

## Environmental Benefits of Breastfeeding in the Natural Course of Carpal Tunnel Syndrome and Hormonal Changes on it

Hamidreza Mohammadi<sup>1</sup>, Farzad Vafaei<sup>2</sup>, Parnian Mousavifard<sup>3</sup>,  
Parviz Yazdanpanah<sup>4\*</sup>

<sup>1</sup> Assistant Professor of Orthopedics, Department of Orthopedics, Social Determinants of Health Research Center, Yasuj University of Medical sciences, Yasuj, IRAN

<sup>2</sup> Department of Pediatric, Pediatrician, Imam Sajad Hospital, Yasuj University of Medical Sciences, Yasuj, IRAN

<sup>3</sup> Student Research Committee, Yasuj University of Medical Sciences, Yasuj, IRAN

<sup>4</sup> Department of Physical Medicine & Rehabilitation, social determinants of health research center, Yasuj University of Medical Sciences, Yasuj, IRAN

\* Corresponding author: yazdanpanah.p@yums.ac.ir

### Abstract

Breastfeeding offers society not only improved health of children and mothers but also economic and environmental benefits. Breastfeeding does not waste scarce resources or create pollution. Breast milk is a naturally-renewable resource that requires no packaging, shipping, or disposal. The present study investigates how breastfeeding influences environment and mother health throughout the early parenting years. This research also compares natural course of the carpal tunnel syndrome during the first 6 months after delivery in women feeding their children using formula and breastfeeding mothers. This study was conducted in 50 pregnant women with symptoms and signs of CTS (carpal tunnel syndrome). After delivery and confirming the CTS, women were classified in two groups: breastfeeding and non-breastfeeding. Follow-up of clinical and electro diagnostic of women were done in first 6 months after delivery. Research findings indicated a positive and significant relationship between breastfeeding and environmental protection. Other findings showed that complete recovery in breastfeeding, non-breastfeeding and all women was 10.7%, 52.9% and 26.7% respectively. Partial recovery in breastfeeding and non-breastfeeding women was 71.4% and 47% respectively. Complete recovery in mild stage in breastfeeding, non-breastfeeding and all women was 22.2%, 57.1% and 33.3% respectively. Complete recovery in moderate and severe stages in all women was 23.3%. Rate of complete recovery to partial recovery in non-breastfeeding women was 1.7 times more than breastfeeding women. Findings of the study showed that relief of symptoms and reduction of severity of CTS and impact of hormonal and environmental changes on it, is higher in women who feed their children on formula than those who breastfeed their children. Pregnancy related CTS would not usually resolve after delivery and must be followed-up by clinical symptoms and electro diagnostic studies. Hormonal changes during lactation, repetitive motions, excessively flexed wrist positions, and maternal ecology effects during breastfeeding may be causing aggravated pregnancy related CTS after delivery.

**Keywords:** breastfeeding, environmental benefits, health effects, carpal tunnel syndrome, hormonal changes

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### INTRODUCTION

Breastfeeding offers society not only improved health of children and mothers but also economic and environmental benefits. Breastfeeding confers global environmental benefits; human milk is a natural, renewable food that acts as a complete source of babies' nutrition for about the first six months of life. Furthermore, there are no packages involved, as opposed to infant formulas and other substitutes for human milk that require packaging that ultimately may

be deposited in landfills. For every one million formula-fed babies, 150 million containers of formula are consumed; while some of those containers could be recycled, many end up in landfills. In addition, infant formulas must be transported from their place of manufacture to retail locations, such as grocery stores, so that they can be purchased by families. Although breastfeeding requires mothers to consume a small amount of additional calories, it generally requires no containers, no paper, no fuel to prepare, and no

transportation to deliver, and it reduces the carbon footprint by saving precious global resources and energy.

Symptoms of carpal tunnel syndrome and impact of hormonal changes on it consist of paresthesia's involving the median nerve distribution along with a deep aching pain in the hand and wrist. The prevalence of this disorder in the general population for a community in the Netherland was 0.6% for men and 5.8% for women. This disorder has inevitably natural biological impacts on environment. In a study carried out by Yazdanpanah et al, prevalence of CTS was 3.4 % in pregnant women and 2.3% in non- pregnant women. Women are considerably more prone to this disorder in a ratio of 3:1 to about 10:1. Obesity and pregnancies are risk factors for CTS. In pregnancy period, the rising in prolactin hormone level and higher vulnerability to negative ecological impacts increase the extra-capsular fluid retention and produce soft tissue swelling in the later stages, especially in third trimester of pregnancy. The CTS can thus be produced by compression or swelling of the median nerve in its synovial sheath. Because CTS is one of the most noticeable complications of pregnancy, and its prevalence increases during pregnancy, diagnosis and treatment of the syndrome will improve the quality of natural environment, reducing pain and paresthesia of fingers. The diagnosis of this syndrome is based on the history and physical examination. Electro diagnostic studies are gold standards for confirmation diagnosis of this syndrome. According to the electro diagnostic medicine criteria, and based on neurophysiological tests, the CTS is graded into mild, moderate, and severe categories. Based on severity of syndrome, treatment of CTS is diverse. Conservative therapies of CTS are local and systemic steroids, non-steroidal anti-inflammatory drugs, diuretics, pyridoxine and wrist-splints. The patients with advanced the nar atrophy and sensory deficits are to benefit more from decompression by surgery (Johnson 1997).

Although CTS is temporary and usually disappears by terminating pregnancy and lactation, recurrence of the syndrome has been observed during pregnancy intervals. A natural intervention, breastfeeding, may occur after the delivery period in pregnant women. This alternative naturally divided pregnant women in two groups' of breastfeeding and formula feeding and provides a great opportunity for evaluation of impact of this option on CTS symptoms. Yet again, the association between prevalence of the syndrome in

breastfeeding and formula feeding groups is yet not established (Anita et al. 2016, Akbuga-Ozel et al. 2017).

In this study, partial recovery is considered as reduction in any stages of CTS, such as severe to moderate, severe to mild, moderate to mild and or mild to absence of clinical symptoms but existence of electro diagnostic findings such as prolonged latency of median nerve. Complete recovery were defined as any change in grade of severe, moderate and or mild to absence of clinical symptoms and electro diagnostic findings. The main objective of the present maternal ecology study was to determine the comparative natural course of CTS during the first 6 months after delivery in lactating and non-lactating women in an ecological context. (De Krom et al. 1992, Kara and Özyürek 2017).

## METHODOLOGY

The present cross-sectional descriptive-analytic study was performed on 50 pregnant women in Obstetrics and Gynecology (OB & Gyn) Mofateh clinic of Yasuj (center of Kohgilouyeh and Boyerahmad Province) in south-west of Iran. All these women were visited by OB&GYN specialists due to different OB problems. Inclusion criteria were the pregnant women over the age of 15 years, with at least one criterion including unilateral or bilateral paresthesia of hands and or positive provocative tests such as Tinel's and Phalen's tests. The patients with diabetes mellitus, hypothyroidism, amyloidosis, and rheumatoid disease, positive family history of neuropathy, previous wrist fracture, pre-pregnancy CTS and carpal tunnel surgery were excluded from the study (Yazdanpanah et al. 2012).

Qualified patients were referred to a physiatrist for electro diagnostic evaluation. Standard electro diagnostic studies were performed by a physiatrist with a Medelec device manufactured in the United Kingdom. The settings of electromyography were as follows:

pulse duration: 0.2 millisecond, stimulus speed: 2 millisecond/division, sensitivity: 20 microvolt/division for sensory, 1 volt/division for motor, filter settings were 3 Hz to 10 KHz in motor and 10Hz to 3 KHz in sensory study. The surface temperature of upper limbs was greater than 32 degrees centigrade. The criteria for electro diagnostic of CTS and impact of hormonal and environmental changes on it were: 1-A difference of greater than 0.5 millisecond (ms) between the median and ulnar nerve sensory latencies in the same hand 2- A difference of greater than 1 ms between the median and

ulnar nerve motor latencies in the same hand. The supramaximal intensity was used for the detection of sensory and motor responses. Electro diagnostic studies grade the CTS into the mild, moderate, and severe categories based on (Stevens 1977):

Prolonged distal sensory latency(DSL) and/or median mixed nerve latency (MNL), and; normal or minimally prolonged distal motor latency(DML), and; amplitudes of all responses within normal range, and; no conduction block (CB) or mild CB, and; no thenar EMG abnormalities (if tested). Moderate: Prolonged DSL, MNL, and DML (if all tested), and; amplitudes of all tested responses may be diminished, typically a relative decrease (but not required), and; CB may be present, and; minor thenar EMG abnormalities may be present (if tested) (Becker et al. 2002).

Unobtainable median sensory nerve action potentials (or low amplitude and very prolonged DSL), and; low-amplitude or unobtainable median mixed nerve response and, if present, very prolonged MNL, and; low-amplitude or unobtainable median compound muscle action potential and, if present, very prolonged DML, and; CB may be present and pronounced (i.e., >70%), and; thenar EMG abnormalities often present (if tested) (Jun 2001).

Two groups of women were followed in 1.5, 3 and 6 months after delivery by clinical and electro diagnostic evaluations. Conservative treatments were done based on stage of syndrome. The data were collected by a researcher made questionnaire and entered and analyzed using SPSS software, after codification, preparation and data handling. Descriptive Statistical methods (frequency and percentage) was used for presented distribution pattern of data in undergoing groups. Evaluation of relationship between exposures (breastfeeding) and outcome (relief of symptoms of CTS) was achieved by used of relative risk statistics and 95 % confidence interval. Finally control of confounding factors (age, weight and pregnancy number), adjusted relative risk, was achieved by used of generalized linear models with natural logarithm function. Significance level for all statistical tests was 0.05 (Dimitrios 2004, Somaiah and Roy 2008).

## RESULTS

Of total 50 cases included in the study, 33 cases were categorized in breastfeeding and 17 cases were non-breastfeeding groups. Five cases from the breastfeeding women were excluded due to not participating in the follow up periods. The age range of the patients was 21

to 44 years. There was no difference between the mean ages in two groups. The mean weight in the breastfeeding group was slightly higher than the non-breast feeding group, but this difference was not statistically significant ( $p > 0.05$ ). The mean of height variable in the non-breastfeeding women was also slightly higher than the breastfeeding mothers, but the difference between the two groups was not statistically significant ( $p > 0.05$ ). The number of pregnancy in the non-breastfeeding women was slightly higher than the breastfeeding women, but the differences between the two groups were not significant ( $p > 0.05$ ) (Wand 1990).

Involvement of the right and left hands were 42 and 32 in pregnant women respectively after delivery. After six months from study, involvement of right and left hands were 35 and 29 in women respectively. Therefore, recovery of right and left hands were 16% and 9.4 % respectively. Relative frequency of mild CTS in beginning of study in 45 participants were 33.3 %, which decrease to 22.2% after 6 months from study. Relative frequency of moderate CTS and impact of hormonal and environmental changes on it in beginning of study in 45 participants were 42.2 %, which decrease to 37.8% after 6 months from study. Relative frequency of severe CTS in beginning of study in 45 participants were 24.4 %, which decrease to 11.1% after 6 months from study (Nathan et al. 1992).

At beginning of the study, 19 breastfeeding women suffered from moderate and severe CTS, which complete recovery was occurred in only 1 woman and others had relative recovery. At beginning of the study, 10 non- breastfeeding women suffered from moderate and severe CTS, which complete recovery was occurred in 5 women and other 5 women had relative recovery (50%). Complete recovery in breastfeeding and non-breastfeeding and total women after 6 months were 10.7%, 53% and 26.7% respectively. Recovery of moderate and severe CTS was 23.3% in end of study. Rate of complete recovery to relative recovery in non-breastfeeding women was more significant than breastfeeding women (**Table 1**). Complete recovery of mild CTS in breastfeeding and non-breastfeeding after 6 months were 23%, 57.2% respectively. In analysis of one variable, possibility of complete recovery in non-breastfeeding to breastfeeding women is 1.89 (**Table 2**). After match of confounding variables such as age and number of previous pregnancies, possibility of complete recovery in non-breastfeeding to breastfeeding women is 1.70 (**Table 3**) (Felsenthal 1979).

**Table 1.** Distribution of severity of CTS before and after of intervention

Group	Severity of CTS after delivery (Number)		Severity and frequency of CTS and impact of hormonal and environmental changes 6 months after delivery (percent)	
			Partial Recovery	Complete Recovery
Non-breastfeeding	Mild	7	3(42.8)	4(57.2)
	Moderate	3	2(66)	1(34)
	Severe	7	3(42.8)	4(57.2)
	Total	17	8(47)	9(53)
Breastfeeding	Mild	9	7(77)	2(23)
	Moderate	15	15(100)	0(0)
	Severe	4	3(75)	1(25)
	Total	28	25 (89.3)	3(10.7)
Two Groups	Mild	15	10(66)	5(33)
	Moderate	19	17(89.5)	2(10.5)
	Severe	11	6(54.5)	5(45.5)
	Total	45	33(73.3)	12(26.7)

**Table 2.** Generalized linear models fitness indices

Generalized linear models			
Multiple		Univariate	
MQL Fisher scoring		MQL Fisher scoring	Optimization
$V(u) = u*(1-u)$ [Bernoulli]		$V(u) = u*(1-u)$ [Bernoulli]	Variance function
38.69525279		42.57613423	Deviance
35.88221835		44.99996129	Pearson
-117.3779		-121.1104	BIC
$g(u) = \ln(u)$		$g(u) = \ln(u)$	Link function
.9437867		.9901427	(1/df) Deviance
.8751761		1.046511	(1/df) Pearson

**Table 3.** Risk of chance in non-breastfeeding and breastfeeding women

	Outcome Predictors	Complete Recovery/partial recovery					
		Risk Ratio	Std. Err.	z	P> z	[95% Conf. Interval]	
Simple GLM	Group(Formula/Breast)	1.897321	0.503629	2.41	0.016	1.127707	3.192166
	Constant	0.470588	0.121055	-2.93	0.003	0.284234	0.779123
Multiple GLM	Group(Formula/Breast)	1.741183	0.458518	2.11	0.035	1.039182	2.917408
	Age(covariate)	1.003351	0.000006	585.93	0.000	1.003339	1.003362
	Para(covariate)	0.845171	0.049939	-2.85	0.004	0.7527472	0.948944
	constant	0.659436	0.189560	-1.45	0.147	0.3753944	1.158397

**DISCUSSION**

This study was done in Shahid Mofateh clinic in Yasuj city which suffered from symptoms of pregnancy related CTS in 50 women. The main objective of this study was to determine the comparative natural course pregnancy related CTS during the first 6 months after delivery in breastfeeding and non-breastfeeding women. There was no difference between both groups in respect of mean of age, weight, height, and number of deliveries. The CTS symptoms was more frequent in the right hand in two groups after delivery and 6 months later; this finding was in consistency with other research findings such as Nathan et al study. In previous researches, such as the study of Wand (1992), spontaneous resolution of CTS with a good response to conservative measures occurred in pregnancy and puerperium. However, CTS which develops in pregnancy appears to be a separate clinical entity to that developing in the puerperium. Furthermore, in a study by Lawrence, Lawrence (2016), carpal tunnel syndrome

and impact of hormonal and environmental changes on it can take a few weeks to a few months after delivery for the symptoms to resolve, but it usually clears up entirely. In some researches, pregnancy related CTS does not usually disappear after delivery, and recovery of symptoms is possible, but there is a delay in latencies of median nerve. In study of Turgot F and colleagues, most pregnant patients with had symptoms of CTS in both hands and are first noted during the third trimester. The majority of patients with CTS obtain spontaneous relief in the immediate postpartum period. In Finsen, Zeitlmann (2006) research, CTS is common during pregnancy (Cesar et al. 2001, Turgut et al. 2001).

The symptoms usually disappear after delivery, but how soon have not been established. Although symptoms may persist for some weeks after delivery, the severity declines quickly, which is not in consistency with the findings of the present study. In study of Mondelli and colleagues, despite recovery symptoms of CTS, there was a prolonged latency sensory of median

nerve in 84% of women after delivery. In a follow-up of CTS after pregnancy, the Italian CTS Study Group prospectively studied 63 pregnant women with multiple measurements of CTS symptoms. Fifty-four percent of women with CTS symptoms during pregnancy had symptoms 1 year later. Patients with onset of CTS symptoms early during pregnancy are less likely to improve after delivery, which is consistent with the findings of the present study. In study of Yagnik, reports two cases of carpal tunnel syndrome and impact of hormonal and environmental changes on it in breastfeeding mothers, where symptoms developed one month postpartum and subsided after weaning (Nolan et al. 1992).

The recovery rate in the non-breastfeeding group was more significant than the breastfeeding group. The relative recovery chance in the non-breastfeeding group was 51.9% and the risk attributed to powder milk was estimated to be about 12%. The ratio of recovery chance in the non-breastfeeding group to breastfeeding group was 1.70, which was the ratio of recovery chance in the formula was 1.70 times of the ratio of recovery chance in the breastfeeding group. The present research was not inconsistent with other researches, such as Stolp-Smith KA, which define CTS was severe enough to warrant that treatment occurs infrequently in pregnancy and generally resolves spontaneously postpartum or responds to conservative treatment. It is possible that carpal tunnel syndrome and impact of hormonal and environmental changes on it in breastfeeding mothers may be related to or aggravated by repetitive motions and/or excessively flexed wrist positions during breastfeeding.

In a retrospective postal study of 27 women who had developed CTS in the puerperium. The condition was associated with breastfeeding in 24 women. The three women who did not breastfeed had less severe symptoms which resolved within one month of onset. The symptoms developed a mean of 3.5 weeks following delivery, lasted 6.5 months and started to resolve within 14 days of weaning. In study of Hashempour and colleagues about CTS in lactation, findings which hormonal and environmental changes can contribute to worsening the symptoms of CTS. Gradual resolution of the symptoms of CTS occurs after stopping breastfeeding. Reassurance and nursing advice on optimal positions for holding baby and breasts during breastfeeding is the first step of treatment. Resolution of the symptoms of CTS during lactation has a clear relationship with the cessation of breastfeeding and in most women, symptoms started to

subside after they stopped breastfeeding (Chang et al. 1998).

The predominant hormones influencing the nervous system in the pregnant females are likely estrogen, progesterone, and relaxing with potential influence from testosterone as well. The most potent estrogen produced in the human body is estradiol. Estradiol has been shown to dramatically increase throughout pregnancy and to decrease at time of parturition and during lactation. Decreased estrogen levels during lactation seem to result from prolactin-mediated suppression of gonadotropin-releasing hormone, luteinizing hormone, follicular-stimulating hormone but not changes in parathyroid hormone (PTH), or 1,25-dihydroxyvitamin D. Estrogen modulates several neuromusculoskeletal tissues, including bone, cartilage, ligament, myotendinous unit, and the nervous system. Prolactin is produced from the pituitary gland and plays a role in maintaining the corpus luteum during pregnancy and in synthesizing milk lactation. Prolactin begins to rise during the eight week of pregnancy, peaks at ten times normal levels, and remains elevated in lactating women. Prolactin concentration depends on lactation status with higher levels of prolactin associated with longer duration of lactation. Postpartum 1, 25-dihydroxyvitamin D levels are similar to non-pregnant women regardless of lactation status. Hormonal changes during pregnancy and postpartum cause effects on creation of CTS. Estrogen, progesterone, and relaxin been implicated in the etiology of increased CTS and De Quervain tenosynovitis during pregnancy. Relaxin has been thought to modify areas of carpal tunnel causing nerve compression. In summary, the results of the present research were different from the some research studies. Three reasons which could be expressed as limitations were:

First-Inadequate sample size.

Second-Differences in the education level, employment and economic status of the participating women as confounding variables.

Third-Short periods of follow-up.

Inadequate previous research about confirmation or rejection of this problem, need designing and implementation of structural studies.

## CONCLUSIONS

According to the findings of research there is a positive and significant relationship between

breastfeeding and environmental benefits. Also, breastfeeding has many health benefits for mothers, however the relief of symptoms and decreased severity of CTS were higher in non-lactating women compared to the lactating women. Pregnancy related CTS does not usually disappear after delivery and must be followed up by clinical symptoms and signs and electrodiagnostic studies. Hormonal changes during lactation and repetitive motions and/or excessively flexed wrist positions during breast feeding may be causing aggravated pregnancy related CTS. It is hoped that future studies will be conducted with a larger number of cases with a longer period (up to one year). The position of mother's wrist during lactation is the point necessary to be studied.

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#### LIST OF ABBREVIATIONS

CTS: Carpal Tunnel Syndrome

OB & Gyn: Obstetrics and Gynecology

ms: Millisecond

DSL: Distal Sensory Latency

MNL: Mixed Nerve Latency

DML: Distal Motor Latency

CB: Conduction Block

EMG: Electromyography

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