

Examining the knowledge of nurses regarding pupil assessment*

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ABSTRACT

Aims: This study was conducted to examine the knowledge of nurses regarding pupil assessment.

Methods: This descriptive cross-sectional study was carried out using an online questionnaire distributed via a virtual snowball sampling method. The study was conducted with 114 nurses who voluntarily agreed to participate between September 1 and December 1, 2023. Descriptive statistics were used in the data analysis. The study was reported in accordance with the STROBE guidelines.

Results: The mean age of the participants was 29.46 ± 5.89 years; 73.7% were female and 74.6% had a bachelor's degree. Of the nurses, 67.5% had between 1 and 5 years of professional experience, and 44.7% were working in an intensive care unit. A total of 51.8% of the participants reported having received training related to pupil assessment. The mean score obtained from the pupil assessment knowledge form was 17.94 ± 4.91 .

Conclusion: Nurses' knowledge levels regarding pupil assessment were found to be at a moderate level. Including practical, topic-specific content in training programs may contribute to clinical decision-making processes and enhance patient safety.

Keywords: Consciousness, neurologic examination, nursing education, pupils

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INTRODUCTION

Neurological and neurosurgical diseases encompass a wide spectrum of clinical disorders affecting the nervous system, ranging from benign to malignant and from acute to chronic conditions. These diseases significantly impact individuals' quality of life and are considered a global health concern, especially due to their higher prevalence in the elderly population (Dumurgier & Tzourio, 2020).

A comprehensive assessment is crucial for individuals presenting with neurological symptoms. Neurological examination is a multifaceted clinical assessment that includes history taking, evaluation of the level of consciousness, cranial nerve functions, and reflexes. Assessing the level of consciousness is one of the fundamental components of neurological examination and is commonly performed using the Glasgow Coma Scale (GCS) (Sepit, 2005; Mehta & Chinthapalli, 2019). In addition to evaluating eye opening, verbal, and motor responses with this scale, other parameters such as pupil activity and brainstem reflexes should also be considered (Mehta & Chinthapalli, 2019). The pupil's response, regulated by the autonomic nervous system, provides critical information regarding the functionality of the sympathetic and parasympathetic systems (Memetoğlu, 2022). In clinical assessment, four essential parameters should be routinely observed: pupil size, light reflex, shape, and the presence of

anisocoria (Kerr et al., 2016). Abnormal pupillary findings can be early indicators of life-threatening conditions such as increased intracranial pressure and serve as warning signs for further investigations (Kebapçı & Topçu, 2020). The reliability of pupil assessment directly depends on the knowledge and skill level of the healthcare professional performing the evaluation. The limited use of objective assessment devices increases dependence on subjective methods, which may lead to inter-observer inconsistencies (Kebapçı & Topçu, 2020). Studies have shown that nurses with lower levels of experience may encounter difficulties in neurological assessment and that knowledge deficits can adversely affect clinical decision-making processes (Kotani et al., 2021; Sharma et al., 2016). In a systematic review conducted by Chan et al. (2013), the challenges nurses face in assessing the level of consciousness were reported to be related to a lack of knowledge and insufficient experience. Similarly, Bae and Roh (2019), in a study conducted among Korean nurses, determined that there is a significant need for intensive training to improve neurological assessment skills.

In this context, determining nurses' knowledge levels regarding pupil assessment, which is an integral part of neurological examination, is crucial for guiding educational planning and enhancing patient safety. The aim of this study is to evaluate the knowledge levels of nurses concerning pupil assessment.

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METHODS

Ethics

Before starting the study, ethical approval was obtained from the Gülhane Scientific Researches Ethics Committee (Date: 22.08.2023, Decision No: 2023/219). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki. At the beginning of the survey, participants were provided with information regarding the aim of the research and the voluntary nature of participation. Only those who consented to the digital informed consent form were included in the study.

Research Design and Population

This research is a descriptive and cross-sectional study conducted to determine the knowledge levels of nurses regarding pupil assessment. The study population consisted of nurses actively working across Türkiye. The sample comprised 114 nurses who voluntarily completed the online questionnaire and met the research criteria.

Inclusion Criteria

The inclusion criteria for participation in the study were determined as being over 18 years of age, able to speak Turkish, actively working in the field, working in adult services and voluntarily completing the online questionnaire. Nurses working exclusively in pediatric settings were excluded from the study, as pupillary evaluation in children differs from that in adults. Pupillary evaluation in pediatric patients differs from that in adults due to the ongoing development of the central nervous system, the prevalence of physiological variations, and limited cooperation (Kline & Bajandas, 2012; Wright & Strube, 2012). Since pupillary reactivity may not be fully developed in newborns, it is recommended to use indirect light sources during examination and to consider retinal sensitivity (Volpe, 2008). In addition, physiological anisocoria is frequently observed during childhood and is generally not clinically significant; however, it should be carefully evaluated in the differential diagnosis of pathological conditions (Wilhelm & Wilhelm, 2005). In this context, it is essential that healthcare professionals performing pediatric neurological examinations adopt a systematic approach appropriate to age and developmental stage (Berk & Yaman, 2007).

Data Collection Tools

A questionnaire consisting of two parts was prepared for data collection. The first part was a data collection form that gathered sociodemographic information (gender, age, educational status, years of experience, department, and level of education). The second part was a 27-item knowledge form developed by the researcher based on a review of the literature (Kebapçı & Topçu, 2020; Kerr et al., 2016; Kotani et al., 2021; Sharma et al., 2016; Tyukhova & Waters, 2018; Kramer et al., 2014; Larson & Behrends, 2015; Omburo et al., 2017; Bergamin et al., 1998; van Rij et al., 2019; Pedrotti et al., 2014; Memetoğlu, 2022; Lee et al., 2017). In this study, expert opinions were obtained to assess the content validity of the knowledge test developed by the researchers. The data were analyzed using the DAVIS technique. For each item, the Content Validity Index (CVI) was calculated, and items with a CVI value of 0.80 or higher were considered appropriate and included in the test. This knowledge form was used to examine nurses' knowledge levels regarding pupil assessment. Each correct answer was scored as 1 point, while incorrect and "no idea" responses were scored as 0 points. The total achievable score ranged from 0 to 27. To ensure that participants carefully read each item, control questions such as "This item is included to assess whether respondents are

reading the questions carefully. If you are reading this, please select 'yes.'" were inserted between questionnaire items.

Data Collection Process

Data were collected online between September 1 and December 1, 2023. During the data collection process, a questionnaire prepared using the Google Forms platform was shared via social media channels (WhatsApp, Twitter, Instagram, etc.) and distributed to the target group using a virtual snowball sampling method. Initially, 20 individuals were contacted, and the survey link was shared with them. Later participants who completed the survey facilitated its distribution by sharing it with their colleagues in their own institutions.

Statistical Analysis

The collected data were analyzed using IBM SPSS Statistics version 25.0. Descriptive statistics such as mean, standard deviation, and percentage were used in the data analysis.

RESULTS

The findings related to the nurses' demographic characteristics are presented in Table 1. The mean age of the 114 nurses who participated in this study was 29.46 ± 5.89 years; 73.7% were female and 26.3% were male. Of the participants, 74.6% held a bachelor's degree, 67.5% had 1–5 years of professional experience, and 44.7% were working in an intensive care unit. Additionally, 51.8% of the nurses reported that they had previously received training on pupil assessment.

Table 1. Descriptive characteristics of nurses (n=114)

Characteristics	n	%
Gender		
Female	84	73.7
Male	30	26.3
Age		
23-33	98	86
34-44	9	7.9
45-55	7	6.1
Education level		
High school	7	6.1
Associate degree	10	8.8
Licence	85	74.6
Master's degree	12	10.5
Working year		
Less than 1 year	6	5.3
1-5 years	77	67.5
6-10 years	12	10.5
11-15 years	14	12.3
More than 15 years	5	4.4
Department of study		
Intensive care unit	51	44.7
Internal clinic	16	14.0
Surgery clinic	19	16.7
Emergency unit	7	6.1
Operating room unit	13	11.5
Other*	8	7.0
Pupil evaluation status in the department worked		
It's not being done.	38	33.3
It is done 1-2 times a day.	25	21.9
It is done throughout the day at 2-3 hour intervals.	6	5.3
It is done according to the patient's condition.	29	25.4
It is performed on every patient for 24 hours.	13	11.4
Other	3	2.6
Previous receiving training on pupil assessment		
Yes	59	51.8
No	55	48.2

n: Number of people, %: Percentage, * Nursing home and blood bank

The nurses' responses to the statements regarding pupil assessment are presented in **Table 2**. Analysis of the 27 statements in the questionnaire revealed that the items with the highest percentage of correct answers were "In pupil evaluation, the light response of the pupils is evaluated." (96.49%) and "In pupil evaluation, the size of the pupils is evaluated. (92.98%). The items with the lowest percentage of correct answers were "In general, as age increases, the size of the pupils may decrease." (30.7%) and "Healthy people can also have anisocoria." (32.46%). When the scores obtained from the pupil assessment knowledge form were examined, the nurses' mean knowledge score was calculated as 17.94 ± 4.91 .

DISCUSSION

This study revealed that nurses' knowledge levels regarding pupil assessment, which is an important part of neurological examination, were at a moderate level. The majority of nurses answered questions correctly about environmental lighting, the power of the light source, and tools such as pupillometry. However, it was observed that correct response rates were lower for questions addressing pharmacological and physiological knowledge, such as 'stress dilates pupils,' 'pain stimuli dilate pupils,' and 'catecholamines dilate pupils.' These findings suggest that while nurses' practical knowledge of assessment techniques is adequate, there are gaps in their understanding

Table 2. Nurses' responses to statements related to pupil assessment (n=114)

Expressions	True % (n)	False % (n)	No idea % (n)	Correct response % (n)
Questions related to pupil physiology				
1. In general, as age increases, the size of the pupils may decrease.	30.70 (35)	21.05 (24)	48.25 (55)	30.70 (35)
2. When the eye focuses on a close point, the pupil narrows.	53.51 (61)	21.05 (24)	25.44 (29)	53.51 (61)
3. The majority of the pupillary response time is typically about 1 second.	39.47 (45)	9.65 (11)	50.88 (58)	39.47 (45)
4. Catecholamines dilate pupils.	45.61 (52)	7.89 (9)	46.49 (53)	45.61 (52)
5. The possibility of anisocoria increases with age.	41.23 (47)	22.81 (26)	36.96 (41)	41.23 (47)
6. Pain stimulus dilates the pupils.	46.49 (53)	18.42 (21)	35.09 (40)	46.49 (53)
7. The light reflex is lost in a person under deep anesthesia.	57.02 (65)	24.56 (28)	18.42 (21)	57.02 (65)
8. In cases of long-term hypoxia, the pupillary reflex may disappear.	84.21(96)	1.75 (2)	14.04 (16)	84.21(96)
9. Healthy people can also have anisocoria.	32.46 (37)	40.35 (46)	27.19 (31)	32.46 (37)
10. A light color of the evaluated eye makes it easier to evaluate pupillary reflexes.	44.74 (51)	30.7 (35)	24.56 (28)	44.74 (51)
11. Stress dilates pupils.	66.67 (76)	10.53 (12)	22.81 (26)	66.67 (76)
12. The duration of the light reflex is prolonged in patients experiencing Increased Intracranial Pressure Syndrome (IPR).	59.65 (68)	1.75 (2)	38.60 (44)	59.65 (68)
13. The patient's history of eye surgery and the presence of a neurological disease may affect pupillary reflexes.	86.84 (99)	1.75 (2)	11.41 (13)	86.84 (99)
14. Hypoglycemia causes the light reflex of the pupils to disappear and the pupils to dilate.	50% (57)	6.14 (7)	43.86 (50)	50% (57)
Expressions	True % (n)	False % (n)	No idea % (n)	Correct response % (n)
Questions related to the technique of pupillary reflex assessment				
1. Pupil evaluation is a subjective evaluation.	39.47 (45)	50.88 (58)	9.65 (11)	50.88 (45)
2. Experience affects pupillary evaluation.	88.60 (101)	10.53 (12)	0.88 (1)	88.60 (101)
3. In pupil evaluation, the size of the pupils is evaluated.	92.98 (106)	4.39 (5)	2.63 (3)	92.98 (106)
4. In pupil evaluation, the light response of the pupils is evaluated.	96.49 (110)	0.88 (1)	2.63 (3)	96.49 (110)
5. In pupil evaluation, the shape of the pupils is evaluated.	78.95 (90)	14.04 (16)	7.01 (8)	78.95 (90)
6. In pupil evaluation, anisocoria status is evaluated.	87.72 (100)	0	12.28 (14)	87.72 (100)
7. Assessment of the pupil light reflex is necessary for the diagnosis of factors such as brain stem lesions, effects of drugs, etc.	83.33 (95)	2.63 (3)	14.04 (16)	83.33 (95)
8. Pupil evaluation should be done by standing directly in front of the patient.	85.09 (97)	7.89 (9)	7.02 (8)	85.09 (97)
9. Measurement tools such as pupilla ruler and pupillometry can be used in pupil evaluation.	61.40 (70)	8.77 (10)	29.83 (34)	61.40 (70)
Expressions	True % (n)	False % (n)	No idea % (n)	Correct response % (n)
Questions related to the light source				
1. During pupil evaluation, excessive ambient lighting may reduce the pupil diameter.	85.09 (97)	10.53 (12)	4.38 (5)	85.09 (97)
2. Low battery power of the light source used may prevent the formation of adequate reflexes in the pupils.	84.21 (96)	4.38 (5)	11.41 (13)	84.21 (96)
3. As the distance between the light source and the pupil increases, it may cause the pupil diameter to be perceived as larger.	74.56 (85)	7.02 (8)	18.42 (21)	74.56 (85)
4. The fact that the light source used during pupil evaluation is not standardized affects the pupil evaluation because it emits light at different levels.	85.96 (98)	0	14.04 (16)	85.96 (98)

n: Number of people, %: Percentage

of pathophysiological mechanisms. The literature also shows that nurses tend to rely more on subjective observation methods and do not sufficiently use objective assessment tools (Kerr et al., 2016; Kebapçı & Topçu, 2020). Limited use of technological tools such as pupillometry may reduce nurses' ability to assess pupillary reflexes accurately and in a standardized manner. Studies by Kramer et al. (2014) and Anderson et al. (2018) have demonstrated that pupillometers provide more reliable results than traditional observation methods. However, the limited use of such devices in clinical practice due to cost and lack of training turns the assessment process from an objective procedure into a subjective one.

It is known that environmental and individual factors such as age, eye color, lighting conditions, and the tools used can affect pupil assessment results (Guillon et al., 2016; Tyukhova & Waters, 2018). According to the survey results, only about one-third of nurses (30.7%) correctly identified the statement 'in general, as age increases, the size of the pupils may decrease.' Similarly, nearly half of the participants (41.23%) correctly agreed with the statement 'the possibility of anisocoria increases with age'. Studies have shown that age affects pupil diameter, that pupils tend to become smaller with age, and that the likelihood of anisocoria increases in some older adults (Kerr et al., 2016; Kotani et al., 2021; Sharma et al., 2016; Guillon et al., 2016). In order to distinguish whether changes in pupil condition are due to neurological causes or normal aging, nurses must be able to make this differentiation. Based on this finding, it can be concluded that participating nurses have knowledge gaps on this topic. The statements 'during pupil evaluation, excessive ambient lighting may reduce the pupil diameter,' 'Low battery power of the light source used may prevent the formation of adequate reflexes in the pupils,' and 'the fact that the light source used during pupil evaluation is not standardized affects the pupil evaluation because it emits light at different levels,' were correctly identified by the majority of nurses (85.9%, 84.21%, and 85.96%, respectively). Another statement, 'as the distance between the light source and the pupil increases, it may cause the pupil diameter to be perceived as larger,' was correctly identified by most nurses (74.56%). The responses indicate that nurses generally have knowledge about ambient light and light sources used during pupil assessment, although about 10–15% lack sufficient information on this topic.

Environmental lighting and the light source used to trigger the reflex are two important factors affecting pupil assessment. Studies have indicated that excessive ambient lighting may trigger the light reflex, making it difficult for the assessor to observe the reflex correctly or leading to misinterpretation. Similarly, the amount of light emitted by the source affects the light reflex. Insufficient light output or an increased distance between the source and the pupil negatively impacts the light reflex (Sharma et al., 2016; Tyukhova & Waters, 2018; Kramer et al., 2014; Omburo et al., 2017; Guillon et al., 2016). Another study found significant differences in pupil assessment results among assessors using different light sources (Omburo et al., 2017).

According to the literature, individuals with light-colored (blue-green) irises have more easily detectable pupillary reflexes than those with dark-colored (brown-black) eyes, and light-colored eyes are more sensitive to light, producing faster

reflexes (Bergamin et al., 1998). Nearly half (44.74%) of the nurses correctly identified the statement 'a light color of the evaluated eye makes it easier to evaluate pupillary reflexes.'

The survey results also revealed that nurses have knowledge gaps regarding pharmacological effects (e.g., catecholamines, stress, anesthesia, hypoxia) and age-related physiological changes. The statement 'assessment of the pupil light reflex is necessary for the diagnosis of factors such as brain stem lesions, effects of drugs, etc.' was correctly identified by the majority of nurses (83.33%). This indicates that nurses recognize the importance of pupil assessment and understand when it should be performed (Kotani et al., 2021). Although the main purpose of pupil assessment is to detect abnormalities, nurses must first understand normal pupillary reflexes to recognize deviations. In this context, about half of the nurses (45.61%) correctly agreed with the statement 'catecholamines dilate pupils,' while more than half (66.67%) correctly identified that 'stress dilates pupils.' Approximately half (46.49%) of the nurses correctly responded to 'pain stimulus dilates the pupils,' and more than half (57.02%) correctly identified 'the light reflex is lost in a person under deep anesthesia.' The statement 'in cases of long-term hypoxia, the pupillary reflex may disappear,' was correctly identified by most nurses (84.21%). Pain and certain drugs can affect the pupillary reflex (Larson & Behrends, 2015; Vinclair et al., 2019; Knaggs et al., 2004).

Increased intracranial pressure may cause abnormal pupillary reflexes, such as prolonged light reflex time (Kotani et al., 2021). More than half of the participants (59.65%) correctly identified the statement 'the duration of the light reflex is prolonged in patients experiencing Increased Intracranial Pressure Syndrome (IPR).' The majority (86.84%) correctly agreed that 'the patient's history of eye surgery and the presence of a neurological disease may affect pupillary reflexes.' About half of the nurses correctly responded to the statement 'hypoglycemia causes the light reflex of the pupils to disappear and the pupils to dilate.'

These findings indicate that topics related to neurological assessment should be addressed more comprehensively and in greater depth in nursing curricula. Early identification of neurological reflexes in clinical decision-making is critical for patient safety.

Limitations

This study has certain methodological limitations. Firstly, the representativeness of the sample is limited due to the small number of nurses reached through the virtual snowball sampling method, which restricts the generalizability of the findings to the entire nursing population. The voluntary nature of participation may also increase the risk of self-selection bias within the sample. Additionally, since the data were collected via an online self-report questionnaire, there is a possibility of social desirability bias, which may have led participants to portray their knowledge levels differently than they actually are. Moreover, this study assessed only theoretical knowledge; no observational or practice-based performance measurements were conducted. As a result, it was not possible to objectively evaluate nurses' actual behavior and knowledge levels in the clinical setting.

CONCLUSION

The results of this study suggest that nurses possess a moderate level of knowledge concerning pupil assessment. Pupil assessment is a vital component of neurological examination and can provide early and critical information about a patient's level of consciousness and brainstem functions. Therefore, it is of great importance for nurses to have sufficient knowledge and to improve their assessment skills to ensure patient safety.

Based on these findings, the following recommendations are offered:

- **Development of training programs:** The scope of theoretical knowledge and clinical practice content related to pupil assessment should be expanded in undergraduate nursing curricula. In particular, simulation-based training programs should be incorporated to develop skills in assessing the pupillary light reflex under realistic conditions.
- **In-service training:** Regular in-person or online in-service training programs should be planned and implemented to keep the knowledge levels of nurses working in clinical settings up to date.
- **Use of objective assessment tools:** The use of objective assessment devices such as pupillometers should be encouraged, and training on the use of these devices should be provided.
- **Standard protocols:** Hospital-based standard protocols for pupil assessment should be developed to ensure that assessments are conducted systematically and reliably.
- **Further research:** Comparative studies with larger sample sizes in different regions will help to more comprehensively reveal nurses' knowledge levels regarding neurological assessment.

Contribution to the Field

To the best of our knowledge, no comprehensive study has previously been conducted on this subject. This study contributes to the limited body of research that examines nurses' knowledge regarding pupil assessment. The findings are expected to offer significant insights for nursing education, clinical practice, and the delivery of healthcare services.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study, ethical approval was obtained from the Gülhane Scientific Researches Ethics Committee (Date: 22.08.2023, Decision No: 2023/219).

Informed Consent

Written informed consent was obtained from all individual participants prior to their inclusion in the study. Participants were fully informed about the study's aims, procedures, potential risks and benefits, and their rights—including the right to withdraw at any time without consequence. All participants voluntarily signed a written informed consent form.

Peer Review Process

This manuscript was subject to external peer review.

Conflict of Interest

The authors declare no conflicts of interest related to this study.

Financial Disclosure

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Author Contributions

All authors contributed significantly to the study's conception, design, data acquisition, analysis, and interpretation. All authors reviewed and approved the final version of the manuscript.

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