JOURNAL FOR HEALTH SCIENCES

University of Miskolc

Volume 15, Issue 2 (2025)

TARTALOMJEGYZÉK

TRIGLYCERIDE-TO-HDL-CHOLESTEROL RATIO AS A MEASURE OF INSULIN RESISTANCE IN OBESE CHILDREN AND ADOLESCENTS

ANNA PANAIKA[1] – LÁSZLÓ BARKAI[1, 2, *]
[1]Department of Paediatrics and Adolescent Medicine, Faculty of Medicine
Pavol Jozef Šafárik University, Kosice, Slovakia
[2]Institute of Theoretical Health Sciences, Faculty of Health Sciences
University of Miskolc, Hungary

Summary: Childhood obesity is associated with insulin resistance, type 2 diabetes, and metabolic syndrome. [1] [2] Although accurate, traditional insulin measurement techniques are not practical for routine clinical usage in pediatric populations [3]. This study investigates whether the ratio of triglycerides to HDL cholesterol can be used as a straightforward indicator of insulin resistance in obese children and adolescents. A retrospective study of 123 obese people aged 5 to 19 years discovered a moderate but substantial positive relationship between this ratio and insulin resistance, as evaluated by HOMA-IR. Higher ratios were associated with higher HOMA-IR readings and insulin levels. The triglyceride-to-HDL ratio may therefore provide a useful substitute for evaluating insulin resistance in clinical contexts, although more investigation is needed to validate its applicability in larger populations.

Keywords: *Childhood obesity, Insulin resistance, Triglyceride-to-HDL-cholesterol ratio, HOMA-IR, Metabolic syndrome.*

1. INTRODUCTION

Childhood obesity is rising globally, increasing the risk of insulin resistance, type 2 diabetes, and cardiovascular diseases. Therefore, there is an increasing need to identify accessible markers for insulin resistance, which is crucial for early intervention. While HOMA-IR and the hyperinsulinemic-euglycemic clamp are standard tools, their time-consuming and expensive nature makes them impractical for routine clinical use. [2] The TG/HDL ratio has emerged as a potential alternative marker, but its use in pediatric populations remains under-researched. This study investigates the relationship between the TG/HDL ratio and insulin resistance in obese children and adolescents. By assessing the correlation between the TG/HDL ratio and HOMA-IR, aiming to determine whether this marker can help identify children at risk for metabolic complications.

2. MATERIALS AND METHODS

2.1. Study Population

Data were collected from 123 obese children (aged 5–19 years) from the database of Department of Paediatrics and Adolescent Medicine, UPJS Kosice, Slovakia and the study was approved by the Ethics Committee of the University.

2.2. Data Collection

Clinical and laboratory parameters were analyzed, including age, sex, glucose, insulin, triglycerides, HDL, BMI, blood pressure, liver enzymes, and lipid profiles, TG/HDL ratio using as a cut off value the mean 1.0.

2.3. Definition of Obesity

Obesity was defined using BMI:
- ≥ 95th percentile for children under 14 years
- BMI ≥ 30 for children older than 14

2.4. Insulin Resistance Assessment

In order to access insulin resistance, HOMA-IR was calculated as:

$$\text{HOMA-IR} = \frac{\text{Fasting Insulin (mIU/L) x Fasting Glucose (mmol/L)}}{22.5}$$

2.5. Statistical Analysis

Correlation analysis was used to assess associations between HOMA-IR and biochemical, laboratory parameters and the correlation between TG/HDL ratio and HOMA-IR. Furthermore multiple regression analysis was performed to evaluate independent predictors of insulin resistance. As a dependent variable HOMA has been used. As an independent insulin level, total cholesterol, triglycerides, HDL, and GGT. The significance level was set as $p < 0.05$.

3. RESULTS

3.1. Correlation between laboratory and anthropometric parameters with HOMA

As a result of correlation analysis between the different parameters and HOMA. A moderate positive association between the triglyceride-to-HDL-cholesterol ratio and HOMA-IR is observed. Additionally, the highest positive correlation was seen with insulin levels. On the other hand, there were weak negative correlations between HOMA-IR and HDL and LDL cholesterol *(Table 1)*.

Table 1
Correlation of parameters with HOMA-IR

Parameters	Correlation with HOMA-IR	P value
TG/HDL ratio	0.2343	0.00000
AGE years	0.0254	0.00000
GLUCOSE mmol/L	0.2901	0.10988
UREA mmol/L	–0.0679	0.54855
INSULIN mIU/L	0.9853	0.00000
BMI kg/m²	0.1470	0.00000
SYSTOLIC BP mmHg	0.1121	0.00000
DIASTOLIC BP mmHg	0.1855	0.00000
TC mmol/L	–0.0099	0.51066
TG mmol/L	0.2552	0.00000
LDL mmol/L	–0.0213	0.00000
HDL mmol/L	–0.0654	0.00000
AST mIU/L	0.0057	0.00000
ALT mIU/L	0.1857	0.00000
GGT mIU/L	0.2134	0.00000

(BMI: body mass index, BP: blood pressure, TC: total cholesterol, TG : triglycerides, LDL: low density lipoprotein, HDL: high density lipoprotein, AST: aspartate aminotransferase, ALT: Alanine aminotransferase, GGT: gamma-glutamyl-transferase. HOMA-IR: Homeostatic Model Assessment for Insulin Resistance)

3.2. Group Comparisons

Participants were divided into two categories based on the mean value 1.00 of TG/HDL ratio. Children with TG/HDL > 1.00 showed higher insulin levels, HOMA-IR, LDL cholesterol, and total cholesterol. Evidence that suggests that patients with a higher TG/HDL ratio exhibited a higher HOMA ratio, indicating that individuals with a higher TG/HDL ratio tend to have greater insulin resistance *(Table 2)*.

Clinical parameters: TG/HDL ratio>1 compare to TG/HDL ratio <1.00

PARAMETERS	TG/HDL >1.00	TG/HDL <1.00	P VALUE
GENDER	32M/24 F	38M/29F	0.96
AGE years	13.00 ±3.31	13.64 ±3.13	0.33
GLUCOSE mmol/L	4.58 ±0.44	4.58 ±0.40	0.91
UREA mmol/L	3.97 ±0.79	4 ±0.83	0.53
INSULIN mIU/L	24.12 ±14.83	17.15 ±10.49	0.003
BMI kg/m^2	31.25 ±6.2	29.80 ±6.23	0.2
SYSTOLIC BP mmHg	124.66 ±15.31	124.149 ±15.56	0.85
DIASTOLIC BP mmHg	78.75 ±8.86	76.94 ±10.11	0.29
TC mmol/L	4.58 ±0.79	4.15 ±0.79	0.004
TG mmol/L	1.72 ±0.57	0.84 ±0.22	0.00
LDL mmol/L	2.99 ±0.66	2.48 ±0.72	0.0001
HDL mmol/L	1.15 ±0.15	1.51 ±0.54	0.00
AST mIU/L	1.24 ±6.22	0.41 ±0.12	0.94
ALT mIU/L	0.46 ±0.23	0.46 ±0.25	0.9
GGT m/IUL	0.45 ±0.41	0.33 ±0.19	0.05
HOMA-IR	4.95 ±3.19	3.53 ±2.15	0.05
% high blood pressure	35(62.5%)	40(59.7%)	0.13

(BMI: body mass index, BP: blood pressure, TC: total cholesterol, TG : triglycerides, LDL: low density lipoprotein, HDL: high density lipoprotein, AST: aspartate aminotransferase, ALT: Alanine aminotransferase, GGT: gamma-glutamyl-transferase. HOMA-IR: Homeostatic Model Assessment for Insulin Resistance)

3.3. Correlation between TG/HDL and other clinical parameters

During the correlation analysis between the TG/HDL ratio and other clinical parameters, there was found a notable positive association between the TG/HDL ratio and HOMA-IR, total cholesterol, LDL cholesterol and gamma-glutamyl transferase (GGT). However, significant negative correlations were observed with glucose and urea *(Table 3)*.

Table 3

Correlation between TG/HDL and other clinical parameter

Parameters	Correlation with TG/HDL	P value
HOMA-IR	0.23	0.05
AGE years	–0.05	0.33
GLUCOSE mmol/L	–0.12	0.91
UREA mmol/L	–0.12	0.53
INSULIN mIU/L	0.27	0.003
BMI kg/m²	0.08	0.2
SYSTOLIC BP mmHg	0.06	0.85
DIASTOLIC BP mmHg	0.18	0.29
TC mmol/L	0.22	0.004
TG mmol/L	0.93	0.00
LDL mmol/L	0.39	0.0001
HDL mmol/L	–0.48	0.00
AST mIU/L	0.05	0.94
ALT mIU/L	0.07	0.9
GGT mIU/L	0.32	0.05

(BMI: body mass index, BP: blood pressure, TC: total cholesterol, TG: triglycerides, LDL: low density lipoprotein, HDL: high density lipoprotein, AST: aspartate aminotransferase, ALT: Alanine aminotransferase, GGT: gamma-glutamyl-transferase. HOMA-IR: Homeostatic Model Assessment for Insulin Resistance)

3.4. Multiple Regression Analysis.

During data analysis using multiple regression analysis, where the dependent variable is HOMA-IR and the independent variables are insulin level, total cholesterol, triglycerides, HDL, and GGT, it was found that insulin levels had the strongest positive effect on HOMA-IR and triglycerides had a significant negative impact on HOMA-IR, while HDL cholesterol had no effect *(Table 4)*.

Predictor (Independent Variable)	Coefficient Effect on HOMA-IR	Std.error	t-value	P-value
Insulin	0.210042	0.00342	61.42198	<0.0001
TC	–0.03303	0.059849	–0.55186	0.582
TG	–0.2053	0.088782	–2.31239	0.022
HDL	0.007334	0.103366	0.070955	0.943
GGT	0.142723	0.144219	0.989627	0.324

Multiple R value is 0.9863, and its **R² is 0.9728** (This means that approximately 97% of the variation in HOMA-IR is explained by the predictors in this model.) **Dependent Variable:** HOMA-IR (Homeostatic Model Assessment for Insulin Resistance) **Independent Variables:** Insulin, Total Cholesterol (TC), Triglycerides (TG), HDL Cholesterol (HDL), Gamma-Glutamyl Transferase (GGT)

4. Discussion

Previous researches have established a strong correlation between the TG/HDL ratio and HOMA insulin resistance, aligning with our findings. These studies suggested mean TG/HDL ratio thresholds for assessing insulin resistance: Olson et al. proposed 2.0 [4], Behiry et al. 1.36 [5], and Iwani et al. 1.11 [6]. In our study, we used a threshold of 1.0 to differentiate between higher and lower TG/HDL ratios. These small differences between the different studies may suggest that there is still not a clear cut off value that can be used for assessing children with insulin resistance using the TG/HDL ratio, further broader studies can help differentiate and establish cut off values for universal use as insulin resistance assessment.

Furthermore our results also confirm the negative association between the TG/HDL ratio and HDL cholesterol, with a correlation coefficient of r = –0.48, consistent with findings by Demiral M. [7] and Olson et al. In addition, we observed a positive connection between the TG/HDL ratio and other metabolic indicators such as triglycerides, insulin, and total cholesterol, supporting its significance as a metabolic marker. Moreover Katsa et al. [8] highlighted the positive correlation between the TG/HDL ratio and LDL cholesterol, linking it to increased cardiovascular risk. Our study supports this association but missing detailed cardiovascular assessments, limiting direct conclusions. Future research should explore this relationship further with comprehensive cardiovascular evaluations.

Comparing this study's results with the ones of Krawczyk et al. [9], there were observed differences and similarities. Unlike their findings, we found no significant relation between weight and the TG/HDL ratio, suggesting population-specific variations. However, both studies confirmed a positive association between the TG/HDL ratio and triglycerides. Furthermore, while we observed a negative correlation between the TG/HDL ratio and HDL cholesterol, Krawczyk et al.

reported a positive connection, potentially due to differences in population characteristics. These findings emphasize the complexity of lipid metabolism and the necessity for further research in diverse populations to clarify these associations. Furthermore, to analyze how the borderline significant and significant data affected the HOMA-IR, a different method of statistical analysis was used, the multiple regression analysis which indicated a strong predictive model for HOMA-IR, with insulin and triglycerides appearing as the most significant predictors. The model had an excellent fit ($R^2 = 0.9728$), explaining nearly 97% of the variance in insulin resistance as evaluated by HOMA-IR. Insulin revealed a strong positive connection with the independent variables, implying that greater insulin levels contribute considerably to increased insulin resistance. Interestingly, triglycerides were also statistically significant in this model, although they linked negatively with HOMA-IR, a finding that needs further exploration. However, despite their biological significance, additional parameters including total cholesterol, HDL, and GGT did not exhibit significant individual impacts. These results underline the importance of triglyceride and insulin levels in regulating insulin resistance in the population under study and support the necessity of taking these factors into account when determining metabolic risk. In conclusion, our study provides strong evidence that the TG/HDL ratio serves as a valuable alternative for assessing insulin resistance. Children with higher TG/HDL ratios showed significantly elevated HOMA-IR levels, confirming its reliability as an alternative method for insulin resistance assessment. However, this research faced some limitations. Firstly the age-related metabolic differences were not analyzed separately. In addition potential measurement errors in laboratory data may affect accuracy. Moreover the study lacked cardiovascular health assessments, limiting conclusions on long-term risks.

5. Conclusion

The TG/HDL ratio offers a simpler and more cost-effective alternative to HOMA-IR for assessing insulin resistance, particularly in pediatric populations. Unlike HOMA-IR, which requires both fasting glucose and insulin levels and needs specialized laboratory tests and careful timing, the TG/HDL ratio can be calculated from a standard lipid profile that is commonly ordered in routine clinical practice. This makes it more accessible, especially in resource-limited settings where insulin specific evaluation tests may not be easily available or affordable. Because elevated triglyceride levels and low HDL cholesterol are both key components of dyslipidemia associated with insulin resistance, the TG/HDL ratio serves as an indirect but practical marker for identifying children at increased risk for metabolic syndrome. Its advantage lies in its simplicity, availability, and its ability to detect early metabolic abnormalities, helping in earlier intervention and potentially preventing progression to more serious conditions such as type 2 diabetes and cardiovascular disease. However, while this study has demonstrated a significant association between the TG/HDL ratio and HOMA-IR, the strength of the correlation

was moderate, so further research is needed to validate its predictive value across larger, more diverse populations.

REFERENCES

[1] Tagi, V. M., Giannini, C. and Chiarelli, F. (2019). Insulin Resistance in Children. *Front. Endocrinol.*, 10, 342.
https://doi.org/10.3389/fendo.2019.00342

[2] Power, A. C. (2015). *Harrisons endocrinology: Diabetes mellitus: diagnosis, classification, and pathophysiology.* In: Kasper, D. L., Fauci, A. S., Hauser, S. L., Longo, D. L., Larry Jameson, J. and Loscalzo, J. (eds.). *Harrison's Principles of Internal Medicine*. Vol. 2, 19th Edition, McGraw-Hill, New York, 2399–2407.

[3] Vandhna R., Sharma, Samantha T. Matta, Morey W. Haymond, Stephanie T. Chung (2020). Measuring Insulin Resistance in Humans. *Horm. Res. Paediatr.*, 93, 577–588. https://doi.org/10.1159/000515462

[4] Olson, Karen et al. (2022). *The Triglyceride to HDL Ratio and Its Relationship to Insulin Resistance in Pre- and Postpubertal Children: Observation from the Wausau SCHOOL Project*. 2012 (794252), 1–4.
https://doi.org/10.1155/2012/794252

[5] Behiry, Eman G. et al. (2019). Evaluation of TG-HDL Ratio instead of HOMA Ratio as Insulin Resistance Marker in Overweight and Children with Obesity. *Endocrine, Metabolic & Immune Disorders – Drug Targets*, 19 (5), 676–682. https://doi.org/10.2174/1871530319666190121123535

[6] Zati Iwani, N. A. K. et al. (2017). Triglyceride to HDL-C Ratio is Associated with Insulin Resistance in Overweight and Obese Children. *Sci. Rep.*, 7, 40055. https://doi.org/10.1038/srep40055

[7] Demiral M. (2021). A novel diagnostic tool in determining insulin resistance in obese children: Triglyceride / HDL ratio. *J. Surg. Med.*, 5 (11), 1144–1147.

[8] Maria Efthymia Katsa et al. (2019). The Roles of Triglyceride/High-Density Lipoprotein Cholesterol Ratio and Uric Acid as Predisposing Factors for Metabolic Syndrome in Healthy Children. *Annals of Pediatric Endocrinology & Metabolism*, 24 (3), 172–179. https://doi.org/10.6065/apem.2019.24.3.172

[9] Krawczyk, Monika et al. (2018). Usefulness of the Triglycerides to High-Density Lipoprotein Cholesterol Ratio (TG/HDL-C) in Prediction of Metabolic Syndrome in Polish Obese Children and Adolescents. *Acta Biochimica Polonica*. https://doi.org/10.18388/abp.2018_2649

PULL-OVER: THE APPLICATION OF PHYSIOTHERAPY TREATMENTS FOR SPORT CLIMBERS WITH PULLEY INJURY

NÓRA BOGNÁR[1, *] – ZOLTÁN BÁDOVSZKY[2] – BARBARA GUZI[1]
[1]*University of Miskolc, Faculty of Health Sciences*
[2]*Kézklinika, Budapest*

Summary: The objective of this research is to assess the condition of sport climbers with pulley injuries, to apply a complex physiotherapy programme and to evaluate the effectiveness of the treatment.

Our study was carried out at the Kézklinika in Budapest between June and October 2024. Ten active sport climbers with injuries sustained at least five days prior to the assessment were investigated. For the assessment we used pain scores (VAS), mobility, muscle strength, flexibility and special tests. The physiotherapy intervention consisted of passive and active elements, comprising 10 sessions of 40 min each. Descriptive statistics were calculated using MS Excel, with results expressed as mean ± standard deviation (SD), as well as median (Me) and interquartile range (IQR). To assess changes, the Wilcoxon signed-rank test was applied, with a significance level set at $p \leq 0.05$.

The study involved 10 participants (6 men), with a mean age of 293 ±10.9 years. The main complaint was pain, which was eliminated after treatment. The distal interphalangeal joint (DIP) flexion motion showed a strong significant change on both sides. Muscle strength on the affected side of the EDC showed a 16,3% increase. Finger flexors on the affected side with a half-closed grip at 25mm edge and 20 mm edge showed a strong significant improvement ($p = 0.008$, $p = 0.007$).

All assessed modalities showed positive changes, allowing a return to climbing. Properly structured rehabilitation and prevention programmes can help prevent further injuries.

Keywords: *sport climbing, pulley injury, hand function, physiotherapy*

1. INTRODUCTION

Until the second half of the 20th century, sport climbing served as a training tool for mountaineering. Today, it has become a sport – in its own right –, and made its first appearance at the 2020 Olympics in Tokyo. Sport climbing is a full-body sport. With an increasing focus on vertical or overhanging walls, greater strain is placed on the hands and fingers. Since its inclusion in the Olympics, the popularity of the sport has continued to grow. [1] There are more than 44.5 million climbers worldwide, and half of them started their climbing career after the Olympic Games. [2] In Hungary,

---

* Corresponding author: Nóra Bognár
Miskolci Egyetem Egészségtudományi Kar
3700 Kazincbarcika Mikszáth u. 14 fsz. /1.
Telephone: +36 20 953 4203
E-mail: bognarnori@icloud.com

the number of climbers registered in 2023 was 2,256 and in 2024, a total of 66 associations were listed in the Hungarian Mountaineering and Sport Climbing Federation. [3] The importance of this topic is also highlighted by the number of injuries: around 75% of elite and recreational sport climbers report upper limb injuries, and roughly 30% have specific signs of pulley tears, which are associated with a reduction in muscle strength and a loss of full range of motion (ROM) in the fingers. [4] On the long fingers there are 5 annular pulleys (A1-A5), 3 cruciate pulleys (C1-C3). The A2, A4 pulleys are wider, stronger and attach directly to the bone, while the others are less rigid and are attached to the palmar plates above the joints.[1, 5] Their function is to eliminate lateral movements, prevent bowstringing, convert linear forces into torque, increase flexor tendon strength and reduce friction through lubrication. [1, 5, 6] Different types of holds apply different forces to the flexor tendons and annular ligaments. The full crimp increases the forces placed on the A4 pulley by 3.9 times compared to the open grip, while the A2 pulley experiences an increase of 31,5 times. Therefore, the A2 pulley is more likely to be damaged. [7]

Although this type of injury is becoming more common, it is often underestimated and given little attention, which can lead to progression of the injury. In the early (mild) stage, finger injuries are easily overlooked and neglected by enthusiastic climbers. However, the truth is that climbing with an injured finger can exacerbate the injury and significantly extend recovery time, potentially doubling or tripling it. [8] This is also why it is necessary to design a well-constructed rehabilitation and prevention programme that can be used with confidence by both those who are affected and those medical professionals who are not familiar with sport climbing.

The objective of this research is to assess the condition of athletes with pulley injuries, to apply a complex physiotherapy programme and to evaluate the effectiveness of the treatment.

2. MATERIAL AND METHODS

Participants

The measurements were carried out between June and October in 2024. The testing and treatments took place at the Kézklinika in Budapest. The study includes active sport climbers who have suffered a traumatic pulley injury while sport climbing. Eligibility criteria required that the participants had a history of at least 5 days since the injury.

Examination

The selection was based on a questionnaire and patient examination. In the anamnesis we recorded the age of the climber, the number and length of training sessions, the time spent in sport climbing, the form and the level of training. We also inquired about the circumstances of the injury, included the type of movement or hold involved. We recorded the symptoms experienced at the time of injury, location, pain, swelling, bruising, loss of mobility, popping sound at the time of injury. Particular attention was paid to the type and intensity of current pain at rest and

during movement, recorded on the Visual Analogue Scale (VAS). Pain intensity was categorised as mild (VAS 1–3), moderate (VAS 4–6), or severe (VAS 7–10). Previous treatments and previous and/or co-injuries were noted. Following this, a visual and palpation examination was performed from the elbow to the distal part of the limb according to the rules of physiotherapy, supplemented by a modified trigger finger examination. For the mobility test, we assessed the active range of motion (AROM). We measured quick finger testing and sagittal movements of the wrist and finger joints using a traditional and finger goniometer. The values are given were expressed in degrees (°). The muscle strength was measured manually and graded on a scale of 0–5. The muscle strength of the wrist flexors and extensors, mm. lumbricales, mm. interosseous volares and dorsales, and the m. extensor digitorum communis (EDC), m. flexor digitorum superfitialis (FDS) and m. flexor digitorum profundus (FDP) of the affected finger were measured on both sides. In addition to muscle strength, the maximum flexibility of the muscles was also tested. The specific tests we used were the Bunnel-Littler-, Retinaculum tests (which was considered positive in the case of pain or if there was no full passive ROM) Proximal Interphalangeal joint (PIP) hyperextension test (positive if there was pain in passive hyperextension), Paper sheet test and the Froment sign (the test is positive, if the sheet of paper could be pulled out). Pressure sensitivity was assessed at the level of the pulleys on the affected finger (positive if pain occurs). In the next step, the strength of the grip was measured with a digital hand dynamometer, followed by the Chuck pinch and Key pinch were measured with Baseline's mechanical pinch gauge, with results recorded in Newton (N) A fingerboard and a dynamometer were used to measure climbing-specific finger strength, which was adapted from Cheung, W. 2023 guideline.[1] The test was performed in the standing position. On the fingerboard, participants performed maximum pulls on 25-, 20-, and 15-mm crimps with half-closed, closed, and open grips. The results, were recorded, are given in N. The intact side was compared individually to the values of the injured side. As a final step in the patient assessment, we performed functional tests and asked about limitations in everyday activities and sport climbing.

Therapy

Individual therapies were provided twice a week for 40 minutes per session. Each participant received a total of 10 sessions, which was combined with home exercise and patient education. The treatment had a threefold structure. The warm-up lasted 10 minutes and was designed to increase blood flow. We used passive and active techniques such as massage on the forearms and fingers (also with tools such as mini SMR roller, finger rollators, massage ring), Floss band exercises and PNF dynamic translation technique. The main training session lasted 20 minutes. Elements included respiratory-circulation exercises, climber-specific isometrics, exercises for neighbouring joints-, followed by all-joint movements, working in ischaemia, antagonist strengthening, mini rubber band exercises, and extension improvement with pencil curl exercises. Darabosné Tim et al., 2020 and Egyedi, B. 1983 [9, 10]

elastic bandage exercise modified with balloon was applied. PNF isotonic combination techniques were performed on wrist and finger extensors.

Strengthening of the flexors was initially done with eccentric rolling of a 2 kg barbell, followed by a combination of Floss band and hangboard. Later, depending on the treatment week, we gave specific training tools: in week 1 a wooden ball, in weeks 1-2 a 25 mm crimp, in week 3, a 20 mm crimp, and in week 4, a 15mm crimp, all pulled with a fixed amount of force. Finally, the fingers were strengthened in function. A rubber band was applied to the fingerboard. Participants first held the hangboard from above, then held it from below and finally pulled it towards them with a Gaston grip. The physiotherapy treatment was completed with a 10-minute cool-down session. It consisted of stretching PIR, PNF hold relax and contract relax techniques, soft tissue mobilisation and massage on the forearm. In chronic phases, it was complemented by a paraffin pack. In cases of severe flexion contracture, a "Chrisofix" orthesis was applied.

Statistical analysis

Descriptive statistics were calculated using Microsoft Office Excel, with results expressed as mean ± standard deviation (SD), and median (Me) and interquartile range (IQR) calculated using SPSS 30.0. To assess changes, the Wilcoxon signed-rank test was applied, with a significance level set at $p \leq 0.05$. Values marked with * indicate $p \leq 0.05$, while values marked with ** indicate $p \leq 0.01$.

3. RESULTS

The study involved 10 participants (6 men) with a mean age of 29.3 ± 10.9 years and a mean sport climbing experience of 9.4 ± 8.16 years. Two participants had completed a UIAA grade X route. The most common training frequency was 3 sessions per week, and each training session lasted 2.7 ± 0.82 hours. Three athletes presented with acute pulley injuries. The ring finger was affected in 6 cases, the middle finger in 3 cases, and the little finger in 1 case. Regarding the injured structures, the A2 pulley was involved in 7 cases, the A4 in 2 cases, and the A3 in 1 case. Baseline characteristics of the sport climbers are shown in *Table 1*.

Table 1

Basic data of the participants before intervention (N = 10)

	Code	Sex	Climbing years	Climbing grade achieved (UIAA)	Training sessions per week	Duration of one session (hours)	Time since injury	Affected finger	Pulley
1.	N1T6	W	6	9	3	3	1 year	3	4
2.	4LA8	M	17	8	1	1	2 weeks	5	3
3.	H31A	W	8	8	3	3	3 years	3	4
4.	H2Á3	M	5	8	3	3	3 weeks	4	2
5.	S19R	W	3	8	2	3	1 year	4	2

	Code	Sex	Climbing years	Climbing grade achieved (UIAA)	Training sessions per week	Duration of one session (hours)	Time since injury	Affected finger	Pulley
6.	G37P	M	25	10	5	3	2 years	3	2
7.	3C4G	M	2	7	2	4	1 year	4	2
8.	HS41	M	4	7	3	2	3 months	4	2
9.	D2A8	M	20	10	5	3	2 years	4	2
10.	S16Z	W	4	8	3	2	5 days	4	2
mean			9.4	8.3	3	2,7		3.8	2.5
SD			8.17	1.06	1.25	0.82		0.63	0.85

SD= Standard Deviation

The main complaint was pain, assessed using VAS. Before the intervention, pain at rest was minimal in one case (VAS = 2), while pain during climbing averaged 4.3 ±2.54. Five climbers reported severe pain (VAS 5-7), two reported moderate pain (VAS= 4-6) and one reported mild pain (VAS 1-3). In the quick range of motion test, the common PIP – Distal Interphalangeal joint (DIP) flexion test showed that half of the participants on the intact side and four participants on the affected side had a range of motion below physiological. The other two tests each showed one case of deficiency on the affected side. The parameters are categorised as hypomobile and hypermobile. The detailed initial AROM averages and the number of participants with hyper- or hypomobility per joint are presented in *Table 2*. The greatest deficits in AROM were observed in the joints of the digits, which may increase the risk of injury. Specifically, wrist extension and DIP flexion were generally hypomobile while PIP extension was hypermobile in the participants. These altered joint mobility patterns may predispose climbers to finger injuries due to abnormal movement mechanics. Furthermore, the flexion range of motion of the affected PIP joint was severly reduced, representing a functional deficit, that couls increase the likelihood of re-injury in sport climbing.

Table 2
AROM mean results by joints before intervention (N = 10)

AROM	Before intervention							
	Intact side (°)		Affected side (°)		Hypomobile (n)		Hypermobile (n)	
	Mean	SD	Mean	SD	Intact	Affected	Intact	Affected
Wrist flexion	89.0	11.623	86.5	9.868	2	1	1	0
Wrist extension	59.2	15.193	60.7	8.512	7	9	0	0
MCP flexion together	85.8	7.480	85.6	8.821	5	4	2	2
MCP extension together	31.2	14.085	28.5	6.964	1	1	0	0
PIP flexion	106.9	6,436	95.5	12.429	1	6	4	2

AROM	Before intervention							
	Intact side (°)		Affected side (°)		Hypomobile (n)		Hypermobile (n)	
	Mean	SD	Mean	SD	Intact	Affected	Intact	Affected
PIP extension	−10.1	7.202	−2.9	8.748	0	3	10	7
DIP flexion	55.0	15.355	52.0	19.223	9	8	0	0
DIP extension	−2.7	5.716	−1.6	5.872	1	3	3	3

SD = Standard Deviation

Based on the study, the greatest deficit on the affected side was observed in the EDC and in the dorsalis interosseus muscles of both hands, which may lead to muscle imbalance. The average muscle strength of the EDC was 4+ on the affected side, with 20% of participants having a muscle strength of 3 and a further 30% having a muscle strength of 4. On average, the dorsal muscle strength of the interosseous mm was 4+ for both sides. The lowest value was muscle strength of 3, which was measured in 30% of the participants on the intact side and 20% on the affected side. In addition, muscle strength 4+ was recorded in 20% of the affected side and above average muscle strength 5+ in the remaining 60%, which was 70% on the intact side. When testing maximum flexibility, both the intact and affected sides of the EDC were shortened in 4-4 participants, indicating a reduction in both muscle strength and flexibility of the EDC were reduced. In addition, I found 1 case of shortening at the FDP on both sides and 2 cases of shortening at the wrist extensors on the affected side. From the findings of the positive specific tests, it can be said that the tests most sensitive for detecting injury were the pressure sensitivity (8+), retinaculum (6+) and PIP hyperextension test (6+) on the affected side. Among the specific tests, we quantified the grip strength, chuck pinch and key pinch *(Table 5)* Except for the key pinch, the other parameters were found to be lacking compared to the intact side. These grips are the most adaptable for sport climbing. The median (Me) and interquartile range (IQR) parameters of the specific finger strength measured with the fingerboard are presented in *Tables 6., 7.* and *8*. The results show that the climbing specific test demonstrated a remarkable lag of the affected side compared to the intact side for all crimp sizes and grip types. This manifests as a functional deficit during climbing, meaning that muscle strength is decreased on the injured side, making it difficult to use the holds and crimps effectively.

At retesting, we found that physiotherapy had completely eliminated pain at rest and during exercise for all participants. In the case of the quick range of motion test, all tests, i.e. fist lock, palm touch and common PIP- DIP flexion tests, are now all possible for sport climbers. The output values for joint active range of motion and the changes in the hypomobile and hypermobile groups are shown in *Table 3*. The intervention resulted in a major reduction of hypomobility, but increased hypermobility in the sagittal movements of the PIP joint. Apart from this, most of the parameters were successfully within the normal range of motion when tested back.

Table 3

*Output values for joint AROM and changes in the hypomobile and
hypermobile groups (N = 10)*

AROM	After intervention							
	Intact side (∘)		Affected side (∘)		Hypomobile (n)		Hypermobile (n)	
	Mean	SD	Mean	SD	Intact	Affected	Intact	Affected
Wrist flex.	95.00	9.37	92.10	6.76	0	0	0	0
Wrist ext.	67.00	4.40	71.10	9.41	5	5	0	0
MCP flex.	93.80	3.52	95.80	6.73	0	0	0	0
MCP ext.	40.80	9.86	40.10	9.01	0	0	1	1
PIP flex.	110.90	4.33	111.40	3.53	0	0	7	6
PIP ext.	−11.10	5.09	−8.20	4.52	0	0	10	10
DIP flex.	78.90	7.59	81.10	4.70	2	0	0	0
DIP ext.	−3.40	6.36	−2.00	4.89	1	1	4	2

SD= Standard Deviation

The sagittal movements of the PIP and DIP joints were statistically tested, summarised
in *Table 4*. A strong significant change was found in the PIP flexion range of motion
on the affected side and in the DIP joint flexion range of motion on both sides. There
is also a significant change on the PIP extension on the affected side.

Table 4

*Statistical results of the sagittal plane movements of the PIP and
DIP joints (N = 10)*

Finger AROM	Intact before (°)	Intact after (°)	Affected before (°)	Affected after (°)
PIP flexion	Me = 106.5 [IQR = 10.5]	Me = 111.5 [IQR = 5.5] p = 0.057	Me = 93.0 [IQR = 20.75]	**Me = 113.0 [IQR = 6.5] p = 0.008
PIP extension	Me = −9.5 [IQR = 8]	Me = −10.0 [IQR = 7.75] p = 0.857	Me = −5.5 [IQR = 14.25]	*Me = −7.5 [IQR = 4.25] p = 0.046
DIP flexion	Me = 56.5 [IQR = 19.25]	**Me = 80.5 [IQR = 12.75]	Me = 50.5 [IQR = 28]	**Me = 82.0 [IQR = 4.75]
DIP extension	Me = −2.0 [IQR = 5]	Me = −1.5 [IQR = 6.25]	Me = −2.5 [IQR = 8]	Me = −1.0 [IQR = 5]

Me = Median; IQR = interquartile range; Values with * indicate $p \leq 0,05$. Results with ** represent
results with $p \leq 0,01$.

When measuring muscle strength retested on the Oxford scale for wrist extensors, all participants finished with a muscle strength of 5, as did FDS, FDP, EDC and mm. lumbricales. Only one case of mm. interossei showed a muscle strength of 4. For the volar interosseus muscles, the mean score was 4.9 ±0.31 on the intact side, while the same result was observed for the dorsal side (4.9 ±0.31). When maximum flexibility was measured back, we found that muscle elasticity was regained in all modalities by the end of the treatments. Of the specific tests, pressure sensitivity was eliminated in all cases, as it was for the Bunnel-Littler test. The Paper Sheet and Retinaculum test was positive in one case on the affected side on remeasurement. The data after treatment for grip strength, peak grip and key grip are given in *Table 5*.

Table 5

Mean values of opening and closing data for grip strength, chuck pinch and key pinch (N = 10)

Special test	Before intervention(N)				After intervention (N)				Changes (%)			
	intact		affected		intact		affected		intact		affected	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Grip strength	429.6	103.57	424.9	100.57	457	105.16	480.6	116.23	6.96	7.1	13.74	14.75
Chuck pinch	102.5	23.83	96	29.88	102.5	19.03	107	23.35	1.36	11.35	16.17	23
Key pinch	102	26.68	107.5	22.26	112	19.17	112	17.82	12.61	12.82	5.34	7.26

SD = Standard Deviation

For special holds used in sport climbing, it can be seen that the affected side has improved on all edge sizes and has improved to nearly match or keep up with the unaffected side. It can be said that by the end of the treatments, the finger strength on both sides became almost symmetrical.

The statistical summary of finger strength is given in *Tables 6., 7.*, and *8*. A strong significant improvement was found at 25 mm with a half-closed grip on the affected side, at 20 mm with a half-closed grip on both side, and at 15 mm with an open grip on the unaffected side. Furthermore, we found a significant change in the 25mm crimp for all hold types on the intact side, at the 15mm crimp with closed grip on the intact side and with open hold on the affected side.

Table 6

Finger strength statistical summary results for 25mm crimp (N = 10)

25mm	Intact before (N)	Intact after(N)	Affected before (N)	Affected after (N)
Half-closed grip	Me = 361.5 [IQR = 154.5]	*Me = 463.5 [IQR = 124.5] p = 0.013	Me = 347.0 [IQR = 109.75]	**Me = 425.0 [IQR = 135.75] p = 0.008

25mm	Intact before (N)	Intact after(N)	Affected before (N)	Affected after (N)
Closed grip	Me = 377.0 [IQR = 165.25]	*Me = 471.5 [IQR = 115] p = 0.022	Me = 382.5 [IQR = 165]	Me = 441.0 [IQR = 135.75] p = 0.093
Open grip	Me = 290.0 [IQR = 163]	*Me = 359.5 [IQR = 166.25] p = 0.022	Me = 325.0 [IQR = 167.5]	Me = 341.0 [IQR = 141] p = 0.074

Me = Median; IQR = interquartile range; Values with * indicate p ≤ 0,05. Results with ** represent results with p ≤ 0,01.

Table 7

Finger strength statistical summary results for 20mm crimp (N = 10)

20mm	Intact before (N)	Intact after(N)	Affected before (N)	Affected after (N)
Half-closed grip	Me = 345.0 [IQR = 71.5]	**Me = 395.5 [IQR = 95] p = 0.005	Me = 302.0 [IQR = 122]	**Me = 410.0 [IQR = 92.75] p = 0.007
Closed grip	Me = 365.0 [IQR = 129]	Me = 446.0 [IQR = 131.75] p = 0.092	Me = 353.5 [IQR = 116.75]	Me = 390.0 [IQR = 110] p = 0.059
Open grip	Me = 335.0 [IQR = 102.25]	Me = 336.5 [IQR = 97.5] p = 0.114	Me = 321.0 [IQR = 125]	Me = 342.0 [IQR = 77.25] p = 0.083

Me = Median; IQR = interquartile range; Values with * indicate p ≤ 0,05. Results with ** represent results with p ≤0,01.

Table 8

Finger strength statistical summary results for 15mm crimp (N = 10)

15mm	Intact before (N)	Intact after(N)	Affected before (N)	Affected after (N)
Half-closed grip	Me = 297.5 [IQR = 76]	Me = 332.0 [IQR = 126.75] p = 0.114	Me = 271.5 [IQR = 124.5]	Me = 325.5 [IQR = 105.25] p = 0.083

15mm	Intact before (N)	Intact after(N)	Affected before (N)	Affected after (N)
Closed grip	Me = 306.0 [IQR = 105]	*Me = 340.0 [IQR = 143.75] p = 0.028	Me = 277.5 [IQR = 81.25]	Me = 352.5 [IQR = 112.25] p = 0.059
Open grip	Me = 252.0 [IQR = 121.5]	**Me = 319.0 [IQR = 91] p = 0.007	Me = 236.0 [IQR = 77.75]	*Me = 308.5 [IQR = 93] p = 0.047

Me = Median; IQR = interquartile range; Values with * indicate $p \leq 0,05$. Results with ** represent results with $p \leq 0,01$.

4. DISCUSSION

The most important finding of our research is that structured physiotherapy completely eliminated pain and resulted in significant improvement in joint mobility and muscle strength in climbers suffering from pulley injuries. It is important to address DIP joint stability, as instability clearly plays a role in pulley injuries, particularly during crimp grips, when hyperextension significantly increases the load on the pulley. [11] Both the interosseous and extensor digitorum communis muscles contribute to finger stability and fine motor control [12], and in our study, these muscles showed measurable improvement. Furthermore, controlled strengthening of the finger flexor muscles is essential, as this not only restores function but also promotes gradual adaptation of the pulley system to mechanical load. [13] In addition, proprioceptive training should also be incorporated, as mechanoreceptors have been identified in the annular ligaments. [14]

In contrast to the Isele, K. 2016 [15] pilot study, that looked at the effect of a single treatment with limited measurements, our study used repeated, structured therapy and assessed a wider range of functional and objective parameters. While Cheung, W. 2023 [1] guide provides a comprehensive overview of the management of pulley injuries, it is missing objective measurements. Thus, our study contributes quantitative, objective data to the physiotherapeutic management of pulley injuries in sport climbers.

Some limitations must be acknowledged. The sample size was small, and all participants were recruited from a single centre. We also lacked a control group, so spontaneous recovery cannot be fully excluded. Furthermore, long-term follow-up was not performed, making it unclear whether improvements were maintained over time. Future studies should include larger, more diverse populations, a control group, and long-term outcome measures.

5. CONCLUSION

The results of the research suggest that pulley injuries can be very manageable, and significant improvement can be achieved with progressive structured rehabilitation and physiotherapy treatments. This opens up the possibility for athletes to return to climbing pain-free, with improved range of motion and muscle strength. The therapies we have used have been most effective in reducing pain and pressure sensitivity as well as in rebalancing joint mobility and antagonistic muscles. The symmetry of sport-specific finger strength was also influenced by our therapy, however, maximizing finger strength and reducing hypermobility would require further therapy. It is essential to continue integrating regular physiotherapy into everyday life and to adopt a preventive approach, such as thorough warm-up and stretching, to avoid future injuries.

REFERENCES

[1]   Cheung, W. Finger Pulley Injuries in Rock Climbing: A Guide for Physiotherapists. Vancouver: Walden Cheung; 2023.

[2]   Symons, W. (2024). *Hungry for more sport climbing after the Olympics?* The World Cup heats up this week! [cited 2025 Jul 26]. Available from: https://shorturl.at/WDdac

[3]   MHSSz. (2024). *A Magyar Hegy- és Sportmászó Szövetség Sportágfejlesztési Stratégiája 2024–2032*. [cited 2025 Jul 26]. Available from: https://mhssz.hu/assets/Uploads/Elements/FileList/MHSSZ-Strategia-2024-2032_vegleges. pdf

[4]   Theumann, N. (2008). Radiologic Perspective: Magnetic Resonance Imaging of the Hand and Fingers. In: Pedowitz, R., Chung, B. C., Resnick, D. (eds.). *Magnetic Resonance Imaging in Orthopedic Sports Medicine*. New York: Springer Science & Business Media, LLC, 241–263.

[5]   Miro, P. H., vanSonnenberg, E., Sabb, D. M., Schöffl, V. (2021). Pulley Injuries in Rock Climbers. *Wilderness & Environmental Medicine*, 32 (2), 247–258.

[6]   Hochholzer, T., Schoeffl, V. (2003). 1.3 Tendon Sheaths and Pulleys. In: Lightner, S. (ed.). *One move too many…, How to understand the injuries and overuse syndroms of rock climbing*. Hersbruck: Druckerei Sonnenschein, 26–27).

[7]   Vagy, J. (2024). *Pulley Injuries Explained*. Part 1. [cited 2025 Jul 26]. Available from: https://theclimbingdoctor.com/pulley-injuries-explained-part-1/

[8]   Hörst, J. E. (2016). *Training for Climbing: The Definitive Guide to Improving Your Performance*. Guilford, Connecticut Helena, Montana: Falcon Guides.

[9]   Darabosné Tim I., Mayer Á., Ober Á. (2020). *Traumatológiai fizioterápia II. Az egyes mozgásszervi szegmentumok sérülésének fizioterápiája*. Budapest: Semmelweis Egyetem Egészségtudományi Kar.

[10] Egyedi, B. (1983). *Mozgásszervi sérültek rehabilitációja.* Budapest: Medicina Könyvkiadó.

[11] Vigoroux, L., Quaine, F., Labarre-Vila, A., Moutet, F. (2006). Estimation on finger muscle tendon tensions and pulley forces during specific sport-climbing grip techniques. *Journal of Biomechanics*, 39 (14), 2583–2592.

[12] Sharma, N., Venkadesan, M. (2022). *Finger stability in precision grips*. University of Pittsbrugh Brain Institute, Pittsburgh, PA; 119 (12) e2122903119.

[13] Wave Tools Therapy (2020). Pulley Injury – Complete Rehabilitation Program for Climbers. [cited 2025 Oct 1] Available from: https://wavetoolstherapy. com/finger-pulley-rehab

[14] Abreu, S. A. R, Rocha, J. P. B., de Sousa, J. A. S. et al. (2025). *Structural and Distribution Analysis of Mechanoreceptors and Free Nerve Endings in the Annular Pulleys of the Flexor Tendons of the Hand*. HAND. 0 (0).

[15] Isele, K. Hay, A. G., Schrank, B., Schweikart, A. (2016). *Treatment of finger problems in climbers with local-osteopathic Isele-methos: a Pilot study*. Unpublished manuscript. Donau University of Krems.

SLEEP AND MENTAL HEALTH IN ADOLESCENTS: A REVIEW OF RECENT SYSTEMATIC REVIEWS

Andrea Lukács
Faculty of Health Sciences, University of Miskolc
E-mail: andrea.lukacs@uni-miskolc.hu

Summary: Sleep plays a vital role in adolescent development, influencing mental, emotional, and cognitive health. Increasing evidence suggests a strong association between sleep disturbances and mental health problems in adolescents, including anxiety, depression, and suicidality. This review aims to synthesize systematic reviews and meta-analyses published between 2020 and 2025 that examine the relationship between sleep and mental health outcomes in healthy adolescent populations. A comprehensive literature search was conducted in PubMed using the keywords healthy AND adolescents AND sleep AND "mental health", limited to systematic reviews published from 2020 to 2025. Sixteen records were identified, and after screening and eligibility assessment based on predefined inclusion criteria, seven studies were included in the final synthesis. PRISMA 2020 guidelines were followed for study selection and reporting. The included studies consistently reported that insufficient sleep duration, poor sleep quality, and irregular sleep patterns were associated with elevated risks of anxiety, depression, emotional dysregulation, and suicidal ideation in adolescents. Some reviews also identified potential moderators such as parental influence, sleep hygiene behaviors, and circadian misalignment. Sleep significantly influences adolescent mental health, and addressing sleep-related factors may be a key avenue for early intervention and prevention strategies.

Keywords: *adolescents, sleep, mental health, systematic review, meta-analysis, sleep disturbance*

1. INTRODUCTION

Adolescence is a critical developmental stage characterized by rapid physical, psychological, and social transformations. During this period, sleep plays an essential role in emotional regulation, cognitive performance, and overall mental health. However, a substantial proportion of adolescents fail to meet the recommended amount of sleep, with estimates suggesting that over 70% of high school students sleep less than 8 hours per night on school days [1]. This widespread sleep deprivation has raised growing concerns about its implications for adolescent mental well-being. A growing body of empirical evidence indicates that insufficient or poor-quality sleep is linked to a heightened risk of mental health issues such as depression, anxiety, and suicidal ideation among adolescents [2, 3]. Longitudinal studies have further shown that sleep disturbances can precede the onset of affective disorders, suggesting a potentially causal or bidirectional relationship [4]. These

findings underscore the importance of sleep as a modifiable risk factor in adolescent mental health prevention and intervention strategies.

In recent years, systematic reviews and meta-analyses have synthesized findings from individual studies, offering a higher-level understanding of the relationship between sleep and mental health. However, the scope, methods, and target populations of these reviews vary, limiting the comparability of their conclusions. Moreover, existing syntheses often include clinical or mixed-age populations, leaving a gap in our understanding of sleep–mental health associations specifically among healthy adolescents.

The current review aims to address this gap by synthesizing findings from systematic reviews and meta-analyses published between 2020 and 2025 that focus on sleep and mental health outcomes in healthy adolescent populations. By identifying consistent patterns, potential moderators, and methodological strengths and weaknesses across the literature, this study aims to inform future research directions and public health efforts focused on adolescent well-being.

2. METHODS

2.1. Search strategy and eligibility criteria

A systematic search was conducted in PubMed to identify relevant meta-analyses and systematic reviews published between January 1, 2020, and July 1, 2025. The search terms included: "healthy AND adolescents AND sleep AND mental health". Filters were applied to retrieve only systematic reviews and/or meta-analyses, in English, focusing on human participants. The inclusion criteria were as follows:
   • The study population primarily consisted of adolescents (typically aged 12–19 years),
   • The review investigated sleep (duration, quality, disturbances, or timing) as a central variable,
   • Mental health outcomes were explicitly examined (e.g., depression, anxiety, suicidality, emotional regulation),
   • The article was a systematic review and/or meta-analysis.

Studies were excluded if they focused on adult populations, specific clinical subgroups unrelated to general adolescent health (e.g., transplant recipients, epilepsy, narcolepsy), or if sleep or mental health were not a central focus of the review.

2.2. Study Selection

A total of 16 articles were retrieved from the PubMed database. Following full-text screening and assessment for eligibility, seven studies were included in the final synthesis. The excluded studies either did not focus specifically on adolescents, did not have sleep or mental health as a primary focus, or examined unrelated clinical populations. The study selection process is summarized in the PRISMA flow diagram. *(Figure 1)*
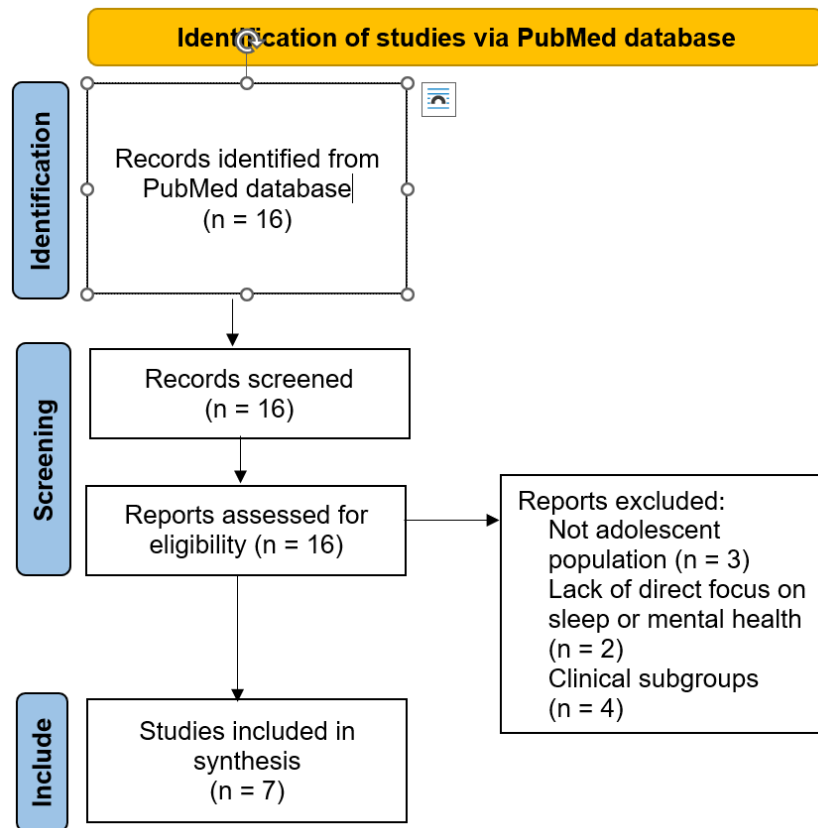
Figure 1. Identification of studies

3. RESULTS

A total of seven systematic reviews and/or meta-analyses met the inclusion criteria for this review. These studies examined the association between various sleep characteristics such as duration, quality, disturbances, hygiene, and circadian rhythms, and mental health outcomes in adolescents. The mental health domains explored included depression, anxiety, emotional regulation, suicidal ideation, and general psychological well-being.

Sample sizes across the included reviews varied considerably, with most incorporating both cross-sectional and longitudinal studies. Despite heterogeneity in methodologies and measurement tools, the majority of reviews reported that poorer sleep was associated with more adverse mental health outcomes. Baldini et al. synthesized data on sleep disturbances and suicidality, finding consistent associations between insomnia symptoms and increased risk of suicidal ideation and behavior [5]. Palmer et al. conducted a meta-analysis of experimental studies, demonstrating that acute sleep deprivation was linked to impaired emotional regulation in adolescents [6]. Khor et al. identified associations between modifiable

parental behaviors such as inconsistent monitoring and permissive bedtime routines, and poor sleep hygiene, depression, and anxiety [7]. Brinsley et al. reviewed the effectiveness of peer-led behavioral interventions and reported that those incorporating sleep hygiene components were associated with improvements in adolescent mental health [8]. Dale et al. examined 24-hour movement behaviors, concluding that sufficient sleep was a key protective factor against symptoms of depression and anxiety [9]. Kocevska et al. reviewed data from large population samples and found that shorter sleep duration and irregular sleep timing in adolescents were associated with increased risk of emotional difficulties [10]. Smith et al. evaluated health interventions in disadvantaged youth populations, noting that sleep education components were linked to improvements in psychological resilience and overall well-being [11].

Table 1
Characteristics of the included studies (n = 7)

Author (Year)	Population	Study type	Main findings
Baldini et al. (2024)	Adolescents (general and clinical samples)	Systematic review and meta-analysis	Sleep disturbances are significantly associated with increased suicidal thoughts and behaviors.
Palmer et al. (2024)	Adolescents and young adults	Meta-analysis	Sleep deprivation significantly impairs emotion regulation across developmental stages.
Khor et al. (2021)	Adolescents and parents	Systematic review and meta-analysis	Modifiable parental behaviors (e.g., inconsistent routines) are linked to poor sleep hygiene and increased emotional problems.
Brinsley et al. (2025)	School-aged adolescents	Systematic review and meta-analysis	Peer-led health promotion programs including sleep education improve adolescent mental health and well-being.
Dale et al. (2025)	General adolescent and adult populations	Systematic review	Adequate sleep duration serves as a protective factor against depressive symptoms.
Kocevska et al. (2021)	Over 1 million participants, including adolescents	Meta-analysis	Sleep duration and timing vary widely; misalignment is associated with emotional dysregulation.
Smith et al. (2021)	Socioeconomically disadvantaged adolescents	Systematic review	Health literacy interventions (including sleep education) promote better mental well-being.

4. DISCUSSION

This systematic review examined recent evidence (2020–2025) on the association between sleep and mental health outcomes among adolescents. Seven systematic reviews and/or meta-analyses were included. The findings consistently support a negative association between inadequate sleep and mental health, with sleep disturbances emerging as a significant correlate of depression, anxiety, suicidality, and emotional dysregulation.

Across studies, several sleep dimensions – short duration, poor quality, irregular timing – were linked with increased mental health symptoms. Notably, Baldini et al. found that sleep problems were significantly associated with suicidal ideation and behaviors in adolescents, underscoring the clinical relevance of early identification and intervention [5]. Similarly, Palmer et al. showed that even short-term sleep loss impairs emotional regulation, a key vulnerability factor for affective disorders [6]. Environmental and psychosocial factors also play an important role. Khor et al. emphasized the influence of parental behavior on adolescent sleep hygiene and subsequent emotional health [7], while Brinsley et al. demonstrated that peer-led interventions may offer an effective and socially resonant strategy for promoting both sleep and psychological well-being [8]. In addition to individual and relational factors, structural determinants such as physical activity levels [9] and socioeconomic context [11] were shown to moderate the relationship between sleep and mental health. These findings suggest that interventions aimed at improving adolescent sleep must be multidimensional, incorporating behavioral, familial, and community-level components. The current evidence also highlights sleep as a potentially modifiable protective factor in adolescent mental health. Studies such as Kocevska et al. support the view that aligning sleep patterns with developmental needs may reduce vulnerability to internalizing symptoms [10].

Overall, this review reinforces the relevance of integrating sleep-focused components into adolescent mental health promotion and prevention strategies. Future research should investigate the causal pathways in longitudinal designs, explore sleep as a target for transdiagnostic interventions, and consider structural factors (e.g., school start times, screen exposure) affecting adolescent sleep.

5. CONCLUSION

Healthy sleep habits are closely associated with better mental health outcomes in adolescents. The systematic reviews and meta-analyses included in this review highlight the strength and consistency of this relationship. Promoting sleep health should be a key component of adolescent mental health strategies. Future research should focus on longitudinal designs, culturally diverse populations, and the effectiveness of sleep-focused interventions.

REFERENCES

[1]   Centers for Disease Control and Prevention (CDC) (2017). *Youth Risk Behavior Survey (YRBS) 2017 results*. https://www.cdc.gov/healthyyouth/data/yrbs

[2]   Shochat, T., Cohen-Zion, M., & Tzischinsky, O. (2014). Functional consequences of inadequate sleep in adolescents: A systematic review. *Sleep Medicine Reviews*, 18 (1), 75–87. https://doi.org/10.1016/j.smrv.2013.03.005

[3]   Beattie, L., Kyle, S. D., Espie, C. A., & Biello, S. M. (2015). Social interactions, emotion regulation, and mood during daily life: Examining the role of sleep. *Sleep Health*, 1 (2), 121–127. https://doi.org/10.1016/j.sleh.2015.02.008

[4]   Lovato, N., & Gradisar, M. (2014). A meta-analysis and model of the relationship between sleep and depression in adolescents: Recommendations for prevention and intervention. *Sleep Medicine*, 15 (2), 137–144. https://doi.org/10.1016/j.sleep.2013.06.013

[5]   Baldini, V., et al. (2024). Association between sleep disturbances and suicidal behavior in adolescents: A systematic review and meta-analysis. *Frontiers in Psychiatry*, 15, 1341686. https://doi.org/10.3389/fpsyt.2024.1341686

[6]   Palmer, C. A. et al. (2024). Sleep loss and emotion: A systematic review and meta-analysis of over 50 years of experimental research. *Psychological Bulletin*, 150 (4), 440–463. https://doi.org/10.1037/bul0000410

[7]   Khor, S. P. H. et al. (2021). Modifiable parental factors in adolescent sleep: A systematic review and meta-analysis. *Sleep Medicine Reviews*, 56, 101408. https://doi.org/10.1016/j.smrv.2020.101408

[8]   Brinsley, J. et al. (2025). Effectiveness of peer-led health behaviour interventions on adolescent's mental health and wellbeing: A systematic review and meta-analysis. *Scientific Reports*, 15, 16480. https://doi.org/10.1038/s41598-025-01053-8

[9]   Dale, R. et al. (2025). 24-hour movement behaviours and mental health in non-clinical populations: A systematic review. *PLOS ONE*, 20 (6), e0325445. https://doi.org/10.1371/journal.pone.0325445

[10]   Kocevska, D., Lysen, T. S., Dotinga, A., et al. (2021). Sleep characteristics across the lifespan in 1.1 million people: A systematic review and meta-analysis. Nature Human Behaviour, 5 (1), 113–122. https://doi.org/10.1038/s41562-020-00965-x

[11]   Smith, C., Goss, H. R., Issartel, J., & Belton, S. (2021). Health Literacy in Schools? A Systematic Review of Health-Related Interventions Aimed at Disadvantaged Adolescents. *Children*, 8 (3), 176. https://doi.org/10.3390/children8030176

HEALTH ANXIETY AND ITS RELATIONSHIP
WITH DIGITAL HEALTH LITERACY IN HUNGARY

ANIKÓ GYULAI[1] – CSABA SZABÓ[2] – CSILLA LAKATOS[2]
[1]*University of Miskolc, Faculty of Health Sciences Institute of Applied Health Sciences*
[2]*University of Miskolc, Faculty of Health Sciences Institute of Basic Health Sciences*

Summary: In the context of digitised health information environments, understanding the relationship between digital health literacy and health anxiety is increasingly important.This study aimed to describe the levesl of digital health literacy and health anxiety among Hungarian adults and to investigate the background factors that influencing both. Additionally the relationship between digital health literacy and health anxiety was also investigated. A total of 314 participants aged 18 years and over completed an online questionnaire. The survey included the eHealth Literacy Scale (eHEALS) and the Short Health Anxiety Inventory (SHAI). Descriptive statistics, analysis of variance (ANOVA), independent samples t-tests, Cohen's d, Pearson and Spearman correlations were applied, with a significance threshold set at $p < 0.05$ were applied. Women reported significantly higher health anxiety scores than men (mean = 34.8 vs. 33.0; $p = 0.005$), particularly for the "perceived likelihood of getting sick" subscale. Health anxiety increased with age, with the highest scores recorded in those over 65 years old ($p = 0.008$). The mean eHEALS score was 30.2 (SD = 6.3). Although no significant difference in health anxiety was found between the participants with low and high eHEALS score groups ($p = 0.12$), a weak yet significant negative correlation was found between digital health literacy and health anxiety ($\rho = -0.18$; $p = 0.001$), suggesting that higher digital health literacy is associated with lower health anxiety. Women, older adults, and individuals with poorer self-rated health tended to report greater health anxiety. These findings highlight the potential importance of targeted digital health education for anxiety prevention and health promotion.

Keywords: health anxiety, digital health literacy, adult, Hungarian adults

1. INTRODUCTION

In the digital age, people are increasingly relying on online sources for health-related information. While this shift offers greater accessibility and autonomy, it also raises concerns about the accuracy of information, users' critical evaluation skills, and the potential psychological impact of exposure to health information. Digital health literacy (DHL) — the ability to seek, understand and evaluate health information from digital sources — has been shown to be a key factor in an individual's ability to navigate this complex information landscape. [1, 2] At the same time, health anxiety, defined as the excessive worry about having or developing a serious illness, can be exacerbated by unfiltered or misunderstood online health content. [3, 4]

Understanding the relationship between DHL and health anxiety is becoming increasingly important in the context of digitized health information. Previous studies have shown that low levels of DHL can contribute to increased anxiety through the misinterpretation of online health information. [5, 6] Conversely, individuals with high levels of health anxiety may compulsively search for health information online, a behavior commonly referred to as cyberchondria. [7]

Poor DHL can exacerbate cyberchondria—the excessive online search for health information—leading to hightened stress and anxiety. Improving digital and general health literacy is proposed as a key strategy to mitigate this effect by improving people's ability to critically appraise, interpret and appropriately apply online health information. [1, 4, 6, 7]

Health anxiety is also positively associated with distrust of healthcare systems and susceptibility to misinformation. People who have difficulty assessing the credibility of online sources may be more susceptible to misleading or alarmist content, which may subsequently exacerbate anxiety. In contrast, higher DHL may help to reduce mistrust by promoting more effective navigation of and understanding of reliable online health information, thereby reducing anxiety. [6, 8] This is particularly important in sociocultural contexts where trust in healthcare institutions is volatile or contested.

However, little is known about how these constructs interact in specific cultural and linguistic contexts, especially among the adult Hungarian population, for which there is little empirical data on this topic. [9] The aim of this study is to investigate the relationship between DHL and health anxiety in Hungarian adults, with the ultimate goal of informing targeted health education strategies and digital health interventions.

2. METHODS

2.1. Participants and procedure

This quantitative cross-sectional study used an anonymous online questionnaire. A total of 314 Hungarian adults aged 18 years or over participated in the survey. Recruitment was carried out using a convenience sample via social media (Facebook) platforms and email lists. Participation was voluntary, anonymous and based on informed consent, in accordance with ethical research guidelines, including the principles of respect for persons, beneficence, and justice as articulated in the Declaration of Helsinki.

2.2. Measures

Digital health literacy (DHL) was measured using the eHealth Literacy Scale (eHEALS) [10], a validated 8-item instrument that assesses individuals' perceived ability to find, evaluate, and use online health information. Items are rated on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree), yielding a total score ranging from 8 to 40, with higher scores indicating higher perceived digital health literacy.

Health anxiety was measured using the Short Health Anxiety Inventory (SHAI),[3] which evaluates health-related worries independently of actual illness. The 18 items are rated on a 4-point scale, and total scores can range from 0 to 54, with higher values reflecting more severe health anxiety.

Mental well-being was assessed using the WHO-5 Well-Being Index,[5] a 5-item questionnaire that captures subjective mental well-being over the past two weeks. Items are rated on a 6-point scale from 0 (at no time) to 5 (all of the time), with a raw score ranging from 0 to 25. The score is then multiplied by four to obtain a percentage scale from 0 (worst) to 100 (best possible well-being). In addition, socio-demographic data were collected, including age, gender, level of education, and place of residence.

2.3. Statistical analysis

All statistical analyses were performed using IBM SPSS Statistics 25. Descriptive statistics were calculated for all variables. Group differences were analyzed using t-tests for independent samples and one-way analysis of variance (ANOVA). Pearson and Spearman correlation coefficients were used to explore associations between continuous and ordinal variables, as appropriate. Cohen's d was calculated to determine effect sizes. A value of $p < 0.05$ was considered statistically significant throughout. In addition, 95% confidence intervals (CIs) were calculated for the proportions of categorical demographic variables using the normal approximation method of the binomial distribution.

3. RESULTS

3.1. Characteristics of the sample

A total of 314 subjects participated in the study. As shown in *Table 1*, the majority of respondents were female (71%), and the most represented age group was 45–54 years. In terms of education, most participants had at least a bachelor's degree, while only a very small proportion had elementary school as their highest qualification. Regarding place of residence, about one-third lived in district towns, with smaller proportions in villages and the capital *(Table 1)*.

Table 1
Estimated demographic characteristics of the sample (N = 314)

Variable	Frequency (n)	Percentage (%)	95% CI Lower	95% CI Upper
Gender:				
Female	223	71.0	66.0	76.0
Male	91	29.0	24.0	34.0
Age:				
18–24	58	18.5	14.2	22.8
25–34	60	19.1	14.8	23.5

35–44	45	14.3	10.5	18.2
45–54	84	26.7	21.9	31.6
55–64	36	11.5	7.9	15.0
65+	31	9.9	6.6	13.2
Education:				
Elementary school	3	1.0	–0.1	2.0
Vocationaltraining	11	3.5	1.5	5.5
Secondary education	81	25.8	21.0	30.6
Post-secondary (non-college)	42	13.4	9.6	17.1
BA/BSc	86	27.4	22.5	32.3
MA/MSc	81	25.8	21.0	30.6
Doctorate	10	3.2	1.2	5.1
Place of residence:				
County seat	114	36.3	31.0	41.6
Other city	98	31.2	26.1	36.3
Capitalcity	54	17.2	13.0	21.4
Village	48	15.3	11.3	19.3

3.2. Health anxiety by gender and its association with psychological well-being

A two-sample t-test was conducted to compare health anxiety and psychological well-being by gender. The mean SHAI score was significantly higher for women (M = 34.8, SD = 7.2) than for men (M = 33.0, SD = 7.3), t(312) = –2.01, p = 0.045. This indicates a small but statistically significant gender difference in health anxiety. In contrast, no significant difference was found between men and women for psychological well-being. To further investigate the gender difference in health anxiety, the two subscales of the Short Health Anxiety Inventory (SHAI) were analyzed separately. The observed gender difference was mainly due to the subscale "Perceived likelihood of becoming ill". Women scored significantly higher on this dimension than men (M = 26.8 vs. 25.2), t ≈ –2.73, p = 0.03, suggesting that women perceive themselves to be at risk of illness more often and/or notice more physical symptoms. In contrast, there was no statistically significant gender difference in the subscale "Perceived severity of illness consequences" (M = 8.0 for women vs. 7.8 for men), t ≈ –0.74, p = 0.53. This indicates that although women perceive a higher likelihood of illness, their assessment of the severity or impact of a possible illness is comparable to that of men. The mean WHO-5 score was 8.64 (SD = 2.90) for men and 8.58 (SD = 2.82) for women, t(312) = 0.15, p = 0.88. These results indicate that although the women in the sample reported slightly higher health anxiety, subjective well-being did not differ between the sexes *(Table 2)*.

Measure	Men (n=91) mean (SD)	Women (n=223) mean (SD)	t	p-value
SHAI total score	33.0 (7.3)	34.8 (7.2)	t = –2.01	0.045*
SHAI subscale score Perceived probability of illness	25.2	26.8	t ≈ -2.73	0.03*
SHAI subscale score Perceived severity of illness consequences	7.8	8.0	t ≈ –0.74	0.53
WHO-5 well-being score	8.64 (2.90)	8.58 (2.82)	t = 0.15	0.88

Further analyses examined gender-specific differences in health anxiety in various socio-demographic subgroups. Overall, women reported higher levels of health anxiety than men in almost all major categories, although the extent of the differences varied. The largest gender difference was observed in the 35–64 age group (mean difference ~2.7 points, p = 0.03), while the differences were smaller and non-significant among younger adults (18–34) and those aged 65+. Of note, both men and women aged 65 and older had higher levels of health anxiety, which is likely due to increased concern about health at older ages. Age had a significant overall effect on SHAI scores ($F_{(2,311)} = 4.95$, p = 0.008), with post-hoc tests showing that older adults reported significantly more anxiety than middle-aged individuals (p = 0.006). However, the interaction between age and gender was not significant. No significant differences in health anxiety were found between the different levels of education. Among respondents with higher education, women and men had almost identical SHAI scores (34.7 vs. 33.5; p = 0.29), while women in the lower education groups tended to report more anxiety (35.2 vs. 31.9; p = 0.07), although the interaction effect was not statistically significant. In terms of marital status, widowed participants reported the highest scores for health anxiety (mean ~40), possibly reflecting older age and social isolation.

3.3. Relationship between digital health literacy and health anxiety

The mean eHEALS score in the total sample (N = 314) was 30.2 (SD = 6.3; median = 31) on a scale from 8 to 40. The mean SHAI score was 34.3 (SD = 7.3; median = 34). Using a median split, participants with lower eHEALS scores (≤ 31 points; n = 165) had a slightly higher mean SHAI score (M = 35.0, SD = 7.6) than participants with higher eHEALS scores (> 31 points; n = 149, M = 33.5, SD = 6.9). However, this difference was not statistically significant (Mann–Whitney U = 13,545.5; p = 0.12). A Spearman rank-order correlation revealed a weak but statistically significant negative correlation between eHEALS and SHAI total scores (ρ = –0.18, p = 0.001), suggesting that higher digital health literacy is associated with lower levels of health anxiety. This trend was further supported by comparing participants at the extremes of the eHEALS distribution. Those with very low digital health literacy (≤ 24 points;

n = 56) had significantly higher SHAI scores (M = 35.7, SD = 7.5), while participants with very high eHEALS scores (≥ 37 points; n = 55) reported lower levels of health anxiety (M = 31.5, SD = 6.9). These results confirm the inverse relationship between digital health literacy and health-related anxiety, especially at extreme eHEALS scores *(Table 3)*.

Table 3

SHAI scores by eHEALS level (median and extreme groups)

eHEALS group	N	SHAI mean (SD)	SHAI median
Low eHEALS (≤ 31)	165	35.0 (7.6)	34
High eHEALS (> 31)	149	33.5 (6.9)	33
Very low eHEALS (≤ 24)	56	35.7 (7.5)	36
Very high eHEALS (≥ 37)	55	31.5 (6.9)	31

*Note: The extreme groups represent values ±1 SD from the mean.

4. DISCUSSION

This study investigated the relationship between digital health literacy (DHL) and health anxiety, as well as the moderating influence of socio-demographic factors and psychological well-being in a sample of Hungarian adults. The results are largely consistent with the existing literature, indicating that higher DHL is generally associated with reduced anxiety and stress across various population groups, albeit with modest magnitudes of association. [11, 12] In our sample, we observed a weak but statistically significant inverse correlation between DHL and health anxiety. While the difference between the low and high DHL groups was not significant on a median basis, participants at the extremes of the distribution—particularly those with very low DHL—reported significantly higher levels of health anxiety. These findings suggest that limited digital skills may impair the ability to interpret health-related information, thereby increasing uncertainty and emotional distress. Gender differences were also found in our study. Women scored consistently higher on the SHAI total and its subscales, particularly on the dimension of perceived likelihood of illness. These results are consistent with previous studies reporting increased health anxiety in women. For example, the Greek validation study of the SHAI found significantly higher scores in women, [13] and more recent population-based data confirm a higher prevalence of health anxiety in females. [14] Although the interaction between gender and age was not statistically significant in our data, the trend of increased health anxiety in women was observed in most age groups. Another important factor was age: regardless of gender, respondents aged 65 and over reported the highest levels of health anxiety. This is likely due to a greater susceptibility to illness and more frequent confrontation with health-related problems later in life, as reported in previous studies linking age and emotional reactivity to health threats. [15] In this study, educational level and occupational field

did not have a strong independent influence on health anxiety. However, respondents who rated their health as poor reported significantly more anxiety, highlighting the importance of subjective health status as a key correlate. This finding supports previous research suggesting that the way people perceive their own health status often has greater predictive power for emotional anxiety than objective indicators alone. [15] From a public health perspective, these findings emphasise the importance of improving both digital and psychological health literacy. Interventions that strengthen digital literacy and reduce health-related anxiety may benefit women, older adults and those with poorer health most. Programmes focusing on digital health literacy (DHL) that include training on evaluating online information, identifying trustworthy sources, and regulating emotional responses may help mitigate the negative effects of digital information overload. [16] Future studies should use longitudinal designs to investigate causality and explore mediators such as trust in health systems, emotional regulation, and perceived credibility of online health information. [11, 17] Additionally, qualitative approaches could also provide deeper insight into how individuals interpret health threats in digital environments and how these interpretations influence their anxiety levels.

This study has several limitations that should be considered when interpreting the results. First, the sample was not nationally representative. Participation was voluntary and recruitment was online, which may have led to self-selection bias. In particular, the sample contained a disproportionately high percentage of highly educated individuals: more than half of respondents had a college degree—about twice the national average—and many participants with a secondary school degree were currently enrolled in college. As a result, the results, particularly those related to digital health literacy, likely reflect the characteristics of a population with above-average levels of education. This may have contributed to higher DHL scores and reduced the variability needed to detect stronger associations.

5. CONCLUSION

This study examined the relationship between digital health literacy and health anxiety among a group of Hungarian adults. The results suggest that higher levels of digital health literacy are associated with slightly lower levels of health anxiety, particularly at the extremes of the distribution. While the correlation was weak overall, those with very low digital health literacy had significantly higher anxiety scores. This highlights the potential mental health risks associated with limited ability to navigate online health information. Women and older adults—particularly those aged 65+ —reported greater health anxiety, indicating the importance of gender- and age-specific mental health measures. Poor self-rated health was also found to be an important correlate of health anxiety, emphasising the subjective nature of perceived vulnerability to illness. Overall, the findings support the integration of digital literacy into public health and mental health strategies. Promoting skills to critically evaluate and apply health information online may help to reduce mental distress related to health issues. Future research should further

investigate how digital literacy interacts with psychological resilience, trust in health systems, and emotional regulation to shape individuals' responses to health-related uncertainty. Another area worthy of future research—similar to new programs developed in specific health promotion areas [18, 19] —is the development of effective health promotion methods for the critical evaluation and application of digital health literacy. Another promising new area of research could be to examine this topic, initially among healthcare workers at high risk of burnout, such as midwives. [20]

Funding

REFERENCES

[1]   Norman, C. D., Skinner, H. A. (2006). eHealth literacy: Essential skills for consumer health in a networked world. *J. Med. Internet Res.*, 8 (2), e9. https://doi.org/10.2196/jmir.8.2.e9

[2]   Dadaczynski, K., Okan, O., Messer, M., Rathmann, K. (2021). Digital health literacy and web-based information-seeking behaviors of university students in Germany during the COVID-19 pandemic: Cross-sectional survey study. *J. Med. Internet Res.*, 23 (1), e24097. https://doi.org/10.2196/24097

[3]   Salkovskis, P. M., Rimes, K. A., Warwick, H. M., Clark, D. M. (2002). The Health Anxiety Inventory: Development and validation of scales for the measurement of health anxiety and hypochondriasis. *Psychol. Med.*, 32 (5), 843–53. https://doi.org/10.1017/S0033291702005822

[4]   Jung, M., Lin, L. (20239. Health information seeking and its association with health anxiety during the COVID-19 pandemic: A cross-sectional study. *J. Affect Disord.*, 320, 670–677. https://doi.org/10.1016/j.jad.2022.10.021

[5]   Topp, C. W., Østergaard, S. D., Søndergaard, S., Bech, P. (2015). The WHO-5 Well-Being Index: A systematic review of the literature. *Psychother. Psychosom.*, 84 (3), 167–76. https://doi.org/10.1159/000376585

[6]   Haktanir, A., Seki, T., Griffiths, M. D. (2024). Digital health literacy and health anxiety among university students: A cross-sectional study during the COVID-19 pandemic. *Front Psychiatry.*, 15, 1421391. https://doi.org/10.3389/fpsyt.2024.1421391

[7] Kırık, A. M., Çetinkaya, A. (2022). The relationship between digital literacy and cyberchondria. In: *Advances in Media, Entertainment and the Arts.* Hershey, PA: IGI Global, Chapter 16. https://doi.org/10.4018/978-1-7998-8630-3.ch016

[8] Dadaczynski, K., Rathmann, K., Okan, O., Lorini, C., Tzogiou, C., Hunger, M. (2023). Digital health literacy and subjective health complaints in university students during the COVID-19 pandemic: The mediating role of information-related stress. *Front. Public Health.*, 11, 1259412. https://doi.org/10.3389/fpubh.2023.1259412

[9] Szabó, Á., Kósa, K., Ádány, R. (2023). eHealth literacy and health perception among Hungarian university students: A cross-sectional study. *J. Med. Internet Res.*, 25, e47595. https://doi.org/10.2196/47595

[10] Norman, C. D., Skinner, H. A. (2006). eHEALS: The eHealth Literacy Scale. *J. Med. Internet Res.*, 8 (4), e27. https://doi.org/10.2196/jmir.8.4.e27

[11] Bak, Á., Sipos, R., Horváth, Z. (2022). Relationship between digital health literacy, distrust in the health system and health anxiety in health sciences students. *Front. Psychiatry.*, 13, 878884. https://doi.org/10.3389/fpsyt.2022.878884

[12] Zsido, A. N., Toth, M. D., Nemeth, D. et al. (2024). Digital health literacy and cyberchondria in university students: The moderating role of gender. *Front Psychiatry.*, 15, 1421391. https://doi.org/10.3389/fpsyt.2024.1421391

[13] Leonidou, C., Panayiotou, G. (2018). Assessing health anxiety with the Greek version of the Short Health Anxiety Inventory: Psychometric properties and associations with health-related variables. *J. Psychosom. Res.*, 110, 62–70. https://doi.org/10.1016/j.jpsychores.2018.04.005

[14] Terra, L., Balsamo, M., Carlucci, L., Saggino, A. (2024). Gender differences in health anxiety: A population-based study on its prevalence and psychological correlates. *Psychiatry Res.*, 336, 115739. https://doi.org/10.1016/j.psychres.2024.115739

[15] Lee, H. Y., Lee, K., Kim, J. (2024). Impact of digital health literacy on health information-seeking behavior and mental health among older adults. *Clin. Gerontol.*, 47 (2), 1–13. https://doi.org10.1080/07317115.2024.2373894

[16] Jung, S. Y., Lee, S. H. (2024). Effects of eHealth literacy interventions on mental health: A systematic review and meta-analysis. *J. Med. Internet Res.*, 26, e51268. https://doi.org/10.2196/51268

[17] Cao, H., Zhang, J., Wang, M. (2024). The mediating role of emotional resilience in the relationship between digital health literacy and mental well-being. *BMC Psychol.*, 12 (1), 45. https://doi.org/10.1186/s40359-024-02276-6

[18] Hodozsó, K., Soósné Kiss, Zs., Jakus, P. et al. (2013). Professional help for visually impaired mothers raising a child. *New Med.*, 17 (3), 136–9.

[19] Soósné Kiss, Zs., Vitrai, J., Takács, J. et al. (2024). Peer education program to improve fluid consumption in primary schools—lessons learned from an innovative pilot study. *Heliyon.*, 10 (5), e26767. https://doi.org/10.1016/j.heliyon.2024.e26767

[20] Lipienné Krémer, I., Dió, M., Vitrai, J. et al. (2023). Kiégésszindróma a magyar szülésznők körében 2014-ben és 2022-ben. *Orv. Hetil.*, 164 (40), 1592–1599. https://doi.org/10.1556/650.2023.00173

FACTORS AFFECTING THE SUCCESS OF LACTATION
IN THE CONTEXT OF BIRTH QUALITY

GYÖNGYI PAPP, NÓRA SIMON
University of Miskolc, Faculty of Healh Sciences

Summary: The initiation and maintenance of breastfeeding are influenced by a wide range of biological, psychological, and environmental factors. The objective of this study was to explore how childbirth circumstances, particularly the quality of the birth experience and the availability of institutional support, affect the success of lactation. The authors conducted an online questionnaire survey in October 2021, resulting in 1,000 fully completed responses. The sample primarily included women residing in urban areas who were highly educated, aged between 25 and 34 years, and had given birth to more than one child. The data collection was supplemented by semi-structured interviews conducted in the autumn of 2023 with mothers who had experienced difficult or noteworthy births. The findings of the study indicate that undisturbed birth and early skin-to-skin contact have a positive impact on maternal confidence and breastfeeding success. Conversely, traumatic childbirth experiences characterised by a loss of control have been more frequently associated with breastfeeding difficulties, maternal insecurity, and early weaning. Despite the quantitative analysis failing to demonstrate a statistically significant correlation between mode of delivery and breastfeeding problems, the qualitative data indicated a clear trend. The research also highlighted that the type of birth preparation, family background, and complex perinatal factors all contribute to lactation outcomes.

Keywords: *Breastfeeding, childbirth experience, maternal competence, undisturbed birth, perinatal care*

1. INTRODUCTION

The quality of labour and birth is one of the most significant experiences in the human life cycle. It has been demonstrated that this experience exerts a considerable influence on the health and developmental outcomes of the child. Furthermore, it is also essential for the mother's sense of competence, the development of attachment [1], and the initiation of breastfeeding. Recent research findings indicate that the development of the relationship between mother and child commences prior to birth, during pregnancy. At this particular stage of pregnancy, it has been observed that women gradually develop a mental representation of their foetus. This mental representation constitutes the foundation for the subsequent emotional attachment that is so integral to the development of the mother-foetus bond. This special relationship is defined in the literature as prenatal attachment and evaluated as an independent psychological phenomenon. [2] Breastfeeding as a biological norm is not merely a method of feeding; rather, it is a complex neuroendocrine and

psychosocial process, the starting point of which is closely related to the aforementioned process, as well as to the experience of childbirth and the environmental and psychological factors associated with it.

As demonstrated by numerous international studies [3, 4], the importance of undisturbed physiological birth is well-documented. This approach supports early skin-to-skin contact, facilitates the golden hour, and has a positive effect on the initiation of breastfeeding. [5] Undisturbuned birth has been shown to reduce anxiety and the development of postpartum depression, and to encourage mothers to be less likely to choose formula during initial difficulties. In addition, newborns are more likely to participate actively in feeding. [4]

The release of the hormone oxytocin during natural birth has been demonstrated to support uterine activity and the milk ejection reflex Furthermore, the neurobiological basis of mother-newborn bonding is formed by this hormone. [6, 7] Conversely, the medicalisation of birth, the large number of interventions, and the experience of birth as a loss of control or traumatisation can adversely affect breastfeeding attitudes, lactation self-confidence, and maternal mental health. These factors can have an impact on later physical and mental health. [8, 9, 10, 11]

Nevertheless, the effects of perinatal events extend beyond the newborn period. Recent advancements in developmental psychology and epigenetic research have demonstrated that early life experiences, particularly the stress surrounding birth, have the capacity to exert a long-term influence on a child's emotional regulation, stress response, and subsequent parenting competence. The quality of maternal care (including the commitment to breastfeeding) exerts a significant influence on the health behaviours of the current generation, while concurrently establishing transgenerational patterns. [12]

In the domain of perinatal sciences, it is imperative to investigate the factors that facilitate a positive birth experience and the efficacy of breastfeeding, particularly during the initial days and weeks postpartum, when mothers are most susceptible to complications. [13]

The selection of this topic is driven by the conviction that a more profound comprehension of the correlation between birth experiences and breastfeeding outcomes can facilitate the evolution of more compassionate, family-oriented care. This enhanced care is expected to not only promote the health of the mother-child duo but also lay the foundation for the establishment of secure attachment, effective stress management, and health-conscious lifestyles for future generations. In such an approach, health professionals – especially health visitors, midwives and birth attendants – can become pivotal in ensuring the positive quality of labour, birth and breastfeeding.

Education is pivotal in the promotion of breastfeeding and the support of lactation. [14] The objective of education is to impart the necessary knowledge to safeguard and support effective breastfeeding and lactation from pregnancy through childbirth until the conclusion of infancy. [15] In addition to preparing for

breastfeeding and childbirth, the responsibility of professionals around families is to influence attitudes and foster a positive atmosphere.

In recent years, there has been a paradigm shift in attitudes towards breastfeeding. Historically, in traditional societies, the sight of a breastfed baby was common; however, this practice is becoming increasingly rare today. Experiential support from immediate family members has proven to be an effective strategy for managing breastfeeding challenges and other problems associated with childbirth. In modern society, parent educators have taken on a role previously filled by women's communities, thereby compensating for the lack of such groups. [4] Individuals who have not had the chance to engage in childbirth preparation training frequently encounter challenges in the organisation and interpretation of information during prenatal care. Consequently, individual needs may be overshadowed in the context of hospital births, leading to a more impersonalised birth experience that adheres to standardised protocols. The absence of adequate caring, emotional and practical support has been demonstrated to engender feelings of insecurity in mothers regarding childbirth. This, in turn, has been shown to exert an indirect negative influence on the initiation and maintenance of breastfeeding. The period of prenatal care could be utilised as an optimal setting for preparing for childbirth and breastfeeding, thereby providing families with the necessary information to enable them to make informed decisions. [16, 17, 18] It is submitted that, in the event of adequate information being made available, a proportion of women may be in a position to eschew the option of caesarean section, which is frequently perceived as a more straightforward alternative. It is acknowledged that this procedure has the potential to engender significant physical, psychological and familial repercussions. A global perspective reveals a substantial increase in the prevalence of caesarean sections in recent years. Presently, surgical intervention is employed in more than a third of global childbirths. [19, 20]

The global caesarean section rate is approximately 21%, which indicates that one in five babies is delivered by caesarean section. This rate is substantially higher than the WHO's previous recommendation of 10–15%. Projections indicate that this rate may rise to 28–29% by 2030. [21] These data further substantiate the hypothesis that opting for the 'easier way' is not merely a matter of individual preference, but rather, is also indicative of a global trend. This trend has far-reaching health and social ramifications.

A review of the relevant literature was conducted the following research questions:
1. The level of experience and support gained during the days following childbirth in the hospital has a significant impact on mothers' attitudes towards breastfeeding.
2. The success of breastfeeding is contingent upon the absence of obstruction and disturbance during childbirth.
3. The presence of healthcare workers during childbirth, as well as the obstetric environment, have been shown to have a significant impact on the development of the mother's perinatal experiences and attitudes.

2. MATERIAL AND METHOD

The research used both primary and secondary data collection methodologies. Data from the authors' previously collected questionnaire were grouped according to specific criteria in the framework of secondary data collection. The target group of the study was mothers who had given birth in the past decade. Data collection was carried out using convenience sampling. Our questionnaire was shared in thematic groups on the largest social media platform (Facebook). Respondents were able to participate anonymously after consenting to complete the questionnaire, while the interview subjects were contacted personally. The research was conducted with the appropriate ethical approvals from the Health Scientific Council Borsod-Abaúj-Zemplén County Ethics Committee.

The online questionnaire includes questions on demographic data, circumstances of childbirth, intention to breastfeed, difficulties encountered during breastfeeding, and the level of information and support received. The questions asked in the study included both closed and open-ended items, with short text explanations to facilitate understanding. The data collection period took place in October, 2021. The survey generated more interest than expected, so the survey was closed after 1000 responses were received. The high number of responses also indicates the significant social relevance of the topic. In order to further interpret the quantitative results, the research was supplemented with semi-structured interviews. The aim of the qualitative phase was to explore the personal, often emotionally charged narratives of mothers' experiences of childbirth and breastfeeding. The eight interviewees were selected to participate in the study through a conscious recruitment process, with particular attention to identifying women who experienced challenges, unusual events or significant psychological distress during childbirth. The interviews were conducted in October and November, 2023. The interview phase was an important addition to the data collected through the questionnaire and contributed significantly to a deeper understanding of the research.

The quantitative data analysis was performed in Excel and a p value of ≤ 0.05 was considered significant. Data were presented as frequency values, mean and standard deviation. The χ^2 test was used to examine the association. The qualitative data were analyzed using thematic content analysis, with particular attention to the development of potential competence, processing of the childbirth experience and attitudes.

3. RESULTS

Table 1 presents the demographic data of the respondents for the 1000 completions, and *Table 2* shows the same datas for the 8 interviewees.

Table 1

Demographic data of the respondents (questionnaire, n = 1000)

Age (%)	
18–24	**4**
25–34	**66**
35–44	**29**
45–54	**1**

Marital status (%)	
married/registered partnership	**95**
unmarried	**3**
divorced/widow	**2**
Education (%)	
primary school or below	**1**
secondary education	**22**
vocational training diploma	**2**
higher education or more	**71**
currently study in higher education	**4**
Place of residence (%)	
capital city	**15**
county seat	**22**
town/city	**37**
village	**25**
farm or homestead	**1**
Number of children (%)	
1	**24**
2	**32**
3	**31**
4 or more	**13**
Mode of delivery (%)	
elective caesarean section	**13**
emergency caesarean section	**19**
vaginal delivery in hospital	**60**
vaginal birth after caesarean	**3**
planned home delivery	**3**
other	**2**
Success of lactation %	
there were no problem	**41**
there were problem	**59**

Table 2

Demographic data of the respondents (interviews, n= 8)

Age (years, mean ±SD)	29.5 ± 2.21
Marital status, %	
married/registered partnership	100
Education, %	
secondary education	25
vocational training diploma	12.5
higher education or more	62.5

The vast majority of participants in both the quantitative and qualitative components of our study consciously prepared for childbirth and breastfeeding and demonstrated a strong commitment to the prospect of a natural, undisturbed birth. This observation

is further supported by the data depicted in *Figure 1*, which shows that 74% of mothers rated the importance of maintaining an undisturbed labour and birth at the highest level on a five-point Likert scale. Additionally, 15% of respondents assigned a high priority to this aspect, whereas the proportions of those expressing a neutral (9%) or low (2%) valuation were minimal. These findings suggest that, for most mothers, childbirth transcends a purely biological event, representing instead a profound biopsychosocial process during which autonomous decision-making, a sense of security, and emotional support are critically important.

However, despite the perceived importance of undisturbed birth, less than half of the respondents (41%) endorsed the view that birth conditions significantly influence breastfeeding success. The proportion of respondents who do not perceive a correlation between the quality of birth and subsequent breastfeeding is relatively high (19%), particularly when contrasted with the proportion of those who regard the peace of birth to be an insignificant factor (2%).
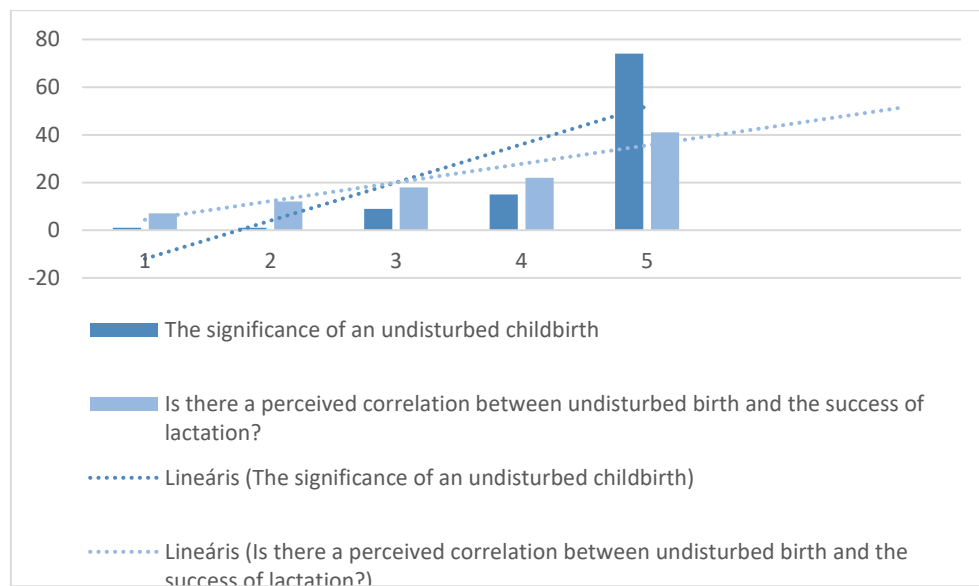

Figure 1. *Perceived Importance of Undisturbed Birth for the Successful Lactation (1 = not at all important, 5 = extremely important) (n = 1000)*

The statistical analysis of the questionnaire data indicated no statistically significant association between the mode of delivery and the occurrence of breastfeeding difficulties ($\chi^2_{(5)} = 2.80$, $p = 0.731$). However, findings from the qualitative data, interviews, and the distribution in *Table 3* suggest an observed association between the quality of the birth experience and breastfeeding success, particularly among primiparous women. *(Table 3)*.

Distribution of mode of delivery and incidence of breastfeeding problems
(N = 1000)

mode of delivery	no breastfeeding difficulties	breastfeeding difficulties	Σ
PVN* in hospital	**64.1%**	**62.3%**	63.2%
emergency caesarean section	**19.8%**	**21.0%**	20.9%
elektive caesarean section	**9.4%**	**12.2%**	10.3%
VBAC**	**3.2%**	**2.1%**	2.7%
home birth	**3.3%**	**2.2%**	2.7%
home birth without professional assistance	**0.2%**	**0.2%**	0.2%
Σ	**100%**	**100%**	100%

*PVN = Per Vias Naturales
** VBAC = Vaginal Birth After Caesarean

A considerable proportion of respondents who completed the questionnaire reported insufficient support during their postpartum hospitalisation. Their responses highlighted that the absence of the "golden hour", early maternal-infant separation, and lack of skin-to-skin contact frequently hindered the timely initiation of breastfeeding. Moreover, mothers who underwent labour induction with synthetic oxytocin or delivered via caesarean section reported breastfeeding difficulties with higher frequency. These quantitative findings are further elucidated and contextualised through detailed analyses of qualitative interview data.

"Oxytocin due to impatience, then non-dilation and 'the baby's heartbeat isn't that good', followed by a caesarean section. After which, due to lack of help, breastfeeding was unsuccessful." (32 years old, first child, caesarean section)

"I think I discovered a perfect parallel between breastfeeding and my birth. The failure of breastfeeding during the golden hour corresponds to the non-start of labour, and then the process that begins with great difficulty and with help – nipple shields for breastfeeding, oxytocin for childbirth – just doesn't go as it should, there are deficiencies and it stops – a tongue tie had to be replaced, which led to sucking difficulties, the baby didn't fit well, so the dilation stopped. Just as the birth that started in the spirit of naturalness ended in the operating room, breastfeeding was slowly replaced by formula" (27 years old, first child, caesarean section).

The quality of the birth experience is significantly influenced by the level of information provided to the woman, her decision-making autonomy, and the quality of communication with healthcare personnel. As illustrated in *Figure 2*, a significant proportion of the respondents (50%) did not receive any substantial information regarding the interventions that were performed during childbirth. Furthermore, 39% of respondents reported only partial information, while only 11% felt that they were provided with adequate support, information or decision-making opportunities. This

proportion is extremely revealing: the majority of mothers did not experience authentic involvement in decision-making around childbirth, or only to a limited extent.
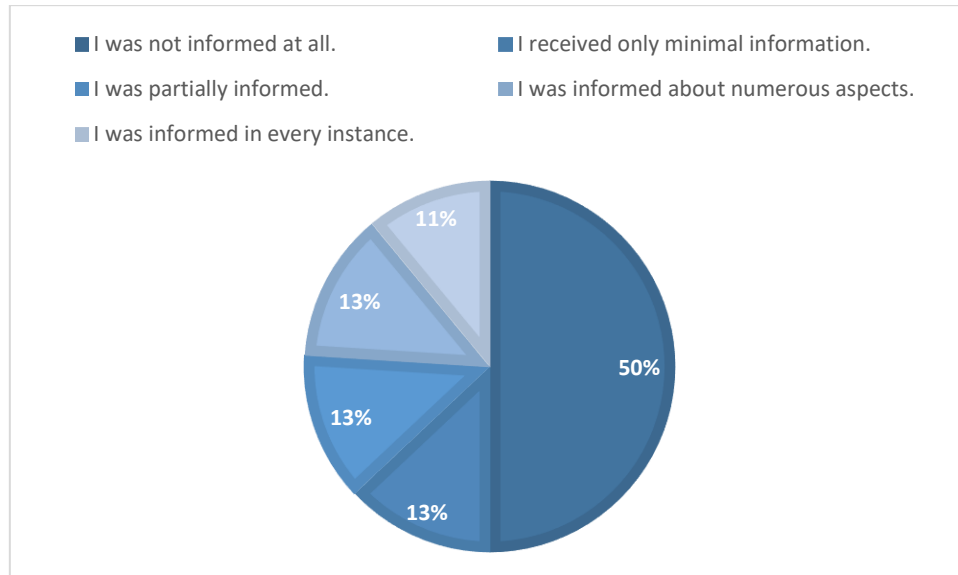

Figure 2. Respondents' evaluations of the level of information received during childbirth (n = 1000)

Similar results were obtained for breastfeeding support in the hospital. As illustrated in *Figure 3*, among the 1,000 participants who were surveyed, 419 (42%) reported not receiving any assistance in initiating breastfeeding during their hospitalisation, while an additional 180 (18%) indicated that they only received partial support. This indicates that 60% of mothers did not receive adequate support for breastfeeding, despite the fact that the initial hours and days following birth are of paramount importance for the initiation of lactation and the establishment of the bond between mother and infant. A multiple-choice format was employed in order to ascertain the source of any assistance, support or information received by the 581 participants who received help during their hospitalisation. The results indicated that the majority of respondents selected the baby nurse (552 people, 95%), followed by the hospital nurse (198 people, 34%), midwife (135 people, 23%), lactation consultant (119 people, 20%) and obstetrician (33 people, 5%).
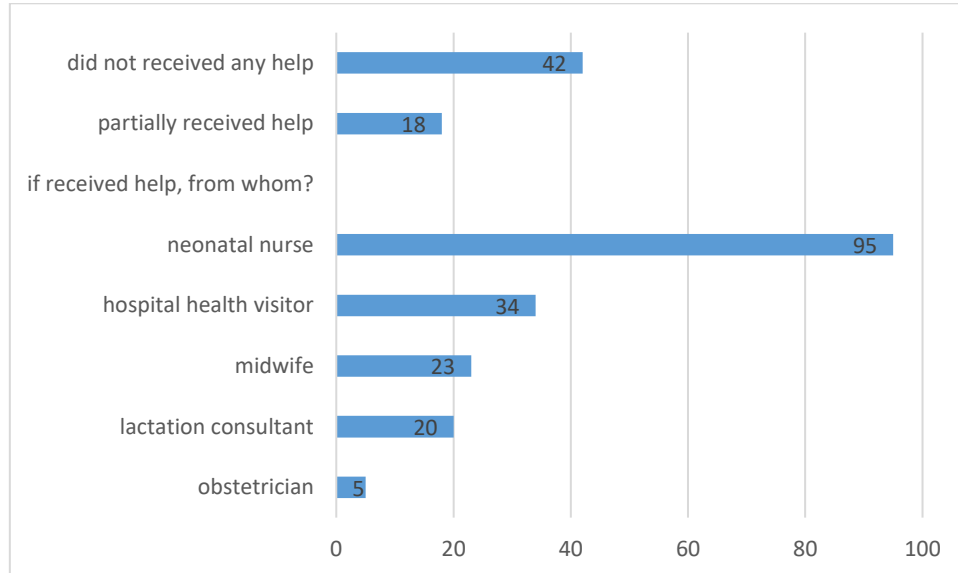
Figure 3. *Breastfeeding support in the hospital (n = 1000)*

The narratives provided by the interviewees reinforce the quantitative findings of the questionnaire-based study and, by contextualizing these results, contribute to a deeper understanding and a more vivid experiential interpretation. *"An opportunity for a golden hour in the caesarean section was present, yet the nurse working on the ward only arrived after several requests for assistance with the breast placement. Following the realisation that success would not be immediate, the nurse departed, resulting in the inability to breastfeed my infant son on the day of his birth." (26 years old, first child, caesarean section)*

"My first birth experience had a very bad effect on me and I experienced it as almost a trauma. I think the babies were the same trauma as me. Breastfeeding was difficult, it hurt, I didn't know how to latch on correctly, what was good and what was bad. The help with this was that they took her out and fed her from a bottle. I had to learn it all over again with my second baby, but this time they were very happy to help in the hospital, they were there with me. I didn't have a hard time. They monitored the breastfeeding, they also helped with the placement on the breast. At that time I had removable stitches, which healed much faster, I was able to breastfeed in several positions because it was easy to move around." (27 years old, 2 children, PVN)

4. DISCUSSION

The initial inquiry examined the extent to which postpartum experiences and the support received within the hospital setting influence maternal attitudes towards breastfeeding. Questionnaire responses indicate that both practical and emotional support provided during hospitalization play a critical role in the initiation and

continuation of breastfeeding, as well as in fostering a mother's sense of security. Interview findings further substantiate the hypothesis that the quality of experiences and the level of support received in the immediate days following childbirth significantly affect maternal attitudes towards breastfeeding. These results align with prior international research, which demonstrates that insufficient postpartum support—particularly following a distressing birth or one involving medical interventions—increases the risk of breastfeeding difficulties and early cessation. [4, 22] The literature consistently identifies elective caesarean section as a major contributor to breastfeeding challenges. [23]

Beyond the physical difficulties, inadequate support may undermine maternal self-efficacy, increase anxiety, and negatively impact the mother-infant relationship. Extant studies emphasize that the provision of authentic, comprehensive information, the adoption of assertive communication strategies, and the upholding of women's rights positively influence the birth experience, enhance maternal self-efficacy, foster trust, and facilitate the establishment of a secure mother–child bond. [16, 21] The findings of the present study corroborate these conclusions, indicating that the majority of women seek not only physical safety but also informational and emotional security during childbirth. Achieving a favorable birth outcome is contingent upon the mother's maintenance of composure and self-confidence, which fundamentally depend on comprehensive informational support, a predictable environment, and continuous emotional care. [24]

In particular, women undergoing caesarean section were more likely to experience delayed lactogenesis, painful breastfeeding, difficulties with infant latch, as well as heightened anxiety and diminished maternal self-efficacy. The results of this study corroborate previously established associations in the literature, demonstrating that birth circumstances—especially reduced maternal autonomy, absence of immediate physical contact, and impersonal care—significantly affect breastfeeding success and the quality of the initial mother–newborn bond. [22, 25] Qualitative analysis of our interview data revealed a pronounced parallel between the nature of women's birth experiences and their breastfeeding outcomes: participants reporting positive birth experiences exhibited greater confidence in breastfeeding and higher rates of successful on-demand feeding. It is well-documented that negative birth experiences, often characterized by loss of control and instances of obstetric violence, are frequently linked to breastfeeding difficulties, premature weaning, or reliance on formula feeding.

The findings of the present study emphasize that the perinatal period necessitates enhanced levels of preparedness, empathy, and attitudinal development—not only among pregnant women and their families but also among healthcare professionals involved in their care. As previously noted, emerging research on transgenerational effects, alongside epigenetic studies, increasingly underscores the imperative for early interventions to interrupt deleterious psychosocial trajectories. If the current state of obstetric care persists, there exists a substantial risk of perpetuating adverse outcomes, such as maternal insecurity and attachment disorders, across generations. [26]

The perinatal period is critically important for the identification and management of psychological challenges arising during pregnancy and the postpartum phase. Promotion and maintenance of optimal childbirth conditions – particularly minimizing unnecessary interference – have been consistently shown to exert beneficial effects on maternal experience, labour processing, and postpartum psychological well-being. [27]

This assertion is corroborated by the findings of contemporary longitudinal studies, which demonstrate a direct correlation between the experience of traumatic childbirth and the subsequent development of postpartum psychological disorders, including post-traumatic stress, depression, and impairment to the mother-child bond. [28, 29] These studies have demonstrated that maternal attachment skills are not merely established in the postpartum period, but also evolve during pregnancy through the formation of mental representations that are developed in conjunction with the fetus. The subjective experience of childbirth held by the mother has been shown to exert a significant influence on the quality of the subsequent mother-child bond, with the intensity of this influence being particularly pronounced in cases where the birth is processed as a negative or traumatic experience. [2, 30, 31] The health workers, by virtue of their unique role in offering ongoing support to families, have been identified as key players in the provision of timely intervention in this process. Health visitors can play a key role in timely intervention within this process, as their continuous presence offers a unique opportunity for providing long-term support to families.

5. CONCLUSIONS

Based on our quantitative and qualitative data, we found that a positive birth experience, particularly in a calm and supportive environment, promotes successful breastfeeding, enhances maternal confidence, and fosters secure early attachment. In contrast, breastfeeding difficulties, insecurity, and challenges in adapting to the parental role were more common following uncontrolled, traumatic birth experiences. Our survey also revealed that the preparation method, the amount of information received, and the attitude of hospital staff influenced mothers' perinatal experiences. This supports previous research concluding that the quality of the birth experience impacts not only the short term but also the long term, affecting the mother's mental health and her relationship with her child.

Health visitors bear significant responsibility in this area. A caring, trusting relationship creates opportunities for personalized information sharing and emotional support. During antenatal care, health visitors can provide women with up-to-date, evidence-based information to help them prepare for childbirth, breastfeeding, and health-related decisions. In the postpartum period, they can identify breastfeeding difficulties early and offer appropriate counseling.

REFERENCES

[1]   Seefeld, L., Weise, V., Knappe, S., Garthus-Niegel, S. (2022). Birth experience mediates the association between fear of childbirth and mother-child bonding up to 14 months postpartum: findings from the prospective cohort study DREAM. *Front Psychiatry*, 12, 776922. https://doi.org/10.3389/fpsyt.2021.776922

[2]   Smorti, M., Ponti, L., Ghinassi, S., Rapisardi, G. (2020). The mother–child attachment bond before and after birth: the role of maternal perception of traumatic childbirth. *Early Hum. Dev.*, 149, 104956. https://doi.org/10.1016/j.earlhumdev.2020.104956

[3]   Wieczorek, C. C., Schmied, H., Dorner, T. E., Dür, W. (2015). The bumpy road to implementing the Baby-Friendly Hospital Initiative in Austria: a qualitative study. *Int. Breastfeed J.*, 10, 3. https://doi.org/10.1186/s13006-015-0030-0

[4]   Wambach, K., Riordan, J. (2019). *Szoptatás és humán laktáció.* Budapest, Hungary: Semmelweis Kiadó.

[5]   Sun, J., Zhu, Y., Li, Y. et al. (2020). Maternal postpartum feeding anxiety was associated with infant feeding practices: results from the mother-infant cohort study of China. *BMC Pregnancy Childbirth*, 20, 780. https://doi.org/10.1186/s12884-020-03483-w

[6]   Varga, K., Bálint, B. (2022). A természetes és a szintetikus oxitocin szüléskor és szoptatáskor. *Orv. Hetil.*, 163 (41), 1629–1638. https://doi.org/10.1556/650.2022.32513

[7]   Roth, M. C., Humphreys, K. L., King, L. S. et al. (2021). Breastfeeding difficulties predict mothers' bonding with their infants from birth to age six months. *Matern. Child Health J.*, 25 (5), 777–785. https://doi.org/10.1007/s10995-020-03036-9

[8]   Andrew, M., Selvaratnam, R., Davies-Tuck, M. et al. (2022). The association between intrapartum interventions and immediate and ongoing breastfeeding outcomes: an Australian retrospective population-based cohort study. *Int. Breastfeed J.*, 17, 48. https://doi.org/10.1186/s13006-022-00492-7

[9]   Kaynak, S., Özçoban, F. A., Duran, S. (2025). The effect of breastfeeding self-efficacy levels on maternal attachment: the mediation role of mothers' traumatic childbirth perception. *Curr. Psychol.*, 44 (2), 1179–1188. https://doi.org/10.1007/s12144-025-07528-1

[10]   Suetsugu, Y., Haruna, M., Kamibeppu, K. (2020). A longitudinal study of bonding failure related to aspects of posttraumatic stress symptoms after childbirth among Japanese mothers. *BMC Pregnancy Childbirth*, 20, 434. https://doi.org/10.1186/s12884-020-03099-0

[11] Hulman, A., Pakai, A., Csákvári, T. (2024). The impact of mode of delivery and postpartum conditions on breastfeeding: a cross-sectional study. *Healthcare*, 12 (2), 248. https://doi.org/10.3390/healthcare12020248

[12] Lester, B. M., Conradt, E., LaGasse, L. et al. (2018). Epigenetic programming by maternal behavior in the human infant. *Pediatrics*, 142 (4), e20171890. https://doi.org/10.1542/peds.2017-1890

[13] Akyıldız, D., Çoban, A., Gör, U. F. (2021). Effects of obstetric interventions during labour on birth process and newborn health. *Florence Nightingale J. Nurs.*, 29 (1), 9–21. https://doi.org/10.5152/FNJN.2021.19093

[14] Coates, D., Donnolley, N., Fouerur, M. et al. (2021). Factors associated with women's birth beliefs and experiences of decision-making in the context of planned birth: a survey study. *Midwifery*, 96, 102944. https://doi.org/10.1016/j.midw.2021.102944

[15] Kiss G. (2022). *A szülésfelkészítők szerepe a várandósgondozásban* [thesis]. Budapest, Hungary: Eötvös Loránd Tudományegyetem. https://mpppot.hu/images/perinat_zarodolgozat_pdf/Kis_Gabriella_A_szules felkeszito_szerepe_2022.pdf.

[16] Wiessinger, D., West, D., Pitman, T. (2013). *A szoptatás női művészete.* Budapest, Hungary: La Leche Liga Magyarország Egyesület.

[17] Kisdi B. (2023). Gyöngéden e világra – A dúla. *Embertárs*, 21 (2), 196.

[18] Lantos, K., Jáni, B., Masa, A., Tobak, O. A védőnői gondozás és testi-lelki szülésfelkészítés összefüggései a szülés és a posztnatális időszak megélésével. *Védőnő*, (4).

[19] Ntiyakunze, G., Kyaruzi, A., Moshi, L. (2025). Mandatory second opinion to reduce caesarean section rate among low-risk pregnant women at a private tertiary hospital, a pre and post intervention study: an analysis using WHO Robson classification. *BMC Pregnancy Childbirth*, 25 (1), 698. https://doi.org/10.1186/s12884-025-07814-7

[20] Shirin, H., Ehsanul, H., Hawlader, M. (2025). Effectiveness of WHO-recommended antenatal care visits, ultrasonography, and health education in reducing unnecessary caesarean sections among pregnant women in Bangladesh: a hospital-based randomised controlled trial. *J. Glo. Health*, 15, 04182. https://doi.org/10.7189/jogh.15.04182

[21] Angolile, C. M., Max, B. L., Mushemba, J., Mahauri, H. L. (2023). Global increased cesarean section rates and public health implications: A call to action. *Health science reports*, 6 (5), 1274. https://doi.org/10.1002/hsr2.12742023

[22] Varga, K., Andrek, A., Molnár, J. E. (2019). *A szülés és születés minősége a perinatális tudományok megközelítésében*. Budapest, Hungary: Medicina Könyvkiadó Zrt.

[23] Li ,L., Wenlin, W., Chan, Z. (2021). Breastfeeding after a cesarean section: A literature review. *Midwifery*, 103, 103117. https://doi.org/10.1016/j.midw.2021.103117

[24] Wagner, M., Gunning, S. (2017). *Szülési terv: Útmutató szüléshez* [Creating Your Birth Plan: The Definitive Guide to a Safe and Empowering Birth]. Budapest, Hungary: Alternatal Alapítvány.

[25] Szakács, A. (2019). A születés élménye. *Gyermeklélek Mag*., (5), 23–25.

[26] McLeish, J., Redshaw, M. (2017). Support during pregnancy and birth for women with social risk: a systematic review. *BMC Pregnancy Childbirth*, 17 (1), 223.

[27] Varga, K. (2011). A transzgenerációs hatások az epigenetikai kutatások tükrében. *Magy. Pszichol. Szemle*, 66 (4), 507–532.

[28] Türkmen, H., Dİlcen, Y. H., Özçoban, F. A. (2020). Traumatic childbirth perception during pregnancy and the postpartum period and its postnatal mental health outcomes: a prospective longitudinal study. *Taylor & Francis*, 422–434. https://doi.org/10.1080/02646838.2020.1792429

[29] Wainwright, J., Tughan, T., Russell, C., Ross-Davie, M., Page, L., Pollock, J. (2021). Trauma-informed maternity care for women: international perspectives and a focus on South Wales. *J. Public Ment. Health*, 18 (2), 105–113.

[30] Simpson, M., Catling, C. (2016). Understanding psychological traumatic birth experiences: A literature review. *Women and Birth*, (3), 203–207. https://doi.org/10.1016/j.wombi.2015.10.009

[31] Choudhary, S., Jelly, P., Mahala, P. (2020). Models of maternity care: a continuity of midwifery care. *Int. J. Reprod. Contracept. Obstet. Gynecol.*, 9 (6), 2666. https://doi.org/10.18203/2320-1770.ijrcog20202373