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MATERNAL-FETAL MEDICINE

Carpal tunnel syndrome during the third trimester of pregnancy: prevalence and risk factors

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Abstract

Purpose To estimate the prevalence of indicative signs and symptoms of carpal tunnel syndrome (CTS) during the third trimester of pregnancy; assess the severity of symptoms and functional impairment; evaluate associated factors; and to evaluate the complaint of CTS in pregnant women through ultrasonography (USG).

Methods A cross-sectional study, in which participants were classified into two groups: presence and absence of indicative signs and symptoms of CTS. Severity of symptoms and functional status was assessed by the Boston Carpal Tunnel Questionnaire. USG was performed by multiplanar technique of static and dynamic evaluation. Association between USG and indicative signs and symptoms of CTS was estimated using Fischer's exact test and Poisson regression models were used to estimate the association of exploratory variables and indicative signs and symptoms of CTS.

Results Altogether, 482 women were recruited and 111 presented indicative signs and symptoms of CTS, resulting in a prevalence of 23.03%. USG was not able to distinguish indicative signs and symptoms of CTS groups. Both the severity of the symptoms and the impairment of the manual function were mild. Being left-handed, gestational diabetes mellitus and maternal age were associated with indicative signs and symptoms of CTS.

Conclusions The high prevalence of indicative signs and symptoms of CTS and the difficulties that they can cause reinforce the importance of adequate diagnosis and treatment. Further studies are needed to assess the value of USG as a diagnostic method for CTS during pregnancy.

Keywords Pregnancy · Carpal tunnel syndrome · Prevalence · Maternal age · Gestational diabetes · Functional laterality

Introduction

Pregnancy is marked by morphophysiological changes which directly affect women's musculoskeletal systems. The dynamic natural changes which come with pregnancy can lead to the development of musculoskeletal system disturbances. Carpal tunnel syndrome (CTS) is one of the most common complaints of this kind among pregnant women [1, 2].

CTS is defined as the dysfunction caused by the compression and/or traction of the median nerve in the carpal tunnel [3, 4]. Tingling, numbness and pain in the middle and index fingers and the thumb, as well as on the radial side of the ring finger, are common symptoms of CTS [5]. Weakness of the thenar musculature and reduction of discriminative pressure and tactile sensibility may also occur [6], as well as pain and burning sensations in the fist, and diminished palmar grip strength and hand dexterity [5, 7]. Symptoms tend to worsen at night, interfering in sleep quality [1, 3], and are generally bilateral, affecting the dominant hand more severely [8], though they may also occur only on one hand. In severe cases, symptoms may irradiate proximally to the forearm, arm, and, in some cases, up to the shoulders [5, 7].

The prevalence of CTS in the general population is of around 4% [1, 7]. Despite CTS being a frequent pregnancy complication, prevalence in this group is unknown, as the

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literature presents rates ranging from 2.3 to 62% [1, 2, 6, 9–11]. It is believed that CTS is more prevalent during the third trimester of pregnancy, though it may occur during any period [1, 2, 12]. As for prognosis, it has been reported that around half of women who present CTS during pregnancy complain of symptoms remaining up to a year after labor [11].

In relation to CTS etiology, there is a well-established link between increases in pressure to the carpal tunnel and the onset of clinical symptomatology [4]. The causes for CTS during pregnancy, however, are not yet clear. The peripheral edema observed on around 80% of pregnant women, especially prevalent in the third trimester of pregnancy, may be one of the determining factors. This edema possibly results from the reduction of venous return [13] coupled with hormonal changes which favor fluid retention [1]. When the edema is located on the fist, it may limit or decrease the diameter of the carpal tunnel, compressing the median nerve which traverses it [6]. Another possible cause may be relaxin secretion, which can induce the relaxation of the transverse carpal ligament, leading to its flattening and, subsequently, to the compression of the median nerve [13]. It is important to highlight that these two mechanisms are not mutually exclusive, and so may occur concurrently.

The gold standard for CTS diagnosis in both clinical and academic environments is clinical evaluation, based on the patient's history and on motor and sensorial signs and symptoms [5]. Tinel's sign and Phalen's test are the most commonly used diagnostic tests used for CTS evaluation [3, 5]. Despite their wide usage, the sensibility and specificity of these tests are matters of intense debate [5]. In the same way, the use of electromyoneurography (EMNG) and medical ultrasonography (USG) as confirmatory examinations for CTS is a controversial topic [5]. Despite being very sensitive [5], EMNG is a costly and lengthy procedure that is also uncomfortable for patients [14]. Beyond this, the value added by EMNG for decision-making in relation to CTS treatment is questionable [5]. Recent technological advances which have allowed USG to have the necessary resolution, coupled with the procedure's low cost and lack of discomfort, have led to USG being considered a viable alternative to EMNG as a confirmatory exam for CTS [5, 14, 15], especially in severe cases of the disease [15]. However, despite these promising findings, more studies are needed to better understand the usefulness of USG as a diagnostic tool for CTS [15]. This is especially true for pregnant patients, since there are no studies which evaluate the validity of USG as a diagnostic tool for CTS in this group.

Taking all of this into account, the goal of this study was: (1) to estimate the prevalence of CTS symptoms and complaints during pregnancy and puerperium; (2) to evaluate the severity of symptoms and functional impairment related to CTS; (3) to evaluate factors associated to its occurrence; and (4) to evaluate pregnant women's CTS complaints through USG.

Methods

The present cross-sectional study was carried out from August 2013 to July 2014 in the maternity service of the Botucatu Medical School Hospital (HC/FMB-UNESP). This service is responsible for more than 90% of births in the municipality. The research and its implementation protocol were approved by the Research Ethics Committee of the Botucatu Medical School (protocol no. 4028/2011).

Taking a universe of 650 eligible births per year, derived from an average of the hospital's historical series for the last 5 years, and assuming an unknown prevalence of CTS (50%) due to the wide prevalence variation found in the literature, it was necessary to evaluate a minimum of 241 eligible patients to identify the prevalence of symptoms suggesting CTS during pregnancy, assuming errors of type I and II (5% and 20%, respectively). In relation to the confirmation of clinical symptoms through USG, previously obtained results [16] indicated that it would be necessary to evaluate a minimum of 34 patients, 17 with complaints and 17 without complaints, chosen randomly from each group [17].

The eligibility criteria were: being a pregnant patient admitted at the service during labor, independently of week of pregnancy; and having agreed to participate in the study (or being authorized to do so, in the case of minors). Prior cases of CTS and its treatment before pregnancy, neuromuscular diseases and diabetes mellitus (DM) prior to pregnancy and inability to respond to the questionnaire were criteria for non-inclusion. It should be emphasized that history of receiving previous treatment for CTS during pregnancy was not an excluding factor.

Both hospital hours and service dynamics were respected and after the patients defined the most comfortable moment for the interview (at some point between hospitalization for labor and discharge, a period which usually lasted 3 days), information was collected in private individual interviews through the application of a questionnaire and an evaluation protocol containing diagnostic tests for CTS. Both the interview and the Phalen and Tinel tests were always carried out by the same researcher.

The Tinel sign was evaluated with patients in a sitting position, with the forearm supported on a table and positioned with the hand in a supine position while the evaluator stabilized the fist with one of their hands while impacting the palmar surface of the fist with a neurological hammer. A positive response to the test entails feeling pain or tingling irradiated to the thumb, index finger and/or middle finger [3]. The Phalen test was evaluated through a fist hyperflexion, keeping them close and still for 60 s, with the patient

sitting down. The test is positive if the patient complains about numbness in the innervation territory of the median nerve [3].

Participants presenting a complaint compatible with CTS (presence of symptoms such as tingling, paresthesia, burning feeling and pain in the median nerve's distribution in the hand) and at least one positive result for CTS in the Tinel and Phalen tests were classified as presenting clinical symptoms suggestive of CTS and included in the group named "Presence of indicative signs and symptoms of CTS".

Participants characterized as presenting indicative signs and symptoms of CTS also answered the Brazilian Portuguese translation/adaptation of the Boston Carpal Tunnel Questionnaire (BCTQ) [18] with the intent of evaluating the severity of symptoms and the degree of impairment of manual functions. The BCTQ consists of two different scales: symptom severity (11 items) and functional status (8 items). Both scales are composed by questions with answers in the format of a Likert five-point scale, and the final point score of both scales is calculated through adding the total amount of points in all questions divided by the number of items.

The USG was then carried out within two weeks after delivery with the intent of detecting edemas in the median nerve in the fist and in the carpal tunnel regions, as well as for its flattening, which leads to an increase in the cross-section of the median nerve and/or to possible morphological alterations of the tissues which compose the carpal tunnel (skin, muscles, and tendons), confirming, therefore, a CTS diagnosis [19]. The USG was carried out with a Philips HD7 device (with 12 MHz transducers) through a multiplanar static and dynamic evaluation technique through special positioning maneuvers. The same physician (a radiologist) carried out all the exams and prepared the diagnostic reports. Each patient's volar (palmar) region was evaluated: skin and subcutaneous tissue, flexor pollicis longus muscle tendon, median nerve, superficial and deep digital flexor muscle tendons were all examined, checking for synovial thickenings and peritendinous liquids. Diagnostic confirmation was based on the diagnostic reports, these results were classified as normal or altered.

The software IBM SPSS Statistics (v25) was used to analyze the data, in which, initially, the prevalence of indicative signs and symptoms of CTS was estimated with a confidence interval of 95%.

Association between USG and indicative signs and symptoms of CTS was estimated through Chi-square tests or through Fischer's exact test, with a significance level of 5%. The same procedure was used to analyze results for the diagnostic tests (Tinel and Phalen).

The exploratory analysis of study variables was made through central trend and dispersal measurements for continuous variables and of simple frequency measurements for categorical variables, as well as through the application of Mann–Whitney tests (since answer distribution of the continuous variables did not adhere to the normality criteria). BCTQ scores for symptom severity were categorized in five groups: ≥ 1 (no symptoms), ≥ 2 (mild symptoms), ≥ 3 (moderate symptoms), ≥ 4 (severe symptoms), 5 (very severe symptoms). The scores for functional status were also categorized in five groups: ≥ 1 (no impairment), ≥ 2 (mild impairment), ≥ 3 (moderate impairment), ≥ 4 (intense impairment, 5 (functional disability).

Initially, simple Poisson regression models with robust variance were adjusted to estimate the association of the exploratory variables and presenting indicative signs and symptoms of CTS. In these models, indicative signs and symptoms of CTS (a dichotomized variable classified as present or not present) were the response variable and the following were the predictor variables: maternal age (continuous variable measured in years), number of pregnancies (categorical variable divided in three groups: one pregnancy, two to three pregnancies and four or more pregnancies), gestational age (continuous variable measured in weeks), gestational weight gain (GWG, continuous variable measured in kilograms), years of schooling (continuous variable measured in years), occupational status (dichotomized variable classified as housewife or other work), dominant hand (dichotomized variable classified as left-handed and right-handed), gestational diabetes mellitus diagnosis (dichotomized variable classified as yes or no), arterial hypertension diagnosis (dichotomized variable classified as yes or no) and occurrence of cramps during pregnancy (dichotomized variable classified as yes or no).

Following that, a multiple Poisson regression model with robust variance was adjusted so that the categorical response variable was presence of indicative signs and symptoms of CTS and the predictive factors were those for which the univariate models produced estimates with a prevalence ration (PR) with value of $p \leq 0.25$.

Results

During the 1-year research period, 482 women were recruited (Fig. 1), twice the minimum required sample group size for comparison between the groups. This resulted in sample power ranging from 70 to 99.5% between statistically significant variables in the final model.

Fist USG exams were performed in 34 women (17 from each group, selected by simple random sampling). Left and right fists were examined. To be considered altered the median nerve needed to present a cross-sectional area of more than 10 mm [20], which was the case for 4 symptomatic participants (23.5%). These findings, however, were not able to statistically distinguish between participants that

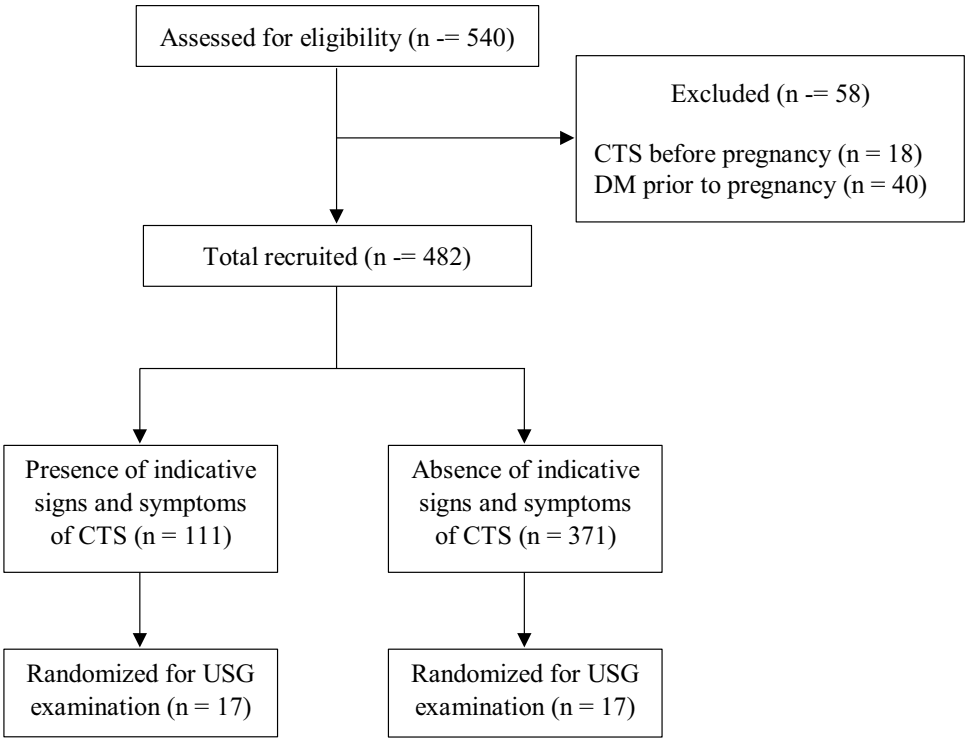

Fig. 1 Flow chart of participation and study design

presented indicative signs and symptoms of CTS and those who did not (Table 1).

Since USG was not able to distinguish between groups, subsequent analyses followed the combination of criteria as defined in the methodology (participants with CTS-related complaints with at least one positive result in the provocative tests were classified as presenting indicative signs and symptoms of CTS). Based on this criteria, 111 women presented indicative signs and symptoms of CTS, resulting in an estimated prevalence of 23.03% (IC95% 19.49–26.99), while 371 (76.97%) were considered asymptomatic.

Table 2 presents results of the application of the Tinel and Phalen tests. When considering results from the Tinel tests for both hands separately, one can see it was positive for around 30% of the participants that presented indicative signs and symptoms of CTS. The same happened for the Phalen tests, which was bilaterally positive in around 40% of the participants. Despite their low precision, both tests were able to statistically differentiate both groups on their own.

Table 3 presents demographic, clinical and anthropometric aspects of each study group. It was verified that being right-handed (though right-handed participants were the majority in both groups), occurrence of gestational diabetes mellitus (GDM) and maternal age was statistically different between groups, whereas parity, arterial hypertension, cramp complaints, occupational status, gestational age, occurrence of pre-eclampsia, GWG and years of schooling were not. In the presence of indicative signs and symptoms of CTS group, over 70% of patients presented symptoms in the third trimester of pregnancy, and the average score in the scale of severity of symptoms and functional impairment,

Table 1 Result of bilateral ultrasound examinations of the fists, stratified by group

	Presence of indicative signs and symptoms of CTS ($n = 17$) n (%)	Absence of indicative signs and symptoms of CTS ($n = 17$) n (%)	p value*
R fist			
Altered	4 (23.5)	0 (0)	
Normal	13 (76.5)	17 (100)	0.105
L fist			
Altered	4 (23.5)	0 (0)	
Normal	13 (76.5)	17 (100)	0.105

*Fisher's exact test

Table 2 Results of bilateral Tinel and Phalen tests, stratified by group

	Presence of indicative signs and symptoms of CTS ($n=111$) *n* (%)	Absence of indicative signs and symptoms of CTS ($n=371$) *n* (%)	*p* value*
R Tinel			
+	39 (35.1)	9 (2.4)	
−	72 (64.9)	362 (97.6)	<0.001*
L Tinel			
+	32 (28.8)	1 (0.3)	
−	79 (71.2)	370 (99.7)	<0.001**
R Phalen			
+	40 (36.0)	0 (0)	
−	71 (64.0)	371 (100)	<0.001**
L Phalen			
+	43 (38.7)	0 (0)	
−	68 (61.3)	371 (100)	<0.001**

*Chi-square

**Fisher's exact test

as obtained through the BCTQ, were of 2.2 (±0.7) and 2.3 (±1.2), respectively.

In relation to results of the simple Poisson regression models with robust variance, the following variables were associated to a presence of indicative signs and symptoms of CTS outcome: maternal age, being left-handed and having developed GDM (Table 4).

Subsequently, a multiple Poisson regression model with robust variance was adjusted in which the categorical dichotomized answer variable was presence of indicative signs and symptoms of CTS and the predictive variables were those in which the simple models produced prevalence ratio (PR) estimates with a value of $p \leq 0.25$ (Table 5). Repeating the findings of the univariate models, being left-handed, GDM and maternal age were kept in the final model, since all three significantly increased the occurrence of indicative signs and symptoms of CTS.

Discussion

The prevalence of patients presenting indicative signs and symptoms of CTS was approximately 23%, much higher than the prevalence of CTS in the general population [1, 7], but similar to the findings of other studies which obtained prevalence values between 18 and 25% among pregnant women [1, 2, 10]. In relation to the onset of symptoms, over 70% of the participants that presented indicative signs and symptoms of CTS referred the early third trimester of pregnancy, similar to another study's result of 67% [1]. Despite previous studies' results [1, 10, 12] pointing to CTS symptoms appearing more frequently during the third trimester of pregnancy, in agreement with the findings of the current study, there is no consensus in the literature about this point, since the literature present disparate results [21].

In relation to BCTQ results, both the severity of symptoms and the manual function impairment caused by them were classified as mild, according to the average of the patients' scores. This result is corroborated by other authors' research [1, 22].

As for the finding that USG could not differentiate between participants that presented indicative signs and symptoms of CTS and those who did not, it should be taken into consideration that the most commonly mentioned result in the literature (concerning CTS diagnosis through USG) is an increase in the cross-sectional area of the median nerve, which would result in its chronic compression [23]. However, since most patients presenting indicative signs and symptoms of CTS referred the onset of symptoms only during the third trimester of pregnancy, it is possible to suppose that the time of exposure (of the median nerve to compression) was not enough to lead to morphological changes. Furthermore, since most patients presenting indicative signs and symptoms of CTS had only mild symptoms and considering that USG seeks to identify morphological changes in intercarpal tissues, it is possible that morphological changes were present, however, at a level below the diagnostic threshold.

Even though we hypothesize that the absence of morphological changes in the USG may be due to the late presentation of the indicative signs and symptoms of CTS and/or the mild severity of symptoms among the participants of this study, attention should be drawn to the fact that this does not, in any way, question the clinical importance of CTS in pregnancy. It has already been shown that CTS symptoms during pregnancy are severe enough to affect hand function and sleep (during a period that both are extremely important),

Table 3 Demographic, clinical and anthropometric aspects, stratified by group

	Presence of indicative signs and symptoms of CTS ($n=111$) *n* (%)	Absence of indicative signs and symptoms of CTS ($n=371$) *n* (%)	*p* value*
Right-handed	100 (90.1)	355 (95.7)	0.024
Parity			
1	39 (35.2)	162 (43.7)	
2–3	55 (49.5)	163 (43.9)	
4[a]	17 (15.3)	46 (12.4)	0.267
Occupation (housewife)	55 (49.5)	196 (52.8)	0.544
Arterial hypertension	17 (15.3)	33 (8.9)	0.052
GDM	16 (14.4)	22 (5.9)	0.004
Cramps	9 (8.1)	15 (4.0)	0.084
Pre-eclampsia	0 (0.0)	0 (0.0)	–
Onset of symptoms—gestational trimester[a]			
1°	6 (5.4)	–	
2°	27 (24.3)	–	
3°	78 (70.3)	–	
Severity of symptoms, according to the BCTQ[a]			
≥1	47 (42.3)	–	
≥2	49 (44.1)	–	
≥3	11 (10.0)	–	
≥4	4 (3.6)	–	
5	0 (0)	–	
Functional impairment according to the BCTQ[a]			
≥1	54 (48.7)	–	
≥2	16 (14.4)	–	
≥3	27 (24.3)	–	
≥4	9 (8.1)	–	
5	5 (4.5)	–	
	Median (1°; 3°)	Median (1°; 3°)	*p* value**
Maternal age	28 (23; 33)	25 (20; 30)	<0.001
Gestational age	39 (37; 40)	39 (38; 40)	0.093
GWG	13 (9; 17)	12 (8,6; 16)	0.114
Years of schooling	11 (7; 11)	11 (8; 11)	0.631

*Chi-square

**Mann–Whitney *U*

[a]Presence of indicative signs and symptoms of CTS only

indicating that quality of life is significantly affected [2] and that around half of women who present CTS during pregnancy complain of symptoms remaining up to a year after labor [11] (something that we were not able to measure, since we have not followed the participants after delivery, due to the cross-sectional design of the study).

According to the results of the final model, being left-handed was strongly associated to indicative signs and symptoms of CTS (PR 2.24) if compared to patients who predominantly used the right hand. Association between lateral dominance and symptomatology in people with CTS has been previously tested [24], and a strong association was found to the right hand (OR 5), but the association was stronger to the left hand (OR 13). Therefore, the present study's results corroborate previous findings which associated CTS to lateral dominance, with a stronger association for left-handed individuals.

Participants presenting indicative signs and symptoms of CTS presented higher ages, similar to the findings of other studies [12, 25]. However, the average age of CTS patients in those studies were superior to 30 years of age, whereas in this study the average ages were lower in both groups (25.7

Table 4 Simple Poisson regression model adjustments with robust variance, for the presence of indicative signs and symptoms of CTS as the response variable

	PR	IC 95%	*p* value
Lateral dominance			
Right	1	–	–
Left	1.908	1.178–3.091	0.009
Number of births			
1	1	–	–
2–3	1.295	0.891–1.873	0.170
4	1.393	0.849–2.285	0.190
Occupational status			
Housewife	1	–	–
Other work	1.152	0.826–1.606	0.404
Arterial hypertensions			
No	1	–	–
Yes	1.464	0.931–2.302	0.099
GDM			
No	1	–	–
Yes	1.975	1.294–3.016	0.002
Cramps			
No	1	–	–
Yes	1.605	0.899–2.865	0.109
Maternal age	1.048	1.025–1.071	< 0.001
Gestational age	0.963	0.907–1.022	0.215
GWG	1.024	0.966–1.052	0.097
Years of schooling	0.981	0.929–1.037	0.503

Table 5 Multiple Poisson regression models with robust variance, for the presence of indicative signs and symptoms of CTS as the response variable

	PR	IC 95%	*p* value
Lateral dominance			
Right	1	–	–
Left	2.244	1.398–3.603	0.001
GDM			
No	1	–	–
Yes	1.649	1.079–2.518	0.021
Maternal age	1.048	1.023–1.073	< 0.001

and 28.4 years of age, for asymptomatic and symptomatic participants, respectively), though still statistically significant. However, as a comparison exercise, if a stratification based on the same cutoff point (up to 30 years of age and more than 30 years of age), the association between symptom groups and age groups still would not be statistically significant ($p = 0.09$). This study has found that each year of maternal age leads to an increment of 5% in CTS prevalence (PR 1.048). In other words, independent classification of patients by age groups and higher maternal ages were associated to increased prevalence of indicative signs and symptoms of CTS.

Both groups presented similar results for gestational age, GWG and time of schooling. Despite studies pointing that excess weight gain during pregnancy could be responsible for the onset of CTS symptoms during pregnancy [21, 26]—due to hormonal factors which lead to fluid retention, swelling of members and compression of the median nerve in the carpal tunnel [1]—these findings were not reproduced in this study. It should be taken into consideration, however, that GWG is not only due to fluid retention: 35% of weight gain during pregnancy is due to the weight of the fetus, the placenta and the amniotic fluid [27]. Other phenomena which lead to increase in gestational weight include increased blood volume and abdominal adiposity [21], leading to an elevated influence of increased extravascular fluid volume on GWG after 30 weeks of pregnancy [1]. Therefore, fluid retention during pregnancy can be a more precise gestational CTS-predictive factor than GWG, since this last variable is related to several factors other than the probable causal mechanism behind CTS.

The prevalence of indicative signs and symptoms of CTS was considerably increased in cases in which the patient developed GDM if compared to those who did not develop it (PR 1.65). Even if GDM has been one of the factors associated to CTS-suggestive symptoms in pregnancy, no studies were found in the literature to help explain this relationship. By analogy, in terms of hyperglycemic disturbances, previous studies found diabetes mellitus type two (DM2) to be both non-associated [28] and associated [29] to CTS. However, the chronicity of exposure to a hyperglycemic state which occurs in DM2 and does not occur in GDM does not allow us to safely explain this association based on the findings of this study.

Some limitations of the present study should be mentioned, such as its cross-sectional design, which hinders further elucidation of cause and effect relations. The lack of blinding of the researcher that was responsible for conducting the Tinel and Phalen tests and for inquiring about the presence of indicative signs and symptoms of CTS, should also be mentioned. It is important to highlight, however, that in the case of the USG examinations, the professional in charge of carrying out the exams and preparing the diagnostic reports had no knowledge regarding the presence of indicative signs and symptoms of CTS or the results of the Tinel and Phalen tests. EMNGs were not carried out to confirm the occurrence of CTS, which is why the term "indicative signs and symptoms of CTS" was used. However, the most important diagnostic criteria for CTS are complaints presented by patients [1, 5]. Furthermore, it has been demonstrated that the use of a questionnaire about the main CTS symptoms based on the BCTQ presents sensibility,

specificity and positive predictive value similar to electrodiagnosis [30]. Therefore, the use of questionnaires is considered appropriate in the case of pregnant patients [1]. After an extensive search through the literature, this study was found to be unique in the sense of evaluating CTS-compatible complaints in pregnant women with USG. Even if the results were negative, this finding may help other authors to look for alternative objective diagnostics exams which may bring more precise answers to be used as a diagnostic confirmation tool.

Conclusion

The results of this study demonstrate a high level of occurrence of indicative signs and symptoms of CTS during the third trimester of pregnancy, much higher than the CTS prevalence in the general population, which demonstrates that pregnancy, by itself, can be considered a risk factor for CTS. Most participants which presented symptoms referred that they started in the third trimester of pregnancy and that the symptoms and manual function impairment were mild, which is consistent with the literature. Despite the favorable prognosis of gestational CTS, the high prevalence of indicative signs and symptoms of CTS and the difficulties that they may entail at a time when mothers need full functional capacity of the hands when caring for their children, reinforces the importance of adequate diagnosis and treatment. We would also like to highlight the lack of association of GWG and indicative signs and symptoms of CTS, which together with the results of previous studies, demonstrates the importance of evaluating fluid retention as a variable in and of itself. Finally, the incapacity of using USG to identify cases classified as presenting indicative signs and symptoms of CTS, as suggested by this study, reinforced the need to carry out more studies which evaluate this diagnostic method in pregnant women, since the characteristics of gestational CTS may negatively influence the diagnostic capacities of USG, as highlighted in the discussion.

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Compliance with ethical standards

Conflict of interest There is no conflict of interest.

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