Incidence rates of surgically treated idiopathic carpal tunnel syndrome in blue-, white-collar workers and housewives of Tuscany, Italy

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ABSTRACT

Objectives: We compared rates of surgically treated CTS among blue-/white-collar workers and housewives in the general population.

Methods: We estimated numbers of surgically-treated cases of idiopathic CTS among 25–59-year-old residents of Tuscany, Italy, during 1997–2000 (when out-of-hospital CTS surgery was extremely rare), based on obligatory discharge records from all Italian public/private hospitals, archived according to residence on Tuscany’s regional database. Population data were extracted from the 2001 census.

Results: After excluding repeat admissions, we identified 8,801 eligible cases. Age-standardized rates (per 100,000 person-years) of surgical CTS were: “blue-collar women”, 367.8; “white-collar women”, 88.1; “housewives”, 334.5; “blue-collar men”, 73.5; “white-collar men”, 15.3. Compared with reference categories (same-sex white-collar workers), women blue-collar workers experienced a 4.2-fold higher standardized rate; housewives, 3.8-fold excess; men blue-collar workers, 4.8-fold excess (all P<0.001). Men and women blue-collar workers showed about 3- to 7-fold higher age-specific rates with respect to white-collar counterparts (all P<0.001). Housewives’ rates appeared superimposable with those of blue-collar women workers up to 40–44 years of age, after which they were significantly lower (P<0.002). At all ages, housewives’ rates were much higher (P<0.001) than those of white-collar women.

Conclusions: Surgically-treated CTS appeared 3 to 7 times more common (depending on age/gender) in blue-collar than in white-collar workers—magnitudes difficult to attribute only to differences in body weight or other individual factors. Thus, occupational risk factors seem relevant throughout working life. The high rates recorded for full-time housewives suggest that domestic chores deserve more investigation as a possible risk factor for CTS.
MAIN MESSAGES
In both women and men, manual work-related risk factors for surgical treatment of idiopathic CTS appear to be relevant throughout working life.

As an occupational category, full-time housewives seem to have a raised risk of surgically treated CTS, possibly related to domestic work.

POLICY IMPLICATIONS
In aetiological studies of CTS, attention should be paid to domestic chores as a potentially relevant risk factor.
INTRODUCTION
Carpal tunnel syndrome (CTS) is a socially relevant disabling condition [1, 2] which accounts for many years of productivity loss.[3] Biomechanical overload associated with repetitive, forceful manual work is a major risk factor for CTS.[4] CTS affects women more frequently than men, with a peak incidence occurring at perimenopausal age (in contrast to a more gradual age-related increase in men).[5] Both overweight and biomechanical overload accompanying repetitive forceful manual tasks are believed to be relevant risk factors for CTS.[6]

A survey of the general population in southern Sweden found that blue-collar workers had roughly double the risk of prevalent symptomatic CTS (and also of electrophysiologically confirmed CTS) with respect to white-collar workers.[7] Cross-sectional studies have suggested raised risks of CTS for a variety of manual occupations, including slaughterhouse, poultry farm, assembly line, clothing, supermarket, food packing and stone-cutting/drilling work), as well as certain white-collar situations involving biomechanical exposure to the hand/wrist (dental hygienist and mouse-intensive computer work [8]). A case-control study of job classes additionally suggested raised risks for cooks.[9] A study of rates of first surgery for CTS in the general population of Montreal, Canada using the provincial health insurance database [10] was able to identify seven at-risk job categories: housekeepers/cleaners, data-processing operators, material handlers, food/beverage processing workers, service workers, and male lorry/bus drivers. However, the entity and age-related risks associated with biomechanical exposures encountered during various types of manual work are debated.[1, 8, 11, 12] Furthermore, the possible relevance of domestic chores [13, 14] has been little studied.

The treatment of choice for cases of severe chronic CTS refractory to conservative approaches is surgery.[15] We used administrative records of hospital treated patients from Tuscany, Italy, to assess incidence rates of hospital-treated idiopathic CTS among blue-/white-collar workers and full-time housewives.

METHODS
Setting and study design
Based on hospital discharge records and census data we were able to evaluate age-sex specific incidence rates of surgically-treated CTS among blue- and white-collar workers and full-time housewives in the general population of Tuscany (3.5 million inhabitants), Italy, during the period 1997–2000. In Italy during this period, diagnosis of CTS supported by median nerve conduction studies was considered a prerequisite for surgical treatment, and out-of-hospital CTS surgery was almost completely absent due to current reimbursement regulations. In Italy, all public/private hospitals obligatorily provide individual, codified discharge records, even after day-treatment. These discharge records are conserved in databases of the patients’ region of residence, irrespective of hospital location. The discharge records of hospitals within the administrative Region of Tuscany (Regione Toscana) from the period also contain codified information on the generic occupational categories listed in Table 1, including a specific code for full-time housewives. This information allowed us to classify patients as white-collar workers, blue-collar workers (including borderline “mixed-collar” workers), full-time housewives, and others. Accordingly, we reviewed the records of all patients resident in the Region of Tuscany with a discharge record issued by any Italian hospital between 1997 to 2000 bearing a principal diagnosis of CTS (ICD-9 code 354.0) coupled with specific surgical treatment (Diagnosis Related Group code 006, “Carpal Tunnel Release”). Repeated outpatient/inpatient admissions with a principal diagnosis of CTS during the study period were excluded.
To restrict the study to idiopathic CTS, we excluded cases with secondary (ie coexisting) diagnoses of conditions thought to be associated with raised risk of CTS:[16-18] namely hypothyroidism (ICD-9 codes 243, 244), thyroiditis (245), diabetes mellitus (250), gout (274.0), amyloidosis (277.3), overweight/obesity (278), complications of pregnancy (646.8, 646.9), connective tissue diseases (710), rheumatoid arthritis (714), osteoarthritis of the hand/forearm (715.3, 715.4), wrist fractures (813.4), shoulder/upper limb peripheral nerve injuries (955) and pregnancy (V22). Because of limited numbers of cases in the youngest age groups and selection bias considerations related to “retired” occupational status, we decided to restrict the study to subjects aged 25–59 years. As shown in Figure 1, we also excluded: members of the armed forces (due to white-/blue-collar classification difficulties); students; full-time “househusbands”; cases with undeclared/unknown employment status (due to treatment outside Tuscany etc.); unemployed or retired subjects (due to lack of information about previous occupational status); first job seekers; “other” (unspecified) job titles. We grouped the job titles reported on the hospital discharge records into occupational categories and classified them into blue-collar (including “mixed-collar”), white-collar and housewives, as shown in Table 1.

Population data for the age-groups of interest in the study area were extracted from the closest national census, conducted in 2001; of note, we are not aware of major workforce transformations in Tuscany between 1997 and 2001. To facilitate white-/blue-collar classification we chose to use census data that had been tabulated based on the ISTAT-2001 Classification of Occupations.[19] We classified the following groupings as white-collar: clerks; technicians and associate professionals; highly skilled professionals; directors and managers. The following groupings were classified as blue-collar (including “mixed-collar”): unskilled workers; production-line/machine workers and drivers; skilled manual workers; farm/horticulture workers; service workers and retailers. Of note, the only other listed employment grouping was members of the armed forces—a category excluded from the study. Numbers of full-time housewives in the general population were extracted from ISTAT’s “non-workforce” classification, which includes a specific “housewife” category.[19]

Statistical analysis
We calculated age-sex specific incidence rates (per 100,000 person-years) and standardized rates (age-adjusted by the Standard European Population proposed by the WHO) [20] with respect to occupational status. Age-sex specific rate ratios for blue collar workers and housewives were calculated taking white-collar workers as reference category. For both rates and rate ratios, we calculated 95% confidence intervals (95% CI) to take into account the sampling error related to a restricted (4-year) time period. For two-way comparisons, we used the z-test to test the null hypothesis that rates in groups of interest were equal.[21] To test age-related trends in incidence rates, we used the score test and reported rate ratio estimates for each one unit increase in age class;[22] for the rate ratios, we used a non-parametric test for trend across ordered groups.[23] Since the hospital discharge records database did not permit identification of patients in years before the observation period, we performed a sensitivity analysis by excluding the first two years of the observation period (ie 1997 and 1998) to explore the possibility that the main analysis might have been distorted by the inclusion of some prevalent cases. Stata 9.0 SE (Stata Corporation, Texas, TX) was used for analysis with a significance level of 0.05.

RESULTS
Identification of surgically treated cases of CTS meeting the study eligibility criteria is summarised in Figure 1. Data regarding employment status were available for 10,181 (94%) of the 10,834 surgically-treated cases of idiopathic CTS aged 25–59 years. A total of 8,801
cases with known active occupational status who satisfied the study eligibility criteria entered the main analysis. Table 1 reports the distribution of white-, blue-/mixed-collar job categories and housewives among the cases.

Overall age-standardized incidence rates of surgically treated CTS (per 100,000 person-years) were 255.4 (95% CI, 249.6–261.2) for women and 46.4 (95% CI, 43.8–49.0) for men. Among women, age-standardized rates were 367.8 (95% CI, 355.1–380.5) for blue-collar workers, 334.4 (95% CI, 322.0–346.9) for housewives, and 88.1 (95% CI, 81.9–94.2) for white-collar workers. Thus, with respect to their white-collar counterparts, women blue-collar workers experienced a 4.2-fold higher rate of surgically treated CTS, and housewives had a 3.8-fold excess. Among men, the age-standardized rates were 73.5 (95% CI, 68.9–78.0) for blue-collar workers and 15.3 (95% CI, 13.1–17.5) for white-collar workers. Thus, men blue-collar workers experienced a 4.8-fold higher rate of surgically treated CTS with respect to their white-collar counterparts. Table 2 and Figure 2 report age-specific rates for women and men, according to occupational categories. Of note, sensitivity analysis based on the last two years of the observation period generated curves that were very similar to those of the main analysis (data not shown), suggesting that distortion due to inclusion of some prevalent cases was unlikely. All the curves shown in Figure 2 broadly displayed expected age-related patterns of CTS incidence,[24] characterized by a peak around 50–54 year age group in women, and a more progressive rise in men. Highly significant age-related trends in incidence rates were apparent in all the occupational categories under study: rate ratios for each 5-year age class unit were 1.30 (95% CI, 1.27–1.32) for women blue-collar workers, 1.35 (95% CI, 1.30–1.40) for women white-collar workers, 1.16 (95% CI, 1.14–1.18) for housewives, 1.27 (95% CI, 1.23–1.31) for men blue-collar workers, and 1.29 (95% CI, 1.19–1.39) for men white-collar workers (always P<0.001 at the score test for trend). Both women and men blue-collar workers showed higher age-specific rates with respect to white-collar workers at all ages (always P<0.001). No difference was apparent between blue-collar women workers and housewives’ rates up to 45–49 years, after which blue-collar women workers’ rates was significantly higher (P<0.002 in both age classes).

Table 3 and Figure 3 report age-sex specific rate ratios of blue-collar workers and (for women only) housewives with respect to white-collar workers. The shapes of the age-related rate ratio curves were again remarkably similar for women blue-collar workers and housewives, apparently characterised by an overall decline, except for a transient peak at 45–49 years (tests for trend: blue-collar workers, P=0.14; housewives, P=0.04). Lifetime variations in the rate ratios for male blue-collar workers appeared rather different (test for trend, P=0.66).
Table 1 Distribution of job categories among surgically treated cases of idiopathic CTS (aged 25–59 years) with known active occupational status

<table>
<thead>
<tr>
<th></th>
<th>Women (n=7,535)</th>
<th>Men (n=1,266)</th>
<th>Overall (n=8,801)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>White-collar workers</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Managers</td>
<td>10</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>Self-employed professionals</td>
<td>22</td>
<td>12</td>
<td>34</td>
</tr>
<tr>
<td>Entrepreneurs</td>
<td>49</td>
<td>26</td>
<td>75</td>
</tr>
<tr>
<td>Clerical workers</td>
<td>570</td>
<td>102</td>
<td>672</td>
</tr>
<tr>
<td>Associate professionals</td>
<td>235</td>
<td>45</td>
<td>280</td>
</tr>
<tr>
<td><strong>Blue-collar (and “mixed-collar”) workers</strong></td>
<td>3,330</td>
<td>1,077</td>
<td>4,407</td>
</tr>
<tr>
<td>Skilled/unskilled manual workers*</td>
<td>1,011</td>
<td>413</td>
<td>1,424</td>
</tr>
<tr>
<td>Service workers†</td>
<td>1,498</td>
<td>407</td>
<td>1,905</td>
</tr>
<tr>
<td>Home-based workers†</td>
<td>154</td>
<td>1</td>
<td>155</td>
</tr>
<tr>
<td>Self-employed workers†</td>
<td>667</td>
<td>256</td>
<td>923</td>
</tr>
<tr>
<td><strong>Housewives</strong></td>
<td>3,319</td>
<td>–</td>
<td>3,319</td>
</tr>
</tbody>
</table>

*Includes apprentices.
†Categories that may include some “mixed-collar” workers.
Table 2 Age-sex-specific rates per 100,000 person-years (with 95% CI) of surgically treated idiopathic CTS according to occupational category, together with absolute numbers [cases/at-risk subjects]

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Blue-collar workers</th>
<th>White-collar workers</th>
<th>Full-time housewives</th>
<th>Blue-collar workers</th>
<th>White-collar workers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Women</td>
<td>Men</td>
<td>Women</td>
<td>Men</td>
<td>Women</td>
</tr>
<tr>
<td>25–29</td>
<td>127.4 (110.5 to 146.9)</td>
<td>24.6 (18.0 to 33.7)</td>
<td>124.5 (94.6 to 163.9)</td>
<td>26.2 (20.6 to 33.4)</td>
<td>4.5 (2.0 to 9.9)</td>
</tr>
<tr>
<td></td>
<td>[190/149,132]</td>
<td>[39/158,240]</td>
<td>[51/40,952]</td>
<td>[65/247,904]</td>
<td>[6/134,288]</td>
</tr>
<tr>
<td>30–34</td>
<td>187.2 (167.8 to 208.9)</td>
<td>38.1 (30.4 to 47.8)</td>
<td>173.8 (146.8 to 205.7)</td>
<td>37.8 (31.5 to 45.5)</td>
<td>10.7 (6.8 to 16.7)</td>
</tr>
<tr>
<td></td>
<td>[320/170,952]</td>
<td>[75/196,876]</td>
<td>[135/77,688]</td>
<td>[113/298,668]</td>
<td>[19/178,036]</td>
</tr>
<tr>
<td>35–39</td>
<td>257.5 (234.0 to 283.4)</td>
<td>58.4 (49.0 to 69.7)</td>
<td>261.3 (232.6 to 293.5)</td>
<td>59.3 (51.0 to 68.9)</td>
<td>8.3 (5.2 to 13.2)</td>
</tr>
<tr>
<td></td>
<td>[419/162,728]</td>
<td>[124/212,272]</td>
<td>[284/108,708]</td>
<td>[170/286,732]</td>
<td>[18/216,388]</td>
</tr>
<tr>
<td>40–44</td>
<td>335.0 (306.4 to 366.3)</td>
<td>95.6 (82.6 to 110.8)</td>
<td>345.6 (312.9 to 381.7)</td>
<td>75.2 (65.1 to 86.8)</td>
<td>12.4 (8.4 to 18.4)</td>
</tr>
<tr>
<td></td>
<td>[483/144,164]</td>
<td>[178/186,136]</td>
<td>[389/112,560]</td>
<td>[185/246,052]</td>
<td>[25/200,976]</td>
</tr>
<tr>
<td>45–49</td>
<td>534.8 (495.6 to 577.0)</td>
<td>106.2 (91.7 to 122.9)</td>
<td>485.3 (448.6 to 525.1)</td>
<td>104.7 (91.7 to 119.6)</td>
<td>22.4 (16.7 to 30.0)</td>
</tr>
<tr>
<td></td>
<td>[665/124,348]</td>
<td>[179/168,588]</td>
<td>[620/127,744]</td>
<td>[218/208,228]</td>
<td>[45/201,196]</td>
</tr>
<tr>
<td>50–54</td>
<td>641.8 (600.1 to 686.4)</td>
<td>160.8 (140.1 to 184.5)</td>
<td>552.1 (518.9 to 587.3)</td>
<td>92.6 (80.5 to 106.5)</td>
<td>25.6 (19.2 to 34.0)</td>
</tr>
<tr>
<td></td>
<td>[851/132,596]</td>
<td>[203/126,260]</td>
<td>[1003/181,680]</td>
<td>[196/211,760]</td>
<td>[47/183,872]</td>
</tr>
<tr>
<td>55–59</td>
<td>511.3 (463.7 to 563.8)</td>
<td>140.1 (113.7 to 172.7)</td>
<td>409.2 (382.4 to 437.9)</td>
<td>125.9 (106.0 to 149.5)</td>
<td>24.8 (17.2 to 35.6)</td>
</tr>
<tr>
<td></td>
<td>[402/78,624]</td>
<td>[88/62,804]</td>
<td>[837/204,524]</td>
<td>[130/103,244]</td>
<td>[29/117,112]</td>
</tr>
</tbody>
</table>
Table 3 Age-sex specific rate ratios for blue-collar workers and full-time housewives (with respect to white-collar workers)

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Blue-collar workers</th>
<th>Housewives</th>
<th>Blue-collar workers</th>
</tr>
</thead>
<tbody>
<tr>
<td>25–29</td>
<td>5.2 (3.7 to 7.3)</td>
<td>5.1 (3.3 to 7.7)</td>
<td>5.9 (2.5 to 13.5)</td>
</tr>
<tr>
<td>30–34</td>
<td>4.9 (3.8 to 6.3)</td>
<td>4.6 (3.4 to 6.0)</td>
<td>3.5 (2.2 to 5.8)</td>
</tr>
<tr>
<td>35–39</td>
<td>4.4 (3.6 to 5.4)</td>
<td>4.5 (3.6 to 5.5)</td>
<td>7.1 (4.4 to 11.6)</td>
</tr>
<tr>
<td>40–44</td>
<td>3.5 (3.0 to 4.2)</td>
<td>3.6 (3.0 to 4.3)</td>
<td>6.0 (4.0 to 9.2)</td>
</tr>
<tr>
<td>45–49</td>
<td>5.0 (4.3 to 5.9)</td>
<td>4.6 (3.9 to 5.4)</td>
<td>4.7 (3.4 to 6.5)</td>
</tr>
<tr>
<td>50–54</td>
<td>4.0 (3.4 to 4.7)</td>
<td>3.4 (3.0 to 4.0)</td>
<td>3.6 (2.6 to 5.0)</td>
</tr>
<tr>
<td>55–59</td>
<td>3.6 (2.9 to 4.6)</td>
<td>2.9 (2.3 to 3.6)</td>
<td>5.1 (3.4 to 7.6)</td>
</tr>
</tbody>
</table>

All statistical comparisons with white-collar worker counterparts (reference categories) were highly significant (P<0.001, z-test).
DISCUSSION
This study indicates that surgically treated idiopathic CTS may be as much as 3 to 7 times more common (depending on age and gender) in blue-collar workers than in their white-collar counterparts. It must be stressed that we were unable to adjust for factors other than age and sex. Nevertheless, we believe that such high excess risks among men and women blue-collar workers of various ages would be difficult to attribute to only moderate differences [25] in body weight and height, or other individual factors such as familiality. Moreover, housewives showed remarkably similar age-related patterns to women blue-collar workers, with rate ratios several times higher than those of women white-collar workers.

Unsurprisingly,[26, 27] perimenopausal incidence peaks were recorded (at 50–54 years of age) for women in all three occupational categories. The findings regarding relative risk of surgically treated CTS in blue-collar versus white-collar workers are broadly in line with the results of a study of the incidence of surgically treated CTS in the general population of Montreal, Canada, which used a similar case definition,[10] as well as with data available from two different studies from southern Sweden (a population-based survey of clinically/electrophysiologically diagnosed CTS [28] and a randomised trial of surgical treatment strategies [7]). Nevertheless, women white-collar workers tended to have incidence rates that were either roughly equivalent to or higher than those of men blue-collar workers (Table 2, Figure 2). This observation underlines the importance of female gender and hormonal factors as a predisposing risk factor for CTS.[11, 29]

The primary explanation for the greatly raised risk of surgically treated CTS recorded among men and women blue-collar workers at all ages is likely to be exposure to types of manual work which involve taxing hand-wrist activities, such as prolonged, highly repetitive wrist flexion/extension, forceful grip in awkward postures, and use of hand-held vibratory tools.[1, 8, 30] These biomechanical exposures are encountered in many blue-collar settings and are thought to be relevant occupational risk factors for CTS. Contributing factors could include the somewhat higher average body weight among individuals of lower socioeconomic status,[31] since overweight is thought to be a further risk factor for CTS.[25] However, based on estimates of the (more limited) entity of the risk associated with overweight,[6] it seems likely that body weight could only explain a small fraction of the discrepancy between blue-collar and white-collar workers.

It might be argued that blue-collar workers are more likely to access surgical treatment due to greater need to conserve manual fitness. However, in a comparison of surgically treated and electromyographically diagnosed CTS patients in the Tuscan town of Siena,[32] the socioeconomic characteristics of the two groups appeared to be broadly similar, and the surgically treated patients actually seemed to have a slightly higher level of education. It also seems unlikely that malingering could have been a major contributing factor as there are many ways of gaining days off work without recourse to surgical treatment, and any “invented” cases would have to get through a preoperative clinical filter.

The characteristics of the Tuscan codification system also allowed us to evaluate the risks associated with unemployed housewife status. The remarkably similar patterns of surgically treated CTS among Tuscan housewives and women blue-collar workers spotlights the question of the aetiological relevance of domestic work. In a case-control study of determinants of surgically treated CTS among Tuscan housewives and women blue-collar workers spotlights the question of the aetiological relevance of domestic work. In a case-control study of determinants of surgically treated CTS, we found that full-time housewives again appeared to have ~4-fold excess risk in comparison with white-collar workers (unpublished data). Furthermore, in an evaluation of associations between marital status and surgically-treated CTS in several Regions of Italy,[33] we noted higher disease rates among married women. These observations encourage us to reevaluate the hypothesis that domestic work may be a relevant risk factor. The results of a Chinese case-control study indicated that household tasks of Beijing women were associated with a raised risk of clinically/instrumentally diagnosed
CTS.[14] A survey of the biomechanical loads encountered in housewives' routine domestic tasks revealed repetitive movements, frequently accompanied by high levels of hand/arm force and awkward postures.[34] Remarkably, in the population-based study of incidence of surgically treated CTS in Montreal,[10] two of the seven specific at-risk occupations identified were housekeepers/cleaners and child care workers (both involving tasks commonly undertaken by housewives). Similar age-related trends were found for housewives and women blue collar workers in terms of both incidence of surgically treated CTS (Figure 2) and rate ratios with respect to white-collar workers (Figure 3). The age-related incidence curve for full-time housewives never dropped much below that of women blue-collar workers, and remained much higher than that of the women white-collar workers; these observations were reflected in the rate ratio curves of housewives and women blue-collar workers, which appeared almost parallel. Taken together, these findings encourage our belief that it is worth studying domestic work as a possible risk factor for CTS.[33]

Study strengths and limitations
The study design allowed estimation of age-related risks associated with blue-collar employment and housewife status in the general population. We are confident that use of the hospital discharge records that every Italian public/private hospital is obliged to supply to local administrations allowed us to identify the vast majority of surgically-treated cases of idiopathic CTS which occurred among residents of Tuscany between 1997 and 2000, when out-of-hospital CTS surgery was almost completely absent in Italy and going abroad for treatment was presumably not a widely considered option for CTS. Nevertheless, subsequent exclusion of retired subjects from the main analysis due to lack of information on occupational history limits the validity of the results around retirement age. Furthermore, our attempt to restrict the numerators to cases of “idiopathic” CTS may have been affected by underreporting of concomitant conditions in the discharge records, perhaps especially in the context of patients with lower educational status. This factor might have led to slight overestimates of 1) the overall rates of surgically-treated idiopathic CTS, and 2) the rate ratios for blue-collar workers and housewives. The routine data on which the analysis was based did not permit adjustment for likely confounding factors other than age and gender. The results regarding housewives may have been particularly vulnerable to unadjusted confounding from factors such as BMI, parity and past working history which could have contributed to an overestimate of risk. Thus, we think that our findings regarding housewives should primarily be considered a stimulus for further study. Clearly, investigation of possible etiological relations between manual work and body weight [11] were outside the scope of the study. Possible discrepancies in blue-/white-collar/housewife classification between cases and the general population must be considered. After exclusion of military personnel and subjects with unknown active occupational status, the occupational groupings used for the census data and the hospital discharge records were readily classifiable into blue-/mixed collar and white-collar status. However, it is likely that both the hospital discharge records and census data contain some incorrectly codified information (plausibly leading to some non-differential misclassification). Of note, we do not think that differential classification of housewives should be a major concern since both the hospital discharge records and the census data provide specific categories for full-time housewives.

Although we were able to exclude repeated admissions with a principal diagnosis of CTS during the study period, we had no reliable way of catching “previous” prior admissions (an issue likely to mainly regard the early part of the 4-year study period): thus the rates recorded are likely to be a slight overestimate. Of note, a sensitivity analysis based on the last two years of the study period did not show signs of distortion due to the inevitable inclusion of some prevalent cases. As regards the external validity of the findings, it is noteworthy that
the overall rates of surgical treatment were broadly in line with those reported in other population-based surveys.[10, 24, 27] However, the relative frequencies of surgery in the three occupational categories may have been influenced by the composition of the Tuscan workforce (including the distribution of blue-collar jobs) and possibly by the particular domestic culture of Italian housewives such as elaborate cooking procedures, being houseproud, etc.

CONCLUSIONS
In conclusion, blue collar workers appear to have much higher rates of surgically treated idiopathic CTS than white-collar workers, irrespective of gender and age group. It is not easy to attribute such discrepancies exclusively to confounding factors such as differential body weight. Thus, the present work seems to underline the relevance of occupational risk factors for surgically treated CTS. Moreover, the remarkably similar patterns recorded for full-time housewives suggest that the role of domestic chores deserves more investigation as a possible risk factor for CTS (not only in full-time housewives). In conjunction with analysis of the possible risks associated with domestic duties, study of the biomechanical profiles of manual domestic chores could also be informative.
COMPETING INTEREST: none.

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FIGURE LEGENDS

**Figure 1** Flow chart of cases meeting the study eligibility criteria.

*FOOTNOTE*: Cases also bearing the following ICD-9 codes were considered non-idiopathic: 245 (hypothyroidism, thyroiditis), 250 (diabetes mellitus), 274.0 (gout), 277.3 (amyloidosis); 278 (overweight/obesity); 646.8, 646.9 (complications of pregnancy); 710 (connective tissue diseases); 714 (rheumatoid arthritis); 715.3, 715.4 (osteoarthritis of the hand/forearm); 813.4 (wrist fractures); 955 (shoulder/upper limb peripheral nerve injuries); V22 (pregnancy).

**Figure 2** Age-specific incidence rates of surgically-treated idiopathic CTS according to occupational category in women (A) and men (B).

**Figure 3** Age-sex specific rate ratios (A, women; B, men) for blue-collar workers and full-time housewives with respect to white-collar workers.
REFERENCES


All public/private hospital CTS cases in study period (residents of Tuscany)

n=18,625

Cases not surgically treated
n=637

All surgically treated cases of CTS
n=17,988

Cases with relevant coexistent conditions*

n=245

Surgically treated cases of idiopathic CTS
n=17,743

Age <25 years, n=222
Age ≥59 years, n=6,687

Surgically treated cases of idiopathic CTS aged 25–59 years
n=10,834

Unknown employment status due to:
- treatment outside Tuscany, n=303
- undeclared occupation, n=350

Surgically treated cases of idiopathic CTS aged 25–59 years with known occupational status
n=10,181

- Unemployed, n=185
- Retired, n=890
- Students, n=16
- Seeking first job, n=22
- Military personnel, n=18
- Full-time “househusbands”, n=13
- Unspecified (“other”) job titles, n=236

Surgically treated cases of idiopathic CTS aged 25–59 years with known active occupational status
n=8,801

White-collar workers
n=1,075

Blue-collar workers
n=4,407

Housewives
n=3,319
Figure 2

(A) Women

(B) Men
Figure 3

(A) Women

(B) Men
Incidence rates of surgically treated idiopathic carpal tunnel syndrome in the blue-/white-collar workers and housewives of Tuscany, Italy

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