physicians in Jeddah, Saudi Arabia from April, 2022 to March, 2023 to assess their knowledge and applications of FRAX as well as the factors influencing the existing situation. Family residents of all levels were eligible to participate in this study. Those participants who did not specify their employment status were excluded from this survey in order to avoid selection bias.

Sampling strategy: The survey link was sent through email or social media to the potential participants. A convenient sampling method was used to reach the participants who met the study's inclusion criteria and completed the questionnaire.

Questionnaire tool: We used a self-administrated online questionnaire, which was adopted from a published study, to investigate the study objectives.[19] The survey was edited to cope with the study objectives and validated by three experts in the field. It was then posted online using Google Forms.

The target population for this study were family residents in Jeddah, Saudi Arabia, and the data was collected through an online survey using Google Forms. The research team distributed the survey link to all family residents via email or social media. The survey questionnaire included a cover page explaining the study's importance regarding the FRAX tool, and an agreement to participate. To ensure anonymity, no identifying details were requested from the respondents.

The assessment tool consisted of six items or questions, and the respondents were asked to select either "Yes" or "No" as their response options. The first part gathered demographic information about the participants. The demographic information which was obtained was gender, age, marital status, university, residency level, and the type and locality of their practice. The second part gathered information about their knowledge of the FRAX tool in osteoporosis treatment among family physicians. The participants were given six questions to answer, each with a Yes/No option. The questions covered topics including the participant's involvement in osteoporosis treatment, their awareness of the FRAX tool, and the success of this tool's incorporation into routine practice. The correlation between the demographic factors and the usage of FRAX was also assessed.

Sample size: WHO recommendations were used to estimate the sample size. The required sample size was calculated to be equal to or greater than 152 participants in order to achieve a 95% confidence interval and a 5% significance level (p-value), estimated using Raosoft® sample size calculator.

Statistical Analysis

SPSS version 26. Means and SD were used to present continuous data, while frequencies and percentages were used to present categorical data. Reliability analysis was performed to validate the self-administered questionnaire in order to assess the awareness and practice of family physicians using Cronbach's alpha. The chi-square test was performed in order to determine significant associations between the variables related to FRAX tool awareness and practice in terms of the sociodemographic characteristics, and a p-value of <0.05 was considered significant.

RESULTS

A total of 152 participants were involved in this study. Most participants were 26-30 years of age (64.50%), followed by 20-25 years (25.70%). Only a few participants were in the 31-35 and 36-40 age ranges. The gender variable revealed that the sample was comparatively evenly split between male and female participants, with (50.70%) being male. More than half of the participants (53.30%) reported being single and attending King Abdulaziz University (52.60%). Nearly half of the participants were at the R_2 level (42.10%), followed by the R_1 level (27.60%) and the R_3 level (20.40%). For the type and locality of their practice, half of the participants (53.30%) reported working in a university or teaching hospital setting (Table 1).

The respondents were asked several questions about their familiarity with and use of FRAX in their practice. Out of the 152 respondents, (73.70%) reported seeing and treating patients with osteoporosis, while (82.20%) reported seeing and treating fewer than ten patients with

osteoporosis per month. Most respondents (88.20%) had heard of FRAX, but only 57.20% reported using it in their practice. Among those who did not use FRAX, the most reported reasons were a lack of a model for their country (57.20%), a busy practice (55.90%), and not knowing how to use it (21.10%) (Table 2). 75% of the respondents believed that FRAX had been incorporated into osteoporosis treatment (Figure 1).

Overall, half (50%) of the male and female respondents, those participants aged 26 to 30 (64.90%), single participants (51.50%), graduates of King Abdulaziz University (56%), and level R_2 residents (42.50%) who practiced primary health care had heard of the FRAX tool. There were no significant gender, age, marital status, residency level, practice type, or practice location differences in FRAX awareness. However, those respondents who had attended King Abdulaziz University and those who practiced in university or teaching institutions tended to be more familiar with FRAX. Marital status had a statistically significant effect on FRAX usage, with a higher proportion of single participants using FRAX. Those participants who had graduated from King Abdulaziz University (50.60%), had residency level R_2 (36.70%) and practiced at a university or teaching facility (50.60%) utilized the FRAX tool in their clinical practice.

Table 1. Socio-demographic and professional characteristics of the participating physicians

Variables	n (%)
Age (years)	
20-25	39 (25.70)
26-30	98 (64.50)
31-35	14 (9.20)
36-40	1 (1.70)
Gender	
Male	77 (50.70)
Female	75 (49.30)
Marital status	
Single	81 (53.30)
Married	69 (45.40)
Divorced	2 (1.30)
University	
Albaha	1 (0.70)
Batterjee Medical College	20 (13.20)
Ibn Sina Medical College	18 (11.80)
King Abdulaziz University	80 (52.60)
King Abdulaziz University for Health Sciences	31 (20.40)
Taif University	1 (0.70)
Uma Alqura University	1 (0.70)
Residency level	
R_1	42 (27.60)
R_2	64 (42.10)
R_3	31 (20.40)
R_4	15 (9.90)
Type and locality of practice	
Community Hospital	11 (7.20)
Primary health care	40 (26.30)
Private practice	20 (13.20)
University or teaching hospital	81 (53.30)

However, the variables of university, residency level, practice type, and practice location lacked statistical significance (Table 3).

DISCUSSION

The incidence of osteoporosis is projected to rise considerably over the next decade, exacerbating an already significant health problem.[20] In Saudi Arabia, the cost of femoral fractures related to osteoporosis is estimated at $1.14 billion annually, and prevention is believed to be one of the most cost-effective strategies.[21] The T-score of -2.5 SD or lower, which has been adopted as the diagnostic and intervention threshold and is widely used today, has high specificity but low

Table 2. Awareness knowledge of the FRAX® tool in OP treatment among family physicians

Question	n (%)
Q1. Do you see and treat patients with osteoporosis?	
Yes	112 (73.70)
No	40 (26.30)
Q2. How many patients with osteoporosis do you currently see and treat per month?	
Less than 10 patients	125 (82.20)
More than 10 patients	27 (17.8)
Q3. Have you heard of the FRAX®?	
Yes	134 (88.20)
No	18 (11.80)
Q4. Have you ever used FRAX® in your practice?	
Yes	87 (57.20)
No	65 (42.80)
Q5. In your opinion, what are the reasons that prevent you from using FRAX®?	
Q5a. Do not know which group of people need FRAX® applications	
Yes	1 (0.70)
No	151 (99.30)
Q5b. The lack of a model for the corresponding country	
Yes	87 (57.20)
No	65 (42.80)
Q5c. Having a practice that was too busy and hence a lack of time to perform a FRAX®	
Yes	85 (55.90)
No	67 (44.10)
Q5d. Do not know how to use it	
Yes	32 (21.10)
No	120 (78.90)
Q5e. Lack of Internet access	
Yes	24 (15.80)
No	128 (84.20)
Q5f. None	
Yes	2 (1.30)
No	150 (98.70)
Q6. As far as you are aware, has FRAX® been incorporated into the osteoporosis treatment?	
Yes	114 (75.00)
No	38 (25.00)

FRAX®: Fracture Risk Assessment Tool.

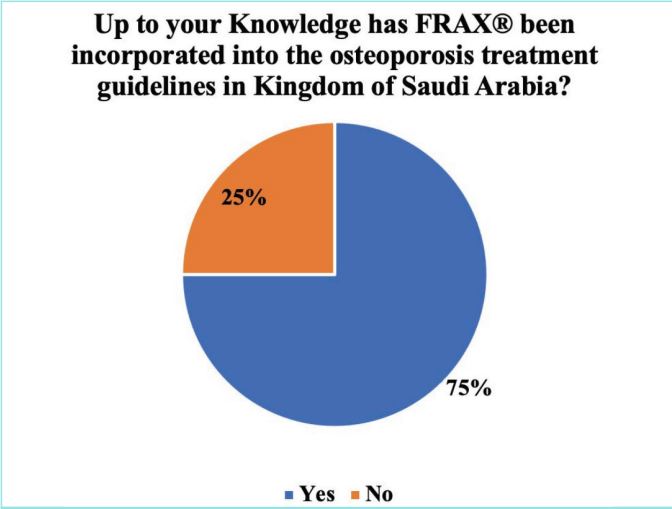

Figure 1. Knowledge of osteoporosis treatment guidelines utilizing FRAX® in Saudi Arabia.

FRAX®: Fracture Risk Assessment Tool.

sensitivity, implying that most fragility fractures occur in individuals whose BMD values are above the abovementioned threshold.[7] Thus, a critical factor for patient management is the ability to assess fracture risks using various screening tools, as they are easy to implement in primary care practices. FRAX was developed in 2008 to evaluate the individualized 10-year probability of a hip or other major osteoporotic fracture (which includes fractures in the clinical spine, distal forearm, or proximal humerus).[22] It has been incorporated into numerous international clinical guidelines as a crucial part of patient screening.[2,23]

FRAX is generally well-received by end-users, doctors, and allied healthcare professionals.[12] Despite the tool's limitations, models for 71 countries are currently accessible, representing 80% of the global population.[17] A country specific FRAX tool has been devised for Saudi Arabia, using an estimate of the incidence of fragility hip fractures in a specific population subset. This model is anticipated to increase the precision of determining the probability of fractures and to assist in treatment decisions.[16]

Our results showed that 88.20% of 152 respondents had heard of FRAX, indicating moderate awareness of this tool among the surveyed group.

Table 3. Factors associated with awareness and practice of the FRAX® tool among family physicians

	Have you ever heard of the FRAX® tool?			Have you ever used the FRAX® tool in your practice?		
	Yes (n, %)	No (n, %)	p	Yes (n, %)	No (n, %)	p
Gender						
Male	67 (50.00)	10 (55.60)	0.658	45 (51.70)	32 (49.20)	0.761
Female	67 (50.00)	8 (44.4)		42 (48.30)	33 (50.80)	
Age						
20-25	34 (25.40)	5 (27.8)	0.839	23 (26.40)	16 (24.60)	0.817
26-30	87 (64.90)	11 (61.10)		55 (63.20)	43 (66.20)	
31-35	12 (9.00)	2 (11.10)		8 (9.20)	6 (9.20)	
36-40	1 (0.70)	0 (0.00)		1 (1.10)	0 (0.00)	
Marital status						
Single	71 (52.99)	12 (66.70)	0.273	39 (44.83)	44 (67.70)	**0.005**
Married	63 (47.01)	6 (33.30)		48 (55.17)	21 (32.30)	
University						
Albaha	1 (0.70)	0 (0.00)	0.204	1 (1.10)	0 (0.00)	0.139
Batterjee Medical College	16 (11.90)	4 (22.20)		9 (10.30)	11 (16.90)	
Ibn Sina Medical College	14 (10.40)	4 (22.20)		8 (9.20)	10 (15.40)	
King Abdulaziz University	75 (56.00)	5 (27.80)		44 (50.60)	36 (55.40)	
King Abdulaziz University for Health Sciences	26 (19.40)	5 (27.80)		23 (26.40)	8 (12.30)	
King Abdulaziz University	1 (0.70)	0 (0.00)		1 (1.10)	0 (0.00)	
King Abdulaziz University	1 (0.70)	0 (0.00)		1 (1.10)	0 (0.00)	
Residency level						
R_1	37 (27.60)	5 (27.80)	0.965	24 (27.60)	18 (27.70)	0.304
R_2	57 (42.50)	7 (38.90)		32 (36.80)	32 (49.20)	
R_3	27 (20.10)	4 (22.20)		20 (23.00)	11 (16.90)	
R_4	13 (9.70)	2 (11.10)		11 (12.60)	4 (6.20)	
Type and locality of practice						
Community hospital	11 (8.20)	0 (0.00)	0.357	8 (9.20)	3 (4.60)	0.188
Primary health care	34 (25.40)	6 (33.30)		20 (23.00)	20 (30.80)	
Private practice	16 (11.90)	4 (22.20)		15 (17.20)	5 (7.70)	
University or teaching hospital	73 (54.50)	8 (44.40)		44 (50.60)	37 (56.90)	

OP: Osteoporosis, FRAX®: Fracture Risk Assessment Tool.

On the other hand, only 57.20% reported using it in their practice. Most respondents who used the FRAX tool were aged 26-30 years (63.20%). These results were consistent with a study on physicians from the United Arab Emirates, Saudi Arabia, Lebanon, and other Middle Eastern countries in which only 42% of professionals used the FRAX tool.[19] Both studies also identified perceived barriers to the use of this tool, such as a lack of knowledge on how to use it or a lack of country-specific calculators.

Our findings indicate no significant difference in awareness of the FRAX tool based on various sociodemographic or occupational characteristics such as gender, age, marital status, residency level, or the type and locality of practice. However, our results showed a trend towards a higher awareness of FRAX among respondents who had attended King Abdulaziz University and those who practiced in university or teaching hospitals, indicating the need for targeted educational interventions for healthcare professionals in other settings. These results draw attention towards the need to improve knowledge and awareness as described in a study conducted in Canada which found that physicians who were more confident in their knowledge of osteoporosis were more likely to use FRAX in their practice.[24]

Most participants reported seeing and treating fewer than ten patients with osteoporosis per month (82.20%), while 73.70% reported seeing and treating patients with osteoporosis in general. Among those who did not use FRAX, the most reported reasons were a lack of a model for their country (57.20%), a busy practice (55.90%), and not knowing how to use it (21.10%). These results suggest that there are perceived barriers to the use of the FRAX tool, which should be addressed in order to improve the tool's usage in the clinical practice. This can be linked to a study which examined the factors which influenced the usage of FRAX in clinical practice and highlighted that the brochure may enhance the knowledge of the FRAX tool as well as medical representative presentations, scientific conferences, and journals.[25]

Study Limitations

This study had some limitations which should be considered when interpreting its results. Firstly, this study used a convenience sampling method, which may have introduced selection bias and limited the generalizability of the findings. Additionally, the small sample size of family physicians may have limited the statistical power of this study and reduced the ability to detect significant associations between the variables. Therefore, further research with a larger sample size, a more diverse population, and multiple specialties treating osteoporosis is needed.

CONCLUSION

In conclusion, the incidence of osteoporosis is projected to rise considerably over the next decade, posing a significant health problem and economic burden. The FRAX tool, which evaluates the individualized 10-year probability of a hip or other major osteoporotic fracture, is widely incorporated into international clinical guidelines and has been adopted in many countries, including Saudi Arabia. Although there is moderate awareness of this tool among healthcare professionals in Saudi Arabia, there are still perceived barriers to its use, such as a lack of knowledge on how to use it and a lack of awareness about country-specific calculators. Targeted educational interventions are needed in order to improve this tool's usage in clinical practice. Further studies are needed to investigate the factors influencing the usage of this tool and to develop strategies to overcome the perceived barriers to its use.

MAIN POINTS

- Numerous countries have adopted the FRAX tool, which calculates the probability of osteoporotic fractures.
- Despite a moderate level of awareness regarding the tool among healthcare professionals in Saudi Arabia, perceived barriers endure.
- There is a need for focused educational interventions to enhance the application of this tool in practice.

ETHICS

Ethics Committee Approval: The Unit of Biomedical Ethics Research Committee of the King Abdulaziz Faculty of Medicine approved this study (approval number: 236-22, date: 21.04.2022).

Informed Consent: It wasn't obtained.

Authorship Contributions

Concept: E.M.S., Design: E.M.S., Data Collection and/or Processing: W.M.A., Analysis and/or Interpretation: E.M.S., W.M.A., Literature Search: W.M.A., Writing: E.M.S., W.M.A.

DISCLOSURES

Conflict of Interest: No conflict of interest was declared by the authors.

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RESEARCH ARTICLE

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Evaluation of Female Sexual Functions after Cesarean Section

Betül Mammadov[1], Ayten Şentürk Erenel[2]

[1]Department of Midwifery, Near East University Faculty of Health Sciences, Nicosia, North Cyprus
[2]Department of Obstetrics and Gynecology Nursing, Gazi University Faculty of Nursing, Ankara, Türkiye

Abstract

BACKGROUND/AIMS: Our study was conducted descriptively in order to determine the sexual functions, the time of returning to sexual intercourse and the factors affecting sexual functions in the first six months postpartum of women after cesarean delivery.

MATERIALS AND METHODS: The sample group of this study consisted of 207 women with 0-6 month-old babies who had given birth by cesarean section. The data were collected through a face-to-face interview method using the introductory information form (18 questions) developed by the researchers, and the Female Sexual Function Index (FSFI).

RESULTS: The FSFI total score average of the women who participated voluntarily in this study was found to be 20.94±6.9 (minimum-maximum: 2.40-31.20) points. The FSFI total score of 80.6% of the women (n=167) was below 26.55, which is considered as being the score for feminine sexual dysfunction. This decrease in FSFI scores was associated with the time to resuming sexual intercourse after cesarean section, breastfeeding, the duration of the marriages, and the increasing ages of the women and their partners.

CONCLUSION: This study revealed that the sexual functions of women were negatively affected in the first six months postpartum following cesarean section delivery. Provided that there is no pregnancy complication requiring cesarean section, women who prefer elective cesarean section in order to protect the quality of their sexuality and the structure of their genitals should be provided with information regarding the advantages of normal vaginal delivery, the complications which can be encountered after cesarean section, and the potential negative effects of cesarean sections on sexual functions.

Keywords: Caesarean, FSFI, sexual health

INTRODUCTION

Sexuality, which can be affected by values, ethos, and social rules, can be defined as a state of being in total health, with its biological, social and psychological aspects, so enabling people to be sexually active, not only physically, but also mentally, emotionally and socially.[1] The World Health Organization defines sexual health as a state of complete physical, emotional, mental and social wellbeing and not merely the absence of disease, dysfunction or disability.[2] Sexual health is one of the components of health, and although sexual health problems do not cause vital problems, it is a condition which negatively affects the quality of life.[3]

Pregnancy, delivery, and postpartum processes are the periods in which women experience significant physical, psychological, hormonal, social and cultural changes. The sexual life of women changes especially during pregnancy and the postpartum period.[4] A wide range of factors such as the adaptation process to their new roles during pregnancy and the postpartum period, hormonal changes, breastfeeding, problems concerning the baby, body image, and mode of birth affect the sexual

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ORCID IDs of the authors: B.M. 0000-0002-9051-0279; A.Ş.E. 0000-0002-0841-2099.

Address for Correspondence: Betül Mammadov
E-mail: betul.mammadov@neu.edu.tr; betulmammadov@gmail.com
ORCID ID: orcid.org/0000-0002-9051-0279

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life and sexual behavior of women.[5] In a study conducted with 336 pregnant women with the purpose of evaluating sexual functions, it was observed that pregnancy reduced the quality of sexual function,[6] and in a study conducted to evaluate sexual function in the postpartum period with 236 mothers with 0-12-month-old babies, it was revealed that a significant number of the women experienced sexual dysfunction.[7] It is stated that the mode of delivery can also negatively affect the sexual functions of women. Different results have been presented by studies evaluating the effects of delivery methods on sexual function. Although some studies evaluating sexual dysfunction by comparing modes of delivery have suggested that sexual dysfunction observed in women giving birth via cesarean is less than that of women who had vaginal birth due to the preservation of the structures in the pelvic floor after cesarean section delivery, some studies comparing cesarean delivery and vaginal delivery have found that sexual function is not affected negatively after normal and spontaneous vaginal delivery.[8-12]

The postpartum period is a process in which the woman's maternal-motherhood roles and emotions are experienced in a very intense and complex manner. Although many factors are effective in attaining competence in these roles, cultural values also play an important role. For this reason, our study was conducted descriptively in order to determine sexual functions, the time of resuming sexual intercourse and the factors affecting sexual functions in the first six months postpartum of women after cesarean delivery.

Research Questions

1. What are the factors affecting the sexual functions of women after cesarean delivery?

2. How are the sexual functions of women whose delivery type was cesarean section affected?

MATERIALS AND METHODS

Design of Study

The study was designed in a descriptive cross-sectional manner.

Place and Time of Research

Our study was carried out on mothers who came to a university hospital pediatrics outpatient clinic in Nicosia for health check-ups for their babies. This study was of cross-sectional type and data collection was carried out between February 1st and April 30th 2016. The sample group of this study consisted of 207 women who gave birth by cesarean section and applied to the outpatient clinic between February and April for a check-up of their 0-6 month old babies. The aim of this study was clearly explained to the women and they agreed to participate voluntarily.

Application of the Study

A questionnaire was given to the women who stated that they had resumed their sexual life after giving birth. In order to ensure the privacy of the women participating in this study, the questionnaires were filled out in an unoccupied room in the outpatient clinic. The data were collected through a face-to-face interview method using the introductory information form (18 questions) developed by the researchers, and the Female Sexual Function Index (FSFI). Questions investigating the women's socio-demographic characteristics, breastfeeding status and their sexual lives were included in the introductory information form.

The FSFI is a Likert-type scale consisting of 19 items developed to measure women's sexual functions. Its six subscales assess sexual desire, arousal, lubrication, orgasm, sexual satisfaction and pain. This scale should be answered with respect to the sexual life of women within the previous 1-month period. FSFI subscale scores are calculated by multiplying the scores obtained from the scale items by the coefficients corresponding to the items. The total score of the subscales gives the FSFI scale total score. The FSFI total score can range between 2 and 36 (Table 1). A higher score on the scale indicates better sexual function. A FSFI total score lower than 26.55 indicates sexual dysfunction. The Turkish validity and reliability of this form was determined by Aygın and Eti Aslan[13]. As test-retest was used to ensure the validity and reliability of the study, a correlation analysis was conducted and consequently the correlation coefficient was calculated as 0.75, while the Cronbach's alpha, which reflects the test score reliability and internal consistency, was calculated as 0.98. Ultimately, the use of the scale was deemed valid for Turkish women.

Ethical Considerations

The documents required for conducting this research, such as written permission from the chief physician of the hospital, the approval of the Near East University Scientific Research Evaluation Ethics Committee (approval number: YDU/2015/35-265, date: 11.02.2015), and the informed consent of the participants, were obtained prior to the research.

Statistical Analysis

The data acquired through this study was saved on computer in the SPSS 22 package program. Before statistical analysis was carried out, Kolmogorov-Smirnov and Shapiro-Wilk tests were used to assess whether the variables had normal distribution or not. Descriptive statistics are given by mean ± standard deviation. The Mann-Whitney U test was used for the analysis of data which did not show normal distribution, and the Spearman correlation coefficient was used to compare groups between discrete or categorical variables. The level of statistical significance was accepted as $p \leq 0.05$.

RESULTS

The average age of the women was 31.23±8.05 (minimum-maximum: 18-42) years, and the average age of their spouses was 35.68±8 (minimum-maximum: 22-48) years. 44.9% of the women and 46.4% of

Table 1. Female Sexual Function Index Score calculation table

Subgroups	Question number	Score range	Factor	Minimum score	Maximum score
Sexual desire	1, 2	1-5	0.6	1.2	6
Arousal	3, 4, 5, 6	0-5	0.3	0	6
Lubrication	7, 8, 9, 10	0-5	0.3	0	6
Orgasm	11, 12, 13	0-5	0.4	0	6
Sexual satisfaction	14, 15, 16	0/1-5	0.4	0.8	6
Pain	17, 18, 19	0-5	0.4	0	6
Scale range				2	36
FSFI mean score of the women participating in this study	20.94±6.9 (minimum-maximum: 2.40-31.20)				

FSFI: Female Sexual Function Index.

their spouses were high school graduates. The average length of marriage for the women was 7.58±7.02 years. When it was investigated why the women preferred cesarean section for delivery, it was determined that fear of birth (27.1%), doctor's recommendation (21.3%), and pelvic stenosis (11.1%) constituted the top three reasons. 67.7% of the women and their spouses used an effective contraceptive method. 59.4% of women still breastfeed their babies (Table 2). When the demographic data of women and their FSFI subscale scores were compared, it was found that the increasing age of the women significantly decreased their arousal (p=0.013), desire (p=0.016), orgasm (p=0.004) and sexual satisfaction (p=0.019) scores. It was also found that the increasing age of the spouse also correlated with a decrease in the sexual desire (p=0.001), arousal (p=0.037) and orgasm (p=0.001) scores in the women. Additionally, it was revealed that a longer period of marriage was associated with a decrease in the sexual desire (p=0.001), orgasm (p=0.030) and pain (p=0.013) scores. When the times they resumed sexual intercourse after cesarean section were compared with the FSFI subscale scores, an increase in the desire (p=0.001), lubrication (p=0.001), arousal (p=0.031), orgasm (p=0.001), and sexual satisfaction (p=0.001) scores and a significant reduction in the pain (p=0.013) score were determined in the scores of those who resumed sexual activity in the late postpartum period. When their breastfeeding status and their sexual function subscale scores were compared, the orgasm (p=0.006), satisfaction (p=0.001) and pain (p=0.023) scores were found to be higher in those women who were not breastfeeding (Table 3).

Table 2. Distribution of socio-demographic and some characteristics of the women (n=207)

	n	%
Education		
Primary education	60	29
High school	93	44.9
Undergraduate or above	54	26.1
Spouse's education		
Primary education	44	21.2
High school	96	46.4
Undergraduate and above	67	32.4
Number of living children		
1	106	51.2
2	58	28.0
3 or more	43	20.8
Time since birth		
0-2 month	68	32.8
2-4 month	125	60.4
4-6 month	14	6.8
Caesarean delivery reason		
Fear of normal birth	56	27.1
Doctor's recommendation	44	21.3
Pelvic stenosis	23	11.1
Macrosomic fetus	20	9.7
Previous caesarean section	19	9.2
Elective cesarean	16	7.7
Breech presentation	14	6.8
Fetal distress	6	2.9
Urgent reasons	6	2.9
Entanglement of the umbilical cord	3	1.3
Use of contraceptive method		
Yes	140	67.6
No	67	32.4
Breastfeeding status		
Yes	123	59.4
No	84	40.6
Opinions on how sexual life has been affected during the postpartum period		
No difference	147	71.0
Worse	43	20.8
Better	17	8.2
Total	**n=207**	**100%**

The FSFI total score average of the women who participated voluntarily in this study was found to be 20.94±6.9 (minimum-maximum: 2.40-31.20) points. The FSFI total score of 80.6% of the women (n=167) was below 26.55, which is considered as a threshold score for feminine sexual dysfunction. Although it was not tabulated, considering the subscale scores and FSFI scale total score averages, no correlation was found between these scores and the educational status of the couples, chronic disease history in the women, the number of children, previous surgery, or the use of contraceptive methods (p>0.05).

The distribution of sexual function status according to the characteristics of the women and their spouses is given (Table 4). It was determined that the overall scale scores of the older women were lower (p=0.035). When the time elapsed since the birth of the baby was compared with the mean scores, it was observed that women with more time since the birth of their baby acquired higher scores (p=0.015). An increase in the scale scores of those women who had sexual intercourse at a later time after cesarean delivery was noticed (p=0.007). When comparing the women with or without sexual dysfunctions with the age of their spouse and the duration of their marriage, no significant difference could be determined (p>0.05).

DISCUSSION

Although resuming sexual life after delivery and the quality of sexuality is an important issue for the new mother and her spouse, this may be affected by factors such as the mother's adaptation to her new role, her relationship with her spouse, and her physical and emotional readiness for sexuality. During the first six weeks of the puerperal period, low libido, continuation of lochia, painful sexual intercourse due to a lack of lubrication during coitus, and milk flow from the nipples upon stimulation cause a delay the acceptance of the first sexual intercourse after childbirth. Our study presents data showing that the desire, lubrication, arousal, orgasm and satisfaction scores of the women who resumed sexual intercourse after a significant time following their cesarean sections were increased. A similar study presented data that postpartum sexual dysfunction is closely associated with the time elapsed to resume sexual intercourse after delivery,[14] while another study indicated that the FSFI scale scores significantly increased in the period beginning from the third month to the seventh month after delivery.[15] During this period, the spouses put their sexual problems into a secondary position due to other reasons such as inadequate sleep or postpartum insomnia, the care burden for the baby, and fatigue and they did not consider this as a health problem.

Table 3. Correlation of FSFI subscales according to some characteristics of women

(n=207)	Sexual desire		Arousal		Lubrication		Orgasm		Sexual satisfaction		Pain	
	r	p	r	p	r	p	r	p	r	p	r	p
Age	-0.167	**0.016***	-0.172	**0.013***	-0.005	0.945	-0.202	**0.004***	-0.162	**0.019***	0.001	0.985
Spouse's age	-0.239	**0.001***	-0.145	**0.037***	-0.050	0.472	-0.224	**0.001***	-0.124	0.075	0.016	0.819
Marriage duration	-0.250	**0.001***	-0.090	0.199	-0.006	0.936	-0.151	**0.030***	-0.065	0.355	0.174	**0.013***
Start time/day of sexual intercourse	0.295	**0.001***	0.160	**0.031***	0.267	**0.001***	0.281	**0.001***	0.275	**0.001***	-0.225	**0.002***
Time elapsed since the birth of the baby	0.227	**0.001***	0.126	0.071	0.090	0.199	0.141	**0.043***	0.171	**0.014***	0.096	0.167
Breast-feeding	0.248	0.473	0.162	0.819	0.279	0.636	0.242	**0.006***	0.216	**0.001***	0.166	**0.023***

*p≤0.05, FSFI: Female Sexual Function Index.

Table 4. Comparison of women with and without sexual dysfunction according to some characteristics

	With sexual dysfunction (26.55 points or below) (n=167) (80.6%)	Without sexual dysfunction (above 26.55) (n=40) (19.4%)	p
Age	31.95±8.22	28.25±6.55	**0.035***
Spouse's age	36.28±9.08	33.20±6.77	0.054
Marriage duration	7.90±7.28	6.13±5.63	0.258
Time since birth (days)	71.31±23.54	73.00±24.30	**0.015***
Time to resuming sexual intercourse after cesarean (day)	43.61±18.91	44.62±18.44	**0.007***

*p≤0.05.

Low levels of estrogen which occur throughout lactation due to the high levels of prolactin are considered to be another reason for decreased sexual function after delivery.[16] High levels of prolactin, which initiate lactation, lead to a significant decrease in the secretion of the estrogen and progesterone hormones. Decreased estrogen levels can cause vaginal epithelial atrophy and dyspareunia (painful intercourse) may occur due to a lack of lubrication.[16] Our study results showed that the subscale scores regarding orgasm and satisfaction, and the FSFI scale overall scores of those mothers who did not breastfeed their babies were higher than the scores of the breastfeeding mothers. Similarly, a study conducted in order to assess the postpartum sexual functions of 684 primiparous women presented data showing that the FSFI scale total scores of the breastfeeding mothers were lower than the scores of those mothers who were not breastfeeding their babies.[17] The results of other studies showed that postpartum breastfeeding lowers the quality of sexual functions and increases dyspareunia due to decreased levels of estrogen.[18-21] There is evidence indicating that the state of experiencing dyspareunia even 6 months after delivery is related to breastfeeding rather than the mode of delivery and that lactating women experience dyspareunia 4 times more than non-lactating women.[22] It is considered that a combination of postpartum factors such as breast fullness, hormonal changes, breast tenderness, breastfeeding, etc. causes a significant decrease in sexual functions. This study also showed that the age of the women and their spouses was another factor affecting their FSFI scores. When compared with the younger couples, it was observed that the FSFI scale scores of the older women were lower; consequently, it was obviously seen that older age is a factor which decreases sexual functions. It can be seen in the literature that sexual dysfunctions vary according to age groups and the prevalence of sexual dysfunctions increases with age.[23,24] In our study, a longer period of marriage was not found to be a significant factor in FSFI overall scores, although this factor lowered the desire and orgasm subscale scores of the women. Compared to the youthful period, in which there is more intense energy, passion and desire, and less responsibility, older age is considered as a period in which energy, passion and desire decrease while responsibility and the possibility of experiencing physiological problems increase. Ultimately, it is believed that sexual functions are affected negatively by age.

When we asked the women to compare their pre-pregnancy and current sexual lives, 71% of them stated that there was no difference between their pre-pregnancy and current sexual lives. Compared to the FSFI scale overall scores, it is considered that these women might have had sexual dysfunction before pregnancy or avoided making their sexual issues known as they live in one of the countries in which talking about sexual issues is considered taboo.

It is one of the most frequently discussed issues that the mode of delivery affects both the time to resume sexual life and the quality of sexual function. Most women tend to give birth to their babies through cesarean section because of a fear of giving birth or the thought that vaginal delivery may cause trauma which may affect their sexuality negatively. The results of both meta-analyses and various studies evaluating the sexual functions of women after cesarean and spontaneous vaginal delivery have shown that there is no significant difference between these two modes of delivery from the third month onwards. For this reason, it is thought that women do not need to opt for cesarean section due to concerns of protecting their sexual functions.[25-33] Considering the results of this study, it was apparent that the FSFI scale total scores of the majority of women were below the cut-off score indicating female sexual dysfunction. This result, which supports the findings in the literature, demonstrates that there is no evidence that cesarean delivery preserves the sexual functions of the women who choose to give birth to their babies through cesarean section. Compared to vaginal delivery, cesarean section, which may cause women to experience a more disadvantageous process due to various possible complications such as the risk of developing infection, its longer healing period of the abdominal incision, increased postpartum bleeding, and persistent abdominal pain after childbirth, is considered to significantly affect sexual functions.

Study Limitations

The results of this study do not represent the whole of North Cyprus and are limited to those women who applied to the hospital where this research was conducted.

CONCLUSION

This study revealed that the sexual functions of women were negatively affected in the first six months postpartum following cesarean section delivery. Provided that there are no pregnancy complications requiring cesarean section, women who prefer elective cesarean section in order to protect the quality of their sexuality and the structure of their genitals should be provided with information regarding the advantages of normal vaginal delivery, the complications which can be encountered after cesarean section, and the potential negative effects of cesarean sections on sexual functions.

MAIN POINTS

- Increasing age of the woman and her partner decreases FSFI scores.
- After caesarean section, a longer period of time is needed to restore sexual function.
- Non-breastfeeding mothers have higher orgasm and satisfaction scores than breastfeeding mothers.
- There is no evidence that cesarean section performed to preserve sexual function is better than normal delivery in terms of sexual function scale scores.

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ETHICS

Ethics Committee Approval: This study was approved by the Near East University Scientific Research Evaluation Ethics Committee (approval number: YDU/2015/35-265, date: 11.02.2015).

Informed Consent: The approval of the informed consent of the participants, were obtained prior to the research.

Authorship Contributions

Concept: B.M., A.Ş.E., Design: B.M., A.Ş.E., Data Collection and/or Processing: B.M., A.Ş.E., Analysis and/or Interpretation: B.M., A.Ş.E., Literature Search: B.M., A.Ş.E., Writing: B.M., A.Ş.E.

DISCLOSURES

Conflict of Interest: No conflict of interest was declared by the authors.

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RESEARCH ARTICLE

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Assessment of Calories Expended and Nutritional and Physical Activity Habits of Medical Faculty Students and Residents in Different Clinics

Emine Sınlık*, Nisa Zülal Sarı*, Sena Arpacı*, Gökçe Nur Durmuş*, Nurcan Aydoğan*, Şule Özbilgin*, Hazal Küçükali*, Volkan Hancı*

Department of Anesthesia and Intensive Care, Dokuz Eylül University Faculty of Medicine, İzmir, Türkiye
**Authors contributed equally.*

Abstract

BACKGROUND/AIMS: In our study, we aimed to assess the calorie expenditure amounts, feeding, night eating and physical activity habits of medical faculty students and assistants.

MATERIALS AND METHODS: A questionnaire consisting of 43 questions was applied to the students and assistant doctors of Dokuz Eylül University Faculty of Medicine and pedometer data obtained by their mobile phones were obtained and recorded.

RESULTS: Our study included 297 medical faculty students and 177 residents for a total of 474 individuals. The mean number of steps was 8,829.80±3,302.88 for students, and 6,618.33±2,811.08 for residents. The calories expended were 441.49±165.14 kCal for students and 330.91±140.55 kCal for assistants. The numbers of students and residents achieving the recommended 10,000 steps was 31.4% and 9.6%, respectively. According to the nutritional habits survey, the proportions of students and residents eating healthily were 32% and 35%, respectively. The incidence of night eating syndrome among students and residents was determined to be 4% and 6.8%. In our study, with increases in the monthly number of on-duty shifts and additional working times for residents, there was a positive correlation with weight, body mass index, dessert intake, soft drink intake and coffee intake; and a negative correlation with vegetable/fruit intake, pulses intake and nutritional habits scores.

CONCLUSION: In our study, medical students and residents did not reach the recommended physical activity levels within their working hours, two thirds of the students and residents had unhealthy nutrition and had higher rates of night eating syndrome compared to the normal population.

Keywords: Medical students, residents, physical activity, pedometry, nutritional habit, night eating syndrome

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ORCID IDs of the authors: E.S. 0000-0002-9472-9382; N.Z.S. 0000-0002-3759-7803; S.A. 0000-0003-4186-8407; G.N.D. 0000-0002-8163-7534; N.A. 0000-0001-6130-3919; Ş.Ö. 0000-0002-2940-8988; H.K. 0000-0003-2264-108x; V.H. 0000-0002-2227-194X.

Address for Correspondence: Şule Özbilgin
E-mail: sozbilginmd@mail.com
ORCID ID: orcid.org/0000-0002-2940-8988

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INTRODUCTION

Being a healthy individual is linked to fulfilling physical, social, emotional, and intellectual needs. Nutrition is a necessary and essential requirement for human life, along with our critical physiological needs such as breathing and excretion.[1] The residency and student periods require physical effort due to intense work tempos and on-duty intensity, occasionally with 24-36 hour periods spent in the hospital environment. Being on-duty, working night shifts, staying in the hospital for long hours, and the related intense physical activity may cause changes in the metabolic activity, physical activity, and nutritional intake patterns of residents and medical students.[2] Previous studies have assessed the nutritional intakes and metabolic markers of residents. Studies determined low intakes of vegetables and fruit in the diet. Additionally, high amounts of desserts, saturated fats, cholesterol, and caffeine intake are common among residents.[3] Eating disorders among medical faculty residents and students, especially night eating syndrome among students working shifts with disrupted normal diurnal rhythms, may cause hormonal changes.[1-3] Additionally, for residents in different departments and medical faculty students, very few studies have determined the mean activity amounts, the number of steps, calorie expenditure, nutritional habits, and night eating syndrome incidences. Our study aimed to assess the calorie expenditure amounts, feeding, night eating, and physical activity habits of students at the faculty of medicine and residents in different departments and to assess any practical factors.

MATERIALS AND METHODS

After receiving ethics committee permission [Dokuz Eylül University Ethics Committee approval was obtained (approval number: 2016/32-34], a 26-question nutritional habits survey[4] and a 17-question night eating survey,[5,6] for a total of 43 questions (Appendix 1), was administered to all Dokuz Eylül University Faculty of Medicine Students and Hospital residents in the basic medical sciences, internal medicine sciences and surgical medical sciences departments. The residents in basic medical science, internal medicine science, and surgical medical sciences had their total working hours and pedometer values while working recorded during three different times on duty. Three similar days when not on duty were measured with a pedometer using a previously downloaded "pedometer application" on their smartphones.[7] Following this, the mean of these values was obtained for their on-duty and off-duty days. Medical faculty students completed the nutritional habits and night eating survey, and the daily activity was assessed for students with their pedometer data.

Power Analysis

The number of volunteers to be included in our study was determined via power analysis. Rand determined the night eating syndrome incidence as being 1.5% in the average population.[8] Our study hypothesized that eating disorders would be higher among medical faculty students and residents and that their night eating syndrome incidence would be higher than for the general population, especially for residents working on-duty departments. As Rand determined,[8] for the average population, with a 1.5% value with an alpha error 0.05, a 7% difference between the groups, and 90% power required a sample number of at least 164 individuals.

Statistical Analysis

The data in our study were recorded and analyzed with the SPSS packet program. Residents in the basic medical sciences, internal medical sciences and surgical medical sciences, and medical faculty students had their physical activity measured with a pedometer application, and also their eating habits and night eating incidences were determined via a questionnaire. Variables with continuous values are given as mean ± standard deviation, with frequency variables given as numbers (n) and percentages (%). Adherence of data with continuous values to the normal distribution was tested with the Kolmogorov-Smirnov test. Comparison of continuous values was completed with the Kruskal-Wallis test, the Mann-Whitney U test, the One-Way ANOVA test, and Student's t-test depending on the normality test results and group numbers. Analysis of data with frequency was completed with the chi-square test and the Fisher's exact test depending on the group and case numbers. Significance was defined as p-values smaller than 0.05.

RESULTS

Our study included 297 medical faculty students and 177 residents for a total of 474 people. The 297 medical faculty students participating in our study were grouped according to their class level. Accordingly, of the 297 medical faculty students in our study, 95 were years 1-2-3, 153 were years 4-5, and 49 were year six students. Of the 177 residents participating in our study, 15 worked in basic medical sciences, 123 were working in internal medical sciences, and 39 worked in surgical medical sciences.

The medical faculty students participating in our study had a mean body mass index (BMI) of 22.37±3.17, with BMI values reducing from year 1 to 6. In our study, the mean number of steps taken by medical faculty students was 8,829.80±3,302.88. The students' nutritional habits score was mean 27.51±5.50, with a mean night eating score of 14.83±5.25. Those with nutritional habits score of above 30 comprised 32% of the students. 4% of the students had night eating score above 25 (Table 1).

The mean BMI of the residents included in our study was calculated as 23.75±3.57. The mean BMI was highest for the surgical medical sciences department. The mean number of steps within the working hours for the residents was 6,618.33±2,811.08, with the highest number of steps observed in the surgical medical sciences. The calorie amounts expended with these step numbers were 441.49±165.12 kCal for medical faculty students and 330.91±140.55 kCal for residents. The weekly mean working hours of the residents participating in our study was 60.88±23.77, with a mean on-duty working hours of 17.69±5.49. The mean steps/working hour rate for the surgical medical sciences (819.80±263.22) was the highest, with the mean on-duty steps/hour rate being highest for the internal medical sciences (551.64±282.86). The mean nutritional habits score for the residents participating in our study was 27.71±5.22, with the mean night eating score calculated as being 15.37±6.28. When compared with the basic and internal medical sciences, the surgical medical sciences had a lower nutritional habits score with a higher night eating score (Tables 2, 3).

In our study, as the class increased, the pulse consumption ($r=-0.160$; $p=0.06$) of medical faculty students decreased, while alcohol ($r=0.118$; $p=0.042$) and coffee ($r=0.243$; $p<0.001$) consumption increased. With an increase in monthly on-duty shifts and additional working durations of the residents, there was a positive correlation with weight ($r=0.250$; $p=0.001$), BMI ($r=0.273$; $p<0.001$), dessert intake ($r=0.171$; $p=0.023$),

Table 1. Demographic data, study data and step data of medical faculty students

	Student			
	Year 1, 2, 3; (n=95)	Year 4, 5; (n=153)	Year 6; (n=49)	Total; (n=297)
Mean age (years)	20.28±1.15	22.74±1.35	23.97±0.94	22.16±1.83
Weight (kg)	66.51±14.84	66.52±13.50	64.16±11.57	66.12±13.62
Height (cm)	171.07±9.26	171.43±8.82	171.04±9.07	171.25±8.97
BMI	22.53±3.67	22.47±3.05	21.78±2.43	22.37±3.17
Female/male	57 (60.0%)/38 (40.0%)	80 (52.3%)/73 (47.7%)	28 (57.1%)/21 (42.9%)	165 (55.6%)/132 (44.4%)
Mean number of steps	9696.86±2949.52	7622.56±3594.64	9271.40±3027.73	8829.80±3302.88
Mean calories (kCal)	484.84±147.47	380.12±178.73	465.60±150.38	441.49±165.14
Mean working hours	-	-	10.07±1.89	9.80±2.11
Mean steps/hour	-	-	928.79±275.10	962.43±295.37
Mean step/hour calorie (kCal)	-	-	46.43±13.75	48.12±14.76
>10000 steps	33.3%	23.3%	37.9%	31.4%
Nutritional habits score	28.32±5.61	26.99±5.44	27.55±5.42	27.51±5.50
Nutritional habits score >30	38 (40.0%)	43 (28.1%)	14 (28.6%)	95 (32.0%)
Night eating score	14.84±5.42	14.78±5.32	15.00±4.74	14.83±5.25
Night eating score >25/24-20/<20	5 (5.3%)/10 (10.5%)/80 (84.2%)	7 (4.6%)/21 (13.7%)/125 (81.7%)	0 (0%)/9 (18.4%)/40 (81.6%)	12 (4%)/40 (13.5%)/245 (82.5%)
Daily smoking (number of cigarettes)	1.43±4.17	2.59±6.54	2.34±5.01	2.18±5.64
Weekly alcohol (mL)	270.52±828.11	759.67±1653.78	1081.67±3666.20	656.33±1971.06

BMI: Body mass index.

soft drink intake (r=0.298; p<0.001) and coffee intake (r=0.206; p=0.006). Additionally, there was a negative correlation with fruit-vegetable intake (r=-0.251; p=0.001), pulse intake (r=-0.303; p<0.001) and nutritional habits score (r=-0.185; p=0.015).

DISCUSSION

Our study aimed to determine the activity levels of medical faculty students and residents. The mean number of steps per day for medical faculty students was 8,829.80±3,302.88, while the mean number of steps during work for residents was 6,618.33±2,811.08.

There are few studies assessing the activity levels of medical faculty students. The single study on this topic by Rye et al.[9] determined that 62 medical students in years 1-4 had mean step numbers of 10,703±3,986 per day. The researchers emphasized that 52% of students had steps above 10,000 per day.[9] In our study, the mean daily step numbers for medical students during the preclinical period for years 1, 2, and 3 were 9,696.86±2,949.52. The mean daily number of steps for medical students in years 4 and 5 when clinical internships begin was 7,622.56±3,594.64. In the internship period of year 6, and for residents, instead of steps being counted for the whole day, the mean number of steps in the working period was counted with a mean internship working hours of 10.07±1.89 hours, and mean the number of steps within the working period being 9,271.40±3,027.73. In our study, only 33.3% of year 1, 2, and 3 students and 23.3% of year 5 and 6 students exceeded the step limits.

When the mean step numbers during the work period for residents have been investigated, these studies are minimal. Rye et al.[9] stated that many doctors had difficulty sustaining a healthy lifestyle during their residency period. The researchers assessed 55 residents with residency durations of 1 to 4 years and stated that residents took a mean of 8,344±3,520 steps per day while working. The researchers emphasized that 35% of residents exceeded 10,000 steps. The researchers determined that senior residents took fewer steps compared to junior residents.

Murphy et al.[10] assessed the number of steps taken by 25 clinicians (15 surgeons, eight doctors, and two emergency medicine specialists) and 25 radiologists during their working days. They found that clinicians took 6,500-6,750 steps and radiologists took between 3,500-3,750 steps. They found a daily mean step difference of 2,985 between these two groups and reported a significant difference.[10]

Another study of emergency medicine residents recorded 91 working periods for 30 emergency medical residents and found that emergency medical residents took a mean of 7,333 steps (95% confidence interval 6,901-7,764). The researchers emphasized that the number of steps varied from 2,323 to 12,923 during the working periods, and only 9.9% reached the target number of steps of 10,000 during pedometer recording.[11] The study period evaluated 47.2% surgical and 52.7% internal medicine work periods with 49.4% daytime and 50.5% night shifts. They stated there was no significant difference in records above 10,000 steps in terms of department or day/night shifts.[11]

Another study evaluating cardiovascular specialists' daily physical activity investigated pedometer data for eight cardiovascular surgeons, seven cardiologists, five invasive cardiologists, and eight cardiac anesthesiologists (for a total of 28 doctors) over two weeks.[12] That study determined the step numbers during daily working hours were 6,540 for general cardiologists, 6,039 for cardiovascular surgeons, 5,910 for invasive cardiologists, and 5,553 for cardiac anesthesiologists. That study stated that there was no significant difference between the groups. That single-center small study by the researchers reported that physical activity related to work did not fulfill guideline recommendations.[12]

Table 2. Demographic data, study data and step data of residents

	Residents			
	Basic medical sciences; (n=15)	**Internal medical sciences; (n=123)**	**Surgical medical sciences; (n=39)**	**Total; (n=177)**
Mean age (years)	28.06±2.40	28.62±3.49	28.58±2.54	28.57±3.21
Weight (kg)	59.61±12.00	68.82±15.10	73.57±15.41	69.09±15.27
Height (cm)	164.06±9.33	169.28±8.75	173.26±10.22	169.72±9.40
BMI	22.05±3.53	23.80±3.66	24.27±3.16	23.75±3.57
Female/male	13 (86.7%)/2 (13.3%)	69 (56.1%)/54 (43.9%)	18 (46.2%)/21 (53.8%)	100 (56.5%)/77 (43.5%)
Seniority	21.09±16.03	22.21±14.47	29.41±17.58	23.80±15.55
Mean monthly on-call	0.66±1.79	5.80±5.99	7.53±2.61	5.75±5.43
Weekly working hours	40.00±0.00	54.19±19.10	88.11±17.89	60.88±23.77
Mean number of steps	4956.78±1854.84	6363.42±2607.69	8034.76±3197.26	6618.33±2811.08
Mean calories (kCal)	240.83±92.74	318.17±130.38	410.73±160.86	330.91±140.55
Mean working hours	8.09±0.30	8.19±1.34	9.89±3.41	8.55±2.06
Mean steps/hour	615.09±236.01	805.19±385.88	819.80±263.22	793.04±354.31
Mean step/hour calorie (kCal)	30.05±11.08	40.25±19.29	42.99±13.16	39.65±17.71
>10000 steps	9.1%	7.4%	16.7%	9.6%
Number of steps on duty	-	8381.73±3817.70	8939.54±3717.03	8509.04±3774.85
Mean calories on duty	-	419.08±190.88	466.97±185.85	425.45±188.74
Mean on duty working hours	-	16.25±4.74	21.19±5.81	17.69±5.49
On duty steps/hour	-	551.64±282.86	446.80±173.89	517.69±259.09
On duty steps/hour calorie (kCal)	-	27.58±14.14	25.34±8.69	25.88±19.95
On duty >10000 steps	-	27.4%	48.1%	33.3%
Nutritional habits score	28.33±3.30	27.93±5.19	26.79±5.89	27.71±5.22
Nutritional habits score >30	6 (40.0%)	44 (35.8%)	12 (30.8%)	62 (35.0%)
Night eating score	14.86±6.03	15.14±6.20	16.30±6.65	15.37±6.28
Night eating score >25/24-20/<20	1 (6.7%)/1 (6.7%)/13 (86.7%)	6 (4.9%)/19 (15.4%)/98 (79.7%)	5 (12.8%)/4 (10.3%)/30 (76.9%)	12 (6.8%)/24 (13.6%)/141 (79.7%)
Daily smoking (number of cigarettes)	0.66±2.58	3.35±7.71	7.20±9.96	3.97±8.16
Weekly alcohol (mL)	176.66±521.28	561.34±1277.53	1187.43±1783.35	666.69±1388.50

BMI: Body mass index.

A study assessing the number of steps taken by doctors in hospital evaluated the working day number of steps for 131 doctors.[13] Researchers determined the mean number of steps as 5,325 (interval: 1,105-10,250) with mean hourly step numbers of 548 (interval: 143-1,105).[13] The researchers reported no significant difference between internal medical sciences and surgical medical sciences or between senior and junior workers. Additionally, they emphasized that age and BMI were essential factors. An increase in age by each year was correlated with a reduction of 5 steps per hour on average. Each 1 kg/m^2 increase in BMI was correlated with a reduction of 20 steps per hour on average.[13] There was no significant difference between the surgical and internal medical sciences in our study in terms of mean step numbers. Additionally, there was no correlation identified between seniority, BMI, or age with the mean number of steps taken during working and on-duty shifts.

Another study[14] assessed the number of steps taken by 16 doctors (4 internal medicine specialists, four surgical specialists, four internal medicine residents, and four surgical residents) working in St. John's Hospital in Livingston. It was conducted over five working days and found the mean number of steps was 7,907 for internal residents, 5,068 for surgical residents, 4,822 for surgical specialists, and 4,647 for internal specialists. The distances walked while on-duty varied from 3.84 km (specialists) to 6.85 km (residents). The researchers emphasized that the walking did not fulfill the daily activity quotas recommended and reported that at least one hour of additional physical exercise was recommended daily to reach this quota.[14]

Studies have evaluated the number of medical students and doctors of varying seniority, but by workers in different branches in hospitals. A study assessing the number of steps taken by 180 health workers in a third stage hospital in Nigeria determined that the health workers' mean daily step number was 7,396.94±2,714.63. That study found that 20% of health workers took a minimum of 10,000 steps per day, with 34.4% slightly less active and 23.9% slightly active. That study found that 43.9% of health workers took more than 7,500 steps per day, with nurses having the highest value of 7,980 steps per day. Physiotherapists followed the nurses at 7,332 steps, and pharmacists were in the last place, taking 6,201 steps. That study emphasized no significant difference in terms of the number of steps taken by the health workers in different groups. That study also found a negative correlation between the number of steps taken by the health care workers with their ages, BMIs, and body fat ratios.[15]

Table 3. Demographic data, study data and step data of residents according to department

	Family practitioner (n=35)	Pediatrics (n=22)	Anesthesiology (n=22)	Emergency medicine (n=20)	Internal medicine (n=18)	Public health (n=15)
Mean age (years)	29.00±3.19	27.36±2.34	28.72±2.33	27.75±2.22	27.61±1.81	32.80±5.97
Weight (kg)	63.62±13.09	67.00±10.78	66.90±12.29	75.05±16.06	70.16±18.19	71.93±17.12
Height (cm)	168.62±7.20	166.27±8.27	169.63±10.51	170.68±10.89	171.27±8.07	167.53±8.70
BMI	22.20±3.31	24.17±3.00	23.09±2.41	25.52±3.41	23.63±4.67	25.31±3.79
Female/male	24 (68.6%)/11 (31.4%)	14 (63.6%)/8 (336.4%)	15 (68.2%)/7 (31.8%)	9 (45.0%)/11 (55.0%)	7 (38.9%)/11(61.1%)	9 (60%)/6 (40%)
Seniority	18.95±11.65	16.27±9.03	26.27±17.43	25.71±17.48	21.23±13.69	26.57±20.27
Mean monthly on-call	1.02±2.17	8.72±1.16	7.09±1.94	15.70±5.45	6.88±1.45	0±0
Weekly working hours	40.14±0.84	83.06±21.61	87.36±9.50	53.86±11.55	65.76±10.60	40.33±2.28
Mean number of steps	6049.40±2373.11	5658.57±2126.98	7773.61±3410.68	7026.73±2132.78	8683.95±2573.18	4143.47±2592.00
Mean calories (kCal)	302.47±118.65	282.92±106.34	392.68±170.53	351.33±106.63	434.19±128.65	207.17±129.60
Mean working hours	7.32±1.65	9.00±0.00	9.75±4.04	8.56±0.87	8.68±1.64	8.00±0.0
Mean steps/hour	896.94±480.09	628.73±236.33	804.89±271.40	817.73±225.61	1015.51±352.74	517.93±324.00
Mean step/hour calorie (kCal)	44.84±24.00	31.43±11.81	42.24±13.57	40.88±11.28	50.77±17.63	25.89±16.20
>10000 steps	2 (5.7%)	1 (4.5%)	3 (13.6%)	0 (0%)	3 (16.7%)	0 (0%)
Number of steps on duty	6718.66±2719.52	7889.72±3903.96	7924.14±2911.62	9945.63±2867.24	9261.19±4588.57	-
Mean calories on duty	335.93±135.97	394.48±195.19	399.20±145.58	497.28±143.36	463.05±229.42	-
Mean on duty working hours	14.13±6.06	17.15±1.39	18.92±3.76	11.48±3.14	18.89±5.73	-
On duty steps/hour	541.63±297.21	461.33±236.87	423.46±143.34	884.22±212.19	510.19±301.08	-
On duty steps/hour calorie (kCal)	27.08±14.86	23.06±11.84	23.17±7.16	44.21±10.60	25.50±15.05	-
On duty >10000 steps	0 (0%)	5 (22.7%)	6 (27.3%)	5 (25.0%)	5 (27.8%)	-
Nutritional habits score	28.25±4.34	30.45±4.70	27.18±5.59	24.90±5.32	27.66±5.25	28.60±3.90
Nutritional habits score >30	11 (31.4%)	11 (50%)	5 (22.7%)	4(20.0%)	7(38.9%)	7 (46.7%)
Night eating score	14.62±7.27	14.77±5.58	18.13±6.95	15.50±7.71	15.72±3.99	13.53±4.37
Night eating score >25/24-20/<20	2 (5.7%)/6 (17.1%)/27 (77.1%)	1 (4.5%)/0 (0%)/21 (95.5%)	4 (18.2%)/4(18.2%)/14 (63.6%)	2 (10%)/4 (20%)/14 (70%)	0 (0%)/3 (16.7%)/15 (83.3%)	0 (0%)/3 (20%)/12 (80%)
Daily smoking (number of cigarettes)	1.42±4.42	2.04±4.86	4.90±7.89	8.05±10.52	0.55±2.35	6.33±10.60
Weekly alcohol (mL)	401.42±621.01	45.45±213.20	839.09±1291.01	1138.75±2163.67	119.44±254.66	388.00±615.81

BMI: Body mass index.

In our study, the nutritional habits of medical faculty students and residents were assessed. A nutritional habits survey was applied in order to determine their nutritional style. Previous studies have stated that scores above 30 on this survey are related to healthy eating habits.[4] In our study, the mean nutritional habits score was determined to be 27.51±5.50. The proportion of students with nutritional habits score above thirty was 32.0%. The mean nutritional habits score for the residents participating in our study was determined to be 27.71±5.22. The proportion of residents with nutritional habits score above thirty was 35%. Studies assessing the nutritional habits of medical students are minimal. A single study on the topic by Rye et al.[9] found that medical students consumed less fruit and vegetables than recommended. In our study, 74.7% of medical students ate vegetables only 1-2 times per day, while 70.2% ate fruit only 1-2 times per day. Our study determined that medical students ate less fruit and vegetables than recommended. Similar to the study by Rye et al.,[9] our study showed that only 32% of medical students had scores indicating healthy eating. In comparison, 53.9% of medical students had fish consumption less than twice per week. It was determined that coffee consumption, junk food consumption, red meat, and white meat consumption increased as the student year increased, while pulse consumption decreased.

There may be changes in nutritional habits during the residency period, mainly due to on-duty hours and night shifts. Different studies have researched doctors' eating habits and a variety of influential factors. Mota et al.[3], emphasizing that on-duty work was typical during the residency period and may require doctors to stay in the hospital for 24 hours, reported that lifestyles with extended stays in the hospital affected nutritional intake, physical activity levels, and the metabolic patterns of individuals. In a study including 72 residents, 52 female, and 20 male, the researchers assessed participants with 3-day diets and the "Adapted Healthy Eating Index." They found bad dietary habits, reduced vegetable and fruit intake, as well as high intakes of desserts, saturated fats, cholesterol, and caffeine among both genders. According to their results, the researchers emphasized that the residents' workloads should be reviewed and developed among doctors in order to prevent the worsening of health problems and that health status should be monitored.[3] Rye et al.[9] found that residents consumed less fruit and vegetables than the recommended portions, with higher BMI and Framingham Risk Score for residents compared to students. The researchers emphasized that residents were less active and ate less fruit and vegetables than students, and this difference was related to high BMI, waist circumference, and cardiovascular risk.[9]

A study by Mota et al.,[2] including 72 residents, 52 female and 20 male, along with other studies, evaluated participants with a 3-day diet and the "Adapted Healthy Eating Index," on-duty durations, and nutritional intake patterns. They found a positive correlation for cereals, bread, and pasta intake with increased weekly additional working hours. There was a negative correlation for additional weekly working hours with fruit intake, bean intake, and the healthy eating index. The researchers emphasized that these factors were predisposing factors for excessive weight gain and metabolic disorder development in shift workers. In our study, there were positive correlations for weight (r=0.250; p=0.001), BMI (r=0.273; p<0.001), dessert intake (r=0.171; p=0.023), soft drink intake (r=0.298; p<0.001) and coffee intake (r=0.206; p=0.006) with increases in the monthly number of on-duty shifts and additional working times for residents. Additionally, there was a negative correlation with vegetable/fruit intake (r=-0.251; p=0.001), pulses intake (r=-0.303; p<0.001) and nutritional habits score (r=-0.185; p=0.015).

Night eating syndrome is characterized by the separation of eating and sleeping circadian rhythms and delayed eating, with symptoms such as evening hyperphagia, waking at night to eat, morning anorexia, and sleep disorders.[5] Night eating can be investigated with the 14-question Night Eating Survey developed by Allison et al.[16] The Turkish version of the survey's validity and reliability was researched by Atasoy et al.[5] This version was used in our study.[5] The incidence of night eating syndrome is reported as 1-1.5% in the adult population.[5] Our literature analysis did not encounter any articles on the incidence of night eating syndrome among medical faculty students or residents.

Additionally, in a study assessing the incidence of night eating syndrome among university students, night eating syndrome was assessed with an online survey of 1,636 university students with ages varying from 18 to 26 years. The incidence of night eating syndrome among university students was assessed to be 4.2%. When the researchers removed excessive eating, they reported this rate as being revised to 2.9%. The researchers did not find any correlation between night eating syndrome and BMI; however, they determined a correlation between night eating syndrome and anorexia nervosa in the study group.[17]

Another study assessing medical faculty students divided them into two groups as those with diurnal lifestyles and those with nocturnal lifestyles in terms of 24-hour endocrine patterns and they found that plasma leptin and melatonin levels peaked at 03.00 in the diurnal lifestyle group. In contrast, these levels were reduced in the group with a nocturnal lifestyle.[18] The researchers emphasized there was a link between night eating syndrome and melatonin and leptin level elevation. In that study, the group with a nocturnal lifestyle had significant decreases in insulin secretion at midnight and in the early hours of the morning; however, plasma glucose concentration continued at high levels. The researchers showed a strong correlation between glucose and insulin after eating in the diurnal lifestyle group, while this was disrupted in the nocturnal lifestyle group. They proposed that the nocturnal lifestyle disrupted the reaction of insulin to glucose. The researchers' results emphasized that individuals with nocturnal lifestyles had several risk factors regarding health, including night eating syndrome, obesity, and diabetes.[18]

Our study calculated the mean night eating score of medical faculty students as 14.38±5.25. The proportion of students with night eating score above 25 was 4%. There is no study assessing the incidence of night eating syndrome among medical doctors, residents, and specialist doctors. Additionally, in another study emphasizing that the prevalence of night eating syndrome and depression is increasing globally, nurses' night eating syndrome incidence was assessed. That study emphasized that nurses were at particular risk of night eating syndrome due to irregular eating behavior, shift work, and their stressful working environments. That study analyzed data from 3,617 nurses and determined the night eating syndrome incidence as being 5.7%[19]. In our study, the mean night eating score of the residents was 15.37±6.28, and the proportion of doctors with night eating syndrome scores above 25 was 6.8%. Compared with the basic and internal medical sciences, the nutritional habits score was lower for surgical medical sciences, while their night eating score was higher.

CONCLUSION

Our study aimed to assess the calorie expenditure amounts, nutritional and physical activity habits, and effective factors among medical faculty students and residents from different departments. We found that the mean number of steps for medical faculty students was 8,829.80±3,302.88, while for residents, the mean number of steps taken while working was 6,618.33±2,811.08. The proportions of students and residents reaching the recommended 10,000 steps were 31.4% and 9.6%, respectively. According to a nutritional habit survey, the proportions of students and residents eating healthily were 32% and 35%, respectively. The incidence rates of night eating syndrome among students and residents were 4% and 6.8%, respectively. In our study, there were a positive correlations for weight (r=0.250; p=0.001), BMI (r=0.273; p<0.001), dessert intake (r=0.171; p=0.023), soft drink intake (r=0.298; p<0.001) and coffee intake (r=0.206; p=0.006) with increases in the monthly number of on-duty shifts and additional working times for residents. Additionally, there were a negative correlations with vegetable/fruit intake (r=-0.251; p=0.001), pulses intake (r=-0.303; p<0.001) and their nutritional habits score (r=-0.185; p=0.015).

In conclusion, medical students and residents did not reach the recommended physical activity levels within their working hours, two thirds of students and residents had unhealthy nutrition and had higher rates of night eating syndrome than the general population. Among residents, an increase in on-duty and additional working hours increased their unhealthy eating behavior such as increased dessert intake, soft drink intake, and coffee intake and reduced their fruit, vegetable and pulse intake. Unhealthy eating habits begun in medical faculties and continuing during internships are continuously increasing among residents, especially with their additional working hours. Healthy eating programs should be created for residents. Awareness on this topic should be increased, with organizations actively leading the way on this topic and taking necessary precautions for healthy nutrition.

MAIN POINTS

- Medical students and residents did not reach the recommended physical activity levels within the working hours.
- Two thirds of the medical students and residents doctors had unhealthy nutrition.
- There was a positive correlation between weight, BMI, dessert intake, soft drink intake, and coffee intake; and there was a negative correlation with vegetable/fruit intake, pulses intake, and

nutritional habits scores with increases in the monthly number of on-duty shifts and additional working times for residents.

- Medical students and residents had higher rates of night eating syndrome compared to the general population.

ETHICS

Ethics Committee Approval: This study was approved by the Dokuz Eylül University Ethics Committee (approval number: 2016/32-34).

Informed Consent: It was obtained.

Authorship Contributions

Concept: E.S., N.Z.S., S.A., G.N.D., N.A., Ş.Ö., H.K., V.H., Design: E.S., N.Z.S., S.A., G.N.D., N.A., Ş.Ö., H.K., V.H., Data Collection and/or Processing: N.Z.S., S.A., G.N.D., N.A., Analysis and/or Interpretation: V.H., Literature Search: H.K., Writing: E.S., Ş.Ö.

DISCLOSURES

Conflict of Interest: No conflict of interest was declared by the authors.

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Appendix 1 Link: http://glns.co/x9wa7

RESEARCH ARTICLE

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Determination of Factors that Affect Health-Related Quality of Life in Health Sciences Students

Ceren Gezer[1], Uğur Bakırezen[1], Mesut Yalvaç[2]

[1]Department of Nutrition and Dietetics, Eastern Mediterranean University Faculty of Health Sciences, Famagusta, North Cyprus
[2]Department of Nursing, Cyprus Science University Faculty of Health Sciences, Kyrenia, North Cyprus

Abstract

BACKGROUND/AIMS: The aim of this study was to evaluate health sciences students' health-related quality of life and the factors which affect it.

MATERIALS AND METHODS: This study was conducted with 293 faculty of health sciences students who were selected using stratified sampling by department. A questionnaire about their demographic characteristics and the Short Form-36 (SF-36) were administered in face-to-face interviews, and some anthropometric measurements were made.

RESULTS: The males' mean scores on the social functioning, pain and general health perception subscales of SF-36 were higher than those of the females ($p<0.05$). The non-smokers had higher mean scores on the physical role limitation, emotional role limitation, vitality, mental health and pain subscales of SF-36 than those who smoked ($p<0.05$). The sports science students had the highest scores on vitality, mental health, pain and general health perception ($p<0.05$). The students with low risk of cardiovascular disease according to their waist/height ratios had higher vitality scores ($p<0.05$).

CONCLUSION: To conclude, gender, smoking, department and anthropometric measurements affected the quality of life of the health science students. In order to determine which factors affect quality of life, it may be useful to conduct more studies with larger samples.

Keywords: Health, lifestyle, quality of life, young adult, student

INTRODUCTION

Health concerns an individual's lifestyle. The definition of quality of life by the World Health Organization is "an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns. It is a broad ranging concept affected in a complex way by the person's physical health, psychological state, personal beliefs, social relationships and their relationship to salient features of their environment".[1] Good quality of life indicates physical, professional, social and mental wellness.[2] Individual lifestyles consist of social practices and individual choices. Lifestyle can be influenced by factors such as socio-economic conditions, ethnicity and gender.[3] Starting a university education and thus experiencing changes in residence and lifestyle can cause problems with nutrition, housing and social life. Students may be exposed to different stresses such as academic pressure, social problems and financial problems. This may affect their academic achievement and increase mental problems which can affect their quality of life.[4] In addition, it has been indicated that health sciences students perceive higher stress levels compare to other study areas, which may be related with lower quality of life.[5] As a result, health sciences students differ from other individuals at university in terms of their anxieties, burdens and worries. This study evaluated health sciences students' health-related quality of life and the factors which affect it.

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ORCID IDs of the authors: C.G. 0000-0002-5647-0103; U.B. 0000-0002-5849-933X; M.Y. 0000-0002-8237-8204.

Address for Correspondence: Ceren Gezer
E-mail: ceren.gezer@emu.edu.tr
ORCID ID: orcid.org/0000-0002-5647-0103

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MATERIALS AND METHODS

This is a cross-sectional study which evaluated the quality of life of health sciences students at the Eastern Mediterranean University. This study was approved by the Ethical Board of Scientific Research and Publication of Eastern Mediterranean University (approval number: ETK00-2016-0021, date: 14.03.2016). All participants were asked to sign an informed consent form according to the Declaration of Helsinki. A questionnaire about the students' general characteristics, their nutritional habits and the Short Form-36 (SF-36) were administered via face-to-face interviews.

Study Population and Sample

The study population consisted of 1,293 students who attended the Eastern Mediterranean University's Faculty of Health Sciences in the 2015-2016 academic year. The sample size was calculated with a 95% confidence interval and 5% sampling error by using the stratified sampling method according to departments [physiotherapy and rehabilitation, nutrition and dietetics, nursing, health management (HM), and sport sciences]. The sample included 293 students from each department who all participated voluntarily (Table 1).

Short From-36

SF-36 is a frequently used measure of health-related quality of life. It has 36 items in eight dimensions which are physical function (PF), physical role limitation (PRL), emotional role limitation (ERL), vitality (VT), mental health (MH), social functioning (SF), pain (PA) and general health perception (GHP). Higher scores in these dimensions indicate increased quality of life. SF-36 was first developed in 1992 and it has Cronbach's alpha coefficients between 0.62-0.94 for each of the eight dimensions. In 1999, it was validated in Turkish with Cronbach's alpha coefficients between 0.73-0.76 for each of the eight dimensions.[6,7] In this study, the Cronbach's alpha coefficients were calculated as being between 0.72-0.79 for each of the eight dimensions.

Anthropometric Measurements

The participants' body weights were measured using a digital scale sensitive to 0.1 g, and their height was measured in the frontal plane, with the head, back, buttocks and heels touching a wall. Body mass index (BMI) was calculated by dividing body weight in kilograms by height in meters squared (kg/m^2). The WHO rates adults with a BMI of <18.5 as underweight, 18.5-24.9 kg/m^2 as normal, 25-29.9 kg/m^2 as overweight, and ≥30 kg/m^2 as obese. Waist circumference was measured from the middle of the lower rib bone and the middle of the crista iliaca adjacent to the feet, with the hands held freely. Hip circumference was measured as the widest hip circumference measurement. When assessing the risk of obesity-related metabolic complications, a waist circumferences of ≥94 cm for men and ≥80 cm for women are considered as risks, and ≥102 for men and ≥88 cm for women are considered to be high risk. The recommended waist/hip circumference is <1.0 for males and <0.85 for females.[8] The waist/height ratio was determined to be 0.5 for Turkish adults, and values above this are considered to be related to increased cardiovascular risk.[9]

Table 1. Sample size according to departments

Department	N	N/Ni	n
Physiotherapy and rehabilitation	583	45.09	132
Nutrition and dietetics	398	30.78	90
Nursing	60	4.64	14
Health management	87	6.73	20
Sport sciences	165	12.76	37
Total	**1,293**	**100.00**	**293**

Statistical Analysis

The data obtained from the questionnaire was processed with Statistical Package for the Social Sciences (SPSS) 21 software. In order to determine the hypothesis tests for comparing SF-36 scores according to the descriptive characteristics of the students, the normal distribution of the data set was tested using the Kolmogorov-Smirnov test, a Q-Q plot and skewness-kurtosis values, and the variance of the data set was seen to be homogeneous as a result of the normal distribution and Levene's test. Independent samples t-test was used when the independent variable was composed of two categories, and variance analysis (ANOVA) was used when the independent variable was composed of more than two categories. If there was a difference between the categories of the independent sample as a result of variance analysis, the post-hoc Tukey test was used to determine the categories in which the difference originated. Statistical significance was set at p-values less than 0.05.

RESULTS

The students' mean age was 20.9±2.22 (18-31) years. They obtained the highest mean score on the SF-36 subscale of PF (91.7±11-32) and the lowest mean score on the VT subscale (63.8±17-75). The males' mean scores on the PA and GHP subscales of SF-36 were higher than those of the females ($p<0.05$) (Table 2). The non-smokers had higher mean scores on the PRL, ERL, VT, MH and PA subscales than the students who smoked ($p<0.05$). There were no statistically significant differences in the SF-36 subscale scores by age group or alcohol use ($p>0.05$) (Table 1). The students in the health sciences department had the highest VT, MH, PA and GHP scores, and the HM students had the lowest PF score ($p<0.05$) (Table 2).

The students who had a high waist/hip ratio cut-off point had higher ERL scores than those with a low cut-off point ($p<0.05$). The students with low risk of cardiovascular disease according to their waist/height ratio had higher VT scores ($p<0.05$). However, SF-36 subscale scores were not statistically different by BMI classification (Table 3).

DISCUSSION

A variety of factors affect quality of life. A study conducted with medical school students in Brazil reported that their health-related quality of life was low, and this was mainly related to their MH. A more detailed evaluation found that the females had lower SF-36 scores with cases of insomnia, headache and inadequate physical activity. Their highest scores on the SF-36 subscales were on the PF subscale, and their lowest scores were on the ERL subscale.[10] This study determined that the students had the highest mean score on the PF subscale (91.7±11.32), and the lowest mean score on the VT subscale (63.8±17.75) (Table 2). In a study conducted with 119 nursing students in Jordan, the highest score was on the PF subscale, and the lowest was on the VT subscale.[11] The students got the next lowest scores on the ERL (65.9±38.51), MH (65.6±15.74) and GHP (68.0±18.15) subscales (Table 2). However, these values were higher than those of 429 health sciences students in Türkiye. That study determined that the SF-36 subscale scores were low (<50 points), and that this was related to MH.[12] A study conducted with 527

Table 2. SF-36 scores by the students' demographic characteristics (n=293)

		PF, $\bar{x}$ ± SD	PRL, $\bar{x}$± SD	ERL, $\bar{x}$ ± SD	VT, $\bar{x}$ ± SD	MH, $\bar{x}$ ± SD	SF, $\bar{x}$± SD	PA, $\bar{x}$± SD	GHP, $\bar{x}$ ± SD
Gender	M	92.5±13.80	84.3±26.30	69.4±37.30	66.1±18.94	65.8±16.07	82.5±19.77	81.8±20.54	73.9±19.42
	F	91.4±10.14	86.6±27.73	64.5±39.01	62.8±17.18	65.5±15.64	77.1±19.18	76.3±21.57	65.5±17.06
	p	0.45	0.51	0.33	0.15	0.89	**0.03***	**0.05***	**0.00***
Age (years)	<21	92.0±11.58	86.9±25.29	62.9±38.38	64.7±17.05	65.9±15.51	77.6±19.19	77.8±21.61	68.3±18.60
	≥21	91.2±10.86	83.9±30.68	71.5±38.32	62.1±18.92	65.0±16.21	80.7±19.93	78.2±21.05	67.4±17.38
	p	0.56	0.37	0.07	0.22	0.62	0.19	0.88	0.67
Alcohol use	Yes	90.5±14.30	82.5±28.97	63.4±37.12	63.6±16.32	63.6±15.82	77.9±20.80	74.9±22.90	70.5±18.46
	No	92.3±9.61	87.5±26.40	67.1±39.18	63.9±18.40	66.5±15.66	79.0±18.87	79.4±20.54	66.8±17.94
	p	0.20	0.14	0.44	0.90	0.14	0.65	0.09	0.10
Cigarette use	Non-smoking	91.6±11.31	87.8±26.22	68.2±37.47	64.8±17.15	66.6±15.09	79.1±19.02	80.0±19.91	68.6±17.75
	Smoking	92.4±11.42	78.3±30.24	57.0±41.54	59.6±19.51	61.6±17.69	76.9±21.25	69.6±24.88	65.4±19.63
	p	0.60	**0.01***	**0.04***	**0.04***	**0.03***	0.42	**0.00***	0.21
Department	PR	91.7±11.10	86.9±27.70	64.8±39.35	63.1±16.94	66.2±14.72	80.8±18.30	78.9±19.44	67.5±17.57
	ND	92.2±10.19	86.3±27.06	66.3±38.86	61.8±18.35	63.6±16.86	74.1±20.07	79.0±20.81	67.8±16.99
	N	94.2±5.49	80.3±34.22	66.6±43.36	62.8±14.10	65.1±15.24	75.0±20.21	61.6±29.73[d]	56.4±12.77
	HM	80.5±18.84[a]	85.0±30.77	60.0±38.38	61.0±21.12	58.8±17.98	81.2±18.36	70.1±24.08	60.5±20.70
	SS	95.9±6.64	83.7±22.21	72.0±33.80	72.8±16.43[b]	72.1±13.54[c]	82.0±21.15	82.2±21.75	78.9±18.56[e]
	p	**0.00**	0.90	0.82	**0.02**	**0.02**	0.07	**0.01**	**0.00**
Year of study	First	94.1±8.89	84.2±27.48	60.2±40.31	64.9±17.27	67.3±15.45	79.4±17.60	79.4±22.41	69.5±18.65
	Second	89.7±12.21	86.0±26.43	63.2±37.69	64.4±17.80	64.1±15.34	73.3±21.10	75.1±22.14	67.6±18.16
	Third	90.7±12.51	91.8±20.77	72.1±35.05	63.8±19.11	65.4±15.73	81.7±17.61	79.8±18.18	67.5±19.42
	Fourth	92.3±11.17	82.9±31.64	69.1±39.81	62.3±17.27	65.5±16.48	80.7±20.14	77.9±22.00	67.4±16.96
	p	0.09	0.25	0.25	0.81	0.66	0.39	0.53	0.88
	Total	91.7±11.32	85.9±27.29	65.9±38.51	63.8±17.74	65.6±15.74	78.7±19.48	77.9±21.38	68.0±18.15

p<0.05, [a,b,c,d,e]: Statistically different from the others, SD: Standard deviation, PF: Physical function, PRL: Physical role limitation, ERL: Emotional role limitation, VT: Vitality, MH: Mental health, SF: Social functioning, PA: Pain, GHP: General health perception, M: Male, F: Female, PR: Physiotherapy and rehabilitation, ND: Nutrition and dietetics, N: Nursing, HM: Health management, SS: Sport sciences.

Table 3. SF-36 scores by the students' anthropometric measurements (n=293)

		PF, $\bar{x}$ ± SD	PRL, $\bar{x}$ ± SD	ERL, $\bar{x}$ ± SD	VT, $\bar{x}$ ± SD	MH, $\bar{x}$ ± SD	SF, $\bar{x}$ ± SD	PA, $\bar{x}$ ± SD	GHP, $\bar{x}$ ± SD
	≤18.49	94.6±6.58	83.3±28.23	65.2±39.90	58.9±19.50	65.5±19.23	74.4±18.97	71.2±24.58	64.17±16.06
BMI (kg/m²)	18.5-24.9	91.4±11.78	87.0±26.19	67.3±38.25	64.2±16.14	66.2±14.68	78.9±19.33	78.2±21.22	67.99±17.90
Classification	25.0-29.9	92.4±10.88	83.6±29.74	62.4±38.52	63.00±22.21	63.0±18.05	80.68±19.22	79.00±20.75	69.8±18.66
	≥30.0	87.00±14.40	75.00±43.30	53.3±50.55	80.00±10.61	70.4±15.13	67.5±30.10	89.00±15.47	69.00±33.05
	p	0.42	0.62	0.74	0.10	0.53	0.34	0.28	0.65
Waist	M: <94 F: <80	92.0±11.08	86.2±26.48	67.1±38.33	63.9±17.39	66.0±15.52	79.2±19.00	77.8±21.35	68.4±17.95
Circumference	M: 94-102 F: 80-88	90.9±14.0	90.3±23.53	64.1±36.42	67.5±16.07	65.2±15.16	78.8±22.84	82.3±21.91	68.2±17.37
(Cm)	M: >102 F: >88	87.0±9.64	68.7±44.11	44.4±43.4	54.1±25.48	58.0±20.57	67.7±20.26	71.4±20.73	58.7±22.97
	p	0.30	0.06	0.13	0.09	0.22	0.13	0.33	0.19
Waist/hip	M: <1.0 F: <0.85	92.0±11.47	85.9±27.03	67.0±37.82	63.9±17.42	65.6±15.48	79.3±19.26	78.1±21.47	68.3±17.83
	M: ≥1.0 F: ≥0.85	88.0±8.43	85.7±31.19	52.3±45.42	61.9±21.93	65.3±19.23	70.2±20.71	76.4±20.62	63.8±22.01
	p	0.33	0.76	**0.03***	0.12	0.32	0.88	0.70	0.23
Waist/height	<0.5	92.1±11.00	86.4±26.36	67.3±38.46	63.8±16.66	66.0±15.48	79.0±19.30	77.7±21.41	68.2±17.76
	≥0.5	90.1±12.72	83.3±31.49	59.4±38.47	63.6±22.36	63.5±16.90	77.2±20.41	78.9±21.41	67.0±20.07
	p	0.70	0.20	0.97	**0.01***	0.62	0.50	0.56	0.26

*: p<0.05, SD: Standard deviation, PF: Physical function, PRL: Physical role limitation, ERL: Emotional role limitation, VT: Vitality, MH: Mental health, SF: Social functioning, PA: Pain, GHP: General health perception, BMI: Body mass index.

medical school students in the Philippines found the highest scores on the PF subscale and the lowest scores on the VT and ERL subscales, and that depression and stress were related to low quality of life.[13] A study conducted with medical faculty students found that females, students

with depression markers and third-year students had the lowest health-related quality of life.[14] Thus, gender differences can affect quality of life along with other factors.

The males' mean scores on the SF, PA and GHP subscales of SF-36 were higher than those of the females in our study ($p<0.05$) (Table 2). A study conducted with 256 university nursing students in Brazil found that males had higher PF, VT, SF, ERL, MH and PA scores than females.[15] A study with 1,751 university students in Türkiye found that males had higher GHP scores than females.[16] A study with 286 university students in Saudi Arabia found that females scored higher on FS and PA, and that males scored higher on the other subscales.[17] A study with 119 nursing students in Jordan found that the males' PF subscale scores were higher than those of the females.[11] A similar study conducted with 468 university students in the UK determined that the physical activity levels of the females were lower.[18] Another study with 3,646 university students in Spain determined that females had lower levels of physical activity and less healthy lifestyles than males.[19] These results indicate that women's quality of life is lower than that of men. The problems of women's rights may be considered an important reason for this.

The non-smokers had higher mean scores on the PRL, ERL, VT, MH and PA subscales than those students who smoked ($p<0.05$). There were no statistically significant differences in the SF-36 subscale scores by age group or alcohol use ($p>0.05$) (Table 2). Similar results were found in a study conducted with 1,751 university students in Türkiye. According to that study, non-smokers had higher PRL and VT subscale scores than smokers, but there were no statistically significant differences in SF-36 subscale scores by age group or alcohol use.[16] A study conducted with 282 university students in Lebanon found that smokers' VT and MH scores were lower by factors of 9.7 and 6.9, respectively. A study conducted with 364 university students in Iran found that smoking was associated with lower scores on SF-36 physical assessments.[20] These results indicate that smoking is also an important factor in university students' quality of life.

The fact that students in the department of sport sciences had the highest quality of life in this study may be related to the fact that the majority of students in this department are male and that the practical courses are based on exercise. Studies have shown that increased physical activity is related to increased quality of life.[21,22]

Those students who had a high waist/hip ratio also had a higher ERL score compared to those with a low ratio ($p<0.05$). The students with low risk of cardiovascular disease according to waist/height ratio had higher VT scores ($p<0.05$). On the other hand, SF-36 subscale scores did not vary statistically by BMI classification (Table 3). The SF-36 scores of university students in Lebanon also did not vary by BMI.[21] However, a study conducted in Romania found that students with BMIs of >30 kg/m^2 had lower quality of life than those with BMIs of <25 kg/m^2.[23] On the other hand, a study conducted with university students in Türkiye determined that higher BMI increased the MH scores related to quality of life by a factor of 1.4.[16]

CONCLUSION

In conclusion the quality of life of the females who participated in our study was lower than the males. In addition to the students' gender, their smoking status, their department and their anthropometric measurements also affected their quality of life contents. In order to determine the factors which affect quality of life, it may be useful to conduct more studies with larger samples and statistical analyses.

MAIN POINTS

- Gender, smoking, department and anthropometric measurements affect quality of life.
- The quality of life of the female health science students was lower than the males.
- The sports science students had the highest quality of life.

ETHICS

Ethics Committee Approval: This study was approved by the Ethical Board of Scientific Research and Publication of Eastern Mediterranean University (approval number: ETK00-2016-0021, date: 14.03.2016).

Informed Consent: All participants were asked to sign an informed consent.

Authorship Contributions

Concept: C.G., U.B., Design: C.G., Supervision: C.G., Materials: C.G., U.B., Data Collection and/or Processing: U.B., Analysis and/or Interpretation: C.G., M.Y., Literature Search: C.G., U.B., Writing: C.G., U.B., Critical Review: C.G., M.Y.

DISCLOSURES

Conflict of Interest: No conflict of interest was declared by the authors.

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RESEARCH ARTICLE

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Evaluating the Personal Protective Equipment and Surgical Hand-Washing Knowledge Levels of Nursing Students in the Preoperative Period

Kerem Yıldız, Tuğba Altun, Fatma Tokpınar

Department of Nursing, Eastern Mediterranean University Faculty of Health Sciences, Famagusta, North Cyprus

Abstract

BACKGROUND/AIMS: Nurses are health professionals who have direct contact with the patient and play an important role in the prevention of healthcare-associated infections. This study was conducted with the aim of evaluating the personal protective equipment (PPE) and surgical hand-washing (SHW) knowledge levels of nursing students in the preoperative period.

MATERIALS AND METHODS: This descriptive and cross-sectional study included 122 nursing students who were studying in North Cyprus. The data of the study were collected in April, 2019 using the PPE (20 questions) and SHW (20 questions) information form (8 questions) which consist of 48 questions in total. Statistical comparisons were made using the Mann-Whitney U test, the Kruskal-Wallis test and the Pearson correlation test. A p-value of <0.05 was considered statistically significant.

RESULTS: Class 2 and 3 had the same amount of the students (61 students in each class). 91.8% of the students had graduated from standard high schools and 122 (100%) of the students had received isolation methods in the courses in their curriculum. The mean total score of the female students was 68.8±8.79 points and the mean total score of the class three students was 68.7±9.72 from the PPE and SHW information form. Students received 67.41±9.44 points from both of the sub-dimensions of the PPE and SHW Form. Correlation levels of PPE and SHW were found to be of a medium level correlation for the average of the total score of the data form ($r=0.418$ $p=0.00$).

CONCLUSION: According to the results of this study, they showed that the student nurses have a medium level of information regarding the PPE and SHW information form.

Keywords: Knowledge, preoperative period, personal protective equipment, hand disinfection

INTRODUCTION

Nurses are health professionals who have direct contact with the patient and play an important role in the prevention of healthcare-associated infections (HAIs).[1,2] HAIs, which pose a great risk for both patients and healthcare workers, are also a potential danger for healthcare students who will be the healthcare professionals of the future.[3-5] Nursing education consists of theoretical and practical training. Practical trainings are carried out in clinical areas and laboratory environments and aim to provide skills to the students via these trainings.[2,6]

Nursing department students can mitigate the risks of infection by knowing the ultimate principles, by using standard precautions, by providing effective care, and by using healthcare services.[7,8] There are important roles and responsibilities in every stage of the preoperative

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ORCID IDs of the authors: K.Y. 0000-0001-8653-9012; T.A. 0000-0002-9307-8135; F.T. 0000-0002-1077-9893.

Address for Correspondence: Kerem Yıldız
E-mail: kerem.yildiz@emu.edu.tr
ORCID ID: orcid.org/0000-0001-8653-9012

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preparation process.[5] Personal protective equipment (PPEs) are a range equipment which should be worn by health professionals in order to eliminate the risks of infection by preventing the transmission of body fluids from the patient to the employee and *vice versa*.[9,10] Hand-washing is the process of washing hands with soap and water in order to prevent the transmission of microorganisms between the employee and patients.[7,14] The purpose of hand-washing and hand hygiene is to remove visible dirt from the hands and to reduce the number of temporary and permanent flora.[11,12] Nursing department students can prevent the risk of infection by knowing the ultimate principles, by using standard precautions, by providing effective care, and by using healthcare services.[7,8] There are important roles and responsibilities in every stage of the preoperative preparation process.[5] Surgical hand antiseptics might be water-based or alcohol-based solutions.[13] Surgical hand-washing (SHW) involves; wetting the hands and forearms with water, applying an antiseptic solution by using the hands or sponges, and then repeating the process.[12,15,16] SHW should be performed within 5 minutes if there is visible contamination, and within 3 minutes if there is no contamination.[7,14,16] Following the hand antisepsis process, the team members prepare for surgery by putting on sterile gloves which serve as a barrier between the surgical staff and the patient.[3,11] Nurses should have the knowledge and competence to be able to use PPEs and SHW procedures in order to protect both themselves and their clients' health.[1,9]

Research Questions

1. Is there a difference between the descriptive characteristics of the nursing students and the information scores on the use of PPE?

2. Is there a difference between the nursing students' descriptive characteristics data and their SHW usage information scores?

3. Is there a difference between the nursing students' descriptive characteristics data and their PPE and SHW total knowledge scores?

MATERIALS AND METHODS

This study was conducted in accordance with a descriptive and cross-sectional design. The population of this study consisted of 160 nursing students in their third (n=77) and fourth (n=83) class in the nursing department of a university in North Cyprus. Thirty-eight students who did not attend the course, refused to participate in this study or had participated in the pre-application were excluded from this study and so this research was completed with 122 students. The "PPE and SHW information form" which was created by the researchers in accordance with the literature was used in this study.[2,15-17] This data collection form consists of three parts. In the first part of the form, there are 8 questions about the descriptive characteristics of the students (age, gender, the school that was previously completed, the class they studied in, etc.). In the second part of the form, there are 20 items for determining the levels of use of PPE and in the third part of the form, there are 20 items regarding their SHW knowledge levels. All necessary information about this study was given to the students before they agreed to participate. After obtaining all necessary permissions, the data were collected from the students in a classroom setting on the day that students had a basic professional nursing courses. Forty items including the information questions were prepared. The students were asked to answer the items by selecting one of "True", "False" or "Don't Know." The correct answers were given 2.5 points for a maximum total of 100 points. Higher scores indicate that the students have a better level of knowledge. In order to evaluate the information form in terms of subject scope adequacy, expert opinions were obtained from 5 faculty members and the final form was created.

In order to determine the comprehensibility of the questions in the data form, a preliminary study was conducted with 10% of the population, i.e. 16 student nurses. Content Validity Index (CVI) was used by taking expert opinions into consideration. CVI; items validity index for items, Item Validity Index (I-CVI) was calculated using the Scale-Content Validity Index (S-CVI) for the whole questionnaire. In this study, S-CVI and I-CVI values were found to be 1.00. The Cronbach's alpha value, which shows the reliability of the questionnaire, was found to be α=0.78.

Permission was received from the Scientific Research Publication Ethics Committee, Health Ethics Subcommittee with the project number (approval number: ETK00-2019-0012) as well as from the Eastern Mediterranean University.

Statistical Analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences version 18.0 software. All results were expressed as mean ± standard deviation or percentage. Statistical comparisons were made using the unpaired Mann-Whitney U test, the Kruskal-Wallis test and Pearson's correlation test. A p-value of <0.05 was considered statistically significant.

RESULTS

In this study; 68% of the nursing students were female and their average age was 22.55±1.53 years. 50% of the students were in the third year and 50% were in the fourth year. 91.8% of the students had graduated from high school, 2.5% had graduated from health vocational high schools and 5.7% had graduated from associate degree programs. 100% of the students had received training on the use of PPE and SHW in the preoperative period within the scope of their curriculum (Table 1).

When the most correct answers were taken into consideration about the usage of PPE, 98.4% (n=120) of the students responded correctly to the item of "All jewelry must be completely removed before putting on PPE", for the item "Protective equipment should not be used only in the operating room' it was 96.7% (n=118), and for "Surgical masks should be worn to cover the entire face (mouth, nose, and chin)" it was 95.1% (n=116) of the students who answered correctly. When SHW procedures were examined, the items of "hands should be washed before and after all procedures", it was 95.1% (n=116) and for "Hand-washing should be performed from the fingertips to the elbow", it was 91.8% (n=112) of the students who answered correctly (Table 2).

In addition, the usage of PPE and SHW items' incorrect answers were examined. Regarding incorrect items about the usage of PPE; 86.9% (n=106) of the students incorrectly answered "When removing the surgical mask, the upper ties should be undone first." The item of "the bottom ties of the mask should be tied before the upper ties" was answered incorrectly by the students at a rate of 68.0% (n=83). When SHW procedures were examined, 67.2% (n=82) of the student nurses answered incorrect by responding "Sterile gowns should be put on by holding at the wrist." The item of "washed hands should be kept at the waist level" was answered incorrectly by 59.8% (n=73) of the students and 54.4% (n=52) of the student nurses answered the item incorrectly by stating "The bonnet and mask should not be put on before SHW" (Table 2).

Table 1. Demographic characteristics of the nursing students (n=122)		
	n	%
Age		
20-21	21	17.2
22-23	82	67.3
24 or above	19	15.5
	Mean ± SD	
	22.55±1.53	
Gender		
Female	83	68.0
Male	39	32.0
Class		
3rd year	61	50.0
Senior year	61	50.0
Type of previous school graduated from		
High school	112	91.8
Health vocational high school	3	2.5
Associate	7	5.7
Isolation methods training status		
Yes	122	100.0
Isolation training method		
Courses in the education curriculum	122	100.0
SD: Standard deviation.		

The nursing students' mean PPE knowledge score average was 29.6±5.32, and their SHW knowledge score average was 37.7±5.88. When the total knowledge scores of the students were examined, it was found that the mean knowledge score was 67.4±9.44. When the total score ranges of the scales were examined, it was found that the lowest score obtained was 40 and the highest was 85. According to these results, it was concluded that the level of knowledge of nursing students was mid-level/intermediate (Table 3).

When the sociodemographic data of the student nurses were examined, it was observed that the results which made a significant difference were based on gender and class. Therefore, when the sub-dimensions were examined, it was seen that the mean score of the use of PPE for female students (30.2±5.17) was higher than the score of the male students, but there was no significant difference ($p>0.05$). The mean scores of the 3rd grade students (30.8±5.23) was higher than the 4th grade students and a significant difference was found between the two classes ($p<0.05$). When the mean scores of SHW was examined, the female students had higher scores (38.6±5.25) than the male students, but it was not statistically significant ($p>0.05$). The mean scores of the 3rd grade students (37.9±6.31) were found to be higher than the 4th grade students, but there was no significant difference between the classes ($p>0.05$). When both total dimension scores were examined, the female students scored higher (68.8±9.79) than the male students. The grade point average of the 3rd grade students (68.7±9.72) was found to be higher than the fourth-grade students. There was no statistically significant difference between the two groups ($p>0.05$) (Table 4). When the relationship between age and PPE and SHW of the nursing students

Table 2. Nursing students' answer to questions related to PPE and SHW (n=122)					
A. Recommendations that students answered most correct		**True**		**False**	
		n	**%**	**n**	**%**
Personal protective equipment	- Jewelry used must be completely removed before wearing protective equipment	120	98.4	2	1.6
	- Protective equipment should only be used in the operating room preparation process	118	96.7	4	3.3
	- Surgical masks should be worn to cover the entire face (mouth, nose, chin)	116	95.1	6	4.9
	- The metal part of the surgical mask should be firmly placed on the face by pressing on the bridge of the nose	115	94.3	7	5.7
	- Protective equipment is not preventive against possible infections	110	90.2	12	9.8
Surgical hand-washing	- No need to wash hands before and after all procedures	116	95.1	6	4.9
	- The use of nail polish and artificial nails is not important in surgical hand-washing	113	92.6	9	7.4
	- Hand-washing should be carried out from the fingertips to the elbow	112	91.8	10	8.2
	- Do not touch the outside of the apron with bare hands	112	91.8	10	8.2
	- Sterile gloves should be worn over the sterile gown so that the wrists are not exposed	112	91.8	10	8.2
B. Recommendations that students answered most wrong					
Personal protective equipment	- When removing the surgical mask, the upper ties should be undone first	16	13.1	106	86.9
	- The ties of the surgical mask should not be discharged node	30	24.6	92	75.4
	- Bonnets should be removed from the back to the front	33	27.0	89	73.0
	- The lower ties of the surgical mask must be tied first and then the upper ties tied	39	32.0	83	68.0
	- Goggles should be removed with gloved hands	50	41.0	72	59.0
Surgical hand-washing	- The sterile surgical gown should be worn to the wrist	40	32.8	82	67.2
	- Washed hands should be kept at waist level	49	40.2	73	59.8
	- The sterile surgical gown should be taken off before removing sterile gloves	67	54.9	55	45.1
	- While putting on sterile gloves, you should put on your passive hand first	66	54.1	56	45.9
	- The bonnet and surgical masks should be worn before surgical hand-washing	70	57.4	52	54.4
PPE: Personal protective equipment, SHW: Surgical hand-washing.					

was examined, a statistically weak, negative (r=-0.027; p=0.766) relationship with PPE and a statistically significant, moderate, positive (r=0.418; p=0.00) relationship with SHW was found. A significant negative correlation was found between the total score and age (Table 5).

DISCUSSION

HAIs are preventable health problems which pose a major health risk, such as reduced quality of life, prolonged hospital stay, and even death. The biggest weapons which can be used to prevent HAIs are hand-washing and the usage of PPE.[7,8]

As reported, 100% of the respondents had attended isolation method trainings. Consequently, 100% of the respondents had received trainings in the courses of their curriculum. In the study of Al-Rawajfah and Tubaishat[4], 68% of students stated that they had received their training via their education curriculum. Nursing education plays an important role in improving the awareness of nursing students in preventing infection cross contamination.[10,13]

In order to provide a successful health service, watches, rings, bracelets, false nails, etc. which carry the risk of infectious agents must be removed by the healthcare professional before operations.[16] In our study, 98.4% of the students responded correctly to the statement that "all jewelry should be removed before putting on PPE." In the perioperative preparation process, the nurses should apply hand hygiene with the appropriate methods in order to prevent the transmission of pathogenic microorganisms in the hand-washing process so as to protect their own and their patient's health.[16] The student nurses answered the question "removing nail polish and artificial nails is important in surgical operations" correctly at a rate of 92.6%. Therefore, they support the principal that cleaning nail polish and removing artificial nails before operations prevents the transmission of infectious agents.

Regarding the item "PPEs should not be used only in the preparation of the operating room", it was answered correctly by 96.7% of the students. Labrague et al.[7] in their study stated that 93.1% of the students supported the statement that they "should wear protective equipment in all operations." Amin et al.[8] in their study reported that 38.6% of students stated that they "should only use the protective equipment when there is contact with blood." When the literature were examined, it could be seen that the student nurses do not have enough knowledge about this subject.[8] Gould and Drey[18] reported that 53.6% of the students did not change their protective clothing during transitions between patients. This finding indicates the possibility of carrying infections between patients will continue and that protection cannot be provided.

Surgical masks prevent the transmission of infections from the respiratory tract (via the mouth and nose). For this reason, surgical masks should be placed covering the mouth, nose and chin.[17] In our study, this item was answered correctly by 95.1% of the students. The metal part of the surgical masks should be placed on the bridge of

Table 3. Nursing Students' Knowledge Average Scores PPE and SHW (n=122)

Sub-dimensions	Mean ± SD	Min.	Max.
Personal protective equipment	29.6±5.32	12.5	40.0
Surgical hand-washing	37.7±5.88	20	47
Total	**67.4±9.44**	**40**	**85**

PPE: Personal protective equipment, SHW: Surgical hand-washing, SD: Standard deviation, Min.: Minimum, Max.: Maximum.

Table 4. Compartments of PPE, SHW and Total Knowledge Scores of students' by students' characteristics (n=122)

Sub-dimensions		n	Mean ± SD	Min.	Max.	p
Personnel protective equipment	Female	83	30.2±5.17	17.5	40	0.150
	Male	39	28.5±5.52	12.5	37.5	
	Class 3	61	30.8±5.23	17.5	40	**0.013**
	Class 4	61	28.55.21	12.5	40	
Surgical hand washing	Female	83	38.6±5.25	22.5	47.5	**0.027**
	Male	39	35.7±6.69	20	45	
	Class 3	61	37.9±6.31	20	47.5	0.611
	Class 4	61	37.5±5.46	22.5	47.5	
Total	Female	83	68.8±8.79	45	85	**0.022**
	Male	39	64.2±10.1	40	82.5	
	Class 3	61	68.7±9.72	40	85	0.086
	Class 4	61	66.1±9.04	40	82.5	

PPE: Personal protective equipment, SHW: Surgical hand-washing, SD: Standard deviation, Min.: Minimum, Max.: Maximum.

Table 5. Nursing students' correlations between age with PPE, SHW and total scores (n=122)

		Personal protective equipment	Surgical hand-washing	Total
Age	r	-0.027	0.418	-859
	p	0.766	0.00	0.00

PPE: Personal protective equipment, SHW: Surgical hand-washing

the nose.[17] This item was answered correctly by 94.3% of the students. Ghalya and Ibrahim[12] stated that 98.9% of the students said that the use of protective equipment prevents the development of infections. Their finding gives almost the same results as in our study.

For effective hand hygiene, the health personnel must act with the principle of "first, do no harm."[16] The item of "Wash hands before and after all procedures" was answered correctly by 95.1% of the students. Garcia-Zapata et al.[6] stated that all students washed before and after all procedures, Labrague et al.[7] stated that 96.6% of students know that they should wash their hands before and after contact with patients. These high levels of results indicate that the students' knowledge about hand hygiene is high.

According to the recommendations of AORN hand hygiene application steps, the process should start under the running water, and the hand-wash should start from the fingers and continue to clean under the fingernails.[15] In our study, the item of "hand-washing should be carried out from the fingertips to the elbow" was answered correctly by 91.8% of the students. This result shows that the students had mastered this subject in their theoretical and laboratory trainings.

When removing the surgical mask, the bottom ties must first be undone in order to prevent contact with infectious agents on the front of the mask to the healthcare personnel.[17] In our study, the item of "the upper ties of the surgical mask should be untied first" was answered significantly wrong by 86.9% of the students. It is thought that the student nurses may not have sufficient skills to use PPE and this finding might originate from this reason.

When tying the ties of the surgical masks, the upper ties should be tied first and then the lower ties.[17] The item of "when tying the ties of the surgical masks, the upper ties should be tied first, and then the lower ties" was answered incorrectly by the 83 (68%) of the nursing department students.

Protective goggles are used to protect from splashing liquids.[17] In the study conducted by Barikani and Afaghi[19], the item of "goggles should be worn to protect the eyes" was answered correctly by 91.2% of the students. In our study, the item "protective goggles are removed with gloved hands to prevent contamination of the face" was answered incorrectly by 59.0% of the students.

The apron should be carefully grasped by the neck so as not to contaminate it from the back while putting it on.[17] The item "a sterile apron should be put on by the wrist" was answered incorrectly by 67.2% of the nursing department students. Some priorities should be followed when taking off PPE. Removal follows the sequence of gloves first, followed by face protection or protective goggles, apron and mask, respectively.[17] The item regarding this sequence (Sterile gown should be removed before removing sterile gloves) was answered incorrectly by 45.1% of the student nurses. In the study by Labrague et al.[7] with nursing students, 100% of the students stated that the aim of taking standard measures (wearing glasses, masks, gloves, gowns) was to protect themselves and their patients, and 98.27% of them were wearing glasses, masks and gowns in order to prevent contamination of blood and body fluids.

In our study, female gender and 3rd grade students had higher information scores (38.6±5.25) on SHW than the male gender or fourth grade students. In a study conducted by Cruz and Bashtawi[20] with nursing students, it was reported that male gender and lower grade students had higher levels of knowledge about hand hygiene than female gender and higher-grade students.

Study Limitations

This study was limited to nursing second grade and third grade university students at the university where the study was conducted.

Within the scope of surgical nursing of the nursing department of our university, the use of PPE and SHW procedures were explained both theoretically and in the basic skills laboratory and applied with the students.

CONCLUSION

Determining the imperfect knowledge about PPE and hand-washing procedures and taking measures, updating and evaluating studies on this subject matter, planning and coordinating training programs about any detected deficiencies by using current guidelines and conducting further research on these issues are recommended.

MAIN POINTS

- Despite the majority of student nurses graduating from standard high schools, they exhibit a moderate level of knowledge regarding personal protective equipment (PPE) and surgical hand-washing (SHW).
- Although all students have received education on isolation methods in their curriculum, their knowledge levels on PPE and SHW vary.
- There are no significant differences in knowledge levels between genders and class levels; students demonstrate similar levels of understanding on PPE and SHW.
- The moderate correlation found between knowledge levels on PPE and SHW suggests an interconnectedness between these two topics, indicating they influence each other.
- The study implies a need for greater emphasis on PPE and SHW within nursing education programs, as these areas are crucial in preventing healthcare-associated infections.

ETHICS

Ethics Committee Approval: Permission was received from the Scientific Research Publication Ethics Committee, Health Ethics Subcommittee with the project number (approval number: ETK00-2019-0012) as well as from the Eastern Mediterranean University.

Informed Consent: Voluntary informed consent form was obtained from the students in writing.

Authorship Contributions

Concept: K.Y., Design: K.Y., Supervision: K.Y., Fundings: K.Y., Materials: K.Y., T.A., F.T., Data Collection and/or Processing: K.Y., T.A., F.T., Analysis and/or Interpretation: K.Y., T.A., F.T., Literature Search: K.Y., T.A., F.T., Writing: K.Y., T.A., F.T., Critical Reviews: K.Y., T.A., F.T.

DISCLOSURES

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RESEARCH ARTICLE

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The Effects of Using Standardized Patients on Nursing Students' Head, Neck and Neurological Examination Skills, Self-Confidence and Satisfaction

Serpil İnce

Department of Fundamentals of Nursing, Akdeniz University Faculty of Nursing, Antalya, Türkiye

Abstract

BACKGROUND/AIMS: The aim of this study was to examine the effects of standardized patient (SP) practice on students' head, neck and neurological examination skills, satisfaction and self-confidence.

MATERIALS AND METHODS: This study was conducted in April and May, 2019 using a comparative design. The sample of this study consisted of 79 students enrolled in the "Assessment of Health" course who agreed to participate. The students were randomly assigned to either two SP simulations (head and neck with a neurological examination) (group 1; n=35) or one SP simulation (just head and neck examination) (group 2; n=44) groups. Data were collected using the "Demographic Data Collection Form for Students", "Skill Evaluation Form (Head and Neck Exam and Neurological Examination)" and "Student Satisfaction and Confidence in Learning Scale."

RESULTS: The performance scores obtained by the head, neck and neurological examination of real patients in both groups were significantly higher than those obtained from the SP performances. The self-confidence and satisfaction scores of the group 1 students after performing the head, neck and neurological examinations on real patients were higher than the group 2 students.

CONCLUSION: The results of this study showed that SP use was effective in improving students' performance levels in head, neck and neurological examinations. Although the students' self-confidence and satisfaction scores were not statistically significant after the actual patient experience, there was an increase.

Keywords: Standardized patient, nursing student, physical assessment, self-confidence, satisfaction

INTRODUCTION

The basis of the nursing profession is using the nursing process as a problem solving method in order to determine the response to treatment of potential or existing health problems of patients of all ages in the healthcare field. The skills used during the nursing process are necessary for the clinical application of knowledge and theory. The diagnostic/data collection phase of the nursing process refers to the determination or assessment of the patient's health. Physical examination of the patient plays an important role in collecting diagnostic data.[1]

In order to perform physical examination, nurses must have psychomotor skills, which are a combination of cognitive and motor activities.

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ORCID ID of the author: S.İ. 0000-0002-2160-8440.

Address for Correspondence: Serpil İnce
E-mail: inceserpil07@gmail.com; serpildogan@akdeniz.edu.tr
ORCID ID: orcid.org/0000-0002-2160-8440

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At first, it is recommended that students apply their newly learned physical examination skills on their peers. This can help students gain organization, trust and certain skills before approaching patients. The development of these skills is only gained when it is applied repeatedly. Before practicing nursing skills on real patients in a clinical setting, it is important to perform repetitive studies in skill laboratories during their nursing education.[2] For this reason, the focus nowadays is on new strategies which make teaching in skill laboratories more effective in order to better prepare students for the clinical environment.

In the literature, it has been stated that the use of teaching methods similar to the clinical environment is beneficial in reducing students' stress and increasing their self-confidence, especially in clinical practice.[3,4] For this reason, simulation practice is widely used in nursing education nowadays. The simulation practice in nursing education enables students to handle an incident as if it were a real case and practice educational work in a laboratory environment.[5] Simulation methods are divided into three groups as low, medium or high reality according to the level of reality and difficulty. Body-separated models, basic plastic mannequins, virtual and tactile reality, realistic high-tech interactive patient simulators and standardized patient (SP) practice are among the methods used.[6,7] The SP practice which belongs in the high reality category is used to gain psychomotor skills,[8,9] teach physical examination methods,[10,11] improve students' communication skills,[12,13] increase students' self-confidence,[4,14] and reduce anxiety.[15,16] SPs who were called "programmed patients" in earlier applications and are now called "simulated patients" are individuals trained to describe disease-consistent behaviors.[17,18]

In nursing studies where SP practice is used, it is stated that this practice has significant contributions on the learning process. It has been observed that SP practice improves students' communication skills and increases their self-confidence in particular.[4,12-14] In recent years, the use of simulation in nursing education has become more common in our country. It has been stated in the literature[6,19] that, despite the benefits gained from simulations with high levels of reality, the proficiency and confidence gained by students with simulation training is not the same as the self-confidence and competency gained when they encounter a real patient in the clinic or field.

As reported, simulation is widely used to create a learning environment which contributes to the students' knowledge, skills and self-confidence; however, there is a gap in the transfer of these gains to the clinical setting.[20] The results of this study are hoped to be beneficial on this point. The aim of this study was to examine the effects of SP practice on students' head, neck and neurological examination skills, satisfaction and self-confidence.

Research Hypotheses

- SP practice increases nursing students' skills in head, neck and neurological examination.

- Repeated SP applications increase the satisfaction of nursing students.

- Repeated SP applications increase the confidence of nursing students.

MATERIALS AND METHODS

A comparative design was used in this study. This research was carried out during the spring semester of the 2018-2019 academic year in April and May. The study protocol was approved by the Clinical Research Ethics Committee of the university hospital (approval number: 19.07.2017/451). Written and verbal informed consent was obtained from all students. Verbal consent was obtained from the patients.

Participants

Students who had one SP experience (head and neck examination) were compared to those who had two SP experiences (head and neck as well as neurological examination) to determine their performances, self-confidence and satisfaction with real patients in a real clinical setting. The sample of this study consisted of 79 students enrolled in the "Assessment of Health" course which aims to teach the physical examination methods to evaluate the body systems of the patient and healthy individual who agreed to participate. Students who volunteered to participate in this study were assigned to the intervention group (head, neck and neurological examination) (group 1; n=35) and the other students were assigned to the control group (just head and neck examination) (group 2; n=44).

Data were collected using the "Demographic Data Collection Form for Students", the "Skill Evaluation Form (Head and Neck Exam and Neurological Examination)", the "Student Evaluation Form for SP" and the "Student Satisfaction and Confidence in Learning Scale."

Demographic Data Collection Form for Students

The form consisting of 7 questions regarding personal information such as the age, gender, place of residence and the reasons for choosing nursing was created by the researcher.

Skill Evaluation Form

The skill evaluation forms are revised by the department's academic staff in line with the literature every academic year. The head and neck examination skill evaluation form consists of 19 items, while the neurological examination skill evaluation form consists of 17 items. On these forms, each item is rated as either "0=Step bypassed or wrong application", or "1=Correct application of the step."

Student Evaluation Form for Standardized Patients

There are 10 statements on this form which was created by scanning the literature.[21,22] SP evaluated the students by responding to these statements as "I agree", "I partially agree" or "I disagree."

Student Satisfaction and Self Confidence Scale in Learning

This commonly used scale to measure students' attitudes and beliefs about simulations was published by the National League of Nurses.[23] The 13-item scale has two sub-dimensions; "Satisfaction with Learning" and "Self-Confidence" in Learning.

The "Satisfaction with Learning" sub-dimension consists of five items: satisfaction with teaching method, diversity of learning materials, facilitation, motivation, and general suitability of the simulation. The self-confidence sub-dimension has eight sub-items which include self-confidence in scope adequacy, content requirement, skill development, available resources and information on how to get help to solve clinical problems in simulation. Item 13 was coded reversely in the scale. The answer options are 5=strongly agree, 4=agree, 3=undecided-neither agree nor disagree, 2=disagree, 1=strongly disagree.

The participants are asked to mark the number which best expresses their opinions for each item. The score is obtained from the sum of all the items of the scale. The highest possible score is 65, while the lowest possible score is 13. High scores obtained from the scale express high satisfaction and self-confidence. The internal consistency coefficient of the scale was found to be 0.94. The internal consistency coefficient of the Student Satisfaction and Self-Confidence in Learning Scale, which was translated into Turkish by Karaçay and Kaya[24], is 0.90). In our study, the internal consistency coefficient of the scale was found to be 0.84.

Procedure

The application of this study was carried out in six stages (Flowchart 1).

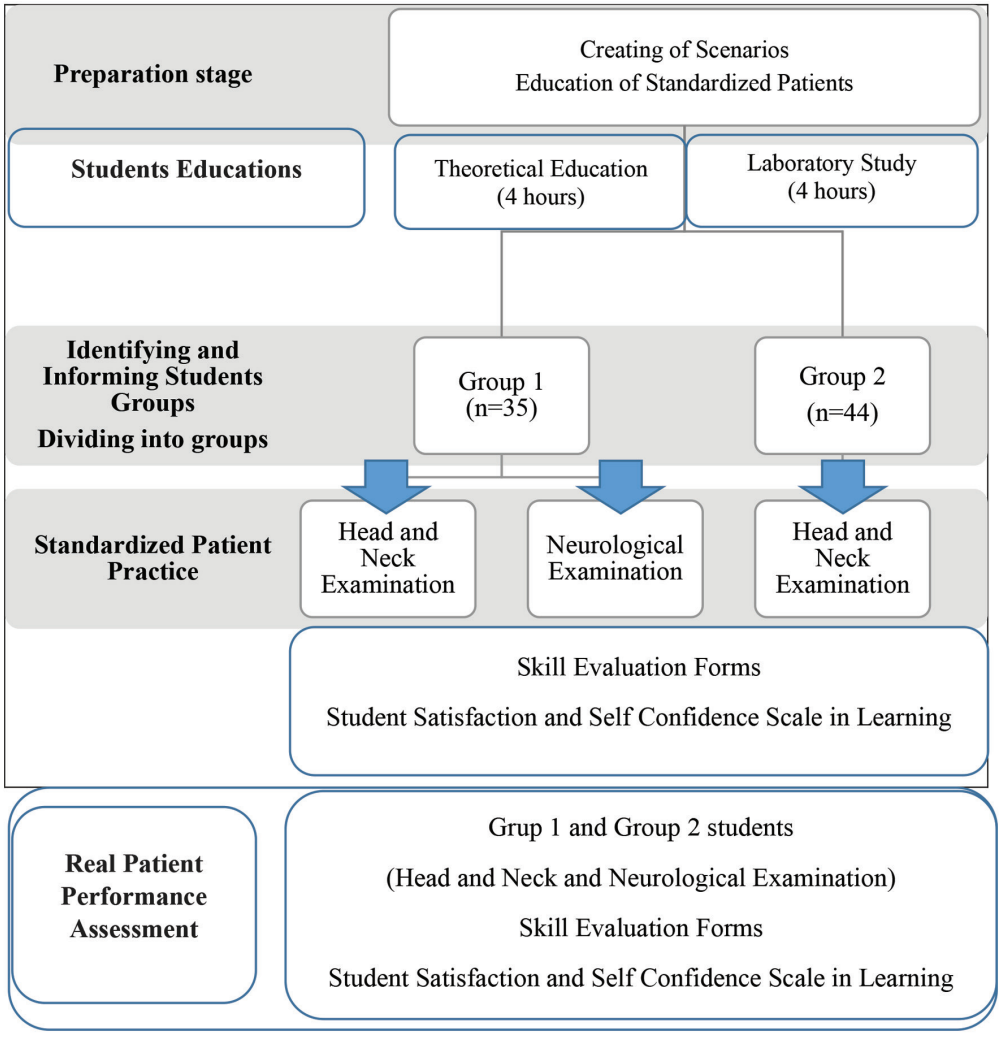
Theoretical education of students: Two hours of presentation on head and neck examination and two hours of neurological examination presentation were given to the students by the researcher.

Faculty information meeting: Before the laboratory implementation sessions, an informative meeting was held with the faculty members who would perform the sessions. The purpose of the study was explained and the "SP Practice Instructor Guide" was given to the academic staff in order to ensure consistency. The guide includes the purpose and objectives of the SP simulation, what the instructor should do before the implementation, the SP scenarios, and the laboratory skill checklists.

Laboratory practice: Students performed 4-hour laboratory practices on a model or peer in nine groups of 11-12 people under the supervision of faculty members. The laboratory sessions were carried out simultaneously.

Standardized patient practice student information meeting: Students were informed about the purpose of this study and how to perform SP practice. In addition, students were informed about the simulation scenario including the duration, patient, the psychomotor skills required, the learning objectives, and the activities which they must complete before the simulation. The students were asked to fill out the "Student Demographic Data Collection Form."

Standardized patient practice: In order to ensure the content validity of the scenarios prepared by the researcher, opinions of one of the course instructors, one of the nursing fundamentals department faculty members and a nurse were received prior to the SP practice.



Flowchart 1. Study of flowchart.

The scenarios were used after the necessary modifications were made in line with their recommendations. The applications were performed with four SPs taken from the SP pool of the faculty of medicine. All SPs were females aged between 40-55 years old. The SP application was performed twice with one week in between the sessions. The SPs received two hours of training on the scenarios two days prior to each application. The SP completed the Student Evaluation Form for SP after each student's performance (Figure 1, 2).

Standardized Patient Scenarios

The head and neck examination scenario included the examination of a patient who was hospitalized in the otorhinolaryngology service with complaints of vision loss for a week and pain and hearing loss in the right ear for the purpose of performing advanced examinations.

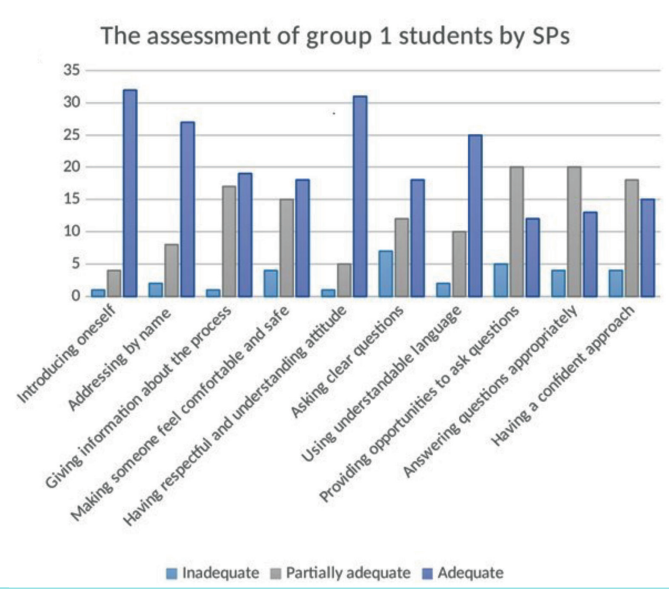


Figure 1. The assessment of group 1 students by SPs.
SP: Standardized patient.

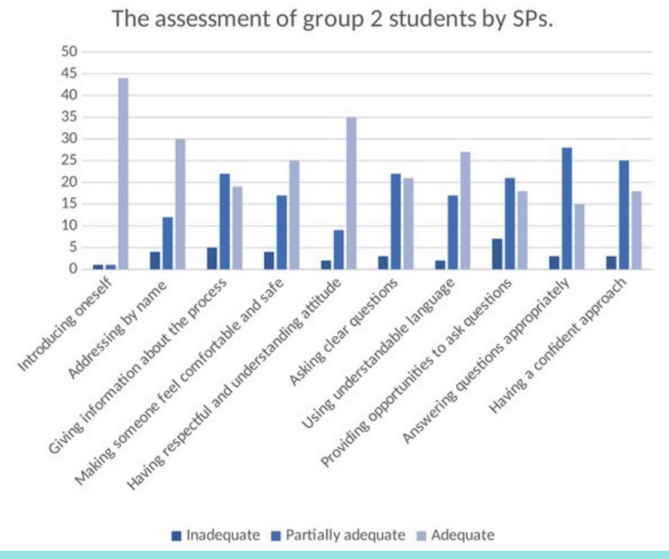


Figure 2. The assessment of group 2 students by SPs.
SP: Standardized patient.

The neurological examination scenario included the examination of a patient who had been hospitalized for a week with complaints of numbness and loss of sensation on the right hand and face, weakness in the right arm and clouding of consciousness.

The SP practicum took place in the skills laboratories of the faculty of nursing. Group 1 students performed head and neck and also neurological examinations with SP in line with the scenario under instructor supervision in the skills labs with one-week intervals. The students' performances were evaluated using the skill assessment forms. After the practicum, the students filled out the "Student Satisfaction and Self-Confidence Scale in Learning." After the SP application, the students were given feedback about their performances (their thoughts on the SP implementation process, how they felt, how they evaluated their performance, etc.) in groups of 5 to 6 people.

Group 2 students performed only the head and neck examination on the SPs according to the scenario. The student performances were evaluated by the instructor using the skill assessment forms. After the practicum, the students filled out the "Student Satisfaction and Self Confidence Scale in Learning." The students were given feedback about their performances.

Clinical performance evaluation: The students were expected to perform a physical evaluation of the patients for whom they were responsible during the clinical practicum. Each student was responsible for the care of one patient. They carried out the care practices in line with the care plan. The students routinely performed physical examinations of their patients for data collection and diagnosis.

Two weeks after the completion of the SP applications, under the supervision of faculty members, the students performed head and neck and neurological examinations on real patients in a clinical setting using the skill assessment forms. After the practicum, the students were asked to fill out the "Student Satisfaction and Self-Confidence Scale in Learning."

Statistical Analysis

Statistical analyses were performed using the SPSS software version 23.0 (IBM SPSS Corp.; Armonk, NY, USA). Descriptive statistical methods (number, percentage, mean, standard deviation) were used while evaluating the data. Parametric tests were used for statistical evaluations since the assumption of normal distribution was provided in the analysis of the data. The independent sample t-test was used to compare the quantitative means of two groups. For the dependent measurements, the dependent sample t-test was used for two measurements, and the Friedman test was used for three replicates. The Cronbach's alpha coefficient was calculated for the reliability of the scale.

The performances of the group 2 students who had one SP application and the group 1 students who had two SP applications on real a patient in the clinic were compared using the t-test. The students' performance scores were converted to percentage values. The students' scores on the Self-Satisfaction and Confidence in Learning Scale were compared by t-test.

RESULTS

The vast majority of students (88.6%) were women. The mean age of the group 1 students was 19.17±1.04 years and for the group 2 students, it was 17.77±0.83 years.

The data obtained from this study are presented under sections of the students' SP performances, performance in clinical practice, and self-confidence and satisfaction.

Students' Standardized Patient Performances

The first SP performance scores of the students in group 1 for head and neck examination were 59.70±19.48 and for group 2, they were 64.71±15.08. When the mean scores were examined, it was seen that the performance scores of the group 2 students were higher than those of the experimental group students. No statistically significant difference was found (p=0.201, p>0.05) (Table 1).

Although the difference between the 1st and 2nd SP performances of the group 1 students was not statistically significant, the second SP (neurological examination) performance scores (66.72±14.75) were higher than the head and neck examination performance scores (Table 1).

Clinical Application Performances

There was a significant difference (p=0.001) between the head and neck examination skill performance scores of the group 1 students on the SP (59.70±19.48) and on the real patients (84.66±12.79). Comparison of the head and neck examination performance scores (group 1= 84.66±12.79; group 2= 72.85±13.04) for group 1 and group 2 students on the real patient was performed with the t-test. The difference was significant (p=0.001). The performance scores obtained by the head and neck examination of the real patients in both groups were significantly higher than those obtained from standard post-patient performances (Table 1).

There was a significant difference between the clinical setting neurological examination performance scores of the group 1 students (82.35±12.11) who carried out neurological examination with the SP and the group 2 students (67.38±15.40) who did not have SP experience (p=0.001) (Table 1).

Self Confidence and Satisfaction Scores

Self-confidence and satisfaction scores after the head and neck examination of the group 1 students (48.37±5.11) were lower than the group 2 students (49.52±6.47). This difference was not statistically significant (p=0.392) (Table 2).

The self-confidence and satisfaction scores of the group 1 students after performing head and neck and neurological examinations on real patients (49.91±2.79) were higher than the group 2 students (48.34±5.55). This difference was not statistically significant (p=0.106) (Table 2).

When the clinical satisfaction scores of the group 1 and group 2 students were examined, it was determined that there was a difference (Table 2). It was determined that the total scores of the group 2 students were higher than those of the group 2 students (Table 2).

Standardized Patients' Views on Student Performance

Figure 1, 2 show the SPs' assessments of the group 1 and group 2 students during their head and neck examination according to the assessment criteria. 86.5% of the group 1 students and 95.7% of the group 2 students introduced themselves to the SP and the majority addressed the patient by name. More than half of the students (group 1= 67.6%; group 2= 58.7%) used a language that the patient could understand. Both groups

Table 1. Comparison of mean scores of students' performance on skills

Skill Evaluation Form	Group 1 (n=35)	Group 2 (n=44)	
	Mean ± SD	Mean ± SD	p
SP head and neck skill	59.70±19.48	64.71±15.08	0.201
Clinical head and neck skill	84.66±12.79	72.85±13.04	<0.001
Clinical neurological skill	82.35±12.11	67.38±15.40	<0.001

P<0.05, independent t-test, SD: Standard deviation, SP: Standardized patient.

Table 2. Comparison of mean scores of students' satisfaction and Self Confidence Scale in learning

	Grup 1 (n=35)	Grup 2 (n=44)	
	Mean ± SD	Mean ± SD	p
SP application			
Satisfaction	19.17±2.96	20.18±2.96	0.136
Self-confidence	28.83±2.96	29.34±4.03	0.531
Satisfaction and self-confidence	48.37±5.11	49.52±6.47	0.392
Clinical application			
	Mean ± SD	Mean ± SD	p
Satisfaction	20.17±1.65	19.14±2.83	0.046*
Self-confidence	29.83±1.73	29.20±3.22	0.275
Satisfaction and self-confidence	49.91±2.79	48.34±5.55	0.106

P<0.05, independent t-test, SP: Standardized patient, SD: Standard deviation.

had similar ratios in asking questions to the patient, giving the patient the opportunity to ask questions and answering their questions but with less than half of the students achieving this adequately. 48.6% of the group 1 students and 39.1% of the group 2 students had a safe approach during implementation.

DISCUSSION

The results of our study showed that the use of SPs improved the head, neck and neurological examination skill performances of the undergraduate nursing students. In addition, it is possible to say that more applications with SPs before experience with a real patient contributes significantly to the students' skills performance.

In one study aiming to compare the effects of using high-fidelity simulators and SPs measuring the levels of knowledge and skills related to thorax, lung and cardiac examinations, using SPs was shown to be effective in improving the knowledge levels of undergraduate nursing students.[10] In another study conducted to evaluate the effectiveness of SPs in developing the health assessment skills of first year nursing students, it was found that the performance scores of students who had worked with SPs were significantly higher than those who had not.[8] In their study, Slater et al.[11] evaluated whether there was a difference between peer education and SP training for physical examination skills. The students stated that the SP was much more realistic than practicing on their peers and that they were more comfortable doing physical examinations. In addition, the students stated that they were satisfied with the reality of the scenario and the feedback of the patients. Luctkar-Flude et al.[25] investigated SP, high-fidelity human simulator and community volunteer methods in the development of physical examination skills. At the end of their study, it was seen that practice with SPs had improved communication skills but that the high fidelity human simulator was more useful for respiratory evaluation.

There are studies emphasizing the positive effects of SP use on nursing students' physical examination skills as well as their nursing skills related to different practices. In a study by Yoo and Yoo[12], students performed oral care, back care, positioning, nelaton catheter and glycerin enema applications with the aid of SP practice. As a result of these applications, when the psychomotor skills of the students were measured by checking skill lists, the students obtained higher scores. In addition to the development of the students' psychomotor skills, an increase in communication and clinical reasoning skills was also observed. Sarmasoglu et al.[9] conducted a study where students performed arterial blood pressure measurement and subcutaneous drug administration with SPs. At the end of their study, it was determined that the students working with SPs had developed their psychomotor skills. In the same study, a student stated the benefit of SP practice to clinical learning as follows; "I had the opportunity to see my mistakes so that I will be more experienced in the clinic." In our study, the clinical performance scores of the students who experienced head, neck and neurological examination skills on SPs saw a significant increase. Liaw et al.[26] stated that frequent applications of simulations with SPs allow the students to prepare for similar cases during real nursing practices.

DeMaria et al.[27] reported that SP applications were considered as additional stress by the participants of the SP group, and that they felt students were more ready to perform similar tasks in real-life settings because they had had this more stressful experience. It is thought that the significantly higher performance scores of the group 1 students who practiced with SPs repeatedly before performing head, neck and neurological examinations with real patients were related to the fact that they felt more prepared for these applications.

Although there was a significant increase in the skill performance scores of the students in our study, there was no difference between the groups in terms of their self-confidence and satisfaction. The ultimate source of self-efficacy beliefs are physiological and emotional states, such as feelings of anxiety. Individuals can assume that their physiological status in a stressful situation indicates a probability of failure. Our students practiced for the first time with SPs and real patients in a clinical setting, both of whom constituted a stress factor for them. Therefore, this stress may have led to a lack of self-confidence in the students.

The complexity and unpredictability of real patients in real clinical settings makes it difficult to make the simulated experiences truly authentic.[6] Pike and O'Donnell[28] stated that clinical simulation can increase the student's self-efficacy in performing skills in a simulated environment, however, since this does not happen while practicing skills in the clinical setting, it therefore can potentially produce a sense of false efficiency. Moreover, it is important to have these experiences to be as realistic as possible in order to improve the learning process.[29] Although the necessary conditions were provided for creating a real clinical environment in our study and the scenarios reflected real situations, it is thought that the stress/anxiety experienced by the student negatively affects their self-confidence. There are studies showing that students had anxiety and stress for every application (laboratory or clinical) which they perform.[30,31] Similarly, Mun[32] reported that students were concerned about what to say to patients in clinical practice and that this was related to their lack of knowledge and experience. At this point, it was thought that since the students were inexperienced and in their first year of schooling, this was reflected in their scores. In addition, the students' perception that they were being evaluated by their mentors during the physical examinations on the real patients may have caused them to focus only on the steps of the application and so to lack self-confidence.

Bandura[33] described the effective mastery of experiences as the most effective sources of information on which self-efficacy beliefs are built. Yong-Shian et al.[4] conducted a study to determine the changes in the satisfaction and self-confidence levels of students using SP practice with or without psychiatric patient care experience. The satisfaction and self-confidence of those students who had previously had care experience with psychiatric patients were found to be significantly higher than for those students without any care experience. As a result of that study, the students stated that they were satisfied with the SP application and "SP application helped them learn and the application motivated them."

In a study by Pike and O'Donnell[28], students expressed a lack of confidence in communication skills categorized as "non-technical skills." Students defined their communication skills as an area of concern and stated that they were very focused on psychomotor aspects. In our study, the application may have focused on psychomotor skills due to the nature of the scenario. The SPs statements about the students being focused more on the process supports this finding. The SPs also stated that the students exhibited a respectful and understanding attitude towards them. However, the students did not give sufficient opportunities to the SPs to ask questions and they did not answer their questions during the

application. This result shows that students were not at the desired level regarding their communication skills. The SPs stated that the students did not have sufficient skills in safely approaching them.

In conclusion, SP practice was shown to be an effective method for developing student skills and applying these improved skills on real patients in real clinical settings. Although there were increases in the self-confidence and satisfaction of students, they were not significant. Different studies have stated that[4,12,13,14,34,35] the SP experience has positive effects on students' self-confidence and satisfaction. Ignacio et al.[19] stated that since the results are obtained from studies conducted in simulated environments, any findings may not be similar to those which are investigated in real clinical settings. We believe that our results should be evaluated in real clinical setting considering performance and self-confidence and satisfaction limitations.

Study Limitations

Since our study was conducted in a single nursing school, our results cannot be generalized. Another limitation is that the SP sessions were conducted with four faculty members in addition to the researcher. These faculty members conducted physical examination laboratories and SP sessions related to different applications on other occasions; however, not all variables which may have affected the SP sessions were controlled. On a different note, the students' feelings of being evaluated may have negatively affected their self-confidence. Despite the fact that the students were informed during the information session that the SP practices would not be part of their course evaluation, performing these applications under the supervision of an educator may have caused stress to the students. This stress factor could not be controlled. Therefore, the students' stress levels in the clinical setting should be considered while evaluating their learning outcomes (self-confidence, skills, critical thinking, etc.). Another limitation of this study can be said to be the use of a single teaching method (SP). It is recommended to plan studies in which different methods can be compared. In addition, due to time constraints in this study, a comparison of two SP applications with a single SP practice was made. It is important to interpret our results in light of this. In order to evaluate the effects of repeated SP practice, it is recommended to increase the number of applications in future studies.

CONCLUSION

The results of this study showed that SP use was effective in improving students' performance levels in head, neck and neurological examinations. In addition, it was determined that experiencing more SPs before performing these applications with real patients significantly contributed to the students' performances. Although the students' self-confidence and satisfaction scores were not statistically significant after the actual patient experience, there was an increase.

SP practice and all other clinical simulation types should not be limited to psycho-motor skills, but also include a number of other skills, such as interpersonal, communication and decision-making skills. It is recommended that studies to determine the effectiveness of SP practices on self-confidence be carried out with students in higher classes.

MAIN POINTS

- The use of standardized patients helped students prepare for the clinical setting.
- The use of standardized patients improved the physical examination skill performances of the undergraduate nursing students.
- Recurrent applications with standardized patients before experience with real patients contributed significantly to the students' skills performance.

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ETHICS

Ethics Committee Approval: The study protocol was approved by the Clinical Research Ethics Committee of the university hospital (approval number: 19.07.2017/451).

Informed Consent: Written and verbal informed consent was obtained from all students.

DISCLOSURES

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RESEARCH ARTICLE

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The Effects of Foot Reflexology Treatment on Work Stress and Anxiety Levels of Nursing Managers

Burcu Genç Köse[1], Havva Öztürk[2]

[1]Department of Nursing, Recep Tayyip Erdoğan University Faculty of Health Sciences, Rize, Türkiye
[2]Department of Nursing, Karadeniz Technical University Faculty of Health Sciences, Trabzon, Türkiye

Abstract

BACKGROUND/AIMS: Nursing managers' stress and anxiety can have a detrimental impact on their management procedures, ultimately affecting the quality of healthcare services provided. Hence, it is crucial to address these issues effectively. This study aimed to determine the effects of foot reflexology on nursing managers' work stress and anxiety levels.

MATERIALS AND METHODS: The study sample in three hospitals included 63 nursing managers, 32 in the control and 31 in the experimental groups. The data were collected via an information form, the job stress scale, and the state anxiety scale used as pre-test, post-test and retention tests. The nursing managers in the experimental group received eight-foot reflexology sessions.

RESULTS: There was no statistically significant difference between the pre-test work stress and state anxiety mean scores of the nurses in the experimental and the control groups ($p>0.05$), but the post-test work stress and state anxiety mean scores of the nursing managers in the experimental group after foot reflexology were statistically significantly lower than in the control group ($p<0.001$). The nursing managers' post-test mean job stress and state anxiety scores in the experimental group were lower than their pre-test and retention test mean scores ($p<0.001$).

CONCLUSION: The application of foot reflexology reduced the nursing managers' work stress levels and state anxiety, but the positive effects disappeared when the application was not continued. Regular applications of reflexology and teaching it to healthcare professionals for their own practice may ensure the continuity of stress management.

Keywords: Anxiety, nurse manage, reflexology, work stress

INTRODUCTION

The presence of nursing managers is important for maintaining quality health services, coping with existing complex problems[1] and delivering effective and efficient nursing services.[2] However, studies have shown that the majority of nursing managers experience stress due to working in understaffed or unfavourable conditions[3] and their involvement in many different roles such as coordinating human relations, planning, and dealing with patients and their families.[4] Labrague's[5] integrative review study revealed that nursing managers experienced moderate stress and that this stress was caused by their workloads, shortfalls in their workforces and/or insufficient budgets. In addition, the time pressure that the nursing managers experience according to Özkan and Kantek[6] and being female in male-dominated societies according to Kelly et al.[7] caused them to experience stress and distress. Another study found that 42% of executive nurses had a level of stress which threatened their health and negatively affected their work.[6] In the study by Güney[8], top and bottom-level managers were more exposed to the negative effects of stress, and middle-level managers experienced more stress than top managers. Furthermore, the job stress experienced by nursing managers is reported to cause burnout,[9] poorer performance and decreased job satisfaction[6] and prompt some to leave or consider

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ORCID IDs of the authors: B.G.K. 0000-0002-0358-6401; H.Ö. 0000-0001-8515-6263.

Address for Correspondence: Burcu Genç Köse
E-mail: burcu.kose@erdogan.edu.tr
ORCID ID: orcid.org/0000-0002-0358-6401

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leaving the profession.[5] The stress in nursing managers brings problems such as insomnia, anger, frustration, impatience, restlessness, and exhaustion.[4] The work stress experienced by nursing managers not only affects themselves, but also directly or indirectly affects the nurses in their team, as well as patient care and service quality.[4,6] A stress-free working environment will boost nurses' efficiency and the success of health service delivery.[10]

Exposure to stress in the workplace is known to cause anxiety, and in one study, it was reported that 51.9% of nurses experienced moderate anxiety.[11] Stress and anxiety, which lead to emotional confusion, disharmony[12] and burnout[13] in nursing managers, are related to each other. Especially difficulties in fulfilling duties and responsibilities and also protecting status and reputation affect the anxiety levels of managers.[12] According to some studies, anxiety experienced in the work environment reduces the performance of managers,[14] decreases the willingness to take risks, and negatively affects their career advancement/promotion.[15] Increased levels of stress and anxiety can render the managers unable to cope over time, with potential adverse outcomes for the institution.[16] Anxiety causes a decrease in professional satisfaction and belief.[17] Therefore, individual or organizational measures should be taken in order to reduce the intensity of work stress and anxiety and their negative effects. The ability of individuals to avoid the negative effects of stress depends on effective stress management.[18]

Among the studies on how nursing managers manage their stress process, an integrative review study found that nursing managers tried to cope with stress by having sufficient decision-making authority, receiving social support from other employees in the institution, taking breaks in intellectual processes and also by using individual coping methods.[5] In another study, they coped with workplace stress by time management and establishing positive interpersonal relationships.[3] In addition to these, complementary therapies, which are preferred because of their practicality, non-invasiveness, and low cost, are also used in coping with stress and anxiety.

Reflexology, as a complementary therapy, is preferred because of its safety and the interaction which inherently develops between the recipient and the practitioner. Reflexology involves applying pressure to each pressure point on the feet, which are connected to the body's muscles, organs and glands. This process spreads energy throughout the body along pathways called meridians.[19] Thus, as determined in the study of Rahmani et al.[20], it creates positive feelings in individuals and reduces their levels of stress and anxiety. In some meta-analyses supporting these statements, reflexology was found to reduce the levels of anxiety in individuals over the age of 18 and affect the stress levels in workers who remained standing for long periods of time.[21,22] Another meta-analysis observed reduced perceived stress, fatigue and depression in healthy individuals who self-applied reflexology.[23]

The studies on work stress and anxiety carried out with nurses were mostly descriptive and did not focus on practical methods to cope with work stress and anxiety.[5-7] Studies on the popular complementary therapy of reflexology[24] were mostly conducted with patients and nursing students,[25,26] with no studies found on how nursing managers can reduce or manage their stress and anxiety with reflexology. Yet, the anxiety and stress levels of nursing managers should be kept under control in order to increase the quality of the service, to ensure that nurses are satisfied with their working life, to establish healthy communication and to better manage healthcare facilities.

The aim of this study was therefore to examine the effects of foot reflexology practice on coping with the stress and anxiety experienced by nursing managers.

MATERIALS AND METHODS

Study design; this was an experimental study with pre-, post- and permanence tests and a control group.

Sample; the population of this study comprised 72 nursing managers working in a university hospital (n=40), a provincial public hospital (n=22) and a district public hospital (n=10) in a city centre. The sample included 54 nursing managers, 27 each in the experimental and control groups, calculated with the G*Power 3.1 program (Germany) with a 95% confidence interval (CI), 5% significance level and 0.25 effect size. Considering the risk of not reaching the sample number due to the limited number of nursing managers in the population, it was aimed to reach approximately 15% more than the required sample size. Of the 72 nursing managers in the population, 9 nursing managers were excluded from the sample as 3 were on psychiatric drugs, 2 were pregnant and 4 did not agree to participate in this study. Thus, 63 nursing managers, corresponding to approximately 15% more than the required sample size and who volunteered to participate in this study were divided into groups by drawing lots, which is a simple randomization method. The 63 nurse managers were listed by numbering them from 1 to 63. Papers containing the numbers were drawn by an impartial person. The subjects were assigned to either the experimental or control groups by assigning the first number drawn to the former and the second to the latter. As a result, the study was carried out with a total of 63 (87.5%) nursing managers, 32 of whom were in the experimental group and 31 in the control group. With this sample size, the study was conducted with a CI of 96%.

Measurement; research data were collected with an information form, work stress scale, and the state anxiety scale [the State-Trait Anxiety Inventory (STAI-1)].

Information form: This information form was created by the researchers as a result of a literature review.[1,3,6,22] It contains 7 questions, 5 about the nursing managers' demographics including age, gender, marital status, parental status and educational status, and 2 about their professional and managerial experience years.

Work Stress Scale: This scale was developed by Dr. Suzanne G. Haynes in 1994 and adapted to Turkish by Mavili Aktaş[27] in 1995. The five-point Likert-type scale is scored between 1-5 points. To evaluate, each "a" choice is given 5 points and each "e" option is given 1. In this scale which consists of 10 questions in total, the second question is scored reversely. The scale score range is between 10-50. As the score increases, the stress level increases, and vice versa. The Cronbach's alpha value of this scale in our study was 0.72.

STAI-1: This inventory was created by Speilberger and Gorsuch in 1964 and it was adapted into Turkish by Öner and LeCompte[28] in 1985. The scale consists of 20 items. The four-point Likert-type state anxiety inventory is scored as 1: not at all, 2: somewhat, 3: moderately so, and 4: very much so. In the inventory consisting of 20 questions in total, questions 1, 2, 5, 8, 10, 11, 15, 19 and 20 are scored reversely. A score ranging from 20 to 80 can be obtained from this scale. A high score from this scale indicates an increased level of anxiety, a low score indicates a low anxiety level. In our study, the Cronbach's alpha value of the state anxiety scale was 0.92.

Intervention; the data were collected between October, 2018 and November, 2019 with the work stress scale and STAI-1, which was used as a pre-, post- and permanence test, after the consent of the nurses to participate in this study was obtained. These tests were given to the participants and collected by the researcher immediately before reflexology, at the end of the reflexology sessions which lasted 4 weeks, and 4 weeks after the reflexology practices were completed. Completion of the scales took approximately 15 minutes in each session. After the pre-test, which was applied simultaneously to both groups, foot reflexology treatments were started in the experimental group, and it was performed in eight sessions, two days a week, for a total of four weeks. According to the literature, four or eight 30-minute sessions of reflexology are sufficient to open the clogged channels and affect the organs.[29] Care was taken to ensure that there was at least one day between sessions and that the same nursing manager was given one-on-one treatment on the same days of the week and in the same therapy room. In addition, taking into account the workload of the participants in the morning, the sessions were carried out by appointment in the afternoon when they were convenient. The reflexology application of a managerial nurse took four weeks, and the entire practice for all individuals was completed in 26 weeks in total. No more than six people per day were treated as the pressure the researcher could deliver decreased as they became tired in practice. Foot reflexology treatment was applied by the first researcher who has a reflexology certificate, in sessions of 30 minutes in total, 10 minutes on the right foot and 20 minutes on the left foot. This treatment time is planned according to the sympathetic parasympathetic reflexology theory stated in the literature. The sympathetic-parasympathetic theory is a recent theory, according to which it is necessary to practice on the left foot in order to affect the parasympathetic nervous system so as to relax and calm the individual, and the reflexology areas on the right foot so as to affect the sympathetic nervous system in order to revitalize and accelerate the organism. To reduce stress and anxiety, the parasympathetic nervous system is stimulated by working on the left foot for longer, allowing the person to relax.[30] In our study, a five-minute warm-up and relaxation were performed on the right foot first. It was then aimed to send a message to the whole body by pressing the "solar plexus" point with the thumb five or six times. The application was continued with pressing, pulling and caterpillar movements. A five-minute treatment was applied to the standing brain, thyroid, sinus, lower lymph nodes, intestinal and spinal cord regions. Finally, the application was completed by pressing the solar plexus. Then, after a five-minute warm-up and relaxation application on the left foot, the same area used on the right foot which affects stress and anxiety was treated with the same method for 15 minutes. These applications took a total of 30 minutes for both feet.

Researcher's foot reflexology competence: As per the regulation on traditional and complementary medicine practices in Türkiye, only certified healthcare professionals can practice reflexology. For this reason, the researcher participated in a program covering 120 hours of theoretical and practical training from the "İstanbul Reflexology and Psychology Center" and received a certificate on the 19.03.2018.

Ethical considerations; approval was obtained from the Karadeniz Technical University Faculty of Medicine Clinical Research Ethics Committee (approval number: 2018/133, date: 31.07.2018). Those nurses who participated in this study were informed about the study, and written informed consent was obtained from those who volunteered to participate. The nursing managers were also reassured that their personal information would not be shared with anyone, and the nursing managers in the control group were informed that they would be offered reflexology if they wanted after this study was completed.

Statistical Analysis

Before the data were analysed, their fit to normal distribution was evaluated with the Kolmogorov-Smirnov test and the data were found to be normally distributed. The socio-demographics, professional characteristics, the comparison of the pre-, post- and permanence tests of the nursing managers in the experimental and control groups, and their work stress levels were analysed by frequency, percentage and chi-square test. Paired-samples t-test and ANOVA were used for intra-group work stress and anxiety level comparisons before and after reflexology and independent t-test, ANOVA and Bonferroni tests were used for the inter-group comparisons of the nurses in the experimental and control groups. The findings were evaluated at a 95% CI and at a 5% significance level.

RESULTS

When the demographic and occupational characteristics of the nursing managers who received foot reflexology were examined, there was no statistically significant difference between the demographics of the nursing managers and their professional and managerial experience years in both groups ($p>0.05$) (Table 1).

Based on the pre-test results of the work stress scale, no statistically significant difference was found between the work stress scale pre-test mean scores of the nursing managers in the experimental (29.64 ± 5.68) and control (29.96 ± 6.15) groups ($p=0.829$; $p>0.05$). For the post-test, the mean score of the nursing managers in the experimental group who received foot reflexology was statistically significantly lower than the control group ($p=0.000$; $p<0.001$) (Table 2).

In the intra-group comparisons, there was no statistically significant difference between the work stress scale pre-test and post-test mean scores of the nursing managers in the control group ($p=0.286$; $p>0.05$), but the mean work stress scale post-test score of the experimental group was statistically significantly lower compared to the pre-test and permanence test scores ($p=0.000$; $p<0.001$) (Table 2).

There was no statistically significant difference between the state anxiety scale pre-test mean scores of the nursing managers in the experimental (39.29 ± 4.56) and control (39.71 ± 5.06) groups ($p=0.726$; $p>0.05$). For the post-test, the state anxiety scale mean score of the nursing managers in the experimental group was statistically significantly lower than the mean score of the control group ($p=0.000$; $p<0.001$) (Table 2). Additionally, the state anxiety scale post-test mean score of the nursing managers in the experimental group was statistically significantly lower than the pre-test and permanence mean scores ($p=0.000$; $p<0.001$). However, the state anxiety scale post-test mean score of the nurses was statistically significantly lower than the pre-test mean score in an intra-group comparison in the control group ($p=0.029$; $p<0.05$) (Table 2).

DISCUSSION

It has been reported in the literature that foot reflexology reduces stress and anxiety[23] but no study has been found in which foot reflexology

Table 1. Comparison of demographics and professional characteristics of nursing managers in the experimental (n=32) and control (n=31) groups

Demographics and professional characteristics		Experimental		Control		p
		n	%	n	%	
Age	20-35 years	7	22.6	14	43.8	0.064*
	36 years and older	24	77.4	18	56.2	
Gender	Male	1	3.2	3	9.4	0.319*
	Female	30	96.8	29	90.6	
Marital status	Married	27	87.1	28	87.5	0.628*
	Single	4	12.9	4	12.5	
Parental status	Parent	27	87.1	27	84.4	0.521*
	Non-parent	4	12.9	5	15.6	
Educational level	Health vocational high school + associate degree	9	29.0	12	37.5	0.328*
	Bachelor's degree	22	71.0	20	62.5	
Professional experience	10 years and less	8	25.8	10	31.2	0.421*
	11 years and more	23	74.2	22	68.8	
Managerial experience	10 years and less	25	80.6	27	84.4	0.477*
	11 years and more	6	19.4	5	15.6	

*p>0.05.

Table 2. Comparison of work stress and state anxiety scale pre-test, post-test and permanence test mean scores of nursing managers in the experimental (n=32) and control (n=31) groups

Work stress and anxiety level	Experimental (n=31)		Control (n=32)		p
	Mean	SD	Mean	SD	
Work stress pre-test[1]	29.64	5.68	29.96	6.15	0.829*
Work stress post-test[2]	19.19	5.21	29.09	5.68	0.000**
Work stress permanence test[3]	30.12	6.41			
F	1,145.906		1.180		
p	0.001**		0.286*		
Bonferroni	2<1 and 3				
State anxiety pre-test[4]	39.29	4.56	39.71	5.06	0.726*
State anxiety post-test[5]	24.67	3.09	35.56	7.70	0.000**
State anxiety permanence test[6]	40.54	4.82			
F	145.21		5.276		
p	0.001**		0.029***		
Bonferroni	5<4 and 6		5<4		

*p>0.05; **p<0.001; ***p<0.05. SD: Standard deviation.

practice was used to reduce the work stress and anxiety levels of nurses, who play an important role in the management of health services. This study, which attempted to reduce work stress and anxiety levels by performing foot reflexology on nursing managers, enrolled nursing managers into experimental and control groups which were comparable in terms of their demographics and professional characteristics. The pre-test revealed moderate levels of work stress for the nursing managers in both groups with no significant difference noted between them. Moderate levels of perceived stress were reported also by another study (15.94±3.45).[10] The post-test results showed significantly decreased levels of work stress for the nursing managers in the experimental group with intra-group comparisons confirming significantly reduced work stress levels for nursing managers in the experimental group, while the work stress levels of the nursing managers in the control group remained unchanged. However, after the post-test, reflexology was discontinued and the permanence test performed one month later revealed that the work stress levels of the nursing managers in the experimental group had increased again. This indicated that reflexology was only temporarily effective on the nursing managers and it reduced their work stress levels only for a certain time, losing its effects when discontinued with the work stress levels returning to their original values. In support of these findings, some other studies conducted with different groups reported that foot reflexology reduced stress levels and was effective in stress management.[23,31,32] Additionally, some studies with non-management nurses reported that complementary therapy[33] and reflexology[34] were effective on stress and anxiety. In one study conducted with a different sample group, foot reflexology influenced physiological parameters, although not in the long term, in alignment with the results of our study.[35] There is an overall consensus that the effects of reflexology treatment start to be seen after the fourth session, with the blocks dissolving only after then. Also, one or two more sessions of treatment should be performed after the individual starts

to feel better, and treatment repeated once every 15 days or once a month after these sessions are completed in order to maintain general relaxation.[29,36]

When the anxiety levels of the nursing managers were examined, the nursing managers in both groups had state anxiety levels which were low or slightly below moderate compared to their pre-test results, but this difference was not statistically significant. Another study evaluating the anxiety levels of nurses reported significantly higher anxiety for nursing managers compared to nurses.[37] In the post-test results, the state anxiety levels of the nursing managers in the experimental group decreased significantly more than for those in the control group. Intra-group comparisons, on the other hand, showed a significant decrease in the state anxiety level of not only the experimental group, but also the control group. However, the permanence test performed one month after the reflexology treatment was discontinued showed that the state anxiety levels of the nursing managers had increased again. These results indicated that foot reflexology reduced the nursing managers' state anxiety levels temporarily and its effects diminished after it was discontinued. Some studies with different sample groups obtained similar results and confirmed that reflexology reduced levels of anxiety[26,38,39] whereas others emphasized that the effects of reflexology decreases after its discontinuation, supporting the results of our study, and so indicating that it should be repeated once or twice a month in order to maintain its effects.[29,36] In addition to this indisputable positive effect of reflexology, the reason for the decrease in the state anxiety levels of the nursing managers in the control group can be attributed to the disappearance of other variables affecting their anxiety levels.

Study Limitations

This study was limited especially with respect to determining the persistent effects test results due to the fact that it was carried out with a small number of nursing managers in a small number of public hospitals in the city where the study was conducted, and that foot reflexology was administered to the nursing managers only for eight sessions in a month.

CONCLUSION

Conducted with nurses who had moderate levels of work stress and near-moderate levels of state anxiety, this study demonstrated that the nursing managers in the experimental group, to whom foot reflexology was applied, had decreased work stress and state anxiety levels compared to the control group, meaning that foot reflexology had a positive effect on their work stress and state anxiety. One month after the foot reflexology treatment was completed and discontinued, the measured work stress and state anxiety levels of the nurses in the experimental group had increased again, showing that the positive effects on work stress and state anxiety could not be sustained and that reflexology sessions need to be applied continuously or with booster sessions.

This study provides important information about the work stress and anxiety levels of nursing managers and how to intervene accordingly. It also revealed the positive effects of foot reflexology on the stress and anxiety levels experienced by these managers. Therefore, foot reflexology sessions can be organized in hospitals to help nursing managers effectively cope with the work stress and anxiety they experience. Owing to the positive effects of these sessions, foot reflexology can be arranged not only for nursing managers, but also for all employees and other managers in the hospital. Treatments can be performed continuously and at regular intervals in order to maintain the effects of foot reflexology on work stress and anxiety levels. In order for employees and even patients to benefit from this treatment, a polyclinic or unit can be established in the hospital where reflexology treatments and other complementary medical applications can be conducted. Additionally, foot reflexology treatments can be performed for nurses, and awareness can be increased by providing information on this subject. Other healthcare professionals and managers can be informed with regards to reflexology. The effects of foot reflexology applied to nurses on their quality of patient care can be measured. In addition, training can be organized in order to teach individual stress management techniques and reflexology to both nursing managers and other healthcare workers so that they can apply them at their convenience. Finally, institutional policies can be developed in order to reduce those factors which create high or moderate levels of work stress and state anxiety in nursing managers.

MAIN POINTS

- Intense and continuous work stress and anxiety have negative effects on individuals and the institution. According to this study, nursing managers, who are responsible for nurses and their patients, experience moderate or high levels of work stress and anxiety.

- This study found that foot reflexology applied to nursing managers had a positive effect and reduced their work stress and anxiety levels.

- Foot reflexology sessions should be performed continuously or periodically in order to maintain this positive effect and ensure its permanence.

ETHICS

Ethics Committee Approval: The approval was obtained from the Karadeniz Technical University Faculty of Medicine Clinical Research Ethics Committee (approval number: 2018/133, date: 31.07.2018).

Informed Consent: Written informed consent was obtained from those who volunteered to participate.

Authorship Contributions

Surgical and Medical Practices: B.G.K.; Concept: B.G.K, H.Ö.; Design: B.G.K, H.Ö.; Data Collection and/or Processing: B.G.K.; Analysis and/or Interpretation: H.Ö.; Literature Search: B.G.K.; Writing: B.G.K, H.Ö.

DISCLOSURES

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CASE REPORT

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A Diagnostic Dilemma: Thrombocytopenia and Hemolysis in a Patient with Systemic Lupus Erythematosus: A Laboratory Perspective

Amin A. Alamin

Department of Pathology, College of Medicine, Taif University, Taif, Saudi Arabia

Abstract

Systemic lupus erythematosus (SLE) is a complex autoimmune disorder with diverse clinical manifestations, including hematological abnormalities. This case report explores the diagnostic challenges associated with hematological complications, specifically thrombocytopenia and hemolysis, in SLE from a laboratory perspective. We present the case of a 38-year-old female diagnosed with SLE who presented with severe thrombocytopenia and hemolysis requiring extensive clinical and laboratory evaluations, including specialized tests. This case highlights the complexity of hematological complications in SLE and underscores the vital role of laboratory assessments in resolving diagnostic challenges, emphasizing the need for a comprehensive, multidisciplinary approach in order to enhance patient outcomes.

Keywords: Systemic lupus erythematosus, thrombocytopenia, hemolysis, autoimmune disorders, laboratory perspective, interdisciplinary collaboration

INTRODUCTION

Systemic lupus erythematosus (SLE) is a complex autoimmune disorder characterized by a range of clinical presentations affecting multiple organ systems. Hematological abnormalities, including anemia, leukopenia, thrombocytopenia, and immune-mediated hemolytic anemia (AIHA), are common in SLE and often lead to significant diagnostic challenges.[1]

Thrombocytopenia and hemolysis are notable among the hematological complications in SLE and emerge from different mechanisms, such as immune-mediated platelet and red blood cell (RBC) destruction, complement dysregulation, or coagulation abnormalities. Accurate identification of the underlying cause is important for treatment, but distinguishing between different causes of thrombocytopenia and hemolysis in SLE patients can be particularly challenging.[2]

In this case report, we describe a complex clinical scenario involving a 38-year-old female with a confirmed diagnosis of SLE. She presented with severe thrombocytopenia and hemolysis, which posed a diagnostic dilemma. This case demonstrates the complex diagnostic challenges often associated with hematological complications in SLE and highlights the critical role of accurate laboratory evaluations in clarifying the underlying pathophysiology and guiding therapeutic interventions.[3]

The primary objective of this report is to emphasize the importance of adopting a laboratory perspective when diagnosing and managing hematological complications in SLE. It provides awareness of the specific laboratory tests and findings essential for resolving the diagnostic complexities associated with this clinical presentation. This case study illustrates the need for a comprehensive approach which integrates clinical assessment, comprehensive laboratory investigations, and specialized testing. This integrated approach addresses the complex

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ORCID ID of the author: A.A.A. 0000-0002-4405-5826.

Address for Correspondence: Amin A. Alamin
E-mail: amakki@tu.edu.sa
ORCID ID: orcid.org/0000-0002-4405-5826

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diagnostic challenges of thrombocytopenia and hemolysis in individuals with SLE, ultimately improving patient outcomes.[4,5]

CASE PRESENTATION

A 38-year-old female with a confirmed diagnosis of SLE presented to our rheumatology clinic with a two-week history of fatigue, pallor, jaundice, and petechiae. She had been diagnosed with SLE three years earlier based on the American College of Rheumatology criteria,[6] as she had exhibited clinical features such as malar rash, arthritis, and positive anti-nuclear antibodies. Her treatment included hydroxychloroquine and low-dose prednisone.

Upon examination, the patient appeared pale, with jaundice in the sclera and skin. However, neither active arthritis nor a malar rash were observed. Laboratory investigations reveal the patient's results compared to the reference ranges, indicating abnormalities in several parameters.

- Hemoglobin: 8.5 g/dL (normal range: 12-16 g/dL)

- Platelet count: 25,000/µL (normal range: 150,000-450,000/µL)

- Total bilirubin: 3.5 mg/dL (normal range: 0.3-1.0 mg/dL)

- Direct bilirubin: 1.8 mg/dL (normal range: 0.1-0.3 mg/dL)

- Lactate dehydrogenase (LDH): 980 U/L (normal range: 140-280 U/L)

- Haptoglobin: <10 mg/dL (normal range: 30-200 mg/dL)

- Reticulocyte count: 8% (normal range: 0.5-2.5%)

- Coombs test [direct antiglobulin test (DAT)]: positive for immunoglobulin G (IgG) and C3d.

These findings were suggestive of thrombocytopenia and hemolysis, indicative of AIHA and immune thrombocytopenia (ITP). Given her history of SLE, further evaluation was necessary in order to clarify the underlying causes.

Laboratory analyses played an important role in resolving this diagnostic dilemma. The following tests were also conducted: antinuclear antibodies: positive, with a high titer, anti-dsDNA antibodies: elevated, confirming active SLE, C3 and C4 complement levels: reduced, indicating complement consumption, and peripheral blood film: no schistocytes were observed.

Based on these findings, a diagnosis of SLE-associated thrombotic thrombocytopenic purpura (TTP) was considered, given the presence of MAHA, thrombocytopenia, and active SLE. An ADAMTS13 activity measurement revealed severely reduced activity (<5%), confirming the diagnosis of TTP.

The patient received initial treatment which included plasmapheresis, high-dose corticosteroids, and rituximab, a B-cell-depleting agent. Her response was favorable, with an increase in platelet count, resolution of hemolysis, and overall clinical improvement. She was discharged with a tapering course of prednisone and scheduled follow-up appointments. Informed consent was obtained.

DISCUSSION

The case of a 38-year-old female patient with SLE presenting with severe thrombocytopenia and hemolysis highlights the complex diagnostic challenges presented by hematological complications in autoimmune diseases, particularly SLE.

Thrombocytopenia is a recognized hematological complication in SLE which arises from various mechanisms, including immune-mediated platelet destruction, bone marrow suppression, and antiphospholipid antibody syndrome (APS).[1,7] In this patient, a positive Coombs test, indicative of immune-mediated hemolysis, raised suspicions of ITP, an autoimmune condition characterized by platelet destruction mediated by autoantibodies.[8] However, the diagnostic uncertainty deepened when the patient's hemolysis was taken into account, and coexisting AIHA and ITP (Evans syndrome) were considered.[9] AIHA can manifest in SLE due to either immune complex-mediated mechanisms or drug-induced hemolysis, particularly from antimalarial agents such as hydroxychloroquine.[3,4]

The diagnostic process advanced through laboratory analyses. A positive DAT for both IgG and complement C3d supported immune-mediated hemolysis, which is consistent with AIHA.[10] To differentiate between drug-induced and autoimmune-mediated hemolysis, medication history and specialized tests, such as RBC eluate analysis, are important.[11,12] Furthermore, given the complex immunological context in SLE, it was necessary to take into account the presence of antiphospholipid antibodies. APS, a common coexisting condition in SLE, can manifest as thrombocytopenia and hemolysis due to thrombotic microangiopathy (TMA). Therefore, careful assessment of the clinical features of TMA, such as schistocytes on peripheral smear and LDH, is essential.[13] In this patient, the absence of schistocytes and a marked elevation of LDH argued against TMA.

This case highlights the necessity of conducting a comprehensive laboratory evaluation, including the DAT, and RBC eluate analysis, in order to decipher the underlying etiology of hematological complications in SLE. It also emphasizes the importance of differentiating between autoimmune-mediated and drug-induced processes, especially when patients are on medications such as hydroxychloroquine.

CONCLUSION

This complex case of an SLE patient with thrombocytopenia and hemolysis highlights the diagnostic challenges associated with autoimmune disorders. SLE presents a spectrum of hematological issues, often involving autoimmune and medication-related factors. Comprehensive laboratory tests which include the DAT and RBC eluate analysis are important for distinguishing between drug-induced and autoimmune hemolysis. Additionally, assessing potential TMA is essential. Collaboration among clinicians, hematologists, and laboratory experts is critical for accurate diagnosis and treatment. In this case, identifying drug-induced hemolysis led to modifications in SLE management, resulting in an improved patient outcome. This highlights the complexity of hematological complications in SLE and also the roles of comprehensive evaluations and teamwork in managing autoimmune disorders.

MAIN POINTS

- This case highlights the intricate nature of hematological issues in systemic lupus erythematosus, often involving a combination of autoimmune and medication-related factors.
- The patient's severe thrombocytopenia and hemolysis presented diagnostic challenges due to the overlapping features of the conditions such as immune thrombocytopenia, autoimmune hemolytic anemia, and drug-induced hemolysis.
- Accurate diagnosis and differentiation between drug-induced and autoimmune processes relied on comprehensive laboratory evaluations, including the direct antiglobulin test and an analysis of red blood cell eluates.
- Collaborative efforts among clinicians, hematologists, and laboratory experts played a pivotal role in achieving the correct diagnosis and guiding treatment decisions.

ETHICS

Informed Consent: Informed consent was obtained.

DISCLOSURES

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