REGISTER NOW

Rare Disease Connect in Neurology

10–12 November 2021

Three half-days of virtual collaboration

04:00–08:00 PST (Los Angeles) I 07:00–11:00 EST (New York)
12:00–16:00 GMT (London) I 13:00–17:00 CET (Paris)
19:00–23:00 JST (Tokyo)

Join us for **Rare Disease Connect in Neurology 2021**, the inaugural meeting of a long-term learning journey, connecting neuromuscular experts committed to delivering excellence for patients living with myasthenia gravis (MG).

Imagine what we could do for patients, together.

Why take part in Rare Disease Connect in Neurology 2021?

With a world-class programme spanning three half-days, developed in collaboration with a steering committee of renowned MG experts, **Rare Disease Connect in Neurology 2021** will feature:

- Live and on-demand content
- Group discussions
- Networking opportunities with your global peers

To join us virtually on 10–12 November 2021

Register your interest now

Inspired by **patients.**
Driven by **science.**

This educational meeting has been organised and sponsored by UCB Biopharma SRL, and is intended for practicing healthcare professionals interested in the area of myasthenia gravis and managing patients in this space. Terms and conditions apply.

EDITORIAL

Muscle Nerve **56:** 1017–1019, 2017

WORK-RELATED CARPAL TUNNEL SYNDROME: WHAT'S IMPORTANT?

GARY M. FRANKLIN, MD, MPH,[1,2,3,4] and ZACHARY GRAY, BS, MPH[4]

[1]Department of Environmental and Occupational Health Sciences, 130 Nickerson Avenue, Suite 212, Seattle, Washington 98109, USA
[2]Department of Neurology, University of Washington, Seattle, Washington, USA
[3]Department of Health Services, University of Washington, Seattle, Washington, USA
[4]Washington State Department of Labor and Industries, Olympia, Washington, USA

Normally, an editorial discusses the background of reasonable work, its scientific merits, and then the context of its findings. The main point in the study by Thiese *et al.*[1] in this issue of the journal, regarding the association between wrist ratio and carpal tunnel syndrome (CTS) and its effect modification by obesity, is almost totally beside the point in the larger context. Focusing on an arbitrary measure of wrist anthropometrics redirects focus from higher risk occupational factors, obfuscating useful and potentially preventable measures, in favor of creating "diagnostic" cut-points of debatable value. So, let us turn things around a bit and start from that context.

The National Institute of Occupational Safety and Health, in 2000, funded a consortium of 6 centers to track more than 3,500 workers across regions of the USA to try to determine, prospectively, risk factors for work-related upper extremity musculoskeletal disorders (WRUEMSKs).[2] The main purpose of these studies was to clarify, after years of heated debate,[3] the relative contribution of various types of common physical work exposures and the risk of incident WRUEMSKs. Being a prospective cohort study, it promised to offer some of the most valid information to date, at least indirectly offering a clearer window into the causation of these disorders. In general, these studies were carefully done and, in spite of some heterogeneity in how each center conducted the studies, common case definitions of some of the WRUEMSKs, including CTS, were implemented across the 6 centers.[2]

The consortium CTS case definition included both typical symptoms and signs, and nerve conduction studies. This is a key point: a proper case definition of CTS for research purposes requires appropriate symptoms and signs *and* electrodiagnostic studies (EDX).[4] This may be particularly critical for CTS cases in the workers' compensation policy arena. Outcomes of various surgical procedures tend to be much worse in workers' compensation than in non–workers' compensation populations.[5] Harris *et al.* included 10 studies of CTS, with the compensation patients experiencing a >4-fold increase in unsatisfactory outcomes compared with the non-compensation patients.[5] In addition, 47% of hand surgeons reported in a national survey that, if CTS symptoms are typical and there is a positive response to steroid injection, there is no need to conduct EDX before performing CTS surgery.[6] These types of results regarding poorer outcomes of CTS surgery in workers' compensation, and attitudes of orthopedic surgeons, has led the Industrial Insurance Medical Advisory Committee of the Washington State Department of Labor and Industries to mandate EDX in combination with appropriate symptoms and signs for CTS before authorizing surgical decompression for work-related CTS.[7] Greater specificity is warranted when a normally effective CTS decompression procedure is considered in an injured worker population.

Thus, in workers' compensation systems, abnormal EDX findings alone are not sufficient to corroborate a diagnosis of CTS. Abnormal EDX results alone are fairly common, and only 23% of workers with abnormal EDX alone followed prospectively eventually develop true CTS.[8] In addition, some investigators have shown that testing for EDX post-offer but pre-employment is not a worthwhile endeavor. Dale *et al.*, in a large retrospective cohort study of 1,648 newly hired manufacturing production workers, showed no association between abnormal pre-placement EDX results and incident CTS[9]; they concluded that EDX screening is ineffective as a preventive strategy for CTS.

The study by Thiese *et al.*, from 2 consortia centers among the 6 centers originally funded to conduct a large prospective study of risk factors for CTS, reports negative findings related to physical risk factors and CTS. None of the specific findings

Correspondence to: G.M. Franklin; e-mail: meddir@uw.edu

Published online 7 June 2017 in Wiley Online Library (wileyonlinelibrary.com).
DOI 10.1002/mus.25719

related to the main physical exposure variables (strain index and the threshold limit value for hand/arm vibration) are actually presented. Thus, the scientific basis of absence of an association between job physical factors and CTS cannot be independently assessed. Even when these factors are presented, cross-sectional studies are a poor method of assessment for factors likely to vary with time, such as physical factors, and thus the finding of non-significance for such factors in the study is inherently flawed. Physical factors were reported to be significantly associated with incident CTS when all 6 centers,[10] or 5 centers,[11] reported overall consortium findings in prospective studies. In those earlier studies, the authors used prospective analyses of the same data set and found a strong relationship with work tasks; workers performing forceful, repetitive hand activities were at greater risk for developing CTS after adjustment for covariates.[12]

None of the articles cited by Thiese *et al.*[1] in support of an association between wrist ratio and CTS are better quality, prospective cohort studies. Five of the articles used only EDX as the principal outcome variable,[13–17] not an outcome with a clinically meaningful case definition.[4] The working hypothesis has been that those with a square-shaped wrist, compared with a more rectangular wrist, are more likely to have CTS. A major confounding factor is that, although obesity is clearly linked to CTS, it may also be associated with wrist ratio and other anthropometric measures of the wrist. Thiese *et al.*[1] used a large occupational cohort to tease-out the relationship between wrist ratio and CTS occurrence, and found support for this only among normal-weight workers and not for obese workers. Some authors studying wrist dimensions and its relation to CTS have cautioned against using wrist dimensions as a diagnostic factor, with Farmer and Davis noting that the difference in wrist dimensions is too small to be of diagnostic value in clinical or epidemiologic practice.[18]

Other concerns are overadjustment, or adjustment for inappropriate variables. For example, one should not adjust for variables that are intermediary factors in a disease process. Also, variables that are highly correlated should not be included in the same model. Body mass index, diabetes mellitus (DM), and depression are likely to be highly correlated (the correlation matrix could have been presented) and, if so, should be evaluated separately. For DM, this could have been addressed by excluding the small number of workers with DM (or with prolonged ulnar latency) from the analysis. Over-adjustment can lead to unstable risk prediction or may mask important contributions of variables.

This cross-sectional study by Thiese *et al.*[1] has some weaknesses that are of concern, and the findings from their study may fan the flames of what has been an effort by some orthopedic surgeons to debunk work-related CTS.[19] Yes, there are still unanswered questions, such as the impact of keyboarding and intensive mouse use—evidence that is weak but suggestive of an association with CTS.[20,21] A responsible policy even for this physical exposure, say in workers conducting intensive data entry most of the work week, would be to consider such cases after detailed assessment of the degree of exposure.[7] Workers gave up their right to sue employers in a so-called "grand bargain" as reflected in most state's workers' compensation laws from the early 20th century.[22] The no-fault principal is to liberally construe benefits in favor of the workers. The science of risk factors related to CTS is solid on physical risk factors and on obesity. In contrast, wrist ratio and other anthropometric measures are likely related to EDX, but there is no compelling evidence relating wrist dimensions to causation of work-related CTS.

REFERENCES

1. Thiese MS, Merryweather A, Koric A, Ott U, Wood EM, Kapellusch J, *et al.* The association between wrist ratio and carpal tunnel syndrome: effect modification by body mass index. Muscle Nerve (to be published).
2. Harris-Adamson C, Eisen EA, Dale AM, Evanoff B, Hegmann KT, Thiese MS, *et al.* Personal and workplace psychosocial risk factors for carpal tunnel syndrome:a pooled study cohort. Occup Environ Med 2013;70:529–537.
3. Silverstein M, Silverstein B, Franklin GM. Evidence for work-related musculoskeletal disorders: a scientific counterargument. J Occup Environ Med 1996;38:1996.
4. Rempel D, Evanoff B, Amadio PC, de Krom M, Franklin G, Franzblau A, *et al.* Consensus criteria for the classification of carpal tunnel syndrome in epidemiologic studies. Am J Public Health 1998; 88:1447–1451.
5. Harris I, Mulford J, Solomon M, van Gelder JM, Young J. Association between compensation status and outcome after surgery. JAMA 2005; 293:1644–52.
6. Lane LB, Starecki M, Olson A, Kohn N. Carpal tunnel syndrome diagnosis and treatment: a survey of members of the American Society for Surgery of the Hand. J Hand Surg Am 2014;39:2181–2187.
7. Washington Department of Labor and Industries. Work-related carpal tunnel syndrome: diagnosis and treatment guideline. http://www.lni.wa.gov/ClaimsIns/Files/OMD/MedTreat/CarpalTunnel.pdf/. Accessed May 21, 2017.
8. Werner RA, Gell N, Franzblau A, Armstrong TJ. Prolonged median sensory latency as a predictor of future carpal tunnel syndrome. Muscle Nerve 2001;24:1462–1467.
9. Dale AM, Gardner BT, Buckner-Petty S, Strickland JR, Evanoff B. Postoffer pre-placement screening for carpal tunnel syndrome in newly hired manufacturing workers. J Occup Environ Med 2016;58: 1212–1216.
10. Kapellusch JM, Gerr FE, Mallow EJ, Garg A, Harris-Adamson C, Bao SS, *et al.* Exposure–response relationships for the ACGIH threshold limit value for hand-activity level: results from a pooled data study of carpal tunnel syndrome. Scand J Work Environ Health 2014;40:610–620.
11. Harris-Adamson C, Eisen EA, Kapellusch J, Garg A, Hegmann KT, Thiese MS, *et al.* Biomechanical risk factors for carpal tunnel syndrome: a pooled study of 2474 workers. Occup Environ Med 2015; 72:33–41.
12. Garg A, Kapellusch J, Hegmann K, Wertsch J, Merryweather A, Deckow-Schaefer G, *et al.* The strain index (SI) and threshold limit value (TLV) for hand activity level (HAL): risk of carpal tunnel syndrome (CTS) in a prospective study. Ergonomics 2012;55: 396–414.

13. Johnson EW, Gatens T, Poindexter D, Bowers D. Wrist dimensions: correlation with median sensory latencies. Arch Phys Med Rehabil 1983;64:556–557.
14. Gordon C, Johnson EW, Gatens PF, Ashton JJ. Wrist ratio correlation with carpal tunnel syndrome in industry. Am J Phys Med Rehabil 1988;67:270–272.
15. Radecki P. A gender specific wrist ratio and the likelihood of a median nerve abnormality at the carpal tunnel. Am J Phys Med Rehabil 1994;73:157–162.
16. Nathan PA, Keniston RC. Carpal tunnel syndrome and its relation to general physical condition. Hand Clin 1993;9:253–261.
17. Chiotis K, Dimisianos N, Rigopoulou A, Chrysanthopoulou A, Chroni E. Role of anthropometric characteristics in idiopathic carpal tunnel syndrome. Arch Phys Med Rehabil 2013;94:737–744.
18. Farmer JE, Davis TR. Carpal tunnel syndrome: a case-control study evaluating its relationship with body mass index and hand and wrist measurements. J Hand Surg Eur 2008;33:445–448.
19. Melhorn JM, Talmadge JB, Ackerson WE, Hyman MH. AMA guides to the evaluation of disease and injury causation, 2nd ed. OEM Press: Beverly Farms, MA; 2013.
20. Andersen JH, Thomsen JF, Overgaard E, Lassen CF, Brandt LP, Vilstrup I, *et al.* Computer use and carpal tunnel syndrome: a 1-year follow-up study. JAMA 2003;289:2963–2969.
21. Eleftheriou A, Rachiotis G, Varitimidis SE, Koutis C, Malizos KN, Hadjichristodoulou C. Cumulative keyboard strokes: a possible risk factor for carpal tunnel syndrome. J Occup Med Toxicol 2012;7:16.
22. Guyton GP. A brief history of workers' compensation. Iowa Orthop J 1999;19:106–110.