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# THE PREVALENCE OF CARPAL TUNNEL SYNDROME AMONG FEMALE DAIRY MILKERS

By

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## Abstract

**Introduction:** Occupation-related Carpal tunnel syndrome represents one of the major health problems among workers in various occupations throughout the world that possess a complex symptoms resulting from compressing the median nerve at the carpal tunnel. Farmers in Egypt are known to use the traditional manual milking of their cattle which needs bilateral repetitive hand movements. **Aim of the work:** To determine the prevalence and severity of CTS among farmers who performed hand-milking task of cattle and correlate these findings with working years and work duration per hours. **Materials and methods:** A structured questionnaire was used to determine demographics; work history, present medications and history of any chronic illness. Clinical examination for CTS symptoms as nocturnal exacerbation, Phalen sign, Tinel sign, sensory hyperalgesia, thenar atrophy and thenar weakness. Electrophysiologic studies were done for 240 female farmers, where half of them were milking their cattle manually the other half is used as control. Both groups are matched for age, and Body Mass Index (BMI). **Results:** The prevalence and clinical severity of CTS were significantly higher among female farmers who milk their cattle than non milkers in both hands ($P<0.001$), The median nerve motor and sensory conductive study was significantly higher among milkers than non milkers farmers (P value<0.001). The electrophysiological findings were significantly correlated with the longer years of work and longer working hours. **Conclusion:** These findings suggest that CTS is a significant occupational health issue for farmers that continue the traditional methods of manual milking. Introduction of automated milking machines may help to reduce this problem among the coming generations of the Egyptian farmers who represents a noticeable part of our community.

**Key words:** Dairy milkers, Carpal tunnel syndrome, Occupational, Egyptian farmers and electrophysiological studies.

## Introduction

Work related musculoskeletal disorders is one of the most common causes of regional pain syndrome, severe long term pain and physical disability affecting millions of people worldwide (Abdel Raoof et al., 2014). This was documented since 1940 by The Italian occupational physician Ramazzini, in his treatise De Morbis Artificum Diatriba (Diseases of Workers). Two hundred and fifty years later in Italy, Cali and Mitra 1956 described an occupational condition termed ''milker's hand'' common among dairy farmers which included symptoms similar to carpal tunnel syndrome (CTS) including pain, tingling, and lack of strength in the hands.

Dairy farming demands a great physical efforts causing high frequency of musculoskeletal disorders (Kolstrup, 2012).

Repetitive strain injury and cumulative trauma are causes of milking related disorders. One of the most common disorders associated with this work is carpel tunnel syndrome CTS (Abdel Raoof et al., 2014).

Carpel tunnel syndrome is a clinical syndrome caused by entrapment or pressure on the median nerve in the wrist; this pressure is the result of swelling or anything that makes the carpal tunnel smaller (Abdellah et al., 2016).

People with CTS experience numbness, tingling, or burning sensations in the thumb and fingers, the index, middle fingers and radial half of the ring finger are particularly affected, because they receive their sensory and motor function (muscle control) from the median nerve. Less-specific symptoms may include pain in the wrists or hands, loss of grip strength, and loss of manual dexterity (Tamparo and Lewis, 2011).

Numbness and paresthesia within the median nerve distribution are the hallmark of neuropathic symptoms (NS) of carpal tunnel entrapment syndrome. Weakness and atrophy of the thumb muscles may occur if the condition remains untreated. Discomfort is usually worse at night and in the morning (Frank, 2011).

Some studies speculate that carpal tunnel syndrome is provoked by repetitive movement and manipulating

activities and that the exposure can be cumulative. It has also been stated that symptoms are commonly exacerbated by forceful and repetitive use of the hand and wrists in different manual occupations (Abdellah et al., 2016).

In Menoufia governorate, Egypt, manual milking of cattle is still performed mostly by female farmers. Both economic and cultural constraints have limited the adoption of modern dairy equipment by Egyptian farmers.

## Aim of work

The aim of the work is to determine the prevalence and severity of CTS among farmers who performed hand-milking task of cattle and to correlate these findings with working years and work duration per hours.

## Materials and methods

**Study design:** A cross sectional study

**Place and duration of the study:** This study was conducted over a period of four months (from the 1st of April to the last of July 2016) to determine the prevalence of CTS among female farmers from three villages (Dakama, Shanawan and El Batanoon) that were selected randomly from villages belonged to Shebein El Kom district in Menoufia governorate, Egypt.

**Study sample:** Out of two hundred and ninety-four (294) female farmers selected from the three villages, two hundred and forty persons were eligible to participate in the study with a response rate about 81.6%. We selected half of the participants at the time of the study to be milkers performing hand-milking task for cattle and the other half to be non-milkers. The manual milking task was typically performed for approximately 30-60 minutes twice per day and involved bilateral repetitive hand and finger movements that are required to draw the milk from the udder.

Exclusion criteria included: medical history of systemic diseases as: diabetes mellitus, rheumatoid arthritis, autoimmune disease, thyroid disorders, hypertension, renal and liver diseases that have been associated with CTS; peripheral neuropathy, connective tissue disease, pregnancy and lactation in the females, patients who receives medical treatment that causes edema and predispose to CTS, intake of drugs induced neuropathy as corticosteroid, vincrestin, colchicine, obese subjects,

benign tumors such as lipomas, ganglion, and vascular malformation that exert pressure on the hand, cervical radiculopathy, thoracic outlet syndrome and medically diagnosed CTS prior to starting the current occupation.

Case definition of CTS

In the present study, the case definition of CTS was based on the results of characteristic hand symptoms and electrophysiologic findings of median nerve motor, sensory and comparative studies.

**Study methods:**

The following procedures were performed for all the participants in this study:

**1. Structured questionnaire:**

The authors performed structured questionnaire and explained the study procedures to the participants. The structured questionnaire was used to determine demographics; work history (duration of working in milking cattle), present medications and history of any chronic illness which is present in exclusion criteria, and the presence of symptoms related to CTS (any hand numbness, tingling, pain, or burning sensation).

Two interviews were conducted. The first one was at the participants' homes or farms for answering the questionnaire. The second one was conducted in the Rheumatology department at the Menoufia University Hospital by a rheumatologist and a neurologist for clinical examinations and electrophysiological studies to diagnose CTS.

**2. Clinical examination: Includes:**

- Assessment of thenar muscle weakness/atrophy (Werner, 2006).
- Assessment of sensory abnormality as numbness in the distribution of the median nerve, nocturnal symptoms and abnormal sensory testing such as two-point discrimination (Graham et al., 2006) by performing the following special signs as:

**Phalen's sign:** the presence of pain and/or paresthesias in the median-innervated fingers with one minute of wrist flexion (Cush and Lipsky, 2004).

**Tinel's sign:** is the development of pain and/or paresthesias of the median-innervated fingers with percussion over the median nerve. It is less sensitive, but slightly more specific than Phalen's sign in diagnosis of CTS (Scott et al.,2009).

**3. Electrophysiological Studies (nerve conduction studies).**

A nerve conduction study measures the integrity of the nerve and diagnoses the presence of nerve injury or entrapment neuropathy and determines its degree as mild, moderate or severe. During the test, electrodes are placed on the hand and a small electrical current is used to stimulate the nerves at the wrist and elbow. The results from the test indicate the degree of nerve damage. Electrodiagnosis rests upon demonstrating impaired median nerve conduction across the carpal tunnel in context of normal conduction elsewhere. Compression results in either damage to the myelin sheath and manifested as delayed latencies and slowed conduction velocities or damage to the axons of nerve fibers with subsequent decreased amplitude and conduction velocity. The diagnosis of carpal tunnel syndrome based on a combination of described symptoms, clinical findings, and electrophysiological testing (Scott et al., 2009).

Electrophysiological studies performed in this research are:

1. Motor conductive studies of the median nerves were performed on both hands of each participant.
2. F- wave which is a latent response used to assess the integrity of proximal segment by distal stimulation of the nerve then the wave travels along it to the anterior horn cells which fires and spread the pulse distally again to exclude proximal entrapment or radiculopathy of all median nerves.
3. Sensory conductive study of median nerves were performed on both hands of each participant.
4. Nerve studies were conducted using the Neuropack S1 Nihon- Kodhen MEB9400 nerve conduction study device.
   - The previous electrophysiological studies were performed by a rheumatologist.
   - Hands were sterilized and warmed in water to obtain the optimum hand temperature during the electrophysiological study.

**Electrodiagnostic grading of CTS** (Cherian and Kuruvilla, 2006).

**- Grade 1.** Very mild CTS -normal standard tests, abnormal comparative sensory tests in which a median /ulnar

peak sensory latency difference equal to or more than 0.5 ms.

**- Grade 2.** Mild CTS - abnormal sensory response (as regard peak sensory latency, amplitude and conduction velocity) with a normal motor response.

**- Grade 3.** Moderate CTS - abnormal median sensory and motor response (as regard peak sensory and distal motor latency, amplitude and conduction velocity).

**- Grade 4**. Severe CTS -absence of sensory response, abnormal distal motor latency.

**- Grade 5.** Extreme CTS - absence of median motor and sensory responses.

**Consent**

All participants gave written informed consent before inclusion. The consent form was developed according to the international ethical guidelines for biomedical research involving human subject, as prepared by the Council for International Organizations of Medical Sciences in collaboration with the World Health Organizations (CIOMS, 2002).

**Ethical approval**

The Menoufia Faculty of Medicine Committee for Medical Research Ethics reviewed and formally approved the study before it began.

**Data management**

The data were collected, tabulated and analyzed by SPSS (statistical package for the social science software) statistical package version 20 on IBM compatible computer.

Descriptive statistics were calculated as means and standard deviations for continuous variables, percentages and frequencies for discrete variables.

Student's t-tests for continuous normally distributed variables while Mann-whitney test for non-parametric variables and chi-square tests of association for categorical variables. Pearson correlation (r) is a test used to measure the association between two quantitative variables.

Statistical significance was set at a P-value $< 0.05$.

## Results

**Table 1: Demographic characteristics of the studied groups.**

| | **Milkers No=120 Mean± SD** | **Non-Milkers No=120 Mean± SD** | **p-value** |
|---|---|---|---|
| **Age (years)** | 42.5±8.8 | 40.8±6.8 | >0.05 |
| **BMI** | 26.2±5.6 | 25.76±4.6 | >0.05 |
| **Working/ years** | 16.4±9.4 | 15.9±6.8* | >0.05 |
| **Working hours/day** | 8.9±2.3 | 8.4±1.9 | >0.05 |

* Mann-Whitney test was used BMI: Body Mass Index

The socio-demographic characteristics of the studied groups were described in table 1 where there was insignificant difference between milkers and non- milkers farmers as regarding their age, BMI, duration of work/year and working hours (P value>0.05).

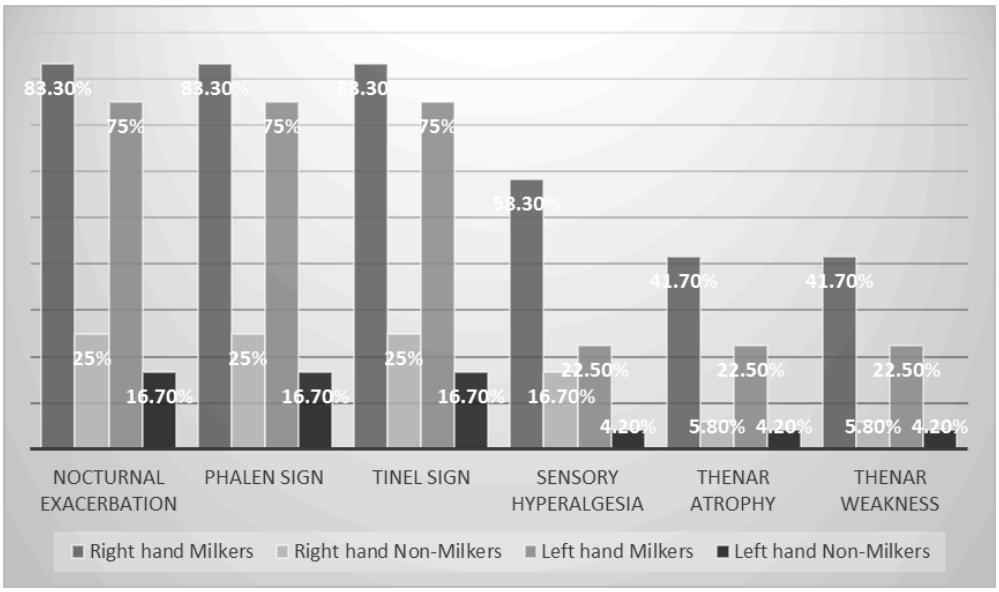


**Figure 1: Distribution of clinical manifestations of CTS among milkers and non-milkers farmers in both hands.**

Figure 1 shows the clinical manifestations of CTS were significantly higher among milkers when compared to non- milkers in both hands (p value<0.001)

**Table 2: Motor and Sensory nerve conduction study and F wave of both hands among milkers and non- milkers farmers.**

| | Motor nerve conduction | | | Sensory nerve conduction | | |
|---|---|---|---|---|---|---|
| | **Milkers No=120 Mean**± SD | **Non-milkers No=120 Mean**± SD | **p-value** | **Milkers No=120 Mean**± SD | **Non-milkers No=120 Mean**± SD | **p-value** |
| **Right Median** | | | | | | |
| Latency | 6.0±1.3 | 2.9±0.6 | <0.001* | 4.5±1.3 | 2.2±1.3 | <0.001* |
| Amplitude | 2.3±0.7 | 4.8±1.2 | <0.001* | 12.3±4.6 | 17.5±6.4 | <0.001* |
| Nerve conduction velocity | 37.8±7.2 | 50.9±10.4 | <0.001* | 42.7±3.8 | 49.2±8.5 | <0.001* |
| F wave Minimal latency | 35.6±6.1 | 27.5±5.6 | <0.001* | ----- | ----- | ----- |
| **Left Median** | | | | | | |
| Latency | 5.0±1.3 | 2.3±0.7 | <0.001* | 4.9±0.8 | 2.2±1.3 | <0.001* |
| Amplitude | 2.2±0.1 | 6.5±1.6 | <0.001* | 13.9±3.9 | 17.5±6.4 | <0.001* |
| Nerve conduction velocity | 41.5±4.3 | 51.6±8.6 | <0.001* | 41.0±4.8 | 49.2±8.5 | <0.001* |
| F wave Minimal latency | 33.8±3.8 | 27.7±4.9 | <0.001* | ------ | ------ | **------** |

*: Significant

Table 2 shows that the median nerve motor and sensory conductive studies were significantly higher among milkers when compared to non milker farmers (p value<0.001).

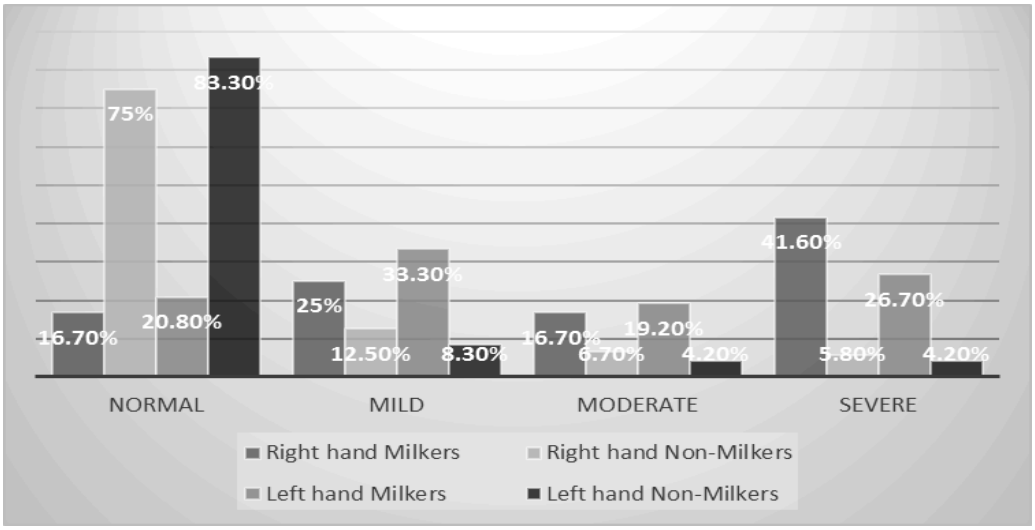


**Figure 2: Clinical grading of CTS among milkers and non-milkers farmers in both hands.**

Figure 2 shows that the prevalence and severity of carpal tunnel syndrome is significantly more obvious on both hands of milkers than non milkers ($p<0.001$), while there is no significant difference between both hands ($p>0.05$).

**Table 3: Correlation between duration of work/years, working hours/day and nerve conduction results**

| | Duration of work/years | | Hours of work/day | |
|---|---|---|---|---|
| | **r** | **p value** | **r** | **p value** |
| **Motor nerve conduction** | | | | |
| **Right Median** | | | | |
| Latency | 0.19 | <0.05* | 0.29 | <0.001* |
| Amplitude | -0.29 | <0.001* | -0.22 | <0.05* |
| Nerve conduction velocity | -0.07 | >0.05 | -0.06 | >0.05 |
| **Left Median** | | | | |
| Latency | 0.004 | >0.05 | 0.18 | <0.05* |
| Amplitude | -0.13 | >0.05 | -0.45 | <0.001* |
| Nerve conduction velocity | -0.16 | >0.05 | -0.58 | <0.001* |
| **Sensory nerve conduction** | | | | |
| **Right Median** | | | | |
| Latency | 0.05 | >0.05 | 0.04 | >0.05 |
| Amplitude | -0.24 | <0.001* | -0.11 | >0.05 |
| Nerve conduction velocity | -0.02 | >0.05 | -0.06 | >0.05 |
| **Left Median** | | | | |
| Latency | 0.16 | >0.05 | 0.02 | >0.05 |
| Amplitude | -0.17 | >0.05 | -0.35 | <0.001* |
| Nerve conduction velocity | -0.09 | >0.05 | -0.19 | <0.05* |
| **F-wave** | | | | |
| **Right Median** | | | | |
| Minimal latency | 0.03 | >0.05 | 0.14 | >0.05 |
| **Left Median** | | | | |
| Minimal latency | 0.08 | >0.05 | 0.12 | >0.05 |

*: Significant

Table 3 shows that with increasing the duration of work/year and working hours/day the latency of sensory and motor nerve fibers significantly increases in both hands, while the amplitude and nerve conduction velocity decrease significantly.

## Discussion

The present study has investigated the prevalence of CTS among milkers farmers and to compare them with non-milkers in a sample of female farmers at Menoufia governorate, milking task is mostly done by females not males in Egypt which is different from Italian study where they recruited their sample from 436 hand-milkers, all of them were males (Rosecrance et al., 2013).

In our study that includes milkers and non milkers' farmers, they were evaluated for clinical manifestations of CTS symptoms as nocturnal exacerbation, Phalen sign, Tinel sign, sensory hyperalgesia, thenar atrophy and thenar weakness. We reported a significant difference between clinical manifestations of CTS of both median nerves among milkers and non milkers' farmers. Previous studies reported a significant difference between clinical manifestations of CTS among milkers and non-milkers farmers which support our results (Patil et al., 2002 and Rosecrance et al., 2013).

This study reported significant difference between milkers and non milker's farmers as regard the median nerve motor and sensory conductive studies and F wave (Table 2). These results are comparable to previous studies done in the US, Turkey and Italy where they reported that the electro-diagnostically estimated relative risks of developing CTS were greater among manual milking group than controls. (Patil et al., 2002, Kutluhan et al., 2009 and Rosecrance et al., 2013).

In this study we reported significant difference between milkers and non milkers' farmers as regard to the presence and severity of CTS in both hands. About 100 cases of bilateral CTS among 120 milkers farmers in which 25% were of mild degree and 16.7% were of moderate degree and 41.6% of severe degree of right hand ,and 33.3% were of mild degree,19.2% were of moderate degree,26.7% were of sever degree in the left hand and about 20 cases of bilateral CTS among120 non milking farmers in which 12.5% were of mild degree and 6.7% were with moderate degree and 5.8% of sever degree of right hand and8.3% were of mild degree and 4.2% were of moderate degree and 4.2% were of severe degree in left hand (Figure 2). Also our study

detected that about 20 milkers' farmers and 90 non milkers' farmers had healthy hands with no CTS (Figure 2). So, that the prevalence of CTS was significantly higher among milker farmers than non milkers and in both groups the affection was bilateral.

This comes in agreement with Patil et al., 2002 as they reported that the prevalence of CTS among the dairy Parlor workers was 16.6% and among non dairy Parlor workers was 3.6%, and concluded that the prevalence of CTS was significantly higher among dairy workers more than non-dairy workers.

Also, a study among Ewe farmers in Sardenia found high prevalence of CTS among dairy farmers comparing to non milkers. The study reported bilateral CTS in 76% of cases, which also supports their suggestions and they detected that there were no differences between right and left hands for all electrophysiological parameters measured. The highly repetitive and synchronous nature of both the right and left hands' activity involved in manual milking might explain the bilateral electrophysiological findings (Rosecrance et al., 2013).

In a previous study of manual milking among rural Turkish women investigators assessed CTS among 160 hands of 80 women that were employed to manually milk cows and sheep. The women employed as milkers were compared to a group of 20 healthy unemployed non milking women. They reported high prevalence of CTS among milking women (Kutluhan et al., 2009).

The present study reported significant increase in the electrophysiological findings of both median nerves among milker farmers with increased the duration of milking (Table 3). In a Brazilian hospital study of 3,125 consecutive CTS patients from various occupations, 43 (1.38%) of the cases had a history of employment in manual milking tasks. The mean time employed in manual dairy milking profession was 20.5 years and they reported the high prevalence of CTS with increased the duration of the work as number of hours per day and number of years of work (Kouyoumdjian and de Araújo, 2006).

Conclusion: These findings suggest that CTS is a significant occupational health issue for farmers that continue the

traditional methods of manual milking. It is probable that the long years of hand milking and longer duration of milking per day account for a majority of CTS cases in this sample of female farmers. Symptoms may be avoidable if good ergonomic practices are followed, and control of risk factors in the workplace can aid rehabilitation of the affected workers. Additional research is needed to determine how the Egyptian farmers could adapt and continue their work of milking without any disabling disorder in their hands.

## Conflict of interest

No conflict of interest.

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