Black Sea Journal of Health Science

Volume 7 | Issue 5

ISSN: 2619 - 9041

BS Journals

BLACK SEA JOURNAL OF HEALTH SCIENCE
(BSJ HEALTH SCI)

Black Sea Journal of Health Science (BSJ Health Sci) is double-blind peer-reviewed, open-access international journal published electronically 6 times (January, March, May, July, September, and November) in a year since January 2018. BSJ Health Sci publishes, in English and Turkish full-length original research articles, innovative papers, reviews, mini-reviews, conference papers, case report, rapid communications or technical note by the scientists on technical and clinical studies related to all health sciences.

ISSN: 2619-9041

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Web site: http://dergipark.gov.tr/bshealthscience

Sort of Publication: Periodically 6 times in a year (January, March, May, July, September, and November)

Publication Date and Place: September 15, 2024 - Samsun, TÜRKİYE

Publishing Kind: Electronically

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Black Sea Journal of Health Science
doi: 10.19127/bshealthscience.1445966

Open Access Journal
e-ISSN: 2619 – 9041

Research Article
Volume 7 - Issue 5: 173-180 / September 2024

ASSESSMENT OF BIOCHEMICAL PARAMETERS AS INDICATORS OF PROTEIN ENERGY MALNUTRITION IN TURKISH CHILDREN: A COMPREHENSIVE AND RETROSPECTIVE STUDY

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Abstract: This study aims to address this research gap by meticulously analyzing the biochemical parameters of children aged 0-59 months diagnosed with Protein Energy Malnutrition (PEM) within the confines of a state hospital over a two-year period. This study is a retrospective study evaluating the biochemistry and hormone laboratory findings of 302 children aged 0-59 months who were diagnosed with Protein Energy Malnutrition between the years 2020-2022 in the pediatric health and diseases clinic of Iğdır State Hospital. This study investigated the distribution of various biochemical parameters in children diagnosed with protein-energy malnutrition (PEM) and explored their significance within this context. The findings, based on reference values, revealed substantial proportions of children with abnormal values for iron, immunoglobulin (IgM and IgA), liver enzymes (ALT and AST), creatinine, CRP, and vitamin D. Gender-based differences were observed for calcium, IgM, Folate, and TSH, with notable variations between male and female children. Correlations between age and various parameters were identified, underscoring the complex interplay between developmental stages and biochemical values. The study highlights the importance of addressing deficiencies, potential complications, and demographic influences in managing PEM. The absence of demographic data integration in existing studies serves as a limitation, emphasizing the need for comprehensive research in this domain. Overall, these insights contribute to a deeper understanding of biochemical dynamics in children with PEM, aiding targeted interventions for improved health outcomes.

Keywords: Protein-energy malnutrition, Turkish children, Biochemical parameters, Podiatry

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Received: March 01, 2024
Accepted: July 16, 2024
Published: September 15, 2024

Cite as: Gülbetekin E, Kılınç N. 2024. Assessment of biochemical parameters as indicators of protein energy malnutrition in Turkish children: a comprehensive and retrospective study. BSJ Health Sci, 7(5): 173-180.

1. Introduction

Malnutrition is a general term and it most often refers to undernutrition resulting from inadequate consumption, poor absorption or excessive loss of nutrients (Ashok et al., 2020).

Inadequate access to food sources and inability to meet daily energy needs lead to malnutrition, also known as nutritional deficiency. Malnutrition is a serious public health problem in different parts of the world, especially in developing countries (Onal et al., 2016). More than 33% of deaths among 0-5 year olds are related to malnutrition (WHO, 2011; UNICEF 2013). The socio-economic status of the family and access to food also has an impact on the occurrence of malnutrition. The most basic indicators of exposure to malnutrition for a long time are; short stature, retardation in growth and development according to age (Elkholy et al., 2012). Preschool children are defined by health professionals as a vulnerable group affected by malnutrition, which is often referred to as malnutrition in the community (Waly, 2014).

It is stated that health problems such as malnutrition and iron deficiency are seen in children aged 0-5 in our country. It was determined that malnutrition developed in 30% of the children in the Eastern Anatolia Region, and 3% of these children had severe malnutrition (Kilic et al., 2004). Protein-Energy Malnutrition (PEM) is a predominant form of malnutrition in developing countries, primarily impacting children between the ages of 6 months and 5 years. This condition arises from insufficient intake of proteins and/or calories, leading to various clinical manifestations that reflect the severity and type of malnutrition (Acar, 2012). PEM is well defined in terms of clinical features; however, its pathophysiology is still not fully understood. In recent studies, free radicals are involved in the pathogenesis of PEM. It has been suggested that the pathogenesis of edema and anemia, commonly found in children with Protein Energy Malnutrition, is due to an imbalance between the production of free radicals and their safe elimination (Thakur et al., 2004; Jain et al., 2013).Clinical findings of Protein Energy Malnutrition; It varies according to the duration and severity of nutritional deficiency, the quality of the diet, and personal factors

(age, infection). While the diagnosis can be made easily in severe malnutrition, it can be difficult to diagnose in moderate or mild patients. In this case, the diet taken by the patient should be controlled, energy needs should be determined, anthropometric measurements and biochemical parameters should be evaluated (Benjamin, 1989; Figueroa, 1993; Gulec, 2011).

Moderate anemia is common in children with PEM. The most common cause of anemia in children with PEM is iron deficiency. Clinical signs of iron deficiency are found in two out of three children with PEM in India (Singh, 2004). Mild protein deficiency, which causes 15-20% reduction in muscle mass, may sometimes not cause a significant reduction in weight and arm circumference. As the protein and energy deficit increases, the decrease in muscle mass and other symptoms become more pronounced (Singh, 2004).

In Kenya and Nairobi, most children with clinically defined rickets are younger than 2 years old and have been associated with rickets, acute malnutrition and developmental delay. When the biochemical characteristics indicating the risk of rickets in children with varying degrees of acute malnutrition were examined, it was determined that there was a relationship between subclinical malnutrition, vitamin D deficiency and severe weight loss (Edwards et al., 2014; Jones et al., 2018).

The existing literature lacks comprehensive investigations into the utilization of biochemical indicators for detecting mild forms of malnutrition, with a predominant focus on elucidating the biochemical alterations associated with severe malnutrition. This study aims to address this research gap by meticulously analyzing the biochemical parameters of children aged 0-59 months diagnosed with Protein Energy Malnutrition (PEM) within the confines of a state hospital over a two-year period. By shedding light on the biochemical intricacies of mild malnutrition, this research contributes to a more holistic understanding of malnutrition's spectrum and its potential implications for early detection and intervention strategies.

2. Materials and Methods

2.1. Study Population and Design

This is a retrospective study in which biochemistry and hormone laboratory findings (Iron, UIBC, TIBC, Calcium, Glucose, IgM, Sodium, Potassium, IgA, ALT, AST, Creatinine, CRP, Ferritin, Folate, T4, TSH, and Vitamin B12) are evaluated. Iğdır State Hospital Pediatric Health and Diseases Polyclinic between 2020 and 2022, belonging to 302 children aged 0-59 months who were diagnosed with Protein Energy Malnutrition (Vitamin D). Necessary permissions were obtained from the relevant institution to conduct the research and obtain data.

The demographic characteristics of the children included in our study are as follows (Table 1).

Table 1. Distribution of demographic characteristics of included children in the study

Variables		n	%
Sex	Female	157	52.0
	Male	145	48.0
Age (Mean±SD)		3.85±1.843	
Total		302	100

Inclusion criteria:

1. Aged 0-59 months,
2. Diagnosed between these dates,
3. Had common laboratory findings,
4. Did not have any other chronic diseases.

Exclusion criteria:

1. Having a different accompanying chronic disease,
2. Children with missing laboratory findings were not included in the study.

2.2. Statistical Analysis

A descriptive analysis of the characteristics was conducted, presenting the outcomes through descriptive tables detailing means, standard deviations (SD), and percentages, as applicable. Significance was determined at a P-value threshold of less than 0.05. The statistical computations were carried out utilizing SPSS for Windows, version 23 (IBM Corpn., Armonk, NY, USA).

3. Results

The present study aimed to investigate the distribution of various biochemical parameters among children diagnosed with protein-energy malnutrition (PEM). The findings provide valuable insights into the prevalence of abnormal values for different biomarkers, shedding light on the significance of these parameters in the context of PEM.

Table 2 presents the distribution of biochemical parameters among the children included in the study, based on reference values. In the case of the iron parameter, 33.8% (102) of the children exhibited values below the reference range, while 64.9% (196) fell within the reference range, and 1.3% (4) had values exceeding the reference range. The data reveal that a considerable proportion of children with PEM, approximately 33.8%, exhibited iron values below the reference range. Remarkably, the investigation of the Unsaturated Iron-Binding Capacity (UIBC) parameter revealed that 3.6% (11) of the children exhibited values below the reference range, while the majority, comprising 94.4% (285) of the cohort, fell within the reference range, and 2% (6) had values above the reference range. Similarly, the analysis of the Total Iron-Binding Capacity (TIBC) parameter showed that 2.3% (7) of the children had values below the reference range, 97% (293) fell within the reference range, and 0.7% (2) had values above the reference range. On the other hand, ferritin parameter, 7.9% (24) of the children had values below the reference range, 90.7% (274) fell within the reference range, and 1.3% (4) had values above the reference range.

Table 2. Distribution of biochemical parameters of children included in the study according to reference values

Biochemical Parameters	Below the Reference Value		Within the Reference Range		Above the Reference Value	
	n	%	n	%	n	%
Iron	102	33.8	196	64.9	4	1.3
UIBC	11	3.6	285	94.4	6	2.0
TIBC	7	2.3	293	97.0	2	0.7
Calcium	6	2.0	295	97.7	1	0.3
Glucose	26	8.6	255	84.4	21	7.0
IgM	22	7.3	280	92.7	-	-
Sodium	34	11.3	266	88.1	2	0.7
Potassium	1	0.3	285	94.4	16	5.3
IgA	71	23.5	219	72.5	12	4.0
ALT	-	-	300	99.3	2	0.7
AST	-	-	267	88.4	35	11.6
Creatinin	297	98.3	5	1.7	-	-
CRP	-	-	168	55.6	134	44.4
Ferritin	24	7.9	274	90.7	4	1.3
Folate	7	2.3	295	97.7	-	-
Free T4	15	5.0	286	94.7	1	0.3
TSH	9	3.0	289	95.7	4	1.3
Vitamin B12	13	4.3	264	87.4	25	8.3
Vitamin D	214	70.9	88	29.1	-	-

Subsequent statistical analysis demonstrated no statistically significant difference between the UIB, TIBC, and ferritin parameters in the cohort of children under investigation.

Regarding the calcium parameter, 2% (6) of the children had values below the reference range, 97.7% (295) fell within the reference range, and 0.3% (1) had values above the reference range. For sodium parameter, 11.3% (34) of the children had values below the reference range, 88.1% (266) fell within the reference range, and 0.7% (2) had values above the reference range. As for potassium parameter, 0.3% (1) of the children had values below the reference range, 94.4% (285) fell within the reference range, and 5.3% (16) had values above the reference range. Statistical analysis demonstrated no statistically significant difference between the calcium, sodium and potassium parameters in the cohort of children under investigation.

For glucose parameter, 8.6% (26) of the children had values below the reference range, 84.4% (255) fell within the reference range, and 7% (21) had values above the reference range. Statistical analysis demonstrated no statistically significant difference between the glucose parameter in the cohort of children under investigation.

In the case of IgM parameter, 7.3% (22) of the children had values below the reference range, and 92.7% (280) fell within the reference range. With respect to IgA parameter, 23.5% (71) of the children had values below the reference range, 72.5% (219) fell within the reference range, and 4% (12) had values above the reference range. The data indicate that a proportion of children with PEM had IgM (7.3%) and IgA (23.5%) values below the reference range. These immunoglobulins play a crucial role in the immune response, defending the body against infections and diseases. Lower than normal IgM and IgA levels could increase the susceptibility of these children to infections and hinder their recovery process.

ALT parameter was within the reference range for 99.3% (300) of the children, and 0.7% (2) had values above the reference range. As for AST parameter, 88.4% (267) of the children had values within the reference range, and 11.6% (35) had values above the reference range. Liver enzymes ALT and AST were within the reference range for the majority of children with PEM, indicating that liver function was relatively preserved. However, a small percentage (0.7%) had elevated ALT levels, and 11.6% had elevated AST levels. Liver dysfunction could further exacerbate the health challenges faced by children with PEM. Identifying the underlying causes of these enzyme elevations and providing necessary interventions are crucial to ensure hepatic health and support overall recovery.

In the case of creatinine parameter, 98.3% (297) of the children had values below the reference range, and 1.7% (5) fell within the reference range. Most children with PEM (98.3%) had creatinine values below the reference range.

For CRP parameter, 55.6% (168) of the children had values within the reference range, and 44.4% (134) had values above the reference range.

For folate parameter, 2.3% (7) of the children had values below the reference range, and 97.7% (295) fell within the reference range. Serum free T4 parameter showed that 5% (15) of the children had values below the reference range, 94.7% (286) fell within the reference

range, and 0.3% (1) had values above the reference range. In terms of TSH parameter, 3% (9) of the children had values below the reference range, 95.7% (289) fell within the reference range, and 1.3% (4) had values above the reference range. As for vitamin B12 parameter, 4.3% (13) of the children had values below the reference range, 87.4% (264) fell within the reference range, and 8.3% (25) had values above the reference range. Statistical analysis demonstrated no statistically significant difference between these parameters in the cohort of children under investigation.

Vitamin D parameter showed that 70.9% (214) of the children had values below the reference range, and 29.1% (88) fell within the reference range. Protein-energy malnutrition (PEM) is commonly linked to inadequate intake of vitamin D.

The analysis results, presented in Table 3, compare the mean values of biochemical parameters based on the genders and ages of the included children. The table reveals statistically significant differences ($P<0.05$) in the mean values of Calcium, IgM, Folate, and TSH parameters between male and female children.

Moreover, upon examining the relationship between the ages of the children and the values of biochemical parameters, several noteworthy correlations were observed ($P<0.05$). There was a positive and low-level correlation between age and Iron, a negative and low-level correlation between age and UIBC, and another negative and low-level correlation between age and Calcium. Additionally, a positive and moderate-level correlation between age and Sodium, and a negative and low-level correlation between age and Potassium were found. Furthermore, the analysis indicated a positive and low-level correlation between age and IgA, a negative and low-level correlation between age and ALT, and a negative and moderate-level correlation between age and AST. Moreover, there was a positive and moderate-level correlation between age and Creatinine, and a negative and low-level correlation between age and CRP. Additionally, age showed a negative and moderate-level correlation with Folate, a positive and low-level correlation with Free T4, and a negative and low-level correlation with TSH. Lastly, age displayed a negative and low-level correlation with Vitamin D. It is crucial to establish diagnostic criteria that can be applied universally across different ages and developmental stages, as this is an essential requirement for accurately assessing the prevalence of rickets. Nonetheless, no significant relationships were found between age and the remaining parameters ($P>0.05$).

Table 3. Comparison of mean values of biochemical parameters based on the sex and age of the included children

Biochemical Parameters	Female X±SD	Male X±SD	Total X±SD	P^T	Age^r
Iron	55.23±31.73	56.84±31.13	56.00±31.40	0.656	0.218*
UIBC	253.17±67.77	247.01±60.19	250.21±64.21	0.406	-0.147*
TIBC	322.08±62.38	315.75±62.55	319.04±62.44	0.379	0.063
Calcium	9.89±0.46	9.76±0.47	9.83±0.47	0.013*	-0.143*
Glucose	87.87±12.62	88.81±12.83	88.32±12.71	0.521	-0.060
IgM	63.81±31.50	76.71±32.13	70.00±32.40	0.000*	-0.015
Sodium	138.02±3.56	138.27±2.91	138.14±3.26	0.506	0.310*
Potassium	4.38±0.36	4.43±0.45	4.40±0.41	0.247	-0.136*
IgA	64.19±54.80	69.02±55.36	66.51±55.03	0.448	0.196*
ALT	14.40±7.32	14.38±5.08	14.39±6.33	0.977	-0.218*
AST	28.98±8.95	30.64±6.94	29.78±8.08	0.073	-0.371*
Creatinine	0.35±0.12	0.36±0.12	0.36±0.12	0.789	0.557*
CRP	2.58±4.56	2.79±5.32	2.68±4.93	0.711	-0.133*
Ferritin	49.36±36.68	41.17±47.21	45.43±42.19	0.092	-0.021
Folate	11.83±4.43	10.78±4.15	11.33±4.33	0.036*	-0.304*
Free T4	1.26±0.19	1.27±0.17	1.26±0.18	0.799	0.212*
TSH	2.34±1.20	2.05±0.83	2.20±1.05	0.015*	-0.180*
Vitamin B12	458.74±196.95	470.71±251.06	464.49±224.26	0.644	-0.019
Vitamin D	24.12±11.56	26.86±14.29	25.43±12.99	0.066	-0.206*

*= $P<0.05$, r= Pearson correlation, T= Independent samples t-test.

4. Discussion

Distribution of biochemical parameters among the children included in the study, based on reference values. The data reveal that a considerable proportion of children with PEM, approximately 33.8%, exhibited iron values below the reference range. This finding highlights the high prevalence of iron deficiency in this vulnerable population. The majority of studies indicated that iron deficiency was the leading cause of anemia in patients with protein-energy malnutrition (Said et al., 1975; Nkrumah et al., 1988; Borelli et al., 2004). In a study conducted it was revealed that 97% of the participants in the experimental group had anemia, and approximately 67% of them had low serum iron level. Iron deficiency

can exacerbate the consequences of PEM, leading to impaired growth, compromised immune function, and cognitive deficits. Proper management of iron deficiency becomes crucial in these children to support their recovery and overall health. Remarkably, the investigation of the Unsaturated Iron-Binding Capacity (UIBC) parameter revealed that 3.6% of the children exhibited values below the reference range, while the majority, comprising 94.4% of the cohort, fell within the reference range, and 2% had values above the reference range. Similarly, the analysis of the Total Iron-Binding Capacity (TIBC) parameter showed that 2.3% of the children had values below the reference range, 97% fell within the reference range, and 0.7% had values above the reference range. On the other hand, ferritin parameter, 7.9% of the children had values below the reference range, 90.7% fell within the reference range, and 1.3% had values above the reference range. Subsequent statistical analysis demonstrated no statistically significant difference between the UIB, TIBC, and ferritin parameters in the cohort of children under investigation. Although the differences between the studies are thought to be due to the sample taken, it is noteworthy that conditions such as iron deficiency aggravate the consequences of PEM (Borelli et al., 2004).

For glucose parameter, 8.6% of the children had values below the reference range, 84.4% fell within the reference range, and 7% had values above the reference range. Statistical analysis demonstrated no statistically significant difference between the glucose parameter in the cohort of children under investigation.

In the case of IgM parameter, 7.3% of the children had values below the reference range, and 92.7% (280) fell within the reference range. With respect to IgA parameter, 23.5% of the children had values below the reference range, 72.5% fell within the reference range, and 4% (12) had values above the reference range. The data indicate that a proportion of children with PEM had IgM and IgA values below the reference range. These immunoglobulins play a crucial role in the immune response, defending the body against infections and diseases. Lower than normal IgM and IgA levels could increase the susceptibility of these children to infections and hinder their recovery process (Nielsen and Hejgaard, 2011).

ALT parameter was within the reference range for 99.3% of the children, and 0.7% had values above the reference range. As for AST parameter, 88.4% of the children had values within the reference range, and 11.6% had values above the reference range. Liver enzymes ALT and AST were within the reference range for the majority of children with PEM, indicating that liver function was relatively preserved. However, a small percentage (0.7%) had elevated ALT levels, and 11.6% had elevated AST levels. Liver dysfunction could further exacerbate the health challenges faced by children with PEM. Identifying the underlying causes of these enzyme elevations and providing necessary interventions are crucial to ensure hepatic health and support overall recovery.

In the case of creatinine parameter, 98.3% of the children had values below the reference range, and 1.7% fell within the reference range. A well-established characteristic of severe chronic renal failure is the spontaneous decrease in dietary protein intake (Kopple, 1999). There is some evidence suggesting that the reduction in protein intake initiates at an early stage of declining renal function (Ikizler et al., 1995). Malnutrition serves as a prognostic indicator for both morbidity and mortality (Soucie and McClellan, 1996). Most children with PEM (98.3%) had creatinine values below the reference range. Creatinine is a marker of kidney function, and low levels may signify impaired renal health in these individuals.

For CRP parameter, 55.6% of the children had values within the reference range, and 44.4% had values above the reference range. The data demonstrate that a significant proportion of children with PEM (44.4%) had CRP values above the reference range. CRP is an indicator of inflammation, and elevated levels suggest an ongoing inflammatory response in these children (Pepys and Hirschfield, 2003). Inflammation can exacerbate PEM's effects and hinder recovery. A study conducted by Sauerwein et al. demonstrated significantly elevated levels of C-reactive protein (CRP) in children with Protein-Energy Malnutrition (PEM) when compared to the control group (Sauerwein et al., 1997).

Vitamin D parameter showed that 70.9% of the children had values below the reference range, and 29.1% fell within the reference range. Protein-energy malnutrition (PEM) is commonly linked to inadequate intake of vitamin D. Additionally, certain individuals with apparently sufficient ultraviolet (UV) exposure may exhibit low serum vitamin D concentrations, attributed to variations in skin pigmentation levels (Binkley et al., 2007).Research investigations have consistently reported a significant prevalence of vitamin D deficiency among children with Protein-Energy Malnutrition (PEM) in comparison to control groups (Amira and Abdel, 2004).

Compare the mean values of biochemical parameters based on the genders and ages of the included children. The table reveals statistically significant differences ($p<0.05$) in the mean values of Calcium, IgM, Folate, and TSH parameters between male and female children. In a study focused on malnutrition among elderly residents in a nursing home, it was observed that the calcium levels were lower in male individuals. Conversely, in Uckun's (2016) investigation of severe short stature, no significant gender-based difference was identified in the TSH ratio. Specifically, female children exhibited higher mean values of Calcium and Folate, whereas male children had higher mean values of IgM and TSH. In a study carried out in Indonesia, it was observed that girls exhibit lower levels of vitamin D, possibly due to their reduced outdoor activities (Onal et al., 2016). In contrast to our findings, investigations into dietary calcium intake

have revealed that only a quarter of adolescent girls manage to meet their daily calcium requirements (Chaki, 2017).

Moreover, upon examining the relationship between the ages of the children and the values of biochemical parameters, several noteworthy correlations were observed ($P<0.05$). There was a positive and low-level correlation between age and Iron, a negative and low-level correlation between age and UIBC, and another negative and low-level correlation between age and Calcium. In a study investigating malnutrition among children with cerebral palsy, no significant differences were observed in calcium levels across different age groups of children. While the traditional focus of iron supplementation has been on pregnant women and children under two years old, recent research suggests that the target group should also encompass all women of childbearing age, as well as preschool children and adolescents. Administering iron support to pregnant women with optimal iron stores enhances its effectiveness during pregnancy and mitigates the risk of iron deficiency in both the mother and the newborn post-delivery (UNICEF, 2013). Additionally, a positive and moderate-level correlation between age and Sodium, and a negative and low-level correlation between age and Potassium were found. Furthermore, the analysis indicated a positive and low-level correlation between age and IgA, a negative and low-level correlation between age and ALT, and a negative and moderate-level correlation between age and AST. Moreover, there was a positive and moderate-level correlation between age and Creatinine, and a negative and low-level correlation between age and CRP. Additionally, age showed a negative and moderate-level correlation with Folate, a positive and low-level correlation with Free T4, and a negative and low-level correlation with TSH. Lastly, age displayed a negative and low-level correlation with Vitamin D. The radiographic scoring method developed and validated by Thacher and colleagues was originally intended for use in children aged 12 months and older, who possessed independent mobility. However, in Nairobi, rickets affects a much younger age group and is often linked to a high frequency of motor developmental delay in these children (Thacher et al., 2002; Edwards et al., 2014; Munns et al., 2016). It is crucial to establish diagnostic criteria that can be applied universally across different ages and developmental stages, as this is an essential requirement for accurately assessing the prevalence of rickets. Nonetheless, no significant relationships were found between age and the remaining parameters.

The primary limitation of our discussion stems from the fact that nearly none of the studies carried out on children diagnosed with protein-energy malnutrition have compared their biochemical parameters with individual demographic information. Given that demographic data significantly influence these parameters, it becomes crucial to augment such research endeavors aimed at elucidating this matter.

5. Conclusion

In conclusion, the current study sought to explore the distribution of various biochemical parameters in children diagnosed with protein-energy malnutrition (PEM). The findings of this research provide valuable insights into the prevalence of abnormal biomarker values among these children, offering a comprehensive understanding of the role these parameters play within the context of PEM. The results revealed that a considerable proportion of children with PEM exhibited deficiencies in iron, an essential element crucial for growth, immune function, and cognitive development. It is essential to note that the diagnostic criteria for rickets need to be universally applicable, accounting for different age groups and developmental statuses. While this study has provided valuable insights into the biochemical profile of children with PEM, it is crucial to acknowledge the limitations. The absence of comprehensive demographic data integration in existing studies hinders a holistic understanding of the factors influencing these parameters. Future research endeavors should focus on bridging this gap, enabling a more comprehensive assessment of the intricate relationship between demographic variables and biochemical profiles in children diagnosed with PEM. In essence, this study contributes to our understanding of the intricate biochemical dynamics associated with protein-energy malnutrition in children. The findings underscore the need for targeted interventions addressing specific deficiencies and potential complications, aiming to improve the health outcomes and overall well-being of this vulnerable population.

Based on the obtained results, it is recommended that pediatric nurses focus their efforts on addressing protein-energy malnutrition and consider children within the context of nutritional disorders. Given its status as a significant public health concern, it holds paramount importance to impart education to families residing in rural areas about proper child nutrition practices.

Limitations and Strengths of the Study

The primary limitation of our discussion stems from the fact that nearly none of the studies carried out on children diagnosed with protein-energy malnutrition have compared their biochemical parameters with individual demographic information. Given that demographic data significantly influence these parameters, it becomes crucial to augment such research endeavors aimed at elucidating this matter.

The strengths of our study are anchored in the rigorous and comprehensive examinations and laboratory analyses conducted on the patient cohort from which our data were derived.

Author Contributions

The percentage of the author(s) contributions is presented below. All authors reviewed and approved the final version of the manuscript.

	E.G.	N.K.
C	70	30
D	70	30
S	50	50
DCP	70	30
DAI	60	40
L	60	40
W	50	50
CR	70	30
SR	80	20
PM	70	30
FA	50	50

C=Concept, D= design, S= supervision, DCP= data collection and/or processing, DAI= data analysis and/or interpretation, L= literature search, W= writing, CR= critical review, SR= submission and revision, PM= project management, FA= funding acquisition.

Conflict of Interest

The authors declared that there is no conflict of interest.

Ethical Approval/Informed Consent

This study was approved by Ethics Committee of Iğdır University (approval date: October 27, 2023, protocol code: E-37077861-900-119343,). Before collecting study data, written permissions were obtained from the relevant hospital (permission date: 19.01.2023).

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Black Sea Journal of Health Science

doi: 10.19127/bshealthscience.1477165

Open Access Journal
e-ISSN: 2619 – 9041

Araştırma Makalesi (Research Article)
Cilt 7 - Sayı 5: 181-188 / Eylül 2024
(Volume 7 - Issue 5: 181-188 / September 2024)

GEBELERİN DOĞUM PLANI VE BU PLANI ETKİLEYEN FAKTÖRLERİN BELİRLENMESİ

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Özet: Bu çalışma, gebelerin kendilerinin oluşturduğu doğum planı ve bu planı etkileyen faktörlerin belirlenmesi amacıyla tanımlayıcı tipte gerçekleştirildi. Çalışmanın evrenini, Aralık 2022-Mart 2023 tarihleri arasında İstanbul'da bulunan Özel Hastanenin A ve B Şubeleri Kadın Hastalıkları ve Doğum Kliniğine doğum için başvuran 206 gebe oluşturdu. Veri toplamada tanıtıcı bilgi formu ve gebelerin doğum planını etkileyen faktörler anket formu ve doğum planı formu kullanıldı. Araştırmaya katılan gebelerin yarısının normal doğum yapmayı planladığı, doğum şeklini belirlemede yaklaşık yarısının hekim önerisinden etkilendiği saptandı. Doğum planında gebelerin yarısı ebe seçerken güvenilir olmasına dikkat ettiğini bildirdi. Gebelerin yarısından fazlasının doğumu kolaylaştırıcı ilaç dışı yöntemleri bildiği belirlendi. Gebeler, kendi doğumlarında sırasıyla mahremiyetine önem verilen (%78,2), loş (%71,4), sakin (%55,8) bir ortam istediğini belirtti. Doğum sırasında gebelerin yanlarında olmasını tercih ettikleri kişiler sırasıyla eş (%85,9), Ebe (%42,7), anne (%18,9) olarak belirlendi. Gebelerin doğum planında %78,6'sı doğumdan hemen sonra yenidoğan ile ten tene temas uygulanmasını bildirdi. Doğum planlarında gebelerin %26,7'si doğumundan sonra plasentasını almak istediğini bildirdi. Sonuç olarak araştırma bulgularına göre kadınların, kendi doğumlarında deneyimli hekim ve güvenilir ebelerin yer almasını, mahremiyetin sağlandığı bir ortamda, ilaç dışı doğumu kolaylaştırıcı yöntemlerin kullanıldığı doğum planladıkları söylenebilir.

Anahtar kelimeler: Doğum planı, Doğum, Doğum deneyimi, Gebelik

Determination of Pregnant' Birth Plan and Factors Affecting This Plan

Abstract: This study was carried out as a descriptive study to determine the birth plan created by pregnant women themselves and the factors affecting this plan. The population of the study consisted of 206 pregnant women who applied for birth to the Gynecology and Obstetrics Clinic of A and B department of the Private Hospital in Istanbul between December 2022 and March 2023. An introductory information form, a survey form on the factors affecting the birth plan of pregnant women, and a birth plan form were used to collect data. It was determined that half of the pregnant women participating in the study planned to have a normal birth, and approximately half of them were influenced by the doctor's recommendation in determining the method of birth. Half of the pregnant women reported that they paid attention to the reliability of the midwife when choosing a birth plan. It was determined that more than half of the pregnant women knew non-drug methods to facilitate birth. Pregnant women stated that they wanted an environment where their privacy was important (78.2%), dimly light (71.4%) and calm (55.8%) during their birth. The people preferred by pregnant women to be with them during birth were determined as spouses (85.9%), midwives (42.7%) and mothers (18.9%). In the birth plan of pregnant women, 78.6% reported skin-to-skin contact with the newborn immediately after birth. In their birth plans, 26.7% of pregnant women stated that they wanted to receive their placenta after birth. As a result, according to the research findings, it can be said that women plan to have experienced physicians and reliable midwives involved in their births, in an environment where privacy is ensured, and where non-drug birth-facilitating methods are used.

Keywords: Birth plan, Birth, Birth experience, Pregnancy

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Gönderi: 07 Mayıs 2024 **Received:** May 07, 2024
Kabul: 26 Temmuz 20234 **Accepted:** July 26, 2024
Yayınlanma: 15 Eylül 2024 **Published:** September 15, 2024
Cite as: Özdilek R, Kısa BN. 2024. Determination of pregnant' birth plan and factors affecting this plan. BSJ Health Sci, 7(5): 181-188.

1. Giriş

Doğum anneliğe uyum sağlamada önemli olan fiziksel, sosyal, biyolojik ve duygusal değişimlerin yaşandığı bir dönemdir. Kadının bu döneme fiziksel ve emosyonel hazırlığının yapılması anne ve fetüsün rahat ve güvenli olarak doğum yapmasına büyük katkıda bulunacaktır (Pekince ve Ertem, 2016). Kadınların doğum deneyiminden memnun olmaları, doğum ve doğum sonu sürecini etkileyen önemli bir faktördür. Bu nedenle kadınların doğumdan beklentilerini belirlemek ve bu süreçte ihtiyaçları olan bilgi, destek ve bakımı verebilmek açısından doğum planı ile ilgili tercihlerini belirlemek ve doğum sürecinde alınacak kararlara onların da katılımını sağlamak önemlidir (Gözükara ve Eroğlu, 2008). Kadınların doğumla ilgili beklentileri karmaşık ve dinamiktir. Duygular, kontrol, ağrı ve obstetrik olaylar gibi doğumun farklı yönleriyle ilgili beklentilerin her kadın üzerinde farklı etkileri olmaktadır. Bu beklentiler sürekli olarak değişmekte, yeni bilgi ve tecrübe ile geliştirilmektedir (Lothian, 2005). Kadın, doğum öncesi

dönemde duygusal, psikolojik, sosyal ve fiziksel ihtiyaçları kapsayan bütüncül bir perspektiften başlayarak doğumda kendi kişisel seçimleri konusunda güçlendirilmelidir (Ayers ve Pickering, 2005). Olumlu bir doğum deneyimi bir kadının, sürekli doğum desteği, klinik ve psikolojik olarak güvenli bir ortam, nazik ve teknik olarak yetkin doğum profesyoneli eşliğinde sağlıklı bir bebeği doğurmak ve bunun yanı sıra kişisel ve sosyokültürel beklentilerini karşılayan veya aşan bir deneyim olarak tanımlanmaktadır (Rocca-Ihenacho ve ark., 2018). Dünya Sağlık Örgütü (DSÖ) pozitif doğum deneyimini güçlendirmek için ebenin kadın ile etkili iletişim kurarak rehberlik etmesini önermektedir (WHO, 2018). Bu bağlamda kadınların ana kahramanı olduğu doğumlarında karar merkezinde olması, ebeler eşliğinde doğum planının farkındalığının sağlanması, doğumun kendi olağan sürecine bırakılması olumlu doğum deneyiminin artmasını sağlayacağı öngörülebilir.

Doğum planı gebelikten önce veya gebelik sırasında, genellikle doğum sınıfları aracılığıyla oluşturulan, annenin doğum değerlerini belirlemesine, doğum için mevcut seçeneklerle tanışmasına ve kendisi için destekleyici bir doğum ortamını kolaylaştırmak için bir kriterler listesi geliştirmesine yardımcı olan bir belgedir (Ghahremani ve ark., 2023). Doğum planı aracılığı ile kadınlar tercihlerini doğum süreci boyunca iletirler (Bailey ve ark., 2008). Ayrıca doğum planı sadece kadınların doğum sırasındaki olaylar üzerinde kontrol sahibi olmalarını sağlamakla kalmayıp, aynı zamanda kadınlar ve doğum sırasında onlara yardımcı sağlık profesyonelleri arasında daha iyi bir etkileşim sağlar (Kaufman, 2007). İskoçya'da doğum planlarının kullanımı ulusal düzeyde onaylanmakta ve ulusal bir doğum kaydına standartlaştırılmaktadır (Whitford ve Hillan, 1998). Amerika Birleşik Devletleri'ndeki bazı kurumlarda da bu tür belgeler uygulamaktadır (Mei ve ark., 2016). Kadınların doğum planı oluşturma nedenleri üçüncü basamak tıbbi müdahalenin yoğun olduğu hastanelerde gereksiz gördükleri müdahalelerden doğum planlarını korumak olarak görülebilir (Lothian, 2019). Mei ve ark. (2016)'nın California'da bir tıp merkezinde doğum planı yapan gebelerle yaptığı çalışmada gerçekleştirilen isteklerin yüzdesinin artmasının, doğum deneyimi memnuniyetini olumlu yönde etkilediği sonucuna varılmıştır. Literatürde, doğum planlarının olumlu doğum deneyimine katkısı olduğu görülmüş, doğum memnuniyetini arttırdığı sonucuna ulaşılan çalışmalar bulunmaktadır. Türkiye'de standardize edilmiş herhangi bir doğum planı yoktur. Çalışmanın yapıldığı süreçte, doğum planına ilişkin bir çalışmanın da Türkiye adresli literatürde yer almadığı görülmüştür. Bu çalışmada Türkiye'de A sınıfı hastanelerden birine başvuruda kendi doğum planlarını talep eden gebelerin doğum planlarının ve bu planlarını etkileyen faktörlerin belirlenmesi amaçlandı.

2. Materyal ve Yöntem

2.1. Araştırmanın Türü

Araştırma, tanımlayıcı bir çalışmadır.

2.2. Araştırmanın Yapıldığı Yer ve Zaman

Araştırma Ocak 2023-Mart 2023 tarihleri arasında İstanbul'da bulunan A sınıfı bir özel Hastanenin iki şubesinin Kadın Hastalıkları ve Doğum Kliniklerinde yürütüldü.

2.3. Araştırmanın Evreni ve Örneklemi

Araştırmanın evrenini İstanbul'da bulunan bir özel hastanenin kadın hastalıkları ve doğum kliniğine doğum için başvuran gebeler oluşturdu. Örneklem hesaplaması için güç analizi yapıldı. A Hastanesinin bir yıllık doğum oranı 750'dir. Araştırmada evreni bilinen örneklem yöntemi kullanılarak %90 güven ve %5 hata ile hesaplandı ve 200 gebe ile görüşülmesi gerektiği tespit edildi. Çalışma 206 gebe ile tamamlandı. Çalışmaya; kendi doğum planını hazırlamış olan gebeler, 18 yaş üzerindeki gebeler, gebeliği 32'inci haftadan büyük gebeler, obstetrik bir komplikasyonu bulunmayan gebeler dahil edildi. Çalışmaya; Türkçe iletişim kurma sorunu olan gebeler dahil edilmedi.

2.4. Veri Toplama Araçları

Araştırma verilerinin toplanmasında "Tanıtıcı Bilgi Formu", ''Gebelerin Doğum Planını Etkileyen Faktörler Anket Formu'', ''Doğum Planı Formu'' Bu formlar araştırmacılar tarafından konu ile ilgili literatür taraması yapılarak oluşturuldu (Kaufman, 2007; Bell ve ark., 2022; Barnes ve ark., 2023).

Tanıtıcı Bilgi Formu: Tanıtıcı Bilgi Formu bireylerin sosyodemografik özelliklerini, obstetrik özelliklerini ve şimdiki gebelik bilgilerini sorgulayan 23 sorudan oluştu (Afshar ve ark., 2017; Barnes ve ark., 2023).

Gebelerin Doğum Planını Etkileyen Faktörler Anket Formu: Gebelerin doğum planı yaparken ebe, hekim, doula, doğum çantası, analjezi tercihi gibi kriterlerini nelerin etkilediğini sorgulayan 10 sorudan oluştu (Ahmadpour ve ark., 2022; Ghahremani ve ark., 2023).

Doğum Planı Formu: Gebelerin doğum öncesi, doğum anı ve doğum sonrası dönemde planlarını sorgulayan 16 soruyu içeriyordu (Merten 2016; Bell ve ark., 2022).

2.5. Verilerin Elde Edilmesi

Araştırmanın duyurusu hastanenin sağlık profesyonellerine ortak elektronik posta sistemi üzerinden duyuruldu. Gebeler ile doğum öncesinde kendi doğum odalarını görmek ve doğum planlarını kliniğe iletmek için geldiklerinde görüşme yapıldı. Gebelere çalışma ile ilgili bilgi verilip onam alınarak çalışmaya dahil edildi. Görüşmede yüz yüze görüşme tekniği kullanılarak tanıtıcı bilgi formu ve anket verileri toplandı. Verilerin toplanması her gebe için ortalama 10-15 dakika sürdü.

2.6. Verilerin Değerlendirilmesi

Araştırmada elde edilen veriler SPSS® 20 paket programına aktarılmıştır. Normallik varsayımını sınayan Shapiro-Wilk-W testi ile verilerin normal dağılıma uyup uymadığı test edildi. Analiz sonuçları nicel veriler için ortalama, standart sapma, ortanca, minimum ve

maksimum olarak hesaplandı. Kategorik veriler ise frekans (yüzde) olarak ifade edildi. Veriler %95 güven aralığında değerlendirildi.

3. Bulgular

Araştırmanın örneklemini oluşturan 206 gebenin yaş ortalamalarının 32,68±5,23, yarısından fazlasının üniversite mezunu (%70,9), çoğunluğunun bir işte çalıştığı (%69) belirlendi. Katılımcıların %68'inin gelir durumunun "geliri giderinden fazla" şeklinde tanımlandığı belirlendi. Katılımcıların %79,1'inin çekirdek aile yapısına sahiptir. Katılımcıların ortalama gebelik haftası 37,7±2,64 ve ortalama gebelik sayısının 1,67±0,87 olduğu belirlendi. Gebelerin %82,5'i (n=170) gebeliğini planladığı saptandı. Tıbbi yardım ile gebe kalanların sayısı 36'dır (%17,5). Gebeliğinde doğuma hazırlık eğitimi alan katılımcı sayısı 82'dir (%39,8) (Tablo 1).

Tablo 1. Gebelerin sosyo demografik ve obstetrik özellerine ilişkin bulgular

	Min-mak.	Ort±ss	
Yaş	21-20	32,68 ± 5,23	
		n	%
Öğrenim durumu	İlköğretim	3	1,5
	Lise	57	27,7
	Üniversite	146	70,9
Eşinin öğrenim durumu	Lise	6	2,9
	Üniversite	200	97,1
Meslek	Ev hanımı	64	31,1
	Memur	37	18
	İşçi	56	27,2
	Serbest meslek	49	23,8
Eşinin mesleği	İşçi	62	30,1
	İşveren	48	23,3
	Memur	33	16
	Serbest meslek	63	30,6
Gelir durumu	Geliri giderinden fazla	140	68
	Geliri giderine eşit	64	31,1
	Geliri giderinden az	2	1
Aile tipi	Çekirdek aile	163	79,1
	Geniş aile	43	20,1
	Min-mak.	Ort±ss	
Gebelik haftası	25-41+6	37,7±2,64	
Gebelik sayısı	1-4	1,67±0,87	
Yaşayan çocuk sayısı	1-3	1,42±0,67	
Düşük ve küretaj sayısı	1-4	1,25±0,60	
		n	%
Gebeliği isteme durumu	Planlı gebelik	170	82,5
	Plansız gebelik	36	17,5
Bebekte istenen cinsiyet	Kız	29	14,1
	Erkek	24	11,7
	Farketmez	153	74,3
Usg'ye göre beklenen cinsiyet	Kız	110	53,4
	Erkek	96	46,9
Gebeliğin oluşma durumu	Spontan	170	82,5
	Tıbbi yardım ile	36	17,5
Önceki gebelikte bir sorun yaşama durumu	Evet	30	14,6
	Hayır	176	85,5
Önceki gebelik ile bu gebelik arasındaki süre	2 yıldan az	52	25,2
	2 yıldan fazla	34	18
	İlk gebelik	117	56,8
Kronik hastalık	Evet	23	88,8
	Hayır	183	11,2
Doğuma hazırlık eğitimi alma durumu	Evet	82	39,8
	Hayır	124	60,2

Gebelerin %49'u vajinal doğumu %51'i sezaryen ile doğumu tercih etmektedir. Vajinal doğumu tercih edenlerin %19,9'u (n=41) suda doğum, %4,9'u (n=10) sezaryen sonrası vajinal doğumu tercih etmektedir. Doğum şeklini belirlerken hekimin önerisi (%39,3), doğal doğum tercihi (%41,3) ve eski sezaryen olması durumu (%12,1) etkili olmaktadır. Doğum sırasında kullanılan ilaç dışı yöntemleri ebe (%44,7), aile, arkadaş, eş (%18,9) ve hekimden (%13,6) öğrendikleri belirlendi. Gebelerin %40,3'ü (n:83) ise bu yöntemlerin hiçbirini bilmediği belirlendi. Doğum sırasında müdahale gerekirse gebelerin tercih ettiği yöntemler arasında ıv kateter (%71,8), epidural kateter (%62,6), analjezik uygulaması (%39,7) bulunmaktadır. Doğum sırasında gebelerin %71,4'ü loş, 55,8'i sakin, %78,2'sinin mahremiyetine önem verilen bir ortamda doğum yapmak istediği belirlendi (Tablo 2).

Gebelerin %42,7'sinin hekim seçerken deneyimli olmasına dikkat ettiği (n=88), %54,9'unun ebe seçerken güvenilir olmasına dikkat ettiği (n=113) belirlendi. Doğum çantası hazırlarken en çok aile, eş ve arkadaştan destek alındığı %45,6 (n=94), doğum yapılacak kurum seçerken ise %52,9 (n=109) ile en çok hekimin önerisine göre seçim yapıldığı belirlendi. Gebelerin %18'inin erken taburculuk istediği belirlendi (Tablo 3).

Doğumdan hemen sonra tercih edilen yöntemler arasında ten tene temas (%78,6), yenidoğan muayenesinin hemen yapılması (%51), geç kordon klempleme (%33), partnerin kordonu kesmesi (%28,6) olduğu belirlendi. Gebelerin %28,2'si kordon kanı ve göbek bağından örnek alınıp saklanmasını tercih ederken %26,7'si de plasentalarını teslim almak istemektedir. Topuk kanı alınması (%1,9), K vitamini uygulaması (%10,7), hepatit B aşısı (%10,7), işitme taraması (%2,9) gibi tıbbi uygulamaların yapılması istenmediği belirlendi (Tablo 4).

Tablo 2. Gebelerin doğum ekibi ve ortamıyla ilgili planına ilişkin bulgular

Ebe seçerken dikkat edilen kriterler	n	%
Güvenilir olması	113	54,9
Deneyimli olması	22	10,7
Tercihlere saygı duyması	41	19,9
Öğrenimi	4	1,9
Hekim seçerken dikkat edilen kriterler	n	%
Güvenilir olması	70	34
Deneyimli olması	88	42,7
Tercihlere saygı duyması	44	21,4
Öğrenimi	32	15,5
Sosyal medyada popüler olması	16	7,8
Doğum çantası hazırlarken destek alınan kişi	n	%
Ebe	87	42,2
Doula	31	15
Hekim	31	15
Emzirme danışmanı	19	9,2
Aile, eş, arkadaş	94	45,6
Doğum yapılacak kurumu seçme sebebi	n	%
Hekim önerisi	109	52,9
Anne bebek dostu olması	36	17,5
A sınıfı olması	30	14,6
Arkadaş önerisi	7	3,4
Daha önce hizmet alınan kurum	33	16
Doğumu kolaylaştırıcı ilaç dışı yöntemlerin öğrenildiği kişi	n	%
Doğumu kolaylaştırıcı ilaç dışı yöntem bilmiyor	83	40,3
Ebe	92	44,7
Hekim	28	13,6
Aile, eş, arkadaş	39	18,9
Doğum sırasında tercih edilen ortam	n	%
Loş	147	71,4
Sakin	115	55,8
Kendi kıyafetini giymek	70	34
Müzik	61	29,6
Hastane kıyafeti giymek	95	46,1
Mahremiyetime önem verilmeli	161	78,2

Tablo 3. Gebelerin doğumlarıyla ilgili planına ilişkin bulgular

Doğum şekli tercihi	n	%
Vajinal doğum	50	24,3
Sezaryen	105	51
Suda doğum	41	19,9
SSVD (Sezaryen sonrası vajinal doğum)	10	4,9
Doğum şeklini belirlemede yardımcı kriterler		
Olumsuz doğum deneyimleri	14	6,8
Olumlu doğum deneyimleri	4	1,9
Eski sectio	25	12,1
Hekimin önerisi	81	39,3
Doğal doğum tercihi	85	41,3
Doğum sırasında yanında olmasını tercih ettiği kişiler		
Eş	177	85,9
Anne	39	18,9
Ebe	88	42,7
Doula	30	14,6
Arkadaş	10	4,9
Doğum sırasında gerekli olursa uygulanması tercih edilen müdahaleler		
IV kateter	148	71,8
Epidural anestezi	129	62,6
Epizyotomi	18	8,7
Analjezik	81	39,7
İndüksiyon	27	13,1
Erken taburculuk isteme durumu		
Evet	37	18
Hayır	169	82

Tablo 4. Doğum planında yenidoğana ilişkin tercihler

Doğumdan hemen sonra uygulanması istenen yöntemler	n	%
Ten tene temas	162	78,6
Yenidoğan muayenesinin hemen yapılması	105	51
Geç kordon klempleme yapılması	68	33
Kordon klemplemenin hemen yapılması	97	47,1
Partnerinin kordonu kesmesi	59	28,6
Yenidoğana uygulanması istenmeyen invaziv ve non-invaziv tıbbi uygulamalar		
Topuk kanı alınması	4	1,9
K vitamini	22	10,7
Hepatit B aşısı	22	10,7
İşitme taraması	6	2,9
Görme taraması	6	2,9
Antibiyotikli göz tedavisi	16	7,8
Kordon kanı ve göbek bağı örneği alınsın mı?		
Evet	58	28,2
Hayır	137	66,5
Aile plasentayı teslim almak istiyor mu?		
Evet	55	26,7
Hayır	151	73,3

4. Tartışma ve Sonuç

Dünya Sağlık Örgütü (WHO), doğum sürecinde kadınların tercihlerine ve ihtiyaçlarına saygı gösterilmesi gerektiğini ve bu nedenle doğum planlarının önemli olduğunu belirtmektedir (WHO, 2018). Benzer şekilde, Amerikan Kadın Hastalıkları ve Doğum Derneği (ACOG), doğum planlarının kadınların doğum deneyimini iyileştirebileceğini ve sağlık hizmeti sunucularına rehberlik sağlayabileceğini belirtmektedir (ACOG, 2019). Birçok uluslararası kuruluş, doğum planlarının önemini vurgulamıştır. Bazı ülkelerin sağlık hizmetleri kapsamında doğum planlarını ulusal düzeyde onayladığı bilinmektedir (Whitford ve ark., 2016). Türkiye'de Sağlık Bakanlığı'nın yayınladığı bir doğum planı bulunmamaktadır.

Araştırmamızdaki katılımcıların ortalama gebelik sayısı 1,67±0,87 ve yaş ortalaması da 32,68±5,23 olarak belirlendi. TNSA 2018 raporunu göre ortanca ilk doğum yaşı 23,3 iken çalışma grubumuzun gebelik sayısı ve yaş ortalamasının Türkiye ortalamasından yüksek olduğu görülmektedir (TNSA 2018). Bunun, örneklemdeki kadınların yükseköğrenim durumu ve gelir düzeyinden kaynaklı olduğu düşünülmektedir.

Araştırmamızdaki gebelerin yarısı sezaryen doğum yapmayı planladığını bildirdi. TNSA verilerine göre Türkiye'de doğumların %52'si sezaryen ile gerçekleşmektedir (TNSA, 2018). Yine aynı raporda sezaryen ile doğum oranını anne yaşı, yükseköğrenim durumu, yüksek gelir durumu ve doğum yapılan kurum gibi faktörlerin etkilediği bildirilmektedir. Ülkemizde sezaryen doğumlar, özel sektöre bağlı sağlık kuruluşlarında %68 oranında olup kamuya göre çok daha yaygındır. Özel sektöre bağlı sağlık kuruluşlarında sezaryen doğumların çoğu (%51) doğum sancıları başlamadan önce planlanmıştır (TNSA, 2018). Araştırmamızdaki gebelerin doğum planlarında yarısının doğum şeklini henüz sancıları başlamadan önce, sezaryen ile gerçekleştirme bulgusu ile TNSA verileri benzerdir.

Çalışmada yer alan gebelerin yarısı, ebe seçerken güvenilir olmasına dikkat ettiğini bildirdi. Pek çok çalışma, kadın ile ebe arasında güvene dayalı bir ilişkinin doğum deneyimi açısından önemli olduğunu göstermektedir (Timur ve Hotun Şahin, 2010; Leap ve ark., 2010; Dahlberg ve ark., 2016; İldan Calim ve ark., 2021). Dahlberg ve arkadaşlarının Norveç'te yaptığı nitel bir çalışmada kadınlar, doğum sırasında ebenin varlığının güven verici bir faktörü temsil ettiğini bildirmişlerdir (Dahlberg ve ark., 2016).

Doğumda ağrıyla baş etmede farmakolojik olmayan yöntemler kullanılabilmektedir. Farmakolojik olmayan yöntemlerin etkin kullanımı bilgi ve rehberlikle ilişkilidir (Avcıbay ve Alan, 2011). Bazı çalışmalar çoğu gebe kadının doğumun farklı aşamalarında ve doğum sırasında kullanılan teknikler hakkında kesin bilgiye sahip olmadığını bildirmektedir (Heim ve Makuch, 2022; Pietrzak ve ark., 2023). Ülkemizde ve dünyada çeşitli doğuma hazırlık eğitimi yaklaşımları farmakolojik olmayan teknikleri içermektedir (Afshar ve ark., 2017; T.C. Sağlık Bakanlığı, 2018; Matabane ve ark., 2023). Doğuma hazırlık eğitimine katılan gebelerin doğumu kolaylaştırıcı ilaç dışı yöntemler hakkında daha fazla bilgi sahibidir (Turgut ve ark., 2017). Araştırmamızdaki gebelerin yarısından fazlası farmakolojik olmayan yöntemler hakkında bilgi sahibiydi. Bu bulgunun, katılımcıların yarısının doğuma hazırlık eğitimi almış olmasından kaynaklanabileceği söylenebilir.

Çalışmada gebelerin çoğunluğu doğum ortamı için mahremiyeti sağlayan ve de loş, sakin bir doğum ortamı beklediklerini bildirmişlerdir. Bunun beklenen bir bulgu olduğu söylenebilir. Doğum ve doğum için gerekli hormonların salınmasını desteklemek için mahremiyet çok önemlidir. Pek çok memeli, izlenildiği hissinden kaçınmak için doğum sırasında mahremiyet arar (Jenkinson ve ark., 2014). Mahremiyete ilişkin algılanan her hangi bir engel doğum için çok gerekli oksitosin salımını engeller (Lothian, 2005). Doğumda fiziksel çevrenin düzenlenmesinde ışık ve gürültünün kontrolü de oldukça önemlidir (Jenkinson ve ark., 2014). Parlak, yapay ışık neokorteksi uyarır ve adrenalin salınımını tetikleyerek doğum fizyolojisini engelleyebilir. Doğru aydınlatma tasarımı aynı zamanda ortamın daha az hissedilmesini de sağlayabilir. Daha düşük aydınlatma gebede daha huzurlu bir ruh hali ve daha fazla mahremiyet duygusu oluşturur (Odent, 2001; Stenglin ve Foureur, 2013).

Gebelerin tamamına yakını doğumda yanında olmasını tercih ettiği kişi olarak eş/partneri bildirmiştir. Doğumda fiziksel desteğin yanı sıra duygusal destek kadının doğum deneyimini etkilemektedir. Doğumda eş desteğinin anksiyeteyi düşürdüğü, ağrı ile baş etmeyi artırdığı ve doğum süresini kısalttığı bildirilmektedir (Waldenström ve ark., 2004; Jenkinson ve ark., 2014; Tokat Çınaroğlu ve Demirgöz Bal, 2022).

Doğum sırasında gerekli olursa uygulanması tercih edilen uygulamalar arasında kadınlar en az oranda (%8,7) epizyotominin yapılabileceğini bildirmiştir. Londra'da yapılan nitel bir çalışmada kadınların epizyotomi onayına ilişkin deneyimleri ortaya konmuştur. Çalışmada zaman baskısı, kadınların fiziksel olarak yorulması ve bebeğin güvenli doğumuna odaklanılması gibi durumların gerçek rızayı kısıtladığı belirtilmiştir. Araştırmacılar gerçek bir seçim duygusu için epizyotomi hakkında bilgilendirmenin daha erken zamanında yapılmasını önermiştir (Djanogly ve ark., 2022). Çin'de yapılan başka bir çalışmada kadınlar, epizyotomiyle verilen zararın kendilerinde uzun vadeli kaygı yarattığını bildirmiştir (He ve ark., 2020). Çalışmamızda gebelerin gereklilik durumunda epizyotomiye çok düşük oranda onay vermesi beklenen bir bulgudur.

Doğumun erken döneminde başlatılan ten tene temasın anne ve yenidoğan sağlığı üzerine pek çok olumlu etkisi bilinmektedir (Yerlikaya ve İldan Calim, 2021). Mete ve arkadaşlarının yaptığı bir çalışmada gebelerin ten tene temas hakkında düşük düzeyde bilgiye sahip olduğu saptanmış ve gebelerin bu konuda yeteri kadar bilgilendirilmesi önerilmiştir (Mete ve ark., 2021). Araştırmamızda yer alan gebelerin tamamının ten tene temas istediğini bildirmesi, doğuma hazırlık sınıflarına katılma, öğrenim durumlarının yüksek olması gibi değişkenlerden kaynaklanmış olabilir.

Doğum planlarında doğumdan sonra plasentasını almak isteyenlerin oranının %26,7 olarak saptanması dikkat çekicidir. Ülkemizdeki literatürde plasentaya ilişkin ritüel ya da diğer uygulamaları konu alan bir çalışmaya rastlanılmamıştır. Plasentanın imhasına ilişkin kültürlerarası farklılıklar bulunmaktadır. Bazı kültürlerde plasentanın anne ya da diğer kişiler tarafından yenerek çeşitli şekillerde tüketilmesi, yakılması, gömülmesi, akan bir suya bırakılması gibi uygulamalar bulunmaktadır (Burns, 2014; Johnson ve ark., 2018; Bukian ve Dewi, 2019; Oe ve ark., 2021; Moeti

ve ark., 2023). Araştırmada yer alan gebelerin bir kısmının doğum planlarında plasentalarını almak istemesinin nedenleri ebe ve hemşireler için başka çalışmalar için araştırma konusu olabilir.

Sonuç olarak araştırma bulgularına göre kadınların, kendi doğumlarında deneyimli hekim ve güvenilir ebelerin yer almasını, mahremiyetin sağlandığı bir ortamda, ilaç dışı doğumu kolaylaştırıcı yöntemlerin kullanıldığı doğum planladıkları söylenebilir.

Araştırmanın Sınırlılıkları

Bu çalışma, sadece bir özel hastaneye başvuran gebeler ile yapıldığı için çalışma sonuçları tüm gebeler için genelleştirilemez. Çalışmada yer alan katılımcıların yarısından fazlası gelir durumunu yüksek olarak bildirmiştir. Dolayısıyla bu yönüyle örneklem grubu, doğum hizmeti alan genel popülasyonu temsil etmemektedir. Verilen yanıtlar bireysel beyana dayalı olduğu için yanılma payı olup, verilerin güvenirliği katılımcıların verdiği bilgilerin doğruluğu ile sınırlıdır.

Katkı Oranı Beyanı

Yazar(lar)ın katkı yüzdesi aşağıda verilmiştir. Tüm yazarlar makaleyi incelemiş ve onaylamıştır.

	R.Ö.	B.N.K.
K	50	50
T	50	50
Y	50	50
VTI	80	20
VAY	80	20
KT	60	40
YZ	60	40
KI	50	50
GR	50	50
PY	50	50

K= kavram, T= tasarım, Y= yönetim, VTI= veri toplama ve/veya işleme, VAY= veri analizi ve/veya yorumlama, KT= kaynak tarama, YZ= Yazım, KI= kritik inceleme, GR= gönderim ve revizyon, PY= proje yönetimi.

Çatışma Beyanı

Yazarlar bu çalışmada hiçbir çıkar ilişkisi olmadığını beyan etmektedirler.

Etik Onay/Hasta Onamı

Bu çalışma Acıbadem Üniversitesi Tıbbi Araştırma Etik Kurulu' tarafından onaylandı (onay tarihi: 18 Şubat 2022, onay numarası: 2022-18/02). Araştırma Helsinki Deklarasyonu Prensipleri'ne uygun şekilde yapılmıştır. Verilerin topladığı kurumdan yazılı kurum izni alınmıştır. Araştırmaya katılmayı kabul eden gebelerden aydınlatılmış onam formu kullanılarak yazılı onam alınmıştır.

Teşekkür ve Bilgilendirme

Araştırmada yer alan gebelere teşekkür ederiz.

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Black Sea Journal of Health Science
doi: 10.19127/bshealthscience.1525069

Open Access Journal
e-ISSN: 2619 – 9041

Research Article
Volume 7 - Issue 5: 189-195 / September 2024

THE RELATIONSHIP BETWEEN DIALYSIS ADEQUACY AND BLOOD PRESSURE AND NUMBER OF INTRADIALYTIC HYPOTENSIVE EPISODES IN HEMODIALYSIS PATIENTS

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Abstract: Dialysis adequacy is currently defined as the dose of dialysis that covers all functions of the kidney and is measured by adequate removal of harmful substances and excess fluid accumulated in the body. The aim of this study is to examine the relationship between dialysis adequacy and blood pressure, as well as the number of intradialytic hypotensive episodes in hemodialysis patients. The study included 50 patients receiving four-hour hemodialysis three times a week at Muş State Hospital. Dialysis adequacy was based on Kt/V and URR values. Demographic data were collected by face-to-face interviews with the participants. Blood pressure, Kt/V, and URR were measured before the hemodialysis session, and then the total number of intradialytic hypotensive episodes within one hemodialysis session was recorded. There was no statistically significant correlation between Kt/V and systolic and diastolic blood pressure and number of intradialytic hypotensive episodes (P>0.05). There was no statistically significant correlation between URR and systolic and diastolic blood pressure and number of intradialytic hypotensive episodes (P>0.05). Our study shows that there is no significant relationship between dialysis adequacy and blood pressure and number of intradialytic hypotensive episodes. Further research is needed to understand how these relationships may vary among patient groups with different demographic and clinical characteristics.

Keywords: Dialysis adequacy, Blood pressure, Intradialytic hypotension

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Received: July 30, 2024
Accepted: August 26, 2024
Published: September 15, 2024

Cite as: Bingölbali Ö, Oğuz S. 2024. The relationship between dialysis adequacy and blood pressure and number of intradialytic hypotensive episodes in haemodialysis patients. BSJ Health Sci, 7(5): 189-195.

1. Introduction

End-stage renal failure is a serious health condition characterized by the inability of the kidneys to effectively filter waste and excess fluid. This condition usually develops as a result of chronic diseases such as diabetes and hypertension. Its treatment involves methods such as kidney transplantation or dialysis. The aim of dialysis is to filter waste products and excess fluid from the patient's blood with the help of a machine (Cheng et al., 2021; Sharanappa et al., 2021). Dialysis therapy consists of two types: hemodialysis (HD) and peritoneal dialysis (Sahathevan et al., 2020; Arasu et al., 2022). One of the important parameters determining the quality of HD is dialysis adequacy (DA) (Ding et al., 2021).

DA is a crucial indicator that is meticulously monitored to enhance patients' quality of life and improve long-term survival (Wayunah et al., 2023). Currently, dialysis dose is defined as the measure encompassing all kidney functions and assessed by the removal of solutes (Zedelenmez and Çağlar, 2019). High-quality dialysis therapy, by effectively removing waste and excess fluid, has positive effects on cardiovascular health, nutritional status, and overall health (Aghsaeifard et al., 2022). Therefore, optimizing DA is of critical importance for the well-being of patients and the effectiveness of healthcare services (Raimundo et al., 2023). Additionally, increasing DA reduces the risk of complications in HD patients, decreases hospitalization rates, and lowers overall healthcare costs (Miyata et al., 2019). DA is an important indicator determining the quality of HD, and it also depends on factors such as the patient's health status, the implementation of the dialysis method, equipment quality, dialysis duration and frequency, nutritional status, and blood pressure (Seng et al., 2020; Sola et al., 2020; Lint et al., 2023). Effective fluid removal during dialysis helps prevent intradialytic hypotension (IDH) (Flythe et al., 2020; Fotiadou et al., 2020). IDH is a condition where blood pressure drops below a certain threshold during hemodialysis, typically caused by rapid volume changes in the body during fluid removal (Karaer et al., 2021; Hamrahian et al., 2023). IDH episodes (IDHE) are defined in two different ways: asymptomatic and symptomatic. Asymptomatic IDHE is characterized by a decrease in systolic blood pressure of more than 20

mmHg from the pre-dialysis value, without the presence of any additional adverse symptoms in the patient (Kanbay et al., 2020). A symptomatic IDHE is characterized by a drop in the average systolic blood pressure of more than 10 mmHg from the predialysis value, along with symptoms such as severe abdominal pain, nausea, vomiting, dizziness, blurred vision, muscle cramps, and severe anxiety (Workgroup, 2005; Alhawari et al., 2020; Allinovi et al., 2022;).

Blood pressure management in dialysis patients is complex and challenging due to the inadequacy of kidney function, autonomic nervous system disorders, and the loss of other autoregulatory mechanisms. To enhance the effectiveness of DA, it is essential to meticulously monitored on blood pressure (Kanno, 2021). Because high blood pressure necessitates the removal of more fluid during hemodialysis, it increases the risk of IDH and makes it difficult to adjust the optimal ultrafiltration rate (Agarwal et al., 2014; Dekker et al., 2018). On the other hand, low blood pressure reduces dialysis tolerance, potentially leading to the early termination of sessions and inadequate treatment (Tawfik et al., 2022; Uduagbamen et al., 2022; Kim et al., 2023). Therefore, understanding the relationship between clinical parameters such as blood pressure and DA allows for a more comprehensive evaluation of treatment processes. Furthermore, the absence of studies primarily investigating this relationship in the literature will allow us to fill this gap. The aim of our study is to examine the relationship between DA, blood pressure, and number of IDHEs.

2. Materials and Methods

2.1 Participants and Sample Size

In our descriptive and cross-sectional study, the sample size was determined using the formula of sample size = $[Z\ (1-\alpha/2)\ /d]^2\ p(1-p)]$ (1) (Charan and Biswas, 2013). Here, p represents the expected proportion of hemodialysis patients. Referring to a published study, the expected proportion was assumed to be 5%, and the precision (d) was set at 0.02 (Karaaslan and Pembegul, 2023). With $\alpha = 0.05$ and $Z\ (1-\alpha/2) = 1.96$, the calculated sample size was found to be 42. Considering a potential 20% loss, 50 hemodialysis patients were included in the study. In this context, the study was completed with 50 patients who met the inclusion criteria and agreed to participate out of 64 patients receiving HD treatment at the Muş State Hospital dialysis unit (Figure 1.). Participants were selected from individuals over 18 years of age who had been receiving regular hemodialysis treatment three times a week for at least six months. The exclusion criteria included patients with health issues such as angina pectoris and uncontrolled arrhythmias, as well as those with communication difficulties, cognitive problems, or orthopedic disabilities that would prevent them from meeting the study requirements.

2.2 Data Collection Tools

Demographic information was collected from the participants included in the study through a personal information form, which included basic data such as age, gender, duration of dialysis treatment, and smoking status.

2.2.1 Measurement of dialysis adequacy

DY is typically measured by evaluating patients' Kt/V and URR values.

Kt/V: This parameter represents the ratio of the volume of blood cleared of waste (K) during dialysis to the patient's total body water volume (V) over the treatment time (t) (Liang et al., 2019). In hemodialysis, a Kt/V value higher than 1.2 is targeted. Higher Kt/V values indicate that the dialysis process effectively removes waste from the body (Ding et al., 2021).

URR: The Urea Reduction Ratio (URR) is calculated by comparing blood urea nitrogen (BUN) levels before and after dialysis (Liang et al., 2019). A higher URR value indicates a more effective dialysis process. An ideal URR is targeted to be 65% or higher (Ferreira et al., 2020). In the study, the values of all participants were based on their measurements taken before the HD session.

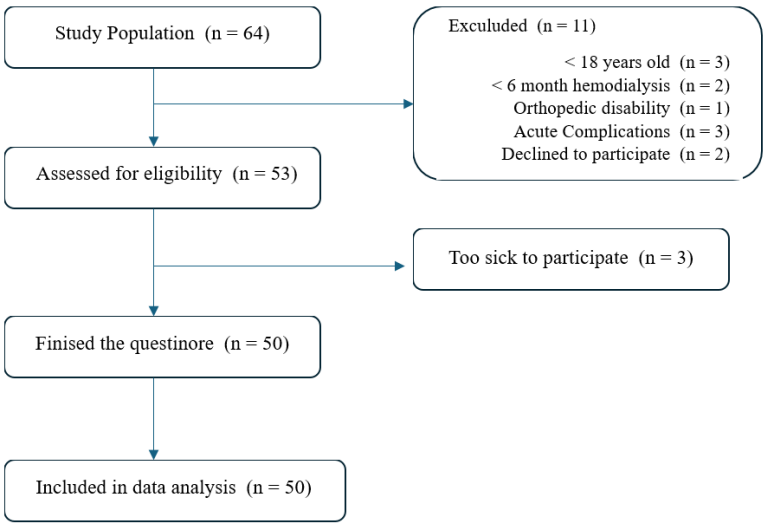

Figure 1. Flowchart to study.

2.2.2. Measurement of blood pressure

Digital blood pressure monitors are widely used to measure blood pressure and pulse. These devices inflate the cuff automatically or semi-automatically and display the patient's systolic and diastolic blood pressure values on a digital screen (Lurbe et al., 2016). In our study, we used the Omron IntelliSense HEM-907XL, IL brand device. Blood pressure was measured before the HD session. The measurement was performed 5 minutes after the patient was lying in bed.

2.2.3 Measurement of İDHA

During data collection, the number of symptomatic IDHEs within one HD session was recorded.

2.3. Statistical Analysis

SPSS (Statistical Package for Social Sciences) Windows v25.0 (SPSS Inc, IBM Corp, Armonk, New York) was used for all statistical analyses in this study. Initially, the basic statistical properties (mean, standard deviation) of the variables in the data set were calculated. The Shapiro-Wilk test was used to examine whether the variables followed a normal distribution. Pearson and Spearman correlation analyses were applied to evaluate the relationships between variables; Pearson correlation was used for normally distributed variables, while Spearman correlation was used for non-normally distributed variables. Finally, the obtained correlation coefficients and p-values were examined to determine statistical significance. A P-value of less than 0.05 was considered statistically significant.

3. Results

The mean age of the participants was 53.72±12.14 years, with an age range of 24 to 80 years. The average duration of hemodialysis treatment was 2.60±1.32 years. The mean Kt/V ratio was 1.34 ± 0.41 (ranging from 0.56 to 2.61), and the mean URR ratio was 64.27±14.26 (ranging from 41.59 to 78.50). Regarding blood pressure values, the average systolic blood pressure was 141.68±19.69 mmHg (ranging from 85 to 181 mmHg), and the average diastolic blood pressure was 82.02±11.27 mmHg (ranging from 56 to 124 mmHg).

The number of IDHEs was recorded as five in total, with three occurring in women and two in men. No patients experienced two different IDHE within the same HD session. The gender distribution showed that 50% of the participants were female and 50% were male (Table 1).

There was no statistically significant relationship between Kt/V and systolic and diastolic blood pressure (P=0.897 and P=0.976, respectively). Similarly, no statistically significant relationship was found between Kt/V and IDHE (P=0.987). These results indicate that there is no meaningful relationship between Kt/V and blood pressure or IDHE (Table 2).

There was no statistically significant relationship between URR and systolic and diastolic blood pressure (P=0.131 and P=0.596, respectively). Similarly, no statistically significant correlation was found between URR and IDHE (P=0.873). These results indicate that there is no meaningful relationship between URR and blood pressure or IDHE (Table 3).

Table 1. Demographic data

Variable		N=50	
		X ± SS	Min-Max
Age		53.72 ± 12.14	24-80
Duration of dialysis treatment (years)		2.60 ± 1.32	1-4
Kt/v Ratio (Male 1,38; Female 1,32)		1.34 ± 0.41	0.56-2.61
URR Ratio (Male 65,5; Female 66,29)		64.27±14.26	41.59-78.50
Systolic Blood Pressure		141.68 ± 19.69	85-181
Diastolic Blood Pressure		82.02 ± 11.27	56-124
		n	(%)
Total Number of IDH Episodes		5	10.0
	Female	25	50.0
Gender	Male	25	50.0
	Total	50	100
	Yes	9	18.0
Smoking Status	No	41	82.0
	Total	100	100

X= arithmetic mean, SD= standard deviation.

Table 2. Relationship between Kt/v blood pressure and number of IDHEs

Variable		SYSTOL	DIASTOL	Number of IDHEs
Kt/V	Correlation Coefficient	0.018	0.004	0.002
	P	0.897*	0.976 β	0.987 β

* Pearson correlation analysis, β Spearman correlation analysis

Table 3. Relationship between URR blood pressure and number of IDHEs

Variable		SYSTOL	DIASTOL	Number of IDHEs
Kt/V	Correlation Coefficient	-0.0216	0.076	-0.023
	P	0.131*	0.596 β	0.873 β

* Pearson correlation analysis, β Spearman correlation analysis

4. Discussion

In our study, the relationship between dialysis adequacy (DA) and blood pressure and the number of IDHEs was examined in hemodialysis patients. Our findings indicate that Kt/V and URR values do not have a significant relationship with blood pressure parameters or the number of IDHEs.

Examining the demographic data reveals that, although middle-aged individuals are predominant, there is a wide age distribution encompassing various age groups. The mean duration of HD treatment suggests that patients typically have a relatively short duration of dialysis treatment, while the standard deviation indicates significant variability in this duration among the patients. Additionally, it was determined that 28% of the participants are smokers.

An examination of the gender distribution revealed that 50% of the participants were female and 50% were male. Although there is no complete consensus in the literature, differences in DA between male and female hemodialysis patients have been reported (Djukanovic et al., 2022). Some studies suggest that women may have higher Kt/V values due to generally lower muscle mass, while others contend that men may have higher Kt/V values than women. Additionally, these studies indicate that the impact of gender on clinical outcomes is minimal (Davenport, 2013; Weigert et al., 2020; Ding et al., 2021). In our study, the observation that men had higher average Kt/V values while women had higher average URR values is consistent with the existing literature.

Our findings indicate that there is no statistically significant relationship between Kt/V and URR values and blood pressure parameters. This result supports the idea stated by Flythe et al. that Kt/V values alone may be insufficient as a determinant of blood pressure management due to the individual differences of patients, different haemodialysis durations and the influence of other clinical factors (Flythe et al., 2020). Liu et al. (2022) posited that the URR value is an inadequate indicator of the impact of haemodialysis on cardiovascular outcomes. They argued that, in addition to the dialysis dose, other factors, including the patient's age, dialysis duration and other clinical variables, must be considered. The absence of a significant relationship between DA and blood pressure suggests that factors such as antihypertensive treatment management, fluid intake, and diet may have a more predominant influence. Indeed, there is evidence to suggest that the regular use of antihypertensive drugs represents a fundamental approach to the control of high blood pressure, with fluid management also playing an important role in ensuring haemodynamic stability in dialysis patients (Saran et al., 2006; Amirul Islam et al., 2021; Kim et al., 2024). Furthermore, the broad age range of patients, variations in the dialysis protocols administered, and individual differences in lifestyle factors may have contributed to the absence of a significant relationship.

The findings of this study revealed that the mean Kt/V ratio was 1.34±0.41, with values ranging from 0.56 to 2.61, and the mean URR ratio was 64.27±14.26, with a range of 41.59 to 78.50. These observed values are generally consistent with the recommended target thresholds for dialysis adequacy, indicating that the dialysis procedures employed were largely effective in achieving the desired solute removal (Ferreira et al., 2020; Ding et al., 2021). However, the absence of a statistically significant correlation between Kt/V and URR values and both blood pressure parameters and the number of intradialytic hypotensive episodes suggests that other clinical variables, such as the management of dry weight, may exert a more prominent influence on patient outcomes. This highlights the complexity of managing dialysis adequacy and suggests a multifactorial approach may be necessary to optimize clinical results.

In our study, no significant relationship was found between DA and IDHE. A comparable study in the literature to directly compare these findings was not identified. However, it is recognized that the complex pathophysiology of IDHE, along with individual variations in hemodynamic regulation and vascular reactivity, can significantly impact this critical complication (Sars et al., 2020). This suggests that each patient may respond differently to dialysis treatment and that these responses may affect DA. In some patients, vascular reactivity may cause sudden drops in blood pressure, which may subsequently result in IDHE. Numerous studies in the literature support this observation (Agarwal et al., 2009; Kanbay et al., 2020; Sars et al., 2020; Timofte et al., 2021; Yildiz et al., 2023). In this context, it is evident that preventing intradialytic hypotension requires consideration not only of Kt/V and URR but also of the individual's hemodynamic stability and fluid status (Timofte et al., 2021; Baeg et al., 2022). The effectiveness of dialysis treatment and the risk of IDHE can be significantly influenced by each patient's unique health status and existing comorbidities. Patients with additional health conditions such as diabetes or cardiovascular disease may be more susceptible to haemodynamic changes, which may increase the risk of IDHE. Indeed, numerous studies have reported the prevalence of cardiovascular comorbidities among HD patients (Luo et al., 2020; Pan et al., 2024).

5. Conclusion

To the best of our knowledge, this study is the first to examine the relationship between DA and the number of IDHEs. The findings of our study indicate that there is no statistically significant correlation between DA and either blood pressure or the number of IDHEs. Further research is required to ascertain whether these relationships will undergo a change in patient groups with disparate demographic and clinical characteristics.

Limitations

The limited demographic and clinical characteristics of our participants, coupled with the fact that a single-session relationship was analysed, may have rendered it challenging to discern potential associations between DA and blood pressure and IDHE. It would be beneficial to conduct long-term follow-up studies in the future, in which the demographic and clinical characteristics of the participants are questioned in more detail. This could include factors such as nutritional status and regular medication use.

Author Contributions

The percentage of the author(s) contributions is presented below. All authors reviewed and approved the final version of the manuscript.

	Ö.B.	S.O.
C	80	20
D	70	30
S		100
DCP	100	
DAI	100	
L	100	
W	70	30
CR	20	80
SR	20	80

C=Concept, D= design, S= supervision, DCP= data collection and/or processing, DAI= data analysis and/or interpretation, L= literature search, W= writing, CR= critical review, SR= submission and revision.

Conflict of Interest

The authors declared that there is no conflict of interest.

Ethical Approval/Informed Consent

The authors confirm that the ethical policies of the journal, as noted on the journal's author guidelines page, have been adhered to. This study was approved by the Scientific Research and Publication Ethics Committee of Muş Alparslan University (approval date: March 13, 2023, protocol code: 86766). Before participation, the purpose of the study was explained to all individuals, and their written consent was obtained. The process was conducted in accordance with the Helsinki Declaration.

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Black Sea Journal of Health Science
doi: 10.19127/bshealthscience.1528743

Open Access Journal
e-ISSN: 2619 – 9041

Araştırma Makalesi (Research Article)
Cilt 7 - Sayı 5: 196-201 / Eylül 2024
(Volume 7 - Issue 5: 196-201 / September 2024)

MOBİL TELEFON YOKSUNLUĞU (NOMOFOBİ): BİR MESLEK YÜKSEKOKULU ÖRNEĞİ

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Özet: Bu araştırma sağlık hizmetleri meslek yüksekokulu yaşlı bakımı programında eğitim gören birinci sınıf öğrencilerin nomofobi düzeylerini ve etkileyen faktörleri incelemek amacıyla gerçekleştirilmiştir. Tanımlayıcı tipte yürütülen araştırmanın örneklemini, bir üniversitenin yaşlı bakımı programına kayıtlı birinci sınıf (n=59) öğrencileri oluşturmuştur. Veriler "Bireysel Bilgi Formu" ve "Nomofobi Ölçeği (NMP-Q)" kullanılarak toplanmıştır. Araştırmaya katılan öğrencilerin yaş ortalamasının 19,64±1,36 yıl, %69,5'inin (n=41) kadın olduğu bulunmuştur. NMP-Q Toplam Puanının 82,0±35,0 olduğu tespit edilmiş olup çalışmaya katılan öğrencilerin orta seviyede nomofobik olduğu belirlenmiştir. Kadınların, nomofobi puanlarının erkeklere göre daha yüksek olduğu belirlenmiştir (P<0.05). Öğrenim gördüğü bölümü istemeyerek seçen öğrencilerin toplam ölçek puanı ve tüm alt boyut puan ortalamalarının istatistiksel olarak yüksek ve anlamlı olduğu bulunmuştur (P<0.05). Öğrencilerin öğrenim gördüğü bölümü istemeyerek seçmelerinin nomofobi riskini artırdığının farkında olunması ve telefon bağımlılığının önüne geçilmesi amacıyla girişimler planlaması önerilmektedir.

Anahtar kelimeler: Nomofobi, Öğrenci, Mobil telefon, Yoksunluk, Bağımlılık

Mobile Phone Deprivation (Nomophobia): A Vocational School Example

Abstract: This study was conducted to examine the nomophobia levels and affecting factors of first-year students studying in the elderly care program of a vocational school of health services. The sample of descriptive study consisted of first-year students (n=59) enrolled in the elderly care program of a university. Data were collected using the "Individual Information Form" and the "Nomophobia Scale (NMP-Q)". The mean age of the students participating in the study was found to be 19.64±1.36, and 69.5% (n=41) were female. The NMP-Q Total Score was found to be 82.0±35.0, and it was determined that the students participating in the study had moderate nomophobia. It was determined that women had higher nomophobia scores than men (P<0.05). It was found that the total scale score and all sub-dimension score averages of students who unwillingly chose their department were statistically significant (P<0.05). It is recommended that students be aware of the fact that choosing their department unintentionally increases the risk of nomophobia and that interventions be planned to prevent phone addiction.

Keywords: Nomophobia, Student, Mobile phone, Deprivation, Addiction

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Gönderi: 05 Ağustos 2024 **Received:** August 05, 2024
Kabul: 26 Ağustos 2024 **Accepted:** August 26, 2024
Yayınlanma: 15 Eylül 2024 **Published:** September 15, 2024
Cite as: Karaman D. 2024. Mobile phone deprivation (Nomophobia): A vocational school example. BSJ Health Sci, 7(5): 196-201.

1. Giriş

Günümüzde hızla ilerleyen bilgi ve iletişim teknolojileri tüm dünyada hayatımızın vazgeçilmez bir parçası haline gelmiştir. Başta gençler olmak üzere her yaştan birçok insan yeni teknolojileri ders çalışmak, oyun oynamak, arkadaşlarıyla iletişim kurmak ve diğer birçok aktivite için kullanmaktadır. Son zamanlarda, kullanımı kolay olan akıllı cep telefonlarının bir statü sembolünden bir zorunluluğa dönüştüğü görülmektedir (Gutiérrez-Puertas ve ark., 2019; Devi ve Dutta, 2022). Ancak çeşitli avantajlar sağlamasının yanı sıra, cep telefonlarının aşırı kullanımı birçok farklı soruna yol açabilir. Elektromanyetik alan radyasyonuyla ilgili durumlar, dikkat dağınıklığı ve yeni teknolojik cihazları kullanamama korkusuyla bağlantılı sosyal, fiziksel ve psikolojik patolojiler bunlardan en önemlileridir (Devi ve Dutta, 2022).

Nomofobi, terim olarak 2008'de ortaya çıkmış olup, taşınabilir teknolojilerden özellikle akıllı telefonlara karşı oluşan, toplum ve bireyler üzerinde patolojik bir bağımlılık yaratan modern bir fobi türü olarak kabul edilmektedir. Bireylerin cep telefonları olmadığında veya kullanamadıklarında yaşadıkları endişe veya korkuyu ifade eder (Bhattacharya ve ark., 2019; Moreno-Guerrero ve ark., 2020; Notara ve ark., 2021). İlgili literatürde nomofobik bireylerin mobil telefonlarına ulaşamadıklarında istemsiz ve mantıksız bir korku yaşadıkları belirtilmektedir. Bu bireyler şarjlarının bitmesinden, kapsama alanı dışında kalmaktan, akıllı telefonlarını herhangi bir yerde unutmaktan dolayı gerçekçi olmayan, abartılı bir korku yaşarlar ve sıklıkla

telefonlarının, şarjlarının, hatta internet bağlantılarının olup olmadığını sürekli kontrol etme eğilimindedirler (Güler ve Veysikarani, 2019; Şahin, 2021; Özsavran ve Ayyıldız, 2022). Bu sorun, üniversite öğrencisi olan ergenler ve genç yetişkin popülasyonda daha şiddetli ve yaygındır. Bu popülasyondaki nomofobinin başlıca sorunları düşük akademik performans ve uyku bozukluklarıdır. Çünkü nomofobi kaygı, stres, bağımlılık, düşük öz saygı, sosyal sorunları tetikleyerek, hayal kırıklığı ve takıntılı düşüncelere yol açabilir. Ayrıca, özgüven eksikliği, düşük öz saygı ve sosyal bağlantılar kurarken sosyal becerilerin eksikliği, cep telefonlarına olan bağımlılığı artırmakla birlikte, zorlu akademik ve kişisel yaşamların bu cihazların kullanımını vazgeçilmez hale getirdiği de dikkate alınmalıdır (Kaur ve ark., 2021; Jahrami ve ark., 2024). Ayrıca üniversite yaşamı, genç bireyler için değişimsel ve dönüşümsel açıdan karmaşık sorunların yaşandığı bir dönemdir. Bu dönemin ilk yılı ise alışılan yaşam çevresinin bir anda değiştiği yeni girilen yabancı sosyal ve akademik çevreye uyum sağlamak zorunda kalınan önemli bir zaman dilimidir. Geçiş aşamasında öğrencilerin stres düzeylerinin artarak bağımlı davranışlara kolaylıkla yatkın hale geldikleri bildirilmektedir (Bülbül ve Güvendir, 2014; Tuhanioğlu ve Gizir, 2019; Arslan, 2020).

Küresel bir bağımlılık ve sorun olarak kabul edilen nomofobinin birinci sınıf üniversite öğrencilerinde yaygınlığını ve etkileyen faktörleri belirlemek önemlidir (Gürbüz ve Özkan, 2020; Notara ve ark., 2021; Jahrami ve ark., 2024). Dolayısıyla bu araştırma bir üniversitenin yaşlı bakımı programında eğitim gören birinci sınıf öğrencilerinin nomofobi düzeyleri ve ilişkili faktörleri belirlemek amacıyla yürütülmüştür.

2. Materyal ve Yöntem

2.1. Araştırmanın Tipi

Bu çalışma yaşlı bakımı programında öğrenim gören birinci sınıf öğrencilerin nomofobi düzeyleri ile ilişkili faktörlerin belirlenmesi amacıyla tanımlayıcı tipte gerçekleştirilmiştir.

2.2. Araştırmanın Evren ve Örneklemi

Araştırmanın evrenini Aralık 2021-Mart 2022 tarihleri arasında bir üniversitenin sağlık hizmetleri meslek yüksekokulu yaşlı bakımı programında (n=72) öğrenim gören birinci sınıf öğrencileri oluşturmuştur. Örneklem hacmi evreni bilinen örneklem formülü kullanılarak, %90 güç ve %95 güven aralığında hesaplanarak (n=58) bulunmuştur. Araştırmanın gerçekleştirildiği tarihte okulda bulunan ve araştırmaya katılmaya gönüllü olan öğrenciler (n=59) çalışmaya dahil edilmiştir.

2.3. Veri Toplama Araçları

Araştırmanın verileri "Bireysel bilgi formu" ve Nomofobi Ölçeği (NMP-Q) kullanılarak toplanmıştır. Bireysel bilgi formunda öğrencilerin yaş, cinsiyet, yaşanılan yer, arkadaş ve öğretim elemanları ile olan ilişkileri ile bölümü isteyerek seçme durumları sorgulanmaktadır.

Nomofobi Ölçeği (NMP-Q) ise; öğrencilerin nomofobi düzeylerini değerlendirmek için Yıldırım ve Correira (2015) tarafından geliştirilen ve Yıldırım ve arkadaşları (2016) tarafından Türkçe'ye uyarlanan bir ölçek olarak, 20 maddeden oluşmaktadır. Ölçekten alınabilecek en düşük puan 20 en yüksek puan ise 140'tır. Bu ölçekte, 0-20 puan arası nomofobi yokluğunu, 21-60 puan arası düşük düzeyde nomofobi, 61-100 puan arası orta düzey nomofobi, 101-140 puan arası ise yüksek düzeyde nomofobi olduğunu göstermektedir (Yıldırım ve Correira, 2015; Yıldırım ve ark., 2016).

Ölçeğin Türkçe'ye uyarlanmasında "Bilgiye Erişememe", "Rahatlıktan Feragat Etme", "İletişim Kuramama", "Çevrimiçi Bağlantıyı Kaybetme" alt boyutlara ait güvenirlik katsayıları sırasıyla 0,90, 0,74, 0,94 ve 0,91 olarak belirtilmiştir. Bu çalışmada ise ölçeğin güvenirlik katsayısı 0,93 olarak tespit edilmiş olup, alt boyutların güvenirlik katsayıları ise sırayla 0,78, 0,84, 0,88 ve 0,89 olarak bulunmuştur.

2.4. Verilerin Toplanması

Araştırma Aralık 2021-Mart 2022 tarihleri arasında yapılmıştır. Anket formu öğrencilerin ders dışı zamanlarında uygulanmıştır. Anket formu uygulanmadan önce öğrencilere araştırmanın amacı açıklanarak bilgilendirme yapılmıştır. Çalışmaya katılmayı kabul eden öğrencilere anket formu araştırmacı tarafından dağıtılarak araştırmacı gözetiminde doldurmaları istenmiştir. Anket formunun uygulanması ortalama 15-20 dakika sürmüştür.

2.5. Verilerin Değerlendirilmesi

SPSS 22.0 paket programı ile incelenen araştırma verilerinin analizinde; sayı, yüzdelik dağılımları, ortalama, standart sapma, t testi ve tek yönlü varyans analizi (ANOVA) kullanılmıştır. İstatistiksel anlamlılık için P değeri 0.05'ten küçük olarak kabul edilmiştir (Genç ve Soysal, 2018).

3. Bulgular

Araştırmaya katılan öğrencilerin yaş ortalamasının 19,64±1,36 yıl olup, %69,5'inin (n=41) kadın olduğu bulunmuştur. Öğrencilerin %81,4'ünün (n=48) eğitim gördüğü bölümü isteyerek seçtiği, %57,8'sının (n=34) yurtta yaşadığı, %50,8'inin (n=30) arkadaş ilişkilerinin çok iyi, %59,3'ünün (n=35) öğretim elemanları ile ilişkilerinin iyi olduğu tespit edilmiştir (Tablo 1).

Öğrencilerin NMP-Q toplam puan ve alt puan ortalamaları dağılımına bakıldığında; bilgiye erişememe alt boyutunun 4,22±1,2, rahatlıktan feragat etme 4,08±1,4, iletişim kuramama 4,15±1,3, çevrimiçi bağlantıyı kaybetme alt boyutunun 4,02±1,4, NMP-Q Toplam Puanının 82,0±35,0 olduğu belirlenmiştir (Tablo 2). Bu sonuçlara göre çalışmaya katılan öğrencilerin orta seviyede nomofobi düzeyine sahip olduğu belirlenmiştir.

Öğrencilerin sosyodemografik özelliklerine göre, nomofobi puanları ve nomofobi alt boyutları puan ortalamaları arasındaki farkın analizi Tablo 3'de gösterilmiştir. Buna göre kadın öğrencilerin, erkek öğrencilere göre nomofobi puanları yüksek olup istatistiksel olarak anlamlı olduğu görülmektedir ($t=-2,084$ $P<0,05$).

Tablo 1. Öğrencilerin bireysel özelliklerinin dağılımı

Öğrencilere İlişkin Özellikler	n	%
Cinsiyet		
Kadın	41	69,5
Erkek	18	30,5
Öğrenim gördüğü bölümü isteyerek seçme		
Evet	48	81,4
Hayır	11	18,6
Yaşanılan yer		
Aile	16	27,1
Arkadaş	5	8,5
Yurt	34	57,8
Yalnız	4	6,6
Arkadaş İlişkileri		
Çok İyi	30	50,8
İyi	26	44,1
Orta	30	5,1
6Öğretim elemanları ile ilişki		
Çok İyi	12	20,3
İyi	35	59,3
Orta	12	20,4

Tablo 2. Öğrencilerin NMP-Q puanlarının ve alt boyut puan ortalamalarının dağılımı

NMP-Q Ölçeği ve Alt Boyutları	$\bar{x}$± SS	Min.-Max.
Bilgiye Erişememe	4,22 ± 1,2	2-7
Rahatlıktan Feragat Etme	4,08 ± 1,4	1-7
İletişim Kuramama	4,15 ± 1,3	1-7
Çevrimiçi Bağlantıyı Kaybetme	4,02 ± 1,4	1-7
NMP-Q Toplam Puan	82 ± 35,0	20-140

$\bar{x}$= ortalama, SS= standart sapma, Min= minimum, Max= maksimum.

Tablo 3. Öğrencilere ilişkin özellikler ile NMP-Q puanlarının ve alt boyut puan ortalamalarının dağılımı

Öğrencilere İlişkin Özellikler		Bilgiye erişememe	Rahatlıktan feragat etme	İletişim kuramama	Çevrimiçi bağlantıyı kaybetme	NMP-Q toplam puan
	n	$\bar{x}$± SS	$\bar{x}$± SS	$\bar{x}$± SS	$\bar{x}$± SS	$\bar{x}$± SS
Cinsiyet						
Kadın		4,91±1,05	4,81±1,24	4,27±1,27	3,89±1,31	91,3±24,0
Erkek	41	3,92±1,20	4,20±1,47	4,09±0,75	4,32±1,64	78,4±20,9
	18	t= -3,034	t=-2,339	t=-1,770	t=-2,942	t=-2,084
		P*=0,004	P*=0,003	P*=0,628	P*=0,296	P*=0,042
Bölümü İsteyerek Seçme		4,03±1,19	3,84±1,24	4,03±1,33	3,83±1,46	78,73±21,6
Evet	48	5,06±1,70	5,10±1,68	4,68±1,06	4,85±0,90	98,19±20,1
Hayır	11	t= -2,665	t= -3,237	t= -1,510	t= -3,034	t= -2,719
		P*=0,011	P*=0,002	P*=0,033	P*=0,007	P*=0,009
Yaşanılan Yer		4,57±1,49	4,43±1,70	4,19±1,35	4,15±1,62	86,44±26,7
Aile	16	3,95±1,19	3,40±1,02	3,86±1,32	4,32±0,94	77,60±20,6
Arkadaş	5	4,04±1,13	4,02±1,30	4,13±1,34	3,87±1,33	80,50±20,7
Yurt	34	4,68±1,04	4,00±1,60	4,45±1,09	4,45±2,19	87,75±27,4
Yalnız	4	F= 0,938	F= 0,808	F= 0,938	F= 0,154	F= 0,341
		P**=0,429	P**=0,495	P**=0,429	P**=0,927	P**=0,796

$\bar{x}$= ortalama, SS= standart sapma.

Tablo 3. Öğrencilere ilişkin özellikler ile NMP-Q puanlarının ve alt boyut puan ortalamalarının dağılımı (devam ediyor)

Öğrencilere İlişkin Özellikler		Bilgiye erişememe	Rahatlıktan feragat etme	İletişim kuramama	Çevrimiçi bağlantıyı kaybetme	NMP-Q toplam puan
	n	x̄± SS	x̄± SS	x̄± SS	x̄± SS	x̄± SS
Arkadaş İlişkisi		4,40±1,35	4,23±1,55	4,11±1,29	4,10±1,54	84,00±1,32
Çok iyi	30	4,09±1,12	3,98±1,30	4,17±1,36	3,90±1,36	80,89±4,55
İyi	26	3,50±0,90	3,40±0,52	4,33±0,92	4,33±0,70	78,67±4,12
Orta	3	F= 0,980	F= 0,517	F= 0,953	F= 0,809	F= 0,844
		P**=0,382	P**=0,599	P**=0,068	P**=0,213	P**=0,170
Öğretim elemanları ile ilişkisi		4,75±1,38	4,48±1,53	4,22±1,36	4,43±1,52	88,92±24,67
Çok iyi	12	4,14±1,12	3,86±1,35	3,99±1,19	3,72±1,24	8,46±20,3
İyi	35	3,93±1,36	4,31±1,47	4,54±1,55	4,51±1,70	87,12±26,0
Orta	12	F= 1,500	F= 0,911	F= 0,796	F= 2,075	F= 1,317
		P**=0,232	P**=0,408	P**=0,455	P**=0,135	P**=0,276

*Bağımsız örneklerde t-test,** Tek yönlü varyans analizi. x̄= ortalama, SS= standart sapma.

Sırasıyla bilgiye erişememe ve rahatlıktan feragat etme alt boyutları puan ortalamalarının kadın öğrencilerde yüksek olduğu tespit edilirken (t=-3,034 P<0.05, t=-2,339 P<0.05), iletişim kuramama ve çevrimiçi bağlantıyı kaybetme puan ortalamalarında cinsiyete göre anlamlı farklılık saptanmamıştır (t=-1,770 P>0.05, t=-2,942 P>0.05). Öğrenim gördüğü bölümü isteyerek seçme durumuna göre, öğrenim gördüğü bölümü istemeyerek seçen öğrencilerin bilgiye erişememe, rahatlıktan feragat etme, iletişim kuramama ve çevrimiçi bağlantıyı kaybetme alt boyutu puan ortalamalarının ve toplam ölçek puanının anlamlı derecede yüksek olduğu bulunmuştur (Sırasıyla t=-2,665, t=-3,237, t=-1,510, t=-3,034, t=-2,719 P<0.05). Yaşanılan yer, arkadaş ve öğretim elemanları ile olan ilişkisi açısından nomofobi puanları ve nomofobi alt boyutları puan ortalamaları arasında istatistiksel olarak anlamlı farkın olmadığı belirlenmiştir (P>0.05).

4. Tartışma

Bu çalışma sonucunda NMP-Q ölçeği puanının 82,0 ± 35,0 olarak tespit edilmiştir. Dolayısıyla araştırmaya katılan yaşlı bakımı birinci sınıf öğrencilerinin orta düzeyde nomofobiye sahip olduğunu görülmektedir. Konu ile ilgili yapılan araştırmalar incelendiğinde gençlerin nomofobi düzeylerinin orta ile yükseğe yakın dereceler arasında değiştiği bildirilmektedir. Bu bilgiyi destekler şekilde Fransa'da üniversite öğrencilerinin yaklaşık %73'ünün nomofobik olduğu belirtilirken, Hindistan'daki tıp öğrencilerinin %67,2'sinin orta düzeyde nomofobik olduğunu bildirilmektedir (Tavolacci ve ark., 2015; Bartwal ve Nath, 2020). Aksoğan ve Atıcı (2022) Türkiye'deki üniversite öğrencilerinin nomofobi düzeylerinin orta seviyede olduğunu bildirirken, benzer şekilde Okuyan ve ark. (2019) tarafından yapılan bir diğer çalışmada da hemşirelik ve tıp öğrencilerinin orta düzeyde nomofobik olduğu belirlenmiştir.

Çalışmamızda kadınların nomofobi düzeyinin erkeklere göre istatistiksel olarak anlamlı derecede yüksek olduğu bulunmuştur. Bu doğrultuda Yılmaz ve ark. (2018) iletişim fakültesi öğrencilerinde, Yolcu ve Çiftçi (2023)'nin ise meslek yüksekokulu bilgisayar programcılığı öğrencilerinde yaptıkları çalışmalarında kadınların nomofobi düzeyinin erkeklerden anlamlı şekilde yüksek olduğu tespit edilmiştir. Bu sonuçları destekler nitelikte, Aldhahir ve ark. (2023) ile Kateb (2017) benzer sonuçlar bildirirken, Than ve Shan (2021) tarafından gerçekleştirilen çalışma sonucunda nomofobi ile cinsiyet değişkeni arasında anlamlı bir ilişki olmadığını bildirilmiştir. Avcı (2022) tarafından ülkemizde nomofobi ile ilgili yapılan çalışmalarda, cinsiyet değişkeninin etkisinin incelendiği meta analiz sonuçlarına göre kadınların erkeklerden daha nomofobik olduğu açıklanmıştır. İlgili literatürde cinsiyet değişkeni ile nomofobi ilişkisi ile ilgili farklı sonuçlar bildirilmektedir. Fakat tartışılan çalışmaların çoğu öğrenci gruplarına uygulanmıştır. Nomofobi çalışmalarının farklı örneklem gruplarına uygulanmasının, popülasyondaki cinsiyetler arasındaki farklılıkların belirlenmesinde önemli rol oynayacağı düşünülmektedir.

Çalışma sonucunda öğrenim gördüğü bölümü isteyerek seçmeyen öğrencilerin, isteyerek seçen öğrencilere göre nomofobi ve tüm nomofobi alt boyutları puanlarının yüksek olduğu bulunmuştur. Yapılan literatür taraması sonucunda nomofobi ve öğrenim görülen bölümün isteyerek seçilmesi arasındaki bağlantıyı araştıran çalışmaya rastlanılamamıştır. Bununla beraber benzer bir konu olan üniversite öğrencilerinde internet bağımlılığının araştırıldığı bir çalışmada hemşirelik bölümünü istemeyerek seçen öğrencilerin, isteyerek seçenlere göre internet bağımlılık düzeyinin yüksek olduğu bildirilmektedir (Kocaaslan ve ark., 2021).

Gerçekleştirilen bu çalışma sonucunda yaşanılan yer, arkadaş ve öğretim elemanları ile olan ilişkisi açısından nomofobi puanları ve nomofobi ölçeğinin alt boyut puan

ortalamaları arasında istatistiksel olarak anlamlı farkın olmadığı belirlenmiştir. Çevik-Durmaz ve ark. (2021) tarafından yapılan çalışmada yurtta kalan öğrencilerin nomofobi düzeylerinin diğerlerine göre daha yüksek olduğuna dikkat çekmektedirler. Aldhahir ve ark. (2023) ise ailesinin yanında yaşamayan öğrencilerin, aileleriyle yaşayan öğrencilere kıyasla önemli ölçüde daha yüksek nomofobi puanlarına sahip olduklarını bildirmektedir. Literatürdeki çalışmalar ile belirlenen bu farkın, öğrencilerin insanlarla iletişiminin yoğun olduğu bir bölümde öğrenim görmeleri ve bireysel sosyal ilişkileri ile ilgili olduğu düşünülmektedir.

5. Sonuç

Bu çalışma, teknoloji toplumlarının yaşadığı modern patolojilerden biri olan nomofobi kavramının yaşlı bakımı öğrencilerindeki düzeyi ve bazı faktörler arasındaki ilişkiyi incelemiştir. Yapılan analizler sonucunda çalışmaya dahil edilen öğrencilerin orta düzeyde nomofobik olduğu, cinsiyet ve öğrenim gördüğü bölümü istemeyerek seçme değişkenlerinin nomofobi düzeyini artırdığı belirlenmiştir. Sonuçların genellenebilmesi için farklı bölgelerde ve bölümlerdeki öğrenciler üzerinde araştırmalar yapılması ve telefon bağımlılığının engellenmek amacıyla girişimler planlaması önerilmektedir.

Araştırmanın Sınırlılıkları

Veri toplama aşamasında sadece derse katılan, araştırmaya katılmayı kabul eden ve tek bir programa kayıtlı öğrencilerle yürütülmesi bu araştırmanın sınırlılıklarıdır.

Katkı Oranı Beyanı

Yazar(lar)ın katkı yüzdesi aşağıda verilmiştir. Yazar makaleyi incelemiş ve onaylamıştır.

	D.K.
K	100
T	100
Y	100
VTI	100
VAY	100
KT	100
YZ	100
KI	100
GR	100
PY	100
FA	100

K= kavram, T= tasarım, Y= yönetim, VTI= veri toplama ve/veya işleme, VAY= veri analizi ve/veya yorumlama, KT= kaynak tarama, YZ= Yazım, KI= kritik inceleme, GR= gönderim ve revizyon, PY= proje yönetimi, FA= fon alımı.

Çatışma Beyanı

Yazar bu çalışmada hiçbir çıkar ilişkisi olmadığını beyan etmektedirler.

Etik Onay/Hasta Onamı

Bu araştırmanın yapılabilmesi için Zonguldak Bülent Ecevit Üniversitesi İnsan Araştırmaları Etik Kurulu'ndan ve çalışmanın gerçekleştirildiği kurumdan izin alınmıştır. (onay tarihi: 06 Aralık 2023, onay numarası: 06.12.19.680). Örnekleme dahil edilen öğrencilere, çalışma hakkında açıklama yapılarak sözel ve yazılı onamları alınmıştır. Araştırma Helsinki Deklerasyonu Prensipleri'ne uygun olarak yürütülmüştür.

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Black Sea Journal of Health Science
doi: 10.19127/bshealthscience.1532937

Open Access Journal
e-ISSN: 2619 – 9041

Research Article
Volume 7 - Issue 5: 202-209 / September 2024

DETERMINATION OF NURSES' KNOWLEDGE LEVELS REGARDING INTRAMUSCULAR INJECTION TO THE VENTROGLUTEAL AREA

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Abstract: This study was aimed to determine nurses' knowledge levels regarding ventrogluteal (VG) area injection. This descriptive and cross-sectional study involved 121 nurses in Türkiye between December 2018 and March 2019. The nurses' descriptive characteristics form and the knowledge suggestions form were completed. Statistical analyzes included the Mann Whitney U test, Kruskal Wallis test, and Spearman correlation. It was found that 61.2% of the nurses received training for the VG area, most nurses (69.4%) never injected the VG area, and 59.5% of those who applied it only once a week. The correct mean of nurses' information suggestions regarding VG area injection was 6.76±3.92. There was a statistically significant difference between the knowledge levels of those over the age of 40 (Mean Rank=45.97) and those under the age of 30 (Mean Rank=70.73) (P=0.022). It was found that the knowledge level of nurses who received training on VG injection, applied VG injection in the department where they worked, and who applied VG injection at least once a week were higher than the others (P<0.05). A weakly negative, statistically significant linear relationship was found between age (r=-0.284, P=0.002), total professional working time (r=-0.265, P=0.003) and knowledge level. In this study, the mean knowledge of nurses regarding the VG area was determined to be slightly lower than the medium level. In order for nurses to have up-to-date information, it is recommended to provide in-service training at regular intervals and to measure training outcomes through exams. In addition, the implementation and supervision of VG area injection in clinics will contribute to the widespread use of VG area in intramuscular injection practice.

Keywords: Nurses, Intramuscular injections, Knowledge

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Received: August 13, 2024
Accepted: September 04, 2024
Published: September 15, 2024

Cite as: Barış Eren N. 2024. Determination of nurses' knowledge levels regarding intramuscular injection to the ventrogluteal area. BSJ Health Sci, 7(5): 202-209.

1. Introduction

Intramuscular injection is one of the most commonly preferred methods of parenteral drug administration. With an intramuscular injection, the drug is administered into the deep muscle tissue under the subcutaneous tissue (Göçmen Baykara et al., 2019; Akbıyık, 2021). Various areas are used for intramuscular injection, and it is stated in the literature that the VG area is the most reliable area (Taylor et al., 2008; Berman et al., 2008; Potter et al., 2009; Kara et al., 2015; İnce et al, 2023). Despite this, it seems that the use of the dorsogluteal area is higher in nurses (Gülnar and Özveren, 2016; Sarı et al., 2017; Şanlıalp Zeyrek and Kuzu Kurban, 2017; Arslan and Özden, 2018; Legrand et al., 2019).

The VG is an area where complications are less common than the dorsogluteal area (Gülnar and Çalışkan, 2014; Tuğrul and Denat, 2014; Oliveira et al., 2015; Kara et al., 2015). The ventrogluteal area has thin subcutaneous fat tissue, allowing the needle to reach the muscle more easily, and since it is far from the rectal region, the risk of contamination is low. In addition, the VG is a safe area for all patients since it is away from large blood vessels and nerves. Patients feel less pain in the VG area compared to the dorsogluteal area and the patient satisfaction level is higher (Güneş et al., 2013; Tuğrul and Khorshid, 2014; Yilmaz et al., 2016; Isseven and Sagkal Midilli, 2020; Apaydın and Öztürk, 2021; Roldán-Chicano et al., 2023; İnce et al., 2023). It has been determined that less bleeding and hematoma occur in injections applied to the ventrogluteal area compared to the dorsogluteal area (Apaydın and Öztürk, 2021; Roldán-Chicano et al., 2023). However, studies show that the VG area is not used effectively (Gülnar and Çalışkan, 2014; Sarı et al., 2017; Şanlıalp Zeyrek and Kuzu Kurban, 2017; Arslan and Özden, 2018; Legrand et al., 2019). This is because nurses lack sufficient knowledge about the VG area and are not accustomed to using it (Sarı et al., 2017; Arslan and Özden, 2018; Sü and Bekmezci, 2020). On the other hand, it is known that the rate of VG injection among nurses increases with education (Gülnar and Özveren, 2016; Şanlıalp Zeyrek and Kuzu Kurban, 2017).

Studies addressing the knowledge levels of nurses regarding VG site injection are quite limited (Gülnar and Çalışkan, 2014; Gülnar and Özveren, 2016; Şanlıalp Zeyrek and Kuzu Kurban, 2017). In this context, it is

important to assess nurses' knowledge levels regarding VG area injections. It is also thought that this study will increase nurses' awareness of VG area injections and their preference for the VG area for intramuscular injections.

This study was conducted to determine the knowledge levels of nurses working in a public hospital regarding intramuscular injection into the VG region.

2. Materials and Methods

We designed a descriptive and cross-sectional study to determine the knowledge level of nurses working in a public hospital regarding intramuscular injection into the VG area.

This study was conducted between December 2018 and March 2019. The sample of the study consisted of 121 nurses working in a state hospital in Türkiye.

The data were collected with the "Nurses' descriptive characteristics form" and "The knowledge suggestions form" created by the researcher in line with the literature (Gülnar and Çalışkan, 2014; Gülnar and Özveren, 2016; Şanlıalp Zeyrek and Kuzu Kurban, 2017). Expert opinion was obtained before the study and then the necessary arrangements were made.

Nurses' descriptive characteristics form: This form consists of 9 questions about the demographic and working characteristics of nurses.

The knowledge suggestions form: This form contains a total of 16 correct and incorrect statements prepared to determine the nurses' knowledge levels regarding VG area injection application. Participants were asked to choose one of the options "correct", "wrong" or "I don't know" for these propositions. The form was developed by the researcher and had a Cronbach Alpha reliability coefficient of 0.91 after content validity was performed.

The dependent variable of the research is the average of the scores they received from the information propositions regarding VG area injection, and the independent variables are the descriptive characteristics of such as age, gender, education level, working unit, total professional working time, working time at the current workplace, status of receiving training for VG injection, VG training where it is received, VG injection application status in the unit where worked, VG injection application frequency.

In this study, statistical analyzes were performed using the SPSS (Version 21.0) package program. Normality distribution was examined with Kormogorov-Smirnov and Shapiro-Wilk tests. Descriptive statistics are presented as numbers and percentages. Age, which is a continuous variable, is presented as the mean±standard deviation of total professional working time years in current institution. Mann Whitney U test and Kruskal Wallis test were used to evaluate the descriptive characteristics of the nurses and their knowledge level regarding VG injection application. The relationship between nurses' descriptive characteristics and their knowledge levels was examined with Spearman correlation analysis. Additionally, the data were evaluated at the $P<0.05$ significance level and 95% confidence interval (Önder, 2018).

3. Results

As shown in Table 1, the average age of the nurses was 31.69±7.702, 48.8% was 30 years below, 35.5% was between 30-40 years and 15.7% was 40 years above. The majority of nurses was women (87.6%) and university (56.2%). 78.5% of the nurses was working in inpatient services and 21.5% was working in intensive care. The average professional working years of nurses was 9.893±7.669, the highest rate (35.5%) was composed of nurses who have worked for less than 5 years, and the second (26.4%) was composed of nurses who have worked for 6-10 years. The average number of years of work at the current workplace was 3.24±3.940 and the rate of employees with less than 3 years (72.7%) was the highest.

61.2% of the nurses stated that they received training on the VG injection, 59.5% stated that they received this training at school, 69.4% stated that they never injected the VG area, and 59.5% stated that they applied it once a week (Table 2).

Table 3 shows the distribution of responses to the suggestions regarding VG injection. Accordingly, the nurses stated that the VG area position for injection is easier than the others (63.6%), that it is not used only in adults (46.3%), that irritating and oily solutions can be administered from this area (33.9%), and that the palm is used to determine the area. The lower part of the femur is located in the greater thoracanter (61.2%), the gluteus medius muscle in the region is sufficiently developed in infants (over 7 months) (55.4%), the region includes the gluteus medius and gluteus minimus muscles (43%), the region is located in the rectum. The risk of fecal contamination due to its remoteness is low (66.1%), the area can be used in weak patients (25.6%), massage of the area after injection is not recommended (8.3%), injection-related nerve damage, tissue necrosis and pain in the area. No complications were observed (36.4%), the right hand was used to determine the area if the injection was to be made on the left side, the left hand was used if the injection was to be made on the right side (29.8%), the area was the safest (55.4%), and the area could be injected with up to 4 ml of medication. They stated that it can be detected (52.9%), that the subcutaneous tissue in the region is thinner (28.9%) and that the detection of the region is based on objective data (51.2%). It was also determined that 49.6% of the nurses thought that they would harm the patient during the VG area injection. The correct mean of the nurses is 6.760±3.922.

Table 1. Descriptive characteristics of nurses (N=121)

Descriptive Characteristics	n	%	X̄±Sd (min- max)
Age			31.69±7.702 (20-52)
Aged 30 years below	59	48.8	
30-40	43	35.5	
Aged 40 years above	19	15.7	
Gender			
Female	106	87.6	
Male	15	12.4	
Education			
Health vocational high school	23	19.0	
Associate degree	22	18.2	
University	68	56.2	
Higher education level	8	6.6	
Working Unit			
Inpatient unit	95	78.5	
Intensive care unit	26	21.5	
Total Professional Working Time			9.893±7.669 (0.5-33)
5 years and less	43	35.5	
6-10 years	32	26.4	
11- 15 years	16	13.2	
16- 20 years	16	13.2	
21 years and more	14	11.6	
Working Time at the Current Workplace			
3 years and less	88	72.7	
4- 6 years	21	17.4	3.24±3.940 (0.5-25)
7- 9 years	5	4.1	
10- 12 years	3	2.5	
13 years and more	4	3.3	

X̄= mean, Sd= standard deviation.

Table 2. Distribution of nurses' characteristics regarding VG injection (N=121)

Characteristics of Nurses Regarding VG Injection	n	%
Status of Receiving Training for VG Injection		
I received training	74	61.2
I didn't receive training	47	38.8
Where to Get Training for the VG Area		
I received training at school	72	59.5
I received training in the hospital	2	1.7
VG Injection Application Status in the Unit Where Worked		
I applied	37	30.6
I didn't apply	84	69.4
VG Injection Application Frequency (per week)		
1	22	59.5
2-3	15	40.5

There was no statistically significant difference between gender, education, working unit, working time at the current workplace and knowledge levels (P>0.05) (Table 4). The knowledge level of nurses regarding injection into the VG area according to their ages was compared using the Kruskal-Wallis H test. Kruskal-Wallis analysis was interpreted using the ranking averages and as a result of the analysis, it was determined that there was a significant difference between the ranking averages of the groups. H(2)/X2(2)=9.674, P=0.008. In line with the significant results, pairwise comparisons between the groups were made in accordance with Dunn's procedure using Bonferroni correction. The adjusted p value calculated with Bonferroni correction was taken into account. As a result of the post hoc analysis, it was determined that there was a statistically significant difference between the knowledge levels of those over the age of 40 (Mean Rank=45.97) and those under the age of 30 (Mean Rank=70.73) (P=0.022), no statistically significant difference was determined as a result of other pairwise comparisons (Table 4).

Table 3. Distribution of nurses' responses to propositions for VG injection (N=121)

No	Propositions	Correct		Wrong		I don't know	
		n	%	n	%	n	%
1	Positioning the patient for injection in the VG area is easier than in other areas (dorsogluteal area).	77	63.6	11	9.1	33	27.3
2	VG area is used only in adults.	25	20.7	56	46.3	40	33.1
3	Irritating and oily solutions are not used in the VG area.	30	24.8	41	33.9	50	41.3
4	To identify the VG injection site, the nurse places the lower part of the palm on the greater thoracanter of the femur.	74	61.2	4	3.3	43	35.5
5	The gluteus medius muscle of the VG area is not sufficiently developed in infants (over 7 months).	7	5.8	67	55.4	47	38.8
6	VG area includes the gluteus medius and gluteus minimus muscles.	52	43.0	8	6.6	61	50.4
7	Since the VG area is far from the rectum, the risk of fecal contamination is low.	80	66.1	6	5.0	35	28.9
8	It cannot be used in patients with weak VG area.	31	25.6	55	45.5	35	28.9
9	After injection, massage of the injection area is recommended.	76	62.8	10	8.3	35	28.9
10	There are no injection-related complications such as nerve damage, tissue necrosis, or pain in the VG area.	44	36.4	43	35.5	34	28.1
11	If the left side hip is used, the left hand is used; if the right side hip is used, the right hand is used.	36	29.8	43	35.5	42	34.7
12	The VG area is the most reliable area.	67	55.4	10	8.3	44	36.4
13	Large volume muscles such as the VG area can accommodate up to 4 ml of medication.	64	52.9	8	6.6	49	40.5
14	I think I will harm the patient when injecting into the VG area.	60	49.6	22	18.2	39	32.2
15	Subcutaneous fat tissue is thicker in the VG area.	33	27.3	35	28.9	53	43.8
16	VG area detection is based on objective data.	62	51.2	12	9.9	47	38.8

Mean correct score X̄±Sd= 6.760±3.922 (Min- Max= 0- 14).

Table 4. The relationship between the descriptive characteristics of nurses and their characteristics regarding the VG injection and their knowledge levels (N=121)

Variables	n	Knowledge Levels X̄±Sd	Test	P
Age				
Aged 30 years below[1]	59	7.91±3.349		
30-40[2]	43	5.97±4.137	KW= 9.674	0.008*
Aged 40 above[3]	19	4.94±4.142		
Bonferroni = 1>3				
Gender				
Female	106	6.88±3.993		
Male	15	5.86±3.356	Z= -1.390	0.165
Education				
Health vocational high school	23	6.34±4.281		
Associate degree	22	6.54±3.776	KW= 0.775	0.856
University	68	7.01±3.975		
Higher education level	8	6.37±3.248		
Working Unit				
Inpatient unit	95	6.60±4.090	Z= -0.583	0.560
Intensive care unit	26	7.34±3.236		

Table 4. The relationship between the descriptive characteristics of nurses and their characteristics regarding the VG injection and their knowledge levels (N=121) (continue)

Variables	n	Knowledge Levels X̄±Sd	Test	P
Total Professional Working Time				
5 years and less	43	8.04±3.387	KW= 11.070	0.026*
6-10 years	32	7.03±3.374		
11- 15 years	16	4.81±4.214		
16- 20 years	16	6.56±4.689		
21 years and more	14	4.64±4.087		
Working Time at the Current Workplace				
3 years and less	88	6.89±3.726	KW=0.848	0.932
4- 6 years	21	6.42±4.489		
7- 9 years	5	6.80±5.118		
10- 12 years	3	4.66±5.033		
13 years and more	4	7.00±4.546		
Status of Receiving Training for VG Injection				
I received training	74	8.54±2.891	Z= -6.243	0.000*
I didn't receive training	47	3.78±3.545		
VG Injection Application Status in the Unit Where Worked				
I applied	37	9.67±2.357	Z= -5.433	0.000*
I didn't apply	84	5.47±3.791		
VG Injection Application Frequency (per week)				
1	22	10.40±2.218	Z= -2.241	0.025*
2-3	15	8.60±2.197		

*=P<0.05, Z= Mann Whitney U test, KW= Kruskal-Wallis test.

Table 5. Correlation of nurses' descriptive characteristics and knowledge levels (N=121)

Variables	Knowledge Levels	
	r	P
Age	-0.284	0.002*
Total Professional Working Time	-0.265	0.003*
Working Time at the Current Workplace	-0.035	0.703
Status of Receiving Training for VG Injection	0.045	0.620

*= P<0.05, r= Spearman correlation analysis.

The nurses' knowledge level regarding injection into the VG area was compared according to their professional working hours using the Kruskal-Wallis H test. Kruskal-Wallis analysis was interpreted using the ranking averages and as a result of the analysis, it was determined that there was a significant difference between the ranking averages of the groups. H(4)/X2(4)=11.070, P=0.026. Post hoc analysis with Bonferroni correction was performed to determine which group caused the difference, but it could not be determined which group specifically caused this difference (Table 4).

A statistically significant difference was found between receiving training on VG area injection, performing VG injections in the unit they work in, and the frequency of weekly VG injections and their knowledge levels (P<0.05). It was determined that the knowledge levels of nurses who received training on VG area injection, applied VG injection in the unit they worked in, and performed VG injection once a week were higher than the others (P<0.05) (Table 4).

The relationship between nurses' descriptive characteristics and their knowledge levels was examined with Spearman correlation analysis. As a result of the analysis, there is a weakly negative, statistically significant linear relationship between age and knowledge level (r=-0.284, P=0.002). There is a weakly negative, statistically significant linear relationship between professional working time and knowledge level (r=-0.265, P=0.003) (Table 5) (Schober et al., 2018).

4. Discussion

In this descriptive and cross-sectional study, which was conducted to determine the knowledge levels of nurses working in a public hospital regarding VG area injection, 121 nurses were reached. The average age of nurses is 31.69±7.702, 48.8% are 30 years below, 35.5% are between 30-40 years and 15.7% are 40 years above, the majority are women (87.6%) and graduated (56.2%).

In Table 2, 61.2% of the nurses stated that they received training on VG area injection, 30.6% stated that they

perform VG area injection in the clinic where they work, and 59.5% stated that they do VG area injection once a week. In a study by Gülnar and Özveren (2016) evaluating the effect of training on the use of the ventrogluteal area in intramuscular injection, 7.4% of nurses used the ventrogluteal area before the training, and this rate increased to 34.6% after the training. In another study conducted by Sarı et al. (2017), the rate of nurses performing VG injections was 17.1%. In a study evaluating the effectiveness of training on nurses' knowledge of dorsogluteal and ventrogluteal region selection in intramuscular injection application and application frequency, the rate of those using the VG area before the training was 20%, while this rate increased to 68.6% after the training (Şanlıalp Zeyrek and Kuzu Kurban, 2017). This finding reveals the need for information regarding VG area use. It appears that most nurses do not perform VG site injections, contrary to what current literature suggests. It is thought that this may be due to nurses not being accustomed to using the VG area (Sarı et al., 2017; Sü and Bekmezci, 2020), not knowing how to determine the VG area (Arslan and Özden, 2018; Sü and Bekmezci, 2020), not having sufficient knowledge about the VG area (Arslan and Özden, 2018; Sü and Bekmezci, 2020), and patients not being accustomed to using the VG area (Sü and Bekmezci, 2020).

In this study, the correct mean of nurses' information suggestions regarding VG area injection was 6.760±3.92 and was found to be slightly lower than the medium level (Table 3). It seems that nurses' knowledge of VG area injection is limited. In Gülnar and Çalışkan (2014)'s study, the mean knowledge score of nurses was found to be at a medium level (13.1±3.7). In the study conducted by Şanlıalp Zeyrek and Kuzu Kurban (2017), it was found that the correct average of nurses was higher than our study. In addition, the average correct score of nurses increased after the training. In another study conducted by Sarı et al. (2017), unlike our study, the VG knowledge level was found to be slightly higher than the medium level, with the mean of correct answers from 24 questions being 14.37. In a study conducted by Yigit Gokbel and Sagkal Midilli (2021), it was found that the mean knowledge of nurses at the first follow-up before training was 45.57±18.502. In the follow-up after the training, it was determined that the mean knowledge of the nurses increased (85.13±7.157 in the second follow-up, and 79.37±6.239 in the third follow-up, and 76.53±5.588 in the fourth follow -up). Our finding may be due to the educational needs of nurses.

It was found that there was a statistically significant difference between the knowledge levels of those over 40 years of age (Mean Rank=45.97) and those under 30 years of age (Mean Rank=70.73) regarding VG area injection in our study (Table 4). As can be seen, the knowledge level of those under the age of 30 is higher than those over the age of 40. Likewise, in our study, it was determined that the knowledge level of nurses who received training on VG area injection, applied VG injection in the department where they worked, and applied VG once a week was higher than the others (Table 4). Our research finding is supported by the study showing that the knowledge level of those who stated that they knew how to identify the IM injection site in the VG area and that they performed IM injection in the VG area was higher than others (Gülnar and Çalışkan, 2014). In another study, it was determined that the average number of injections made per week was 20.15, while the average injection made in the VG area was 1.54. It was also determined that nurses did not use the VG area for reasons such as not being used to the VG area (40%), not having enough knowledge (33%), and not knowing how to identify the exact area (31%) (Sü and Bekmezci, 2020). It is thought that as the level of knowledge about VG area injection increases, the frequency of VG area injection will also increase.

In this research, a weakly negative, statistically significant linear relationship was found between age, total professional working time and knowledge level (Table 5). As age and years of experience increase, the level of knowledge about the VG site injection decreases. This finding may be due to the fact that the trainings do not continue regularly and individuals forget and do not update the existing information. Therefore, this study highlights the importance of continuity in education.

This study contains some limitations. The sample size was limited, and only nurses working at one state hospital were included.

5. Conclusion

In conclusion, nurses' knowledge level regarding VG area injection was found to be slightly below the medium level. Regular in-service training on VG injection and evaluation of the training results will ensure that nurses have up-to-date knowledge. In addition, implementation and supervision of VG injection in clinics will expand the use of VG injection.

Author Contributions

The percentage of the author(s) contributions is presented below. The author reviewed and approved the final version of the manuscript.

	N.B.E.
C	100
D	100
S	100
DCP	100
DAI	100
L	100
W	100
CR	100
SR	100
PM	100
FA	100

C=Concept, D= design, S= supervision, DCP= data collection and/or processing, DAI= data analysis and/or interpretation, L= literature search, W= writing, CR= critical review, SR= submission and revision, PM= project management, FA= funding acquisition.

Conflict of Interest

The author declared that there is no conflict of interest.

Ethical Approval/Informed Consent

Approval for the research was received from Hitit University Non-Interventional Ethics Committee with the letter dated March 28, 2018 and numbered 2018-47. In addition, permission was obtained from the institution where the study was conducted. First, participants were informed and their consent was obtained. The research was conducted under with the Principles of the Declaration of Helsinki.

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Black Sea Journal of Health Science
doi: 10.19127/bshealthscience.1507825

Open Access Journal
e-ISSN: 2619 – 9041

Research Article
Volume 7 - Issue 5: 210-217 / September 2024

EFFECTS OF IN VIVO / IN VITRO MELATONIN APPLICATION ON THE DUODENUM IN RATS WITH EXPERIMENTAL HYPERTHYROIDISM

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Abstract: The aim of this study was to investigate the effects of melatonin on the intestinal motility of hyperthyroidism rats. Therefore, we determined *in vivo* and *in vitro* effects of melatonin on duodenal tissue in experimental hyperthyroid rats. 34 Wistar-Albino male rats were fed with physiological conditions, and then euthanized by cervical dislocation. The experimental animals, Group 1: Control group (n=5), Group 1B: Melatonin group *in vitro* (n=5), Group 1C: Melatonin group *in vivo* (n=6), Group 2: 2A: Hypertension group (n=6), 2B: Group 2: Hyperthyroidi sm *in vitro* melatonin group (n=6), 2C: Hyperthyroidism *in vivo* melatonin group (n=6). Acetylcholine (ACh, 10^{-7}, 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}, 10^{-2} M), potassium chloride (KCl, 20, 40, 60, 80, 100 mM) at the end of the incubation period different doses were given to the bathing environment. In *in vitro* melatonin groups, the determined submaximal doses (ACh 10^{-4} M, KCl 60 mM) and melatonin at different doses (Mel 10^{-10}, 10^{-9}, 10^{-8}, 10^{-7}, 10^{-6}, 10^{-5} and 10^{-4} M) were applied. It was determined that the contraction responses of the isolated duodenal tissues induced by KCl and ACh increased significantly ($p<0.001$) in experimental rats with hyperthyroidism. In the same way, it was found that in the groups treated with melatonin *in vivo*, there was a significant ($P<0.001$) increase in the contraction responses compared to those of control group in the isolated tissue. It was found that hyperthyroidism significantly decreased the contraction responses compared with the hyperthyroidism melatonin treated groups *in vivo*. In melatonin groups, responses to different logarithmic doses of melatonin administered with subcutaneous doses of KCl and ACh were evaluated. According to the findings, contraction responses to different doses of melatonin were found to vary significantly. It was determined that *in vivo* administration of melatonin on intestinal motility decreased the contraction responses in experimental hyperthyroidism induced rats. Melatonin given in the bath environment *in vitro* was found to increase or decrease contraction responses on intestinal motility significantly in different doses. Melatonin is thought to be a positive effect of on intestinal motility.

Keywords: Hyperthyroidism, Acetylcholine, Duodenum, KCl, Melatonin, Rat

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Received: July 01, 2024
Accepted: September 11, 2024
Published: September 15, 2024

Cite as: Şentürk E, Çelebi F. 2024. Effects of in vivo / in vitro melatonin application on the duodenum in rats with experimental hyperthyroidism. BSJ Health Sci, 7(5): 210-217.

1. Introduction

Hyperthyroidism is a condition where the thyroid gland produces too much thyroid hormone, leading to high levels of thyroid hormone in the bloodstream and low levels of thyroid-stimulating hormone (TSH). This causes the thyroid gland to grow larger than average, and increases the body's metabolism, leading to symptoms such as increased excitability, heat intolerance, sweating, weight loss, muscle weakness, psychological and nervous disorders, excessive fatigue, inability to sleep, tremor in hands, and endophthalmitis. Additionally, the increased metabolism also causes an increased oxygen consumption rate (Shahid et al., 2020). Gastrointestinal symptoms are common in both hypothyroidism and hyperthyroidism. Although the number of daily feces may be average in hyperthyroidism, the number of bowel movements may be increased (hyper defecation). This is because the increased metabolism causes an increase in appetite and nutrient intake, as well as an increase in the rate of transit through the gastrointestinal tract, leading to diarrhea. On the other hand, in hypothyroidism, the opposite effect occurs, with decreased metabolism leading to constipation (Hall, 2011; Shahid et al., 2020).

The pineal gland is a small endocrine gland located in the brain responsible for melatonin production. Melatonin is a hormone that helps regulate our sleep-wake cycle in response to changes in light exposure. The pineal gland receives signals from the environment about light levels, and adjusts the production of melatonin accordingly. Melatonin is secreted by cells in the pineal gland called pinealocytes. It acts as an inhibitory agent on various endocrine glands, including the adenohypophysis, neurohypophysis, endocrine pancreas, adrenal cortex, adrenal medulla, parathyroid, and gonads (Aulinas, 2019). Melatonin is not only produced in the pineal gland in the brain, but it is also produced by other cells in the body. Even if the pineal gland is removed, melatonin levels will decrease but not disappear entirely. Other

cells in the body that also produce melatonin include enterochromaffin cells in the digestive tract, liver, trachea, thyroid, renal tissue, adrenal cortex, thymus, and placenta, as well as cells in the immune system, such as natural killer cells and eosinophilic leukocytes. These cells can produce melatonin to communicate with each other by locally releasing the hormone; this process is called paracrine (Touitou, 2001). Melatonin helps regulate various bodily functions, including the gastrointestinal tract. It has been found to suppress the contractions of the intestines that are induced by serotonin. It also reduces sodium absorption from the gut lining, and limits the growth of cells in the small intestine. Additionally, melatonin has been found to improve the function and regeneration of the cells that line the gastrointestinal tract, reduce the tension of the muscles in the gut, and strengthen the immune system. It also has antioxidant properties that can prevent damage to the lining of the gut, reduces the production of stomach acid, and helps to renew the surface of the gut lining (Lee and Pang, 1993; Ganguly et al., 2005; Martin et al., 2005; Moezi et al., 2010).

The incidence of hyper defecation and diarrhea increases in individuals with hyperthyroidism due to increased appetite and food intake, metabolic rate, and the rate of passage in the gastrointestinal tract. Individuals with hyperthyroidism may experience increased bowel movements (hyper defecation) and diarrhea. This is because their high metabolism increases appetite and food intake, as well as an increased rate of passage through the gastrointestinal tract. This can cause the food to move through the gut more quickly, leading to more frequent bowel movements and diarrhea (Karbownik and Lewinski, 2003; Hall, 2011).

This study aimed to investigate the effects of melatonin, a neuroendocrine inhibitory hormone, on intestinal motility in rats with experimentally induced hyperthyroidism.

2. Materials and Methods

2.1. Experimental Animals and Chemicals

Thirty-four male Wistar-Albino rats (220-240 g) were used in our study. The rats were fed 12 hours at night and 12 hours daily, with rhyming rhythm in the wireframe at 22 °C temperature and 50-60% humidity. Melatonin (CAS no: 73 - 31 - 4, Santa Cruz, ABD), $MgSO_4$ (CAS No: 7487-88-9, Fluka, ABD), other chemicals used in this study were supplied by Sigma-Aldrich (Germany).

2.2. Experimental Groups

Group 1A, Control Group (n=5): The rats in this group were injected with 0.5 ml/day intraperitoneal 0.9% isotonic NaCl for 14 days. After euthanasia, the abdomen was opened, and the duodenum was taken immediately after ostium plorikum and hung in an isolated organ bath. Acetylcholine (ACh) (10^{-7}, 10^{-6}, 10^{-5}, 10^{-4},10^{-3} and 10^{-2} M) and potassium chloride (KCl) (20, 40, 60, 80, and 100 mM) in the bath medium to determine the contraction responses of duodenal tissues of rats in this group different concentrations were applied.

Group 1B, (n=5) Control + *In vitro* Melatonin Group: The rats were fasted the night before euthanasia. 0.5 ml 0.9% isotonic NaCl was administered intraperitoneally. After cervical dislocation, the abdomen was opened and the duodenum was removed without damaging the tissues. After applying 1g of tension in the isolated organ bath, the tissue was washed at 15-minute intervals and rested for 1 hour. The submaximal doses of KCl and ACh determined in group 1A (KCl 60 mM and ACh 10^{-4} M) were repeated three times and averaged. Melatonin was dissolved in 0.5 ml 0.9% isotonic NaCl solution and administered. Dose-response curves were determined by exposure to different melatonin concentrations (Mel 10^{-10}, 10^{-9}, 10^{-8}, 10^{-7}, 10^{-6}, 10^{-5}, and 10^{-4} M) after the averaged responses. After the submaximal doses were tried three times and averaged, the responses of KCl 60 mM and different melatonin concentrations were obtained. After resting the tissue for 10 minutes, the coexistence curves of different ACh 10^{-4} M concentrations and melatonin were evaluated.

Group 1C, (n=6) Control + *in vivo* melatonin Group: Intraperitoneally, 3 mg/kg/day melatonin was administered for two weeks at 21:00 at night. At the end of 14 days, after the duodenal tissue of the rat whose application was completed, 1 g of tension was applied in the isolated organ bath. KCl (20, 40, 60, 80, and 100 mM) and ACh (10^{-7}, 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}, and 10^{-2} M) to the tissue that was washed with 15 minutes intervals and rested for 1-hour different concentrations were given to the medium. Dose-response curves were determined.

Group 2A, Hyperthyroidism Group (n = 6): The rats in this group were administered 0.3 mg/kg/day L-thyroxine intraperitoneally every day for two weeks to create experimental hyperthyroidism. Different concentrations of ACh and KCl were applied to the bath medium to determine the contraction responses by taking duodenal tissues.

Group 2B, *In Vitro* Hyperthyroidism Group (n=6): The rats in this group were administered 0.3 mg/kg/day L-thyroxine intraperitoneally every day for two weeks in order to create experimental hyperthyroidism. The duodenal tissue was taken and placed in an isolated organ bath. In order to determine the contraction responses of the duodenal tissues of the rats in this group, submaximal doses of ACh and KCl and different concentrations of Mel were applied to the bath environment.

Group 2C, (n=6) Hyperthyroidism + *In Vivo* Melatonin Group: L-thyroxine hormone at a dose of 0.3 mg/kg/day intraperitoneally at 08:00 in the morning and melatonin hormone at a dose of 3 mg/kg/day at 21:00 for two weeks. At the end of 14 days, after the duodenal tissue of the rat whose application was completed, 1 g of tension was applied in the isolated organ bath. KCl (20, 40, 60, 80, and 100 mM) and ACh (10^{-7}, 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}, and 10^{-2} M) to the tissue that was washed in 15 minutes intervals and rested for 1 hour. Different concentrations were given to the medium. Dose-response curves were determined (Table 1 and 2).

Table 1. Control group, *in vivo* and *in vitro* applications

Groups	Intestinal Tissue
1. Control Group (n=16)	No experimental application was done to the rats in the control group. Melatonin was applied intraperitoneally to the rats in the 1C group for 14 days.
1A. No application can be made (n=5)	ACh - (10^{-7}, 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3} ve 10^{-2} M) KCl - (20, 40, 60, 80 ve 100 mM)
1B. *İn Vitro* melatonin application (n=5)	ACh - (10^{-7}, 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3} ve 10^{-2} M) KCl - (20, 40, 60, 80 ve 100 mM) Melatonin-(Mel 10^{-10}, 10^{-9}, 10^{-8}, 10^{-7}, 10^{-6}, 10^{-5} ve 10^{-4} M)
1C. *İn Vivo* melatonin application (n=6)	ACh - (10^{-7}, 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3} ve 10^{-2} M) KCl - (20, 40, 60, 80 ve 100 mM) (*In vivo* melatonin administration was administered intraperitoneally for 14 days)

Table 2. Hyperthyroid group, *in vivo* and *in vitro* applications

Groups	Intestinal Tissue
2. Hyperthyroidism group (n=18)	Intraperitoneal L-thyroxine injection was applied for 14 days. After the disease was created, the tissues were suspended in the isolated organ bath, while L-thyroxine was applied only in the 2C group, while melatonin was administered *in vivo* for 14 days.
2A. No application was made after hyperthyroidism was created (n=6)	ACh - (10^{-7}, 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3} ve 10^{-2} M) KCl - (20, 40, 60, 80 ve 100 mM)
2B. *In vitro* melatonin administration was performed after hyperthyroidism was created (n=6)	ACh - (10^{-7}, 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3} ve 10^{-2} M) KCl - (20, 40, 60, 80 ve 100 mM) Melatonin - (Mel 10^{-10}, 10^{-9}, 10^{-8}, 10^{-7}, 10^{-6}, 10^{-5} ve 10^{-4} M)
2C. *In vivo* melatonin application was performed while creating hyperthyroidism (n=6)	ACh - (10^{-7}, 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3} ve 10^{-2} M) KCl - (20, 40, 60, 80 ve 100 mM) (*In vivo* melatonin administration was administered intraperitoneally for 14 days)

2.3. Test Protocol

After euthanasia, the abdomens of the rats were opened along the median line. The duodenum tissues, determined after ostium pyloricum, which is the intestine of the small intestine with the stomach, were taken with the help of scissors. The isolated duodenum tissue was removed from the connective tissue around it by taking the cold tyrode solution. The lumen content of the duodenum was cleaned with a tyrode solution using an injector. After all of these procedures, sections 1-1.5 cm long were taken from the isolated duodenum tissue. The connective tissues were ligated and fixed in a 10 ml isolated organ bath, with the cleaned duodenum tissues in a continuously ventilated tyrode solution (Tyrode solution contains 119 mM NaCl, 4.75 mM KCl, 1.5 mM $MgSO_4$, 1.2 mM $NaHCO_3$, 2.5 mM $CaCl_2$, and 1.1 mM glucose) (Lucchelli et al. 1997) at 37 °C and a mixture of 5-95% carbon dioxide-oxygen. Tissue fragments were kept in a solution of tyrode every 15 minutes for 1 hour. After the adjustment period, KCl, ACh and melatonin were added into the solution in different concentrations. After each response, the tyrode solution was changed three times to reach the previous tone of the tissues by changing the solution two times, and the tissue was rested for 10 min before starting the other chemical doses.

3.4. Statistical Analysis

SPSS 24 was used to analyze the data we obtained at the end of our study. Post-hoc Tukey test was used to evaluate the results and the One Way ANOVA test. Values are given as mean (X) ± Standard deviation (SD). Values of $P<0.05$ were considered significant (Genç and Soysay, 2018).

3. Results

This study seeks how melatonin affects the duodenum (a section of the small intestine) of rats with hyperthyroidism. The researchers will be studying the effects of melatonin both inside the body (*in vivo*) and outside the body (*in vitro*) on the duodenal tissue of these rats.

Duodenal tissues isolated from rats in Control (1A), Control + *in vivo* melatonin (1C), Hyperthyroidism (2A), and Hyperthyroid + *in vivo* melatonin (2C) groups were induced with different doses of KCl. Dose-response curves by evaluating the obtained contraction responses are shown in Figure 1. It was determined that the contraction responses of the isolated duodenal tissues of the rats in the Control group were significantly lower than other groups, and the contraction responses of the duodenal tissues in the hyperthyroid group were higher

than the others. In both groups who were administered intraperitoneal melatonin for 14 days, it was found that the contraction responses of duodenal tissues were higher than the control group. However, these responses were lower than the Hyperthyroid group.

Isolated duodenal tissues in Control, Control + *in vivo* melatonin, Hyperthyroid, and Hyperthyroid + *In vivo* melatonin groups were induced with different doses of ACh. Dose-response curves are shown in Figure 2 by evaluating the contraction responses of ACh given to the isolated organ bath at different concentrations. It was determined that the contraction responses of the rats in the control group obtained from the duodenal tissues were significantly lower than the other groups, and the contraction responses of the tissues in the hyperthyroid group were higher than the other groups. The contraction responses of duodenal tissues were higher in both groups, in which *in vivo* melatonin was applied compared to the Control group. In Control + *in vivo* melatonin group, the contraction responses of the tissue were higher at low ACh concentrations (10^{-7}, 10^{-6}, and 10^{-5} M) compared to the Hyperthyroid group but lower at other doses than in the same group. The Hyperthyroid + *in vivo* melatonin group was higher in the first two doses (10^{-7} and 10^{-6} M) compared to the Hyperthyroid group and lowered in the other doses.

In the Control + *in vitro* melatonin (1B) and Hyperthyroid + *in vitro* melatonin (2B) groups, the submaximal dose of KCl was applied three times and the mean values were determined. By applying a submaximal dose of KCl and doses of different concentrations of melatonin together, the contraction responses of the isolated duodenal tissues of the rat were evaluated.

Figure 3A. (a, b; a, c; b, c; P<0.0001) and Figure 3B. It was observed that there was a statistically significant difference in columns with different letters in (a, bc; a, c; ab, c; P<0.0001, ab, c; P<0.05). The submaximal dose of ACh was administered three times in the Control + *in vitro* melatonin (n=5) and Hyperthyroid + *in vitro* melatonin (n=6) groups. The mean values of the three submaximal doses administered were calculated. The contraction responses of duodenal tissues isolated from rats were evaluated by giving a submaximal dose of ACh and different melatonin concentrations to the bath environment. Figure 3C. (a, c; P<0.0001, ab, c; P<0.001, a, bc; P<0.001) and Figure 3D. It was observed that there was a statistical difference in columns with different letters in (a, bc; a, c; p <0.0001, a, bcd; ab, c; P<0.001).

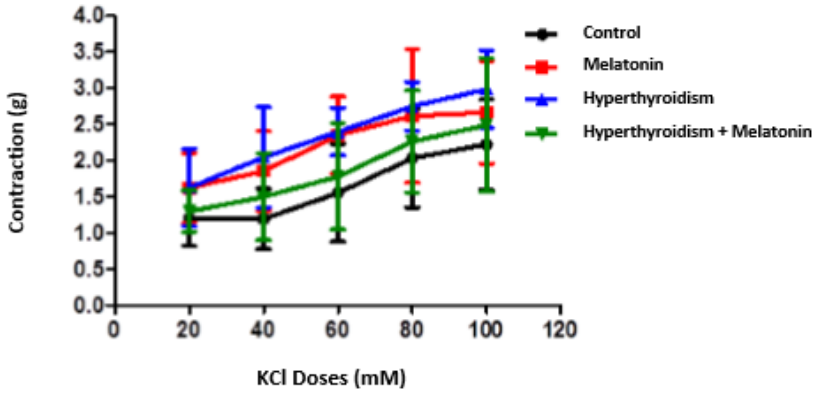

Figure 1. KCl-induced isolated duodenal tissue dose-response curves in Control (1A), Control + *in vivo* melatonin (1C), Hyperthyroidism (2A), Hyperthyroidism + *in vivo* melatonin (2C) groups.

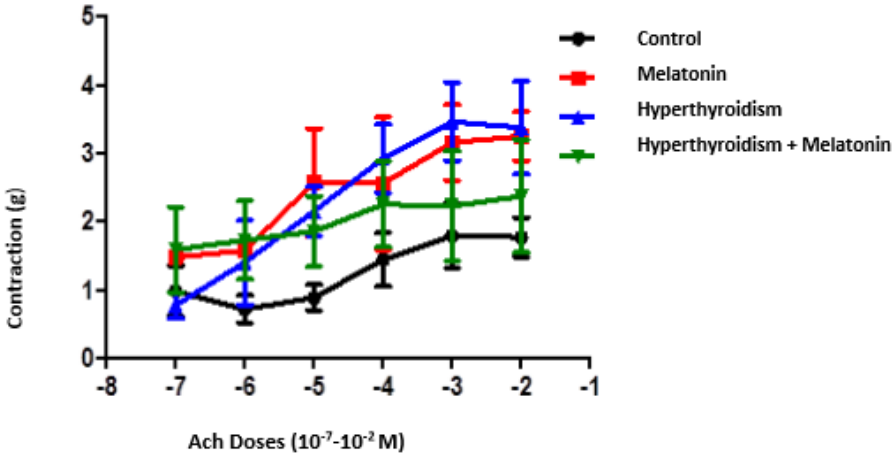

Figure 2. ACh-induced isolated duodenal tissue dose-response curves in Control (1A), Control + *in vivo* melatonin (1C), Hyperthyroidism (2A) and Hyperthyroidism + *in vivo* melatonin (2C) groups.

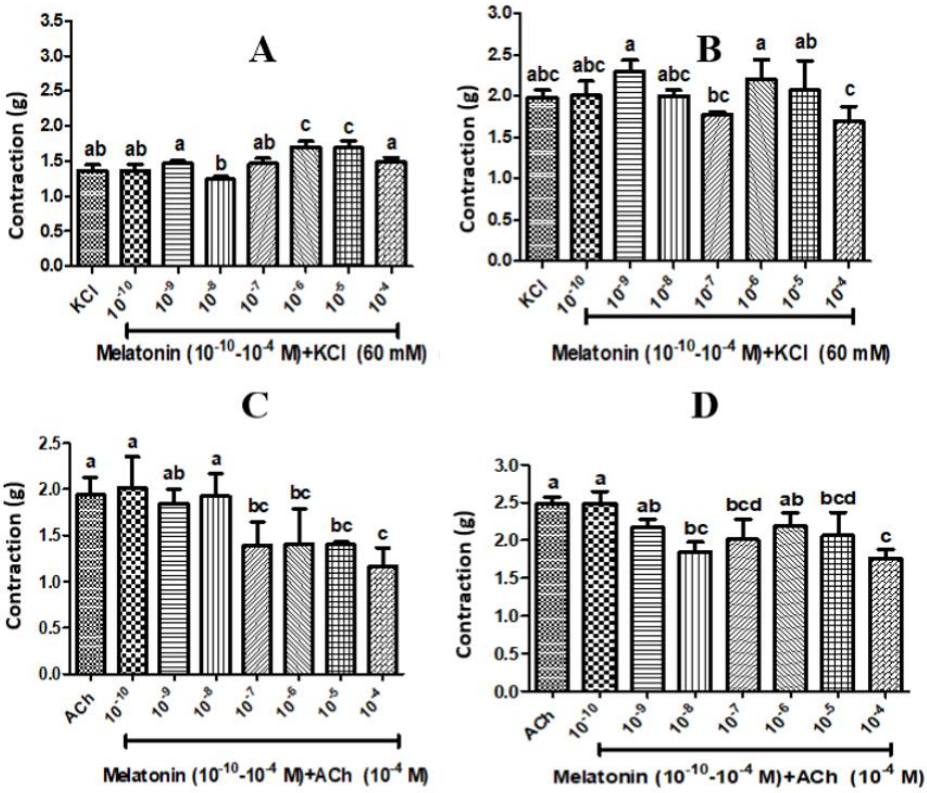

Figure 3. A: The contraction responses of the control + *in vitro* melatonin group to melatonin applied with submaximal KCl (60 mM) to duodenal tissues. B: The contraction responses of hyperthyroid + *in vitro* melatonin group to melatonin applied with submaximal KCl (60 mM) to duodenal tissues. C: The contraction responses of the control + *in vitro* melatonin group to melatonin administered with submaximal ACh (10^{-4} M) on duodenal tissues. D: The contraction responses of hyperthyroid + *in vitro* melatonin group to melatonin applied with submaximal ACh (10^{-4} M) to duodenal tissues.

4. Discussion

This research aims to understand the impact of melatonin on duodenum (a section of the small intestine) of rats with hyperthyroidism. This hormone has inhibitory effects on certain bodily functions, on the duodenum (a part of the small intestine) of rats induced with hyperthyroidism. The researchers observed the effects of melatonin on the duodenal tissue of these rats by applying it both inside the body (*in vivo*) and outside the body (*in vitro*) and comparing the results.

Thyroid hormones, which increase metabolic activity in almost all tissues and organs in the body, have an effect on all systems. Hyperthyroidism is a clinical condition that results from the excessive secretion of thyroid hormones (Shahid et al., 2020). The small intestines digest the nutrients taken in the blood and absorb the blood. Intestinal motility, the contents of the stomach, bile, pancreas, and small intestine secretions by mixing the turn into a column turns into kimus. This transition in the intestinal tract varies between about 2-4 hours (Daher et al., 2009). In diseases of the thyroid gland, changes in bowel movement and digestion may occur due to variations in the time it takes for food to move through the digestive system, changes in the body's metabolism, and differences in the absorption of nutrients.

According to the study by Drago et al. (2002), it was determined that low doses of melatonin injected intraperitoneally increase intestinal transit and high doses decrease this transition. In the 1B group, where we gave melatonin to the bathing environment, there was a significant increase in the doses of submaximal KCl (60 mM) and melatonin 10^{-6} and 10^{-5} M in combination with the submaximal dose of KCl. It was determined that the contractility decreased significantly.

Although hyperthyroidism was detected in the 2B group with submaximal KCl and melatonin combined with the bathing environment, there was an increase in the concentration of melatonin 10^{-9} M, 10^{-6} M, 10^{-5} M, and submaximal KCl according to the contraction response to a submaximal dose of KCl. Reduction of contraction responses in concentrations of 10^{-7} M and 10^{-4} M melatonin was detected. In the duodenum tissue induced by the submaximal dose of ACh, the contraction responses were not changed in the tissue in which submaximal ACh and melatonin 10^{-10} M, and 10^{-8} M concentrations were applied in the 1B group. In contrast, the other doses of melatonin were decreased. In the 2B group, 10^{-10} M melatonin and ACh were found to be decreased in all doses except the submaximal dose of ACh according to the contraction response to the submaximal dose of ACh.

Mogulkoç et al. (2006) found that oxidative damage to the brain, liver and heart tissues of hyperthyroid rats was high in the Hyperthyroidism group. They observed that melatonin reduced the negative effect of this oxidative damage. In some studies, melatonin has been reported to be protective in the gastrointestinal tract. Brzozowski et al. (1997) observing that melatonin reduced gastric lesions due to stress and ischemia-reperfusion (Bandyopadhyay et al. 2002).

In a study, melatonin was shown to protect the gastric mucosa from indomethacin-induced damage in diabetic rats (Pradeepkumar Singh et al., 2011). The study observed that the symptoms decreased after melatonin treatment in patients with constipation and intestinal bowel syndrome (IBS) (Chojnacki et al., 2013). Their studies found that the ethanol-induced rat permeability of the duodenal mucosa reduced melatonin. In addition, they demonstrated that melatonin abolished ethanol-induced duodenal hypermotility but had no effect on basal motor activity. In our study, the hyperthyroidism model that causes increased intestinal motility was created in rats in similar with the researches in the literature (Sommanson et al., 2013; Sommanson et al., 2014). Tissue contractility was determined by inducing the duodenum suspended in the isolated organ bath system with different doses of KCl and ACh. It was found that contractions increased significantly in the Hyperthyroid group compared to the Control group, and these increases were significant.

Similarly, in the *In vivo* melatonin-applied groups, it was observed that contraction increased compared to the Control group, but when compared with the Hyperthyroid group, contractility decreased, and that the contraction response in the Control + *in vivo* melatonin group was higher than in the Hyperthyroid + *in vivo* melatonin group.

Bondarenko et al. (2011) reported a significant relationship between the thyroid gland and the pineal gland. Baltaci et al. (2017) found that plasma melatonin levels were significantly higher in the experimental hyperthyroid group compared to the control group. In general, it was reported that there was a significant relationship between thyroid and pineal glands, and impaired thyroid function could alter the release of melatonin (Rom-Bugoslavskaia et al., 1984; Bondarenko et al., 2011; Baltacı et al., 2017). Drago et al. (2002) According to their study, we have mentioned above that high doses of melatonin injected intraperitoneally reduce intestinal passage. Bondorenko et al. (2011) and Rom-Bugoslavskaia et al. (1984) Plasma melatonin level of hyperthyroidism was found to increase and melatonin supplementation increased the level of plasma melatonin in hyperthyroid rats. Lucchelli et al. (1997) observed that spontaneous and serotonin-induced contractions of rat duodenum *in vitro* were determined by high-dose melatonin. In parallel with these studies, it was determined that the contact responses of rat-isolated duodenal tissues in the Hyperthyroid + *in vivo* melatonin group to different concentrations of KCl and ACh were lower than the contraction responses of the Control + *in vivo* melatonin group and the Hyperthyroid group.

Our study determined that contraceptive responses of duodenum tissues induced by different logarithmic melatonin and submaximal KCl and ACh *in vitro* melatonin groups were different. In the Control group of melatonin treated *in vitro*, melatonin combined with a submaximal dose of KCl was found to be significantly decreased in 10^{-8} M rat tissue. However, there was a significant increase in contraction responses to melatonin administered at doses of 10^{-6} and 10^{-5} M in combination with a submaximal dose of KCl in the same group. In 14 days, hyperthyroidism was induced by L-thyroxine, and melatonin was given to the bathing environment. An increase in KCl and melatonin levels of 10^{-9} and 10^{-6} M was observed according to submaximal KCl-induced groups. It was observed that 10^{-7} and 10^{-4} M concentrations decreased significantly compared to the other doses. The responses to different logarithmic doses of melatonin in rats' isolated tissues induced by the submaximal dose of ACh (10^{-4} M) were found to differ from those given to the submaximal dose of KCl.

This study investigated the effects of *in vivo* and *in vitro* application of melatonin on duodenal tissues isolated from rats with experimental hyperthyroidism.

Duodenal tissues isolated from rats in the Control group, Control + *in vivo* melatonin group, Hyperthyroid group, and Hyperthyroid + *in vivo* group were induced with different doses of KCl and ACh, and dose-response curves were determined according to the contraction responses of the contractions. It was found that the contraction responses obtained from the isolated duodenal tissues obtained from the experimental Hyperthyroid group by administering 0.3 mg/kg/day L-thyroxine in all doses of ACh and KCl for 14 days increased significantly compared to the contraction responses obtained from the other groups. It was found that the contraction responses to KCl in Control + *in vivo* melatonin group increased significantly compared to the contraction responses of the duodenal tissues in the Control and Hyperthyroid + *in vivo* melatonin groups, whereas these responses were found to be lower than the Hyperthyroid group. Responses of isolated duodenal tissues to ACh in the same group were significantly higher than in the control group. According to the Hyperthyroid group, the responses of the Control + *in vivo* melatonin group to ACh 10^{-7} M, 10^{-6} M, and 10^{-5} M doses were found to be lower than the other high doses in the Hyperthyroid group. The responses of tissues in the Hyperthyroid + *in vivo* melatonin group to different doses of KCl were found to be higher than the Control group and lower than the Control *in vivo* melatonin group. The responses to ACh were observed to be higher than all other groups in their responses to 10^{-7} M and 10^{-6} M concentrations. In contrast, responses to other doses of ACh were lower than those of tissues in the Hyperthyroid and Control + *in vivo* melatonin groups.

Submaximal doses of KCl and ACh were administered three times with logarithmic doses of melatonin in the *In vitro* melatonin-applied groups and averaged. Then, the contraction responses were evaluated by giving the determined submaximal doses and logarithmic doses of melatonin together. According to the responses of isolated duodenal tissues to KCl in the Control + *in vitro* melatonin group, there was a significant decrease in KCl + melatonin dose of 10^{-8} M, while a significant increase in KCl + melatonin 10^{-6} M and 10^{-5} M was observed. In the responses given to ACh, it was determined that the responses of ACh to the submaximal dose of ACh + melatonin doses of 10^{-7} M, 10^{-6} M, 10^{-5} M, and 10^{-4} decreased significantly. In the Hyperthyroid + *in vitro* melatonin group, KCl + melatonin responses were found to be increased by 10^{-9} M and 10^{-6} M. However, according to the responses given to KCl in the same group, it was determined that the responses of KCl + melatonin to 10^{-7} M and 10^{-4} M doses were low, and the same responses were obtained at other concentrations. In the responses of the Hyperthyroid + *in vitro* melatonin group to submaximal ACh, a significant decrease was found in the contraction responses of all concentrations except ACh + melatonin 10^{-10} M. Our findings from this study show that melatonin has therapeutic potential in treating digestive disorders caused by hyperthyroidism.

5. Conclusion

This research aims to underline the impact of melatonin on the duodenum of rats with hyperthyroidism. Melatonin was applied both *in vitro* and *in vivo*, and its effects on the duodenal tissue were compared with control groups. Previous studies have shown that melatonin has protective effects on the gastrointestinal tract and reduces oxidative damage to various organs. In the present study, it was observed that the contractility of the duodenum increased in the hyperthyroid group compared to the control group, and *in vivo* melatonin application decreased this contractility. A significant relationship exists between the thyroid gland and the pineal gland, and impaired thyroid function can alter melatonin release. Different doses of melatonin have been shown to reduce intestinal transit.

Author Contributions

The percentage of the author(s) contributions is presented below. All authors reviewed and approved the final version of the manuscript.

	E.Ş.	F.Ç.
C	50	50
D	60	40
S		100
DCP	80	20
DAI	70	30
L	80	20
W	50	50
CR	60	40
SR	70	30
PM	40	60
FA	40	60

C=Concept, D= design, S= supervision, DCP= data collection and/or processing, DAI= data analysis and/or interpretation, L= literature search, W= writing, CR= critical review, SR= submission and revision, PM= project management, FA= funding acquisition.

Conflict of Interest

The author declared that there is no conflict of interest.

Ethical Approval/Informed Consent

This study was conducted under the approval of the Ethics Committee of Atatürk University (approval date; January 05, 2017; protocol code: 75296309-050.01.04-E.1700034113.

Acknowledgments

This study was supported by the Scientific Research Projects Coordinator of Atatürk University with project number 2017-6093 BAP.

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Black Sea Journal of Health Science

doi: 10.19127/bshealthscience.1539717

Open Access Journal
e-ISSN: 2619 – 90410

Review
Volume 7 - Issue 5: 218-225 / September 2024

ADVANCES IN ARTIFICIAL INTELLIGENCE-AIDED INTRAORAL IMAGING ANALYSIS IN PERIODONTICS

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Abstract: Artificial intelligence has increasingly influenced the field of periodontology by enhancing diagnostic accuracy and treatment planning through advanced data-driven techniques. It was aimed to examine the integration of artificial intelligence, particularly deep learning and machine learning, in analyzing intraoral photographs for periodontal conditions in this review. Periodontal assessments rely on clinical and radiographic evaluations, but artificial intelligence introduces a transformative approach by analyzing large datasets to improve clinical decision-making. The review investigates the effectiveness of artificial intelligence-enhanced intraoral photograph analysis, focusing on methodologies for dataset creation, model development, training, and performance evaluation. A thorough search of databases such as PubMed, Scopus, Google Scholar, and IEEE Xplore identified 338 articles, with 16 meeting the inclusion criteria. These studies primarily utilized convolutional neural networks and architectures like DeepLabv3+ and U-Net, demonstrating high accuracy in detecting conditions such as gingivitis, dental plaque, and other periodontal issues. The dataset sizes ranged from 110 to 7220 images, affecting the models' generalizability. Most studies employed supervised learning, with models trained on labeled datasets to achieve precise diagnostic outcomes. The review highlights that while artificial intelligence and machine learning techniques, including convolutional neural networks and U-Net, offer significant improvements in periodontal diagnostics, the choice of model and the quality of the dataset are crucial for performance. Hybrid approaches that combine automated and expert-driven methods might provide a balance between efficiency and accuracy. The successful integration of artificial intelligence into clinical practice requires continuous validation and adaptation to ensure that these technologies remain accurate and relevant. Future research should focus on enhancing model robustness, expanding dataset diversity, and refining clinical applications to fully exploit the potential of artificial intelligence in periodontology.

Keywords: Artificial intelligence, Periodontics, Photograph

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Received: August 28, 2024
Accepted: September 11, 2024
Published: September 15, 2024

Cite as: Aykol Şahin G. 2024. Advances in artificial intelligence-aided intraoral imaging analysis in periodontics. BSJ Health Sci, 7(5): 218-225.

1. Introduction

Artificial intelligence (AI) is a broad discipline focused on creating machines that can replicate human cognitive abilities (Sharifani and Amini, 2023). The advancement of AI has significantly influenced various fields within healthcare, enhancing areas from diagnostics to personalized medicine. The integration of AI is likely to lead to notable advancements in various aspects of periodontology, including diagnosis, treatment planning, and patient management (Scott et al., 2023). In the last ten years, AI, particularly deep learning (DL) and machine learning (ML) has emerged as a transformative tool for precision and efficiency in diagnosing and managing periodontal diseases (Pitchika et al., 2024). Periodontal diseases are generally initiated as gingival inflammation by a host response to oral microorganisms colonizing the subgingival area and might lead to periodontal tissue destruction (Löe et al., 1965; Tonetti et al., 2018). Plaque-induced gingivitis may exhibit various patterns of observable signs and symptoms of inflammation localized to the gingiva and initiated by accumulating a microbial biofilm on teeth. Gingival inflammation is considered a prerequisite for the subsequent development of periodontitis and progressive attachment loss around teeth. Management of gingivitis is a key preventive strategy for periodontitis (Murakami et al., 2018). Periodontology focuses on the prevention, diagnosis, and treatment of periodontal diseases. It is a complex field that requires precise clinical decision. Periodontal assessments have been reliant on the clinician's experience and clinical examinations, which have often been supplemented by radiographic evaluations. However, the advent of AI has introduced a more data-driven approach, whereby algorithms are used to analyze large datasets and generate insights that can enhance clinical decision-making.

Most AI research in periodontics focuses on diagnosing, staging and grading periodontitis using radiographic images, based on the 2017 classification (Tonetti et al., 2018). However, identifying gingival inflammation and gingivitis, which are early and reversible signs of periodontal disease, is also critical (Löe et al., 1965). Besides, it is equally crucial to identify dental biofilm, the

primary cause of gingivitis, to effectively manage and prevent the progression of periodontal diseases. These early detections are essential for preventive dentistry, emphasizing the importance of early intervention to prevent more severe periodontal diseases (Löe and Silness, 1963). Nowadays, teledentistry has become an effective way to interact remotely with patients to provide dental consultations and instructions to reach patients who would otherwise not have access to dental care (such as in rural areas, patients in nursing facilities, or during a pandemic). As these applications grow in popularity, digital images have also become increasingly vital for monitoring and facilitating diagnosis and treatment planning for patients. Over the past 10 years, research on detecting periodontal structures and oral disease and conditions through intraoral photographs has evolved significantly. Initially leveraging machine learning techniques, these studies have advanced with the development of deeper AI algorithms, mainly through the adoption of sophisticated deep learning models.

The aim of this review is to summarize research using intraoral photographs in periodontics, outline advancements, and highlight future research directions in this field.

2. Review

The focused question used for the current review was "What is the effectiveness of AI-enhanced intra-oral photograph analysis in periodontics?" The secondary questions focused on identifying the methodologies employed in these studies for dataset creation, model development, training, testing, and performance reporting. Additionally, in instances where the models were evaluated against human performance, the questions sought to determine which metrics were used for comparison and what the resulting outcomes were.

A detailed search was conducted using a range of databases, including PubMed, Scopus, Google Scholar and IEEE Xplore, using the keywords according to Boolean search strategy "Periodontics" AND "Artificial Intelligence" OR "Machine Learning", "Periodontitis" OR "Gingivitis" OR "Gingiva" AND "Artificial Intelligence" OR "Machine Learning" OR "Deep Learning" AND "intraoral photograph", "Deep Learning OR ML AND dental plaque AND intraoral imaging", "Artificial Intelligence" AND "intraoral photograph" OR "dental image" and demonstrated in Table 1. The publication period was set at 20 years. This review included original articles, clinical trials and conference proceedings that utilized AI and intraoral images for periodontal diagnosis and detection of periodontal tissues or dental plaque, as well as study designs in which AI was used as the independent variable. Studies published in languages other than English, studies utilizing software other than AI-based tools, and studies employing AI for purposes other than periodontology or not evaluated with intraoral images were excluded from the review.

Table 1. Description of included studies

Study	Year	Brief Description	Image Total	ML Architecture	Performance Comparison	CNN Performance Comment
Alalharith	2020	An evaluation of the effectiveness of deep learning based CNNs for the pre-emptive detection and diagnosis of periodontal disease and gingivitis by using intraoral images.	134	Faster R-CNN	Previously published outcomes	Faster R-CNN had 77.12% accuracy to detect inflammation.
Andrade	2023	Assessed the U-Net neural network's ability to detect dental biofilm on tooth images automatically.	480	U-Net	Not comparative	The U-Net model achieved an accuracy of 91.8%. The accuracy was higher in the presence of orthodontic appliances (92.6%).
Aykol-Sahin	2024	Assessed different CNNs in deep learning algorithms to detect keratinized gingiva based on intraoral photos and evaluated the ability of networks to measure keratinized gingiva width.	600	Res-Net 50, Mobilenettv2, ResNet 18, UNet	Periodontists	Among the compared networks, ResNet50 distinguished keratinized gingiva at the highest accuracy rate of 91.4%. The measurements between deep learning and clinicians were in excellent agreement according to jaw and phenotype.
Chau	2023	An assessment of a novel AI system to detect gingivitis from intraoral photographs	567	DeepLabv3+built on Keras (v2.12,GoogleLLC) with Tensor Flow2	Dentist	The accuracy of this method was above 90% in diagnosing gingivitis

Table 1. Description of included studies (continue)

Study	Year	Brief Description	Image Total	ML Architecture	Performance Comparison	CNN Performance Comment
Chen	2020	Visual recognition of gingivitis testing a novel ANN for binary classification exercise—gingivitis or healthy.	180	ANN (no description)	Not comparative	ANN accuracy of 75% for presence of gingivitis from photographs.
Joo	2019	Descriptive analysis of preliminary data for imaging analysis concepts, employing a method that confirms the presence of periodontal disease by photographs with a CNN.	451	CNN encoder + 1 dense layer	Not comparative	Reported CNN accuracy of 70–81% for validation data
Khaleel	2021	Assessment of different algorithms' efficacy in recognizing gingival and oral diseases.	120	BAT algorithm, PCA, SOM	Not comparative	BAT method provided 95% accuracy against ground truth
Kurt-Bayrakdar	2023	Evaluated the effectiveness of the deep learning algorithm YOLOv5 in identifying key periodontal conditions such as frenulum attachments, gingival hyperplasia, and gingival inflammation from digital dental photographs.	1296	YOLOv5	Not comparative	In this detection analysis, frenulum accuracy was 71%, gingival hyperplasia accuracy was 56%, and gingival inflammation accuracy was 64%.
Li.GH	2021	Different CNNs trialed for RGB assessment of gingival tissues to assess inflamed gingiva detection on photographs.	110	DeepLabv3+	Not comparative	MobileNetV2 performed in a similar manner to Xception65; however, Mob, was 20× quicker.
Li	2021	CNN was used for gingivitis, its irritants, calculus, and soft deposit detection by photographs.	3932	Multi-Task Learning CNN (FNet, CNet and Lnet)	Not comparative	The model achieved a classification AUC of 87.11% for gingivitis, 80.11% for dental calculus, and 78.57% for soft deposits.
Li	2024	Evaluated deep convolutional neural networks, particularly ResNet and GoogLeNet, using ensemble learning to effectively identify gingivitis from intraoral images.	683	ResNet and GoogLeNet	Not comparative	Among the four models, the ResNet and GoogLeNet models performed well with high recognition accuracy. GoogLeNet detected gingivitis from oral images, achieving the highest diagnostic accuracy, 97%.
Moriyama	2019	CNN was used to establish if there is a correlation between pocket depth probing and images of the diseased area.	820	AlexNet with GAN-based augmentation	Not comparative	Changes in ROC curves significantly affected outcomes. The sensitivity was 74.0%, and the specificity was 88.7%.
Rana	2017	The machine learning classifier provided pixel-wise inflammation segmentations for the gingival index scores from photographs of color-augmented intraoral images.	405	CNN Autoencoder	Not comparative	AU ROC curve of 0.746 for classifier to distinguish between inflamed and healthy gingiva.
Shang	2021	Comparison of U-Net vs. comparison between U-Net and DeepLabv3/PSPNet architecture for image recognition on intraoral photos for wear, decay, calculus, and gingivitis.	7220	U-Net	Dentists	U-Net to have a 10% increased recognition of calculus, wear facets, gingivitis, and decay
You	2020	CNN used to assess plaque presence in primary teeth	886	DeepLabv3+	Orthodontists	MIoU of the AI model was 72%. No statistically significant difference in the ability to discern plaque on photographs compared to clinician.
Yüksel	2024	Evaluated deep learning to diagnose dental plaque from photographs of permanent teeth.	168	DeepLabv3+	Dentist	DeepLabv3+ detected dental plaque with 87% accuracy and showed significantly higher performance than the dentist.

The author comprehensively analyzed the titles and abstracts, identifying the most relevant papers aligned with the current topic. Any articles deemed irrelevant were excluded. The full texts were then reviewed to ascertain their eligibility for studies that met the established inclusion criteria.

3. Results

3.1. Study Selection and Data Compilation

The search strategy led to the identification 338 studies from the selected databases: 140 from Google Scholar, 110 from Pubmed, 68 from Scopus and 20 from IEEE Xplore. 338 records were screened for titles and abstracts, leading to the selection of 21 studies potentially eligible for this systematic review. 5 studies were excluded due to exclusion criteria. These studies were evaluated for eligibility by full-text assessment. The flowchart of the study selection was shown in Figure 1. Finally, 16 articles were included in the analysis. The included articles were evaluated based on a set of predefined criteria, with the key findings summarized in Table 1. A total of ten studies assessed the detection of gingivitis and inflammation, while four studies evaluated dental plaque. Additionally, two studies evaluated calculus. There was one study each evaluating keratinized gingiva, frenulum attachment, gingival hyperplasia, and periodontal pocket.

3.2. Publication Year

Figure 2 illustrates the year in which the studies were published. The first was released in 2017, and the frequency of publication increased over the subsequent seven years, with the exception of 2022.

3.3. ML Architectures

The included studies used a wide range of convolutional architectures (n=16). The most common architectures were different CNN algorithms of DeepLabv3+ series network (n=6). ML architectures of the studies were presented in Table 1.

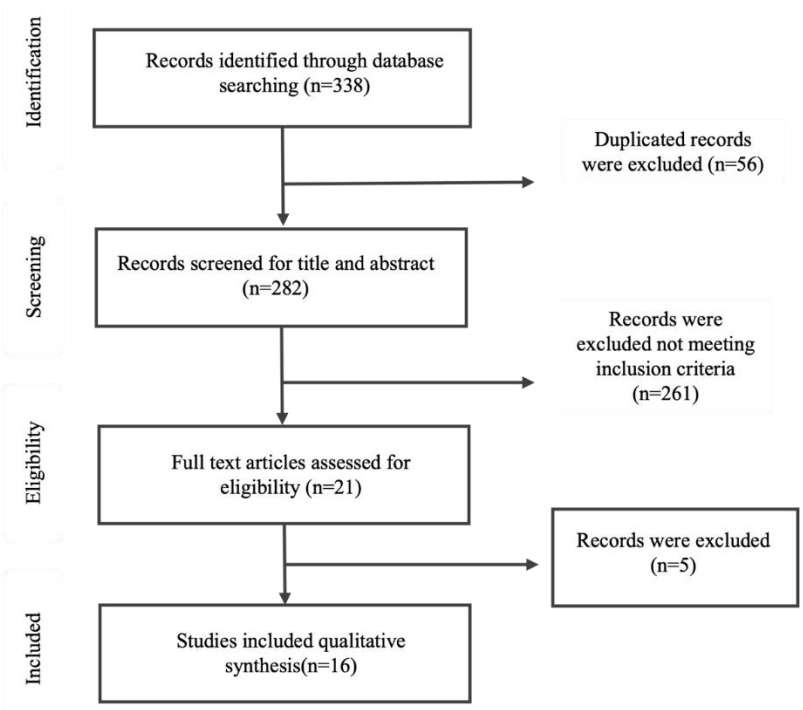

Figure 1. Flow diagram of the review strategy.

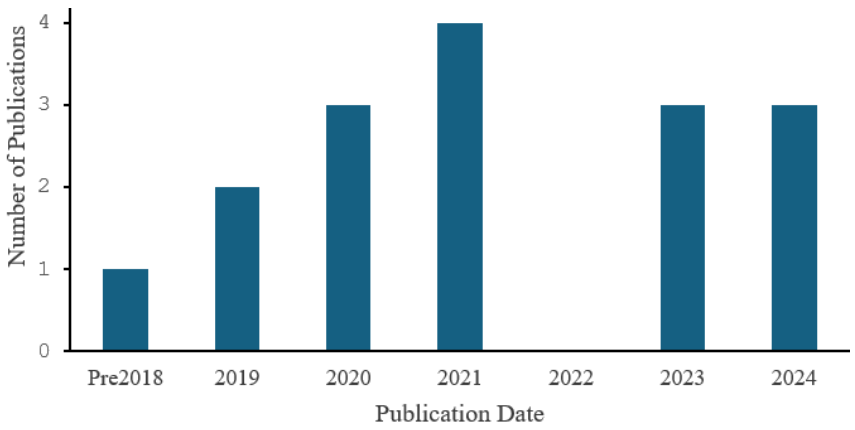

Figure 2. Distribution of publications according to years.

3.4. Datasets and Training

In the context of image data processing, CNNs are designed to emulate human cognitive processes, necessitating a training phase to enable them to perform their intended functions. Datasets for image processing studies ranged from 110 to 7220. The distribution of image dataset numbers was presented in the Figure 3. In the included studies, the majority of labeling methods involved manually annotating by drawing or labelling the external pixels of the desired features.

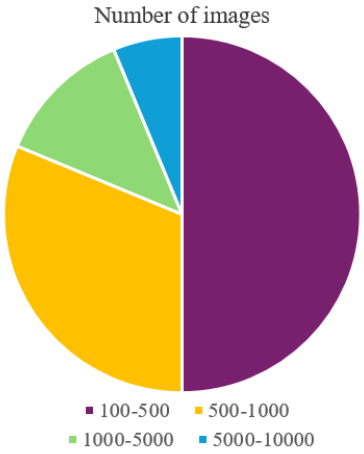

Figure 3. Numbers of images used in training datasets.

4. Discussion

Machine learning, a subfield of artificial intelligence, entails the construction of statistical models for the classification of data or images and the prediction of risks or outcomes (Sharifani and Amini, 2023). This is achieved through the utilization of techniques such as regression, k-nearest neighbours, decision trees, random forests, support vector machines (Sharifani and Amini, 2023). In essence, ML is a field of study that aims to enable computers to recognize patterns and make decisions based on data. Machine learning can be classified into supervised and unsupervised learning. In supervised learning, models are developed using training data that includes known outcome labels or classification variables. In contrast, unsupervised learning does not provide models with outcome labels, necessitating the independent identification of structures and patterns within the data (Pitchika et al., 2024). Irrespective of the approach employed, the trained model is validated using an independent dataset, and its performance is evaluated with metrics such as sensitivity, specificity, accuracy, balanced accuracy, and F1-score (the harmonic mean of precision and recall), among others (Hicks et al., 2022). Deep learning, a subset of ML, employs algorithms inspired by the structure and function of the human brain, namely artificial neural networks (ANNs). These consist of interconnected neurons capable of processing information and learning from data. CNNs, a subclass of DL models, are particularly adept at analyzing complex image modalities (Pitchika et al., 2024). This is achieved by employing convolutional layers to process data in small, overlapping sections, thereby enabling the recognition of local patterns within an image (Huang et al., 2023). While few of the included studies (Joo et al., 2019; Chen and Chen, 2020; Khaleel and Aziz, 2021) used unsupervised learning, supervised learning where models are trained on labeled datasets was opted in most studies. These labels assist the algorithm in identifying the patterns associated with specific outputs. Chen and Chen (2020) used unsupervised learning algorithms (Gray-Level Co-occurrence Matrix, Artificial Neural Network and Genetic Algorithm) for detecting gingivitis. They added Genetic algorithm to solve the binary classification problem in their previous studies. Their accuracy improved to 75% from 68%. Another unsupervised learning study was by Khaleel and Aziz (2021). Unlike Chen and Chen (2020) which distinguished the health gingiva and gingivitis, Khaleel and Aziz (2021) assessed recognizing different gingival and oral diseases. They used the BAT algorithm with a self-organization feature map. With this method, they detected different gingival and oral diseases with 95% accuracy against ground truth. On the other hand, while slower and more resource-intensive, labeling provides high-quality data crucial for training accurate supervised learning models (Peng and Wang, 2021). Labeling involves manually or automatically assigning labels to data points so that a machine learning algorithm can learn to predict these labels from the features of the data. It is particularly effective when high diagnostic precision is required. In practice, a hybrid approach that combines automated methods for initial analysis and data reduction, followed by expert-driven labeling for final model training, could potentially offer a balance between efficiency and accuracy (Das et al., 2017). Alalharith et al. (2020) indicated that they utilized Padilla and Silva's implementation, which compares the ground truths to the model's detections to evaluate the object detection model accurately and unbiasedly for the detection of early signs of gingivitis. They reported that their model has achieved an accuracy that is 10% higher than that of models using traditional machine learning methods, thus proving the current technique to be more advantageous than traditional methods. Unlike traditional machine learning techniques, deep CNN algorithms have the capability to efficiently learn representations and extract features that may hold great predictive capabilities due to their deep multi-layer architecture (Alalharith et al., 2020). Rana et al. (2017) used a machine learning classifier, CNN-encoder, to provide pixel-wise inflammation segmentations for the gingival index scores from photographs of color-augmented intraoral images and compared the results with dentists. Three dentists validated the classifier segmentation and the agreement between the experts and the classifier. CNN-encoder can learn from unlabeled data, making them useful when explicit annotations are scarce or expensive to obtain. However, while they can generalize well, this is contingent on having a diverse training dataset that

captures all variations of gingivitis. CNNs recognize and segment the images, and to capture local patterns, they utilize filters such as edges, shapes, and textures in images. The ability of these networks to learn such features layer by layer (moving from simple to complex structures) is fundamental to their success (Huang et al., 2023).

DeepLabv3+ is used for semantic image segmentation, which is critical for accurately delineating object boundaries. DeepLabv3+ employs atrous convolutions to capture multi-scale context, which involves recognizing local and broader patterns to improve segmentation accuracy (Chen et al., 2018). In the included studies, the most common architectures were different CNN algorithms of the DeepLabv3+ series network (You et al., 2020; Li et al., 2021; Chau et al., 2023; Aykol-Sahin et al., 2024; Li et al., 2024; Yüksel et al., 2024). If the goal is simultaneously identifying gingivitis while also recognizing related conditions like dental calculus or plaque levels, CNNs with Multi-task Learning present advantages. Li et al. (2021) used Multi-task CNN to detect gingivitis and its irritants, calculus, and soft deposits. It achieved a classification AUC of 87.11 for gingivitis, 80.11% for dental calculus, and 78.57% for soft deposits (Li et al., 2021). Shang et al. (2021) used U-Net to detect wear, decay, calculus, and gingivitis from intraoral photos. U-Net recognized calculus, wear facets, gingivitis, and decay 10% more effectively than DeepLabv3/PSPNet architecture, with an average mIou of 50.41% (Shang et al., 2021). On the other hand, Kurt-Bayrakdar et al. (2023) assessed the detection of different gingival diseases and anatomical structures using a different CNN model, YOYOv5. YOYOv5 is fine-tuned for high accuracy across various object detection tasks. They found the frenulum accuracy was 71%, gingival hyperplasia accuracy was 56%, and gingival inflammation accuracy was 64%. Unlike Shang et al. (2021), Andrade et al. (2023) had higher accuracy at 91.8%, in detecting dental biofilm using U-Net. Due to its specialization in segmentation, U-Net is likely more suited to detect and precisely delineate one specific situation in dental images. YOLOv5 would be more advantageous in scenarios requiring broader object detection within dental photos, such as quickly identifying various conditions or anomalies within a broader diagnostic context. DeepLabv3+ and U-Net are both strong in segmentation tasks. DeepLabv3+ is optimized for more generalized tasks, with its atrous convolution allowing an adaptable field of view, making it suitable for varied image resolutions. U-Net, with its specific design for medical segmentation, might provide better results in medical contexts where high precision in small-scale segmentation is required. Yüksel et al. (2024) evaluated DeepLabv3+ to diagnose dental plaque from photographs of permanent teeth. DeepLabv3+ detected dental plaque with 87% accuracy and showed significantly higher performance than the dentist. Aykol-Sahin et al. (2024) compared the efficiency of different CNN models in distinguishing keratinized gingiva from nonkeratinized gingiva. Among the compared networks, ResNet50 with the DeepLabv3+ architecture distinguished keratinized gingiva at the highest accuracy rate of 91.4%. However, U-Net showed the lowest accuracy value compared to other DeepLabv3+ models. They also evaluated the efficiency of measuring keratinized tissue wide from the results of ResNet50 and compared it with two clinicians. The measurements between deep learning and clinicians agreed according to jaw and phenotype. Chau et al. (2023) assessed a novel AI system, DeepLabv3+built on Keras with Tensor Flow2 to detect gingivitis from intraoral photographs. The accuracy of this method was above 90% in diagnosing gingivitis. The novel AI system was able to identify specific sites with and without gingival inflammation with sensitivity and specificity that was almost on par with human dentists.

Datasets for image processing studies in the present review ranged from 110 to 7220. The amount of data directly influences a model's ability to generalize well to new, unseen data. With insufficient data, models are more prone to overfitting, where they perform well on training data but poorly on any new data. A larger dataset provides a more diverse range of examples from which the model can learn, allowing it to capture a wide array of features and nuances that might be missed with a smaller dataset (Kufel et al., 2023). Augmentation models are typically effective in making datasets larger and more varied for training robust machine learning models (Sharifani and Amini, 2023). Five studies in the current review used augmentation methods in their study (Moriyama et al., 2019; Li et al., 2021; Andrade et al., 2023; Aykol-Sahin et al., 2024; Li et al., 2024). In their study, Chen and Chen (2020) stated their intention to collect a larger number of images of gingivitis and employ data augmentation techniques to construct a valid dataset for future studies. Furthermore, Joo et al. identified the overfitting problem as a limitation, noting that additional data or the application of data augmentation and data regularization techniques not utilized in their paper would be beneficial in addressing this issue. Moriyama et al. (2019) presented an approach to enhancing the accuracy of periodontal pocket detection by utilizing a MapReduce-like model integrated with advanced neural network techniques. This approach, specifically tailored to estimate pocket depth from enhanced pocket region images, improved the estimation accuracy from 78.3% to 84.5% and sensitivity from 50.4% to 74.0%, with a specificity of around 90%, compared to the MapReduce-like model without the augmentation.

The integration of AI in periodontology offers significant potential to improve clinical practice by enhancing early detection and diagnostic accuracy. However, successful implementation requires addressing several practical considerations, such as training clinicians to effectively interpret AI insights and integrating AI tools into existing workflows without disruption. Challenges include

ensuring data quality, addressing regulatory and ethical concerns, managing costs, and facilitating clinician acceptance and adaptation.

Limitations of this review may include a limited focus on specific AI techniques or applications, potentially overlooking other relevant AI advances or methods in periodontology. The review may have relied on a few studies with varying dataset sizes and quality, which may affect the generalizability of findings and the effectiveness of AI models. In addition, potential biases in AI models and their impact on diagnostic accuracy may not be fully addressed, affecting the reliability of AI systems in different patient populations.

5. Conclusion

The application of artificial intelligence has the potential to significantly enhance periodontics and preventive dentistry, particularly through the analysis of intraoral photographs, which could facilitate more accurate detection and decision-making. Selecting the appropriate deep learning model, such as CNNs for spatial analysis or U-Net for precise segmentation, is critical to effectively interpreting dental images. Training these models on diverse datasets that include various dental conditions might ensure better generalization and diagnostic accuracy. Integrating these technologies into clinical workflows might enhance usability for dental professionals, allowing them to apply AI insights in patient care easily.

Author Contributions

The percentage of the author(s) contributions is presented below. All author(s) reviewed and approved the final version of the manuscript.

	G.A.Ş.
C	100
D	100
S	100
DCP	100
DAI	100
L	100
W	100
CR	100
SR	100
PM	100
FA	100

C=Concept, D= design, S= supervision, DCP= data collection and/or processing, DAI= data analysis and/or interpretation, L= literature search, W= writing, CR= critical review, SR= submission and revision, PM= project management, FA= funding acquisition.

Conflict of Interest

The author declare that there is no conflict of interest.

Acknowledgments

The author would like to thank Assoc. Prof. Sibel Kayaaltı Yuksek and Istanbul Okan University, Faculty of Dentistry, Periodontology Department for their invaluable support and contributions.

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