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Correlation of Carpal Tunnel Syndrome with Hand Grip Strength among Pregnant Females: A Cross-Sectional Study

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ABSTRACT

Pregnancy induces physiological changes, including hormonal fluctuations and fluid retention, which may affect musculoskeletal function. These factors can reduce hand grip strength (HGS) and increase susceptibility to Carpal Tunnel Syndrome (CTS), caused by median nerve compression. CTS symptoms, including pain, numbness, and weakness, may hinder daily activities. Early detection during pregnancy is crucial for timely intervention. **Objectives:** To determine the frequency of hand-grip weakness (HGW) among pregnant women and to evaluate its correlation with clinical signs of CTS. **Methods:** This analytical cross-sectional study was conducted with 292 pregnant women aged 18–45 years, recruited through non-probability purposive sampling from multiple Karachi hospitals. HGS was measured with a Camry EH101 dynamometer following ASHT protocol; CTS was assessed using Phalen's and Tinel's tests. Data were analyzed using descriptive statistics, Chi-square, t-tests, ANOVA, and correlation analysis. **Results:** HGW was observed in 92.8% of participants. Phalen's and Tinel's tests were positive in 62.0% and 56.5%, respectively, and both showed significant associations with weak grip ($p<0.001$). Correlation analysis confirmed positive associations (Phalen's $r=0.301$, Tinel's $r=0.264$, $p<0.001$). Mean grip strength was lower in the weak group (16.11 ± 3.59) than in the normal group (23.93 ± 2.56; $p<0.001$), with no significant trimester differences. **Conclusions:** HGS measurement is a simple, non-invasive screening tool for early detection of CTS in pregnancy. Routine incorporation into antenatal care may facilitate timely management and preserve maternal hand function. Longitudinal studies are recommended.

INTRODUCTION

Pregnancy induces physical, physiological, emotional, social, and musculoskeletal changes, often reducing quality of life [1, 2]. Organ systems undergo significant transformations, creating a distinct physiology [3]. Despite challenges, pregnancy offers physiological and emotional benefits, enhancing long-term well-being through hormonal shifts, healthier lifestyles, and reduced cancer risk [4]. Mental health also improves, strengthening relationships and building resilience [5]. Hormones during pregnancy and breastfeeding cause structural changes in the musculoskeletal system, essential for movement. A measurable marker of musculoskeletal health is Hand Grip Strength (HGS), a reliable indicator of overall health that reflects immune function, nutritional status, bone density, and muscle strength, especially relevant during pregnancy and postpartum. Hormonal variations like elevated estrogen and fluid retention contribute to reduced HGS, measured by a handgrip dynamometer. HGS strongly correlates with physical traits across age and gender. Reduced HGS in pregnant women has significant implications, impairing daily activities, underscoring the need to monitor maternal health [6, 7]. Carpal Tunnel

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Syndrome (CTS), common in pregnancy, involves median nerve compression due to hormonal changes, ligament laxity, or fluid retention [8, 9]. CTS causes pain, numbness, tingling, burning, reduced sensation, and disturbed sleep, affecting up to 70% of pregnant women, often after 30 weeks of gestation. Prolonged CTS can lead to thenar muscle atrophy, impairing hand function [10, 11]. Peripheral edema and fluid retention, common pregnancy conditions, exacerbate CTS symptoms. About 80% of pregnant women experience peripheral edema, often from hormonal fluid retention and reduced venous return [10]. Approximately 62% report fluid retention, worsening CTS symptoms [12, 13]. Relaxin secretion may also contribute by promoting fluid accumulation, decreasing blood flow to the median nerve, and thickening the carpal ligament, furthering nerve compression [14, 15]. Lumbrical muscles, essential for grip strength, are affected in CTS as finger flexion power decreases due to median nerve involvement [16, 17]. CTS symptoms typically intensify as pregnancy progresses, with studies showing a marked increase in the third trimester [18, 19]. Wrist pain patterns vary with parity and hormonal fluctuations. Evidence reveals 74.5% of pregnant women experience reduced grip strength in the dominant hand and 83.9% in the non-dominant hand. Compared to non-pregnant women, pregnant individuals show significantly diminished HGS, linked to higher body fat, parity, and hormonal changes [3, 6, 13]. Despite its prevalence, CTS often goes underdiagnosed; only 35% of symptomatic women seek medical care [20, 21]. Pregnancy can trigger first CTS episodes or worsen pre-existing symptoms, prompting medical consultation [14]. This underrecognition highlights the need for enhanced clinical awareness. This study focuses on HGS as a potential indicator of CTS in pregnancy, addressing a gap in the literature. By exploring this association, the study aims to support the development of simple, non-invasive screening protocols using HGS measurements for early CTS detection during prenatal care. Identifying grip weakness is crucial for recognizing contributing factors like hormonal shifts, edema, and altered biomechanics, aiding in enhanced care through interventions such as early screening, physical therapy, ergonomic modifications, and preventative strategies. Understanding the HGS-CTS relationship may improve clinical decision-making and prenatal care by enabling earlier treatment and symptom management. Currently, most literature on CTS in pregnancy emphasizes its symptoms, including pain, numbness, and tingling, while overlooking its direct effect on HGS [19]. This lack of focus limits a comprehensive understanding of the musculoskeletal impacts of pregnancy and their functional consequences. Pregnant women were chosen because hormonal changes, ligamentous laxity, and fluid retention during pregnancy increase intracarpal pressure and median nerve compression, making them especially vulnerable to CTS. This study aims to determine the frequency of hand grip weakness among pregnant women and to evaluate its correlation with clinical signs of Carpal Tunnel Syndrome.

METHODS

This analytical cross-sectional study was conducted from September 2024 to February 2025 at Dow University of Health and Sciences (Ojha Campus), Sindh Government Hospitals, and Al Tibri Medical College and Hospital. Ethical approval was obtained from the Institutional Review Board of the Sindh Institute of Physical Medicine and Rehabilitation, Karachi (Ref. No. SIPM&R/IRB/2024/50). The study used a non-probability purposive sampling method to recruit eligible pregnant women within the study timeframe. Exclusion criteria included comorbidities such as diabetes, hypertension, thyroid, cardiovascular, or neurological disorders (e.g., multiple sclerosis, Parkinson's), previous CTS diagnosis, limb or head injuries, rheumatoid arthritis, or gout. To reduce potential selection bias, participants were drawn from multiple hospitals across Karachi to enhance representativeness. A total of 292 pregnant women aged 18–45 years, in any trimester, and either primigravida or multigravida were enrolled after providing informed consent. The sample size was calculated using OpenEpi (Version 3.01), based on a reported 74.5% prevalence of hand grip weakness (HGW) among pregnant women, a 5% margin of error, and a 95% confidence interval, yielding approximately 292 participants [6]. Demographics, medical history, and assessments were recorded using a structured proforma. HGS was measured using a Camry EH 101 mechanical hand grip dynamometers. Participants, seated comfortably, gripped the device with maximal effort using their dominant hand. Arm and wrist positions were standardized according to the American Society of Hand Therapists (ASHT) protocol: shoulder adducted, elbow flexed at 90°, forearm neutral, and wrist in 0–30° extension. Three readings were taken with >30 seconds rest between each, and the mean was recorded in kilograms. Grip strength was classified as 'weak' or 'normal' based on age- and sex-matched reference values, with values below the 25th percentile considered weak [7]. CTS was assessed using Tinel's sign and Phalen's test [22]. For Tinel's sign, participants sat with forearms supported while the examiner tapped over the median nerve at the distal wrist crease; tingling in the fingers indicated a positive result. For Phalen's test, participants flexed their wrists fully by pressing the backs of their hands together for 60 seconds; paresthesia indicated a positive result. Reported sensitivity and specificity were 66%/94% for Tinel's sign

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and 78%/94% for Phalen's test [23]. Dependent variables were HGW and CTS, while independent variables included age, trimester, gestational age, and parity. Data analysis was performed using IBM SPSS Statistics Version 20.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize data: means and standard deviations for continuous variables, and frequencies with percentages for categorical variables. Normality was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests; as data were normally distributed ($p > 0.05$), parametric tests (Independent t-test and one-way ANOVA) were applied. Chi-square tests examined associations between categorical variables, and Spearman's correlation assessed the relationship between grip strength and CTS signs, as Phalen's and Tinel's tests are binary categorical variables. (Figure 1).

Age	Male (kg)			Female (kg)		
	Weak	Normal	Strong	Weak	Normal	Strong
10-11	<12.6	12.6-22.4	>22.4	<11.8	11.8-21.6	>21.6
12-13	<19.4	19.4-31.2	>31.2	<14.6	14.6-24.4	>24.4
14-15	<28.5	28.5-44.3	>44.3	<15.5	15.5-27.3	>27.3
16-17	<32.6	32.6-52.4	>52.4	<17.2	17.2-29.0	>29.0
18-19	<35.7	35.7-55.5	>55.5	<19.2	19.2-31.0	>31.0
20-24	<36.8	36.8-56.6	>56.6	<21.5	21.5-35.3	>35.3
25-29	<37.7	37.7-57.5	>57.5	<25.6	25.6-41.4	>41.4
30-34	<36.0	36.0-55.8	>55.8	<21.5	21.5-35.3	>35.3
35-39	<35.8	35.8-55.6	>55.6	<20.3	20.3-34.1	>34.1
40-44	<35.5	35.5-55.3	>55.3	<18.9	18.9-32.7	>32.7
45-49	<34.7	34.7-54.5	>54.5	<18.6	18.6-32.4	>32.4
50-54	<32.9	32.9-50.7	>50.7	<18.1	18.1-31.9	>31.9
55-59	<30.7	30.7-48.5	>48.5	<17.2	17.2-31.5	>31.5
60-64	<28.2	28.2-44.0	>44.0	<15.4	15.4-27.2	>27.2
70-99	<21.3	21.3-35.1	>35.1	<14.7	14.7-24.5	>24.5

Figure 1: Reference Values for Handgrip Dynamometer

RESULTS

A total of 292 participants were enrolled and included in the final analysis, with no dropouts, deaths, or missing data. All participants completed the study, and none were lost to follow-up. Group-wise classification was not applicable, as all participants were analyzed as a single. Normality of the data was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests, both of which indicated that the data were normally distributed ($p>0.05$), supporting the use of parametric statistical analyses for further evaluation. The following table summarizes the key demographic characteristics of the study participants. The total number of participants was 292. Among these, the majority of pregnant females were in the third trimester of pregnancy (47.6%). A larger proportion of the participants had experienced previous pregnancies (69.5%). Additionally, most participants were right-handed (93.5%) (Table 1).

Table 1: Demographic Characteristics of Study Participants (N=292)

Variables	Category	Frequency (%)
Trimester	First	56 (19.2%)
	Second	97 (33.2%)
	Third	139 (47.6%)
Gravida	Primigravida	89 (30.5%)
	Multigravida	203 (69.5%)
Hand dominance	Right-handed	273 (93.5%)
	Left-handed	19 (6.5%)
Total participants		292 (100%)

Among pregnant participants, the majority, 92.8% (n = 271), exhibited weak hand grip strength, whereas only 7.2% (n=21) demonstrated normal strength (Figure 2).

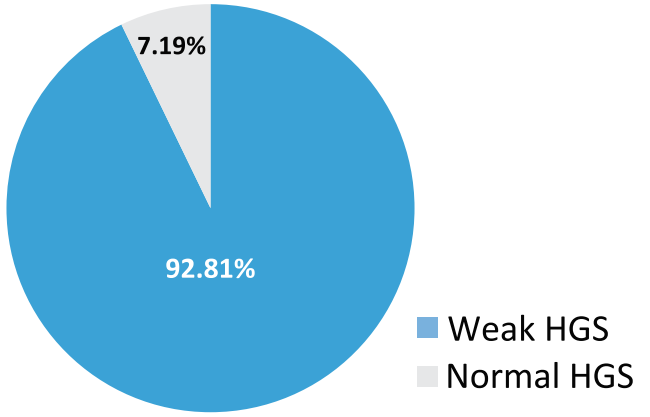

Figure 2: Frequency of HGW

Phalen's test, an indicator of CTS, was positive in 62.0% (n=181) of pregnant females and negative in 38.0% (n=111). Similarly, Tinel's sign was positive in 56.5% (n=165) and negative in 43.5% (n=127) (Figure 3).

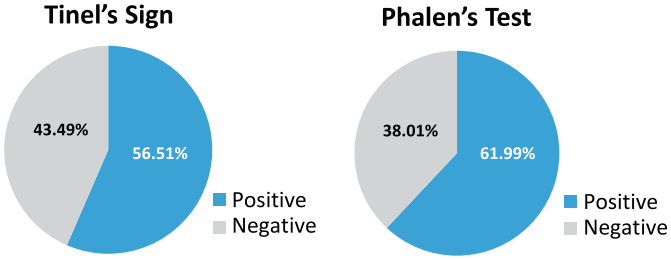

Figure 3: Frequencies of Tinel's Sign and Phalen's Test

Among participants, 92.8% (n=271) had weak hand grip strength, while 7.2% (n=21) demonstrated normal strength. Phalen's test was positive in 62.0% and Tinel's sign in 56.5% of participants. Chi-square analysis confirmed significant associations between weak hand grip strength and both Phalen's and Tinel's tests ($p<0.001$) (Table 2).

Table 2: Association and Correlation Between Hand Grip Weakness and Clinical Tests for Carpal Tunnel Syndrome

Test	Group	Weak n (%)	Normal n (%)	Total n (%)	Pearson Chi-Square	p-Value
Phalen's Test	Positive	179 (98.9)	2 (1.1)	181 (100.0)	26.430	<0.001*
	Negative	92 (82.9)	19 (17.1)	111 (100.0)		
Tinel's Sign	Positive	163 (98.8)	2 (1.2)	165 (100.0)	20.323	<0.001*
	Negative	108 (85.0)	19 (15.0)	127 (100.0)		
Total		271 (92.8)	21 (7.2)	292 (100.0)	–	–

*Values marked with an asterisk (*) denote statistical significance at $p \leq 0.05$

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Spearman's correlation analysis demonstrated a positive association between hand grip strength (HGS) and CTS signs, with Phalen's test (r=0.301, p<0.001*) and Tinel's sign (r=0.264, p<0.001*) both showing significant correlations. Additionally, Phalen's and Tinel's tests were strongly correlated with each other (r=0.565, p<0.001*). Independent t-test analysis revealed that women with weak grip strength had significantly lower mean HGS compared to those with normal grip (16.11 ± 3.59 vs. 23.93 ± 2.56; p<0.001). However, one-way ANOVA indicated no statistically significant difference in mean HGS across pregnancy trimesters (p=0.258) (Table 3).

Table 3: Comparison of Hand Grip Strength Between Groups and Across Pregnancy Trimesters

Variables	Group	n (Mean ± SD)	Test Statistics	DF	p-Value
HGS (kg)	Weak grip	271 (16.11 ± 3.59)	t = -9.858	290	<0.001*
	Normal grip	21 (23.93 ± 2.56)			
Trimester	First	56 (17.17 ± 3.76)	F = 1.362	2, 289	0.258
	Second	97 (16.96 ± 3.92)			
	Third	139 (16.27 ± 4.22)			
Total		292 (16.67 ± 4.04)			

Values marked with an asterisk (*) indicate statistical significance at p≤0.05*

When comparing CTS indicators across trimesters, one-way ANOVA showed no significant differences for either Phalen's test (p=0.650) or Tinel's sign (p=0.843) (Table 4).

Table 4: Comparison of CTS Indicators Across Pregnancy Trimesters

Variables	Group	n (Mean ± SD)	Test Statistics	DF	p-Value
Phalen's Test	First trimester	56 (1.41 ± 0.50)	F = 0.432	2,289	0.650
	Second trimester	97 (1.40 ± 0.49)			
	Third trimester	139 (1.35 ± 0.48)			
	Total	292 (1.38 ± 0.49)			
Tinel's Sign	First trimester	56 (1.45 ± 0.50)	F = 0.171	2,289	0.843
	Second trimester	97 (1.45 ± 0.50)			
	Third trimester	139 (1.42 ± 0.50)			
	Total	292 (1.43 ± 0.50)			

DISCUSSIONS

In this study, participants were classified as CTS-positive if they demonstrated a positive result on either Phalen's test or Tinel's sign, consistent with established clinical criteria [23]. Pregnant women often have reduced HGS, with previous studies reporting that 74.5% of participants exhibited weak grip strength in their dominant hand [6]. This decline is largely due to physiological changes, including hormone imbalances and fluid retention, which increase ligament laxity and median nerve pressure, predisposing women to CTS [8, 9]. These changes intensify in the third trimester due to peak fluid retention and weight gain, exacerbating CTS symptoms and contributing to hand grip weakness [24]. Early detection and intervention are crucial. This study found a significant association between weak HGS and positive Phalen's test (62.0%) and Tinel's sign (56.5%), with a correlation of p<0.001, indicating that CTS may substantially contribute to grip weakness. Previous research has shown that CTS affects 31–62% of pregnant women, with symptom severity increasing in later trimesters [11, 16], underscoring the importance of integrating CTS screening into prenatal care to prevent long-term complications and support quality of life. However, no significant HGS differences were observed across trimesters in this study, diverging from some previous findings. Despite 47.6% of participants being in their third trimester, no trimester-based HGS variation emerged, suggesting that other factors, such as genetics or lifestyle, may influence grip strength and CTS risk. CTS is common in middle-aged and pregnant women, primarily due to hormonal changes and increased intracarpal pressure [8, 9]. Earlier studies have reported that sensory symptoms are more prevalent than motor symptoms, with the dominant hand more frequently affected. Pregnancy-related CTS (PRCTS) may worsen in the third trimester, causing pain, numbness, sleep disruption, and emotional distress. Yet, only 46% of symptomatic pregnant women reportedly seek medical help, and just 35% receive treatment, highlighting the need for education and timely care. Diagnostic methods such as Phalen's and Tinel's tests, with reported sensitivities of 78% and 66% and specificities of 94% and 64–80%, respectively, remain clinically valuable for CTS assessment [13, 20, 21]. Previous studies suggest that CTS progresses with pregnancy and is most prevalent in the third trimester [16, 17]. Other research supports CTS occurrence at any stage of pregnancy, unrelated to age or gestational month, aligning with our findings [25]. This indicates that fluid retention and hormonal shifts, rather than the gestational stage alone, may drive CTS. Some CTS symptoms may persist postpartum, warranting follow-up [20, 26]. Maintaining hand health positively impacts maternal well-being, as research links maternal happiness during pregnancy to reduced psychiatric risks and improved fetal development [27]. HGS reduction may serve as an early indicator of CTS and broader health decline, supporting its use as a low-cost, non-invasive screening tool during antenatal care, which also provides opportunities to address unhealthy behaviors [28]. Furthermore, literature supports physiotherapy for mild to moderate CTS, with wrist splinting and Kinesio taping proving effective for symptom management [29]. Kinesio taping has shown superior outcomes in pain reduction and grip strength improvement compared to splinting [30]. Addressing systemic health factors such as inflammation and nutrition may further

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enhance HGS and prevent CTS. Overall, integrating HGS testing into prenatal care, promoting physiotherapy, educating women on CTS, and conducting longitudinal studies including comparisons between primigravida and multigravida participants are recommended to improve management and understanding of pregnancy-related CTS.

CONCLUSIONS

This study confirms that handgrip weakness is common among pregnant women and strongly associated with clinical signs of CTS. These findings support the use of HGS as a prognostic indicator for early detection of CTS during pregnancy. Regular assessment during antenatal visits can help prevent functional impairment and improve quality of life.

Authors Contribution

Conceptualization: AAS
Methodology: AN, YK, AW, HBA, SMO
Formal analysis: AN, YK, AW, HBA, SMO
Writing review and editing: AAS, AN, YK, AW, HBA, SMO

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

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REFERENCES

[1] Santos ML, Macêdo SG, Fernandes J, Pirkle CM, Câmara SM. Muscle Strength During Pregnancy and Postpartum in Adolescents and Adults. PLOS ONE. 2024 Mar; 19(3): e0300062. doi: 10.1371/journal.pone.0300062.

[2] Fiat F, Merghes PE, Scurtu AD, Almajan Guta B, Dehelean CA, Varan N, *et al.* The Main Changes in Pregnancy - Therapeutic Approach to Musculoskeletal Pain. Medicina. 2022 Aug; 58(8): 1115. doi: 10.3390/medicina58081115.

[3] Nguyen BN, Britten-Jones AC, Bui BV, Walker LE, Titter P. Physiological and Pathological Changes to the Eye and Vision During and After Pregnancy. Clinical and Experimental Optometry. 2025 Jan; 108(1): 5-13. doi: 10.1080/08164622.2024.2410031.

[4] Bagherzadeh R, Gharibi T, Safavi B, Mohammadi SZ, Karami F, Keshavarz S. Pregnancy; an Opportunity to Return to a Healthy Lifestyle: A Qualitative Study. BMC Pregnancy and Childbirth. 2021 Nov; 21(1): 751. doi: 10.1186/s12884-021-04213-6.

[5] Jordan SJ, Na R, Weiderpass E, Adami HO, Anderson KE, van Den Brandt PA, *et al.* Pregnancy Outcomes and Risk of Endometrial Cancer: A Pooled Analysis of Individual Participant Data in the Epidemiology of Endometrial Cancer Consortium. International Journal of Cancer. 2021 May; 148(9): 2068-78. doi: 10.1002/ijc.33360.

[6] Abdullahi A, Bala AS, Danazumi SM, Abubakar SM, Adamu RI, Truijen S, *et al.* Determination of Hand Grip Strength and Its Correlates During Pregnancy: A Cross-Sectional Study. BMC Pregnancy and Childbirth. 2021 Aug; 21(1): 540. doi: 10.1186/s12884-021-04003-0.

[7] Mbada CE, Adeyemi AB, Omosebi O, Olowokere AE, Faremi FA. Hand Grip Strength in Pregnant and Non-Pregnant Females. Middle East Journal of Rehabilitation and Health. 2015 Apr; 2: e27641. doi: 10.17795/mejrh-27641.

[8] Muñoz-Gómez E, Aguilar-Rodríguez M, Mollà-Casanova S, Sempere-Rubio N, Inglés M, Serra-Añó P, *et al.* A Randomized Controlled Trial on the Effectiveness of Mirror Therapy in Improving Strength, Range of Movement and Muscle Activity in People with Carpal Tunnel Syndrome. Journal of Hand Therapy. 2024 Oct; 37(4): 534-43. doi: 10.1016/j.jht.2024.02.007.

[9] Parikh S, Harihara Prakash R, Challawala S. Association Between Bilateral Grip and Pinch Strength in Sub-Clinical Carpal Tunnel Syndrome in Patients with Unilateral Carpal Tunnel Syndrome. 2024.

[10] Zahrah HA, Ardhi MS. Risk Factors for Carpal Tunnel Syndrome in Pregnant Women: A Literature Review. Risk Factors for Carpal Tunnel Syndrome in Pregnant Women: A Literature Review. 2023 Jan; 117(1): 3-. doi: 10.47119/IJRP1001171120234417.

[11] Long G, Yao ZY, Na Y, Ping Y, Feng Y, Xiangsheng T, *et al.* Hand Grip Strength as a Predictor of Recovery from Low Back Pain in Pregnant Women - A Prospective Study. Journal of Orthopaedic Science. 2021 Jul; 26(4): 566-71. doi: 10.1016/j.jos.2020.06.002.

[12] Keskin YA, Kilic G, Taspinar O, Posul SO, Halac G, Eren F, *et al.* Effectiveness of Home Exercise in Pregnant Women with Carpal Tunnel Syndrome: Randomized Control Trial. 2020.

[13] Waris M, Arshad N, Naz A, Shabbir M, Hanif M, Rehman M. Carpal Tunnel Syndrome in Pregnant Women: A Cross-Sectional Study. Pakistan Journal of Medical Research. 2021; 60(4): 178-82.

[14] Cîmpeanu MC, Roman N, Grigorescu S, Grigorescu OD, Miclăuș RS. Management of "De Novo" Carpal Tunnel Syndrome in Pregnancy: A Narrative Review. Journal of Personalized Medicine. 2024 Feb; 14(3): 240. doi: 10.3390/jpm14030240.

DOI: https://doi.org/10.54393/pjhs.v6i9.3225

[15] Sasaki T, Makino K, Nimura A, Suzuki S, Kuroiwa T, Koyama T, *et al.* Assessment of Grip-Motion Characteristics in Carpal Tunnel Syndrome Patients Using a Novel Finger Grip Dynamometer System. Journal of Orthopaedic Surgery and Research. 2020 Jul; 15(1): 245. doi: 10.1186/s13018-020-01773-9.

[16] Afshar A, Tabrizi A. Pregnancy-Related Hand and Wrist Problems. Archives of Bone and Joint Surgery. 2021 May; 9(3): 345.

[17] Mateen A, Tanveer F, Abdullah MA. Prevalence of Carpal Tunnel Syndrome in Pregnancy; a Cross-Sectional Study: Prevalence of Carpal Tunnel Syndrome in Pregnancy. The Healer Journal of Physiotherapy and Rehabilitation Sciences. 2024 Feb; 4(2): 965-70. doi: 10.55735/hjprs.v4i2.196.

[18] Khosrawi S and Maghrouri R. The Prevalence and Severity of Carpal Tunnel Syndrome During Pregnancy. Advanced Biomedical Research. 2012 Jan; 1(1): 43. doi: 10.4103/2277-9175.100143.

[19] Nageswari C, Meena N, Devi TR. A Noninvasive Approach to Prevent Carpal Tunnel Syndrome in IT Women During Pregnancy. YMER. 2022; 2: 542-4.

[20] Ozturk AA, Erpala F. Pregnancy-Related Carpal Tunnel Syndrome; Non-Invasive Early Diagnosis and Postpartum Evaluation. Medicine Science. 2023 Mar; 12(1). doi: 10.5455/medscience.2022.12.260.

[21] Yaseen F, Mahmood M, Akhtar MW, Naseem M, Zafar M, Rizwan M, *et al.* Prevalence of Carpal Tunnel Syndrome During Pregnancy. Journal of Health and Rehabilitation Research. 2024 Feb; 4(1): 769-73. doi: 10.61919/jhrr.v4i1.480.

[22] Genova A, Dix O, Saefan A, Thakur M, Hassan A, Arguello MT, *et al.* Carpal Tunnel Syndrome: A Review of Literature. Cureus. 2020 Mar; 12(3). doi: 10.7759/cureus.7333.

[23] Padua L, Coraci D, Erra C, Pazzaglia C, Paolasso I, Loreti C, *et al.* Carpal Tunnel Syndrome: Clinical Features, Diagnosis, and Management. The Lancet Neurology. 2016 Nov; 15(12): 1273-84. doi: 10.1016/S1474-4422(16)30231-9.

[24] Alahgholi A, Bagheri RB. Pregnancy-Related Hand & Wrist Problem; Focus in Surgery: Systematic Review. Eurasian Journal of Chemical, Medicinal and Petroleum Research. 2022 Oct; 1(4): 237-49.

[25] Shaheen Noor AS, Tariq R, Tahir H, Tariq A. Carpal Tunnel Syndrome and Its Associated Factors in Third Trimester of Pregnancy. Rawal Medical Journal. 2020 Apr; 45(2).

[26] Seror P. Conduction Blocks of The Median Nerve at The Wrist in Pregnancy and Postpartum Carpal Tunnel Syndromes. Muscle & Nerve. 2023 Oct; 68(4): 380-7. doi: 10.1002/mus.27929.

[27] Naaz A and Muneshwar KN. How Maternal Nutritional and Mental Health Affects Child Health During Pregnancy: A Narrative Review. Cureus. 2023 Nov; 15(11). doi: 10.7759/cureus.48763.

[28] Rockliffe L, Peters S, Heazell AE, Smith DM. Factors Influencing Health Behaviour Change During Pregnancy: A Systematic Review and Meta-Synthesis. Health Psychology Review. 2021 Oct; 15(4): 613-32. doi: 10.1080/17437199.2021.1938632.

[29] Gräf JK, Lüdtke K, Wollesen B. Physio-Und Sporttherapeutische Interventionen zur Behandlung Eines Karpaltunnelsyndroms. Der Schmerz. 2022 Aug; 36(4): 256-65. doi: 10.1007/s00482-022-00637-x.

[30] Nadar MS, Alotaibi N, Manee F. Efficacy of Splinting the Wrist and Metacarpophalangeal Joints for the Treatment of Carpal Tunnel Syndrome: An Assessor-Blinded Randomised Controlled Trial. BMJ Open. 2023 Nov; 13(11): e076961. doi: 10.1136/bmjopen-2023-076961.