CORRESPONDENCE

Use of screening nerve conduction studies for predicting future carpal tunnel syndrome

Editor—Werner *et al*¹ consider a question critical to the interpretation of nerve conduction studies used as a screening tool to identify workers at risk of hand and finger disorders associated with repetitive motion. They conclude that an abnormal median sensory nerve conduction in asymptomatic active workers is not predictive of development of hand and finger symptoms in the future.

The results do not discuss the possibility of selection bias in choosing asymptomatic workers employed for years in manufacturing jobs with a range of repetitive hand movements. Active workers with abnormal nerve conduction studies who perform repetitive tasks for years and remain asymptomatic may be the ones that have attributes, yet to be determined, that prevent the attainment of a symptom threshold. The lack of follow up nerve conduction studies did not allow the authors to answer their question regarding the predictive value of abnormal median sensory nerve conduction. Without these data it is not known whether the active workers and controls who developed symptoms had a progression in their nerve conduction studies; whereas the nerve conduction studies in those with no symptoms at follow up remained unchanged or improved. It was only determined that at one point in time 77 active workers had abnormal nerve conduction studies not accompanied by symptoms. As the reliability of abnormal nerve conduction studies in this setting is not established, it may be premature to use nerve conduction studies as a biomarker to predict risk. For example, it is not known if the nerve conduction studies of the 77 asymptomatic workers would remain abnormal at follow up one to two years later.

Median mononeuropathy associated with carpal tunnel syndrome has numerous underlying pathological processes from ischaemia secondary to altered blood flow, direct axonal compression, and chronic degenerative changes. Therefore it is not surprising that various combinations occur when screening workers with quantitative nerve studies and a symptom questionnaire. Those who commonly examine cases of median mononeuropathy (carpal tunnel syndrome) often find a low correlation between symptoms, physical findings, and nerve conduction studies. This is not unexpected as carpal tunnel syndrome is a multifactorial problem in which the time line for change and the underlying pathology may differ.

Before discarding nerve conduction studies as a screening tool, another approach that may yield results more predictive of risk is the examination of median nerve function in workers at pre-employment with follow up studies to identify change and the association with ergonomic stressors. Also electrodiagnostic measures known to better identify abnormalities in the carpal canal portion of the median nerve such as the midpalmar latency have increased sensitivity.²

Abnormal nerve conduction studies as an isolated finding should not be treated or used to screen out workers but rather should be followed up to establish, if it exists, the natural history of median nerve function and hand symptoms. The sound practice of medicine dictates treatment of the patient, not the abnormal laboratory value. Nerve conduction studies must use norms based on a healthy population without known exposures. If a shift in median nerve function is found more often in workers involved in repetitive activities, this cannot be accepted as a worker norm in the absence of prospective studies to determine the long term consequences. An oft quoted saying by Carl Sagan fits the study's conclusion of median sensory nerve conduction not predicting hand symptoms, "Absence of evidence is not evidence of absence."

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- 1 Werner RA, Franzblau A, Albers JA, Buchele H, Armstrong TJ. Use of screening nerve conduction studies for predicting future carpal tunnel syndrome. *Occup Environ Med* 1997;54:96-100.
- 2 AAEM Quality Assurance Committee. Literature review of the usefulness of nerve conduction studies and electromyography for the evaluation of patients with carpal tunnel syndrome. *Muscle Nerve* 1993;16:1392-414.

Authors' reply—We appreciate the comments from Blecker regarding our recent article on the predictive value of nerve conduction studies in predicting future symptoms consistent with carpal tunnel syndrome (CTS).¹ The issues raised are appropriate and will hopefully encourage more research in this area. The concerns about a possible selection bias are real as our study was based upon active workers and did not represent an inception cohort of workers. We agree that this type of study needs to be duplicated with an inception cohort to show the natural history of median nerve conduction across the wrist over time, with a close correlation of hand and finger symptoms. Our sample was randomly chosen and did have a high participation rate. The duration of employment at their present job did not influence the reporting of symptoms in our study; this argues against a selection bias of survivors but does not rule out the possibility.

The issue of whether or not the latency of the median nerve evoked response changes over time in active workers was not considered in our study and may provide some additional insight into the natural history of median mononeuropathy at the wrist but it does not assess the risk for CTS. Our study supports the conclusion that an active asymptomatic worker, with a documented median mononeuropathy, is not at increased risk for developing CTS (even though this contradicts our original hypothesis). Knowing the change in latency at follow up would not change this conclusion.

We are in agreement with Blecker that you treat the patient and not the test. Unfortunately, many clinicians think that a prolonged median latency is the equivalent of carpal tunnel syndrome. This is because of the high sensitivity reported for nerve conduction studies in relation to CTS.^{2,3} We raise the issue that the high sensitivity noted in a clinical

setting with symptomatic patients is not found in the cross sectional screening in the workplace.^{4,5} Also, the specificity is lower than previously thought.^{1,4,5}

This study questions the value of a screening nerve conduction study but also raises issues with their value as a diagnostic test. We think that the current criteria for determining a threshold for a prolongation of the median nerve evoked response across the wrist in the active worker needs to be re-evaluated. Our normative data, from our asymptomatic workers, suggest that a relative difference of 0.8 ms be used instead of 0.5 ms that is used in many laboratories.^{2,3} The data from Stetson *et al*⁶ supports the assumption that active industrial workers represent a shift in the population with more prolongation of the median nerve present among active workers. A longitudinal study will be necessary to find whether the active worker with a prolonged median nerve evoked response across the wrist develops any significant problems in the future. Our study showed that within a mean of 17 months of follow up that asymptomatic workers with a median mononeuropathy were not at greater risk of developing symptoms consistent with CTS. This argues against using nerve conduction testing as a screening procedure but a definitive study remains to be done.

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The sex ratios of offspring of people exposed to non-ionising radiation

Editor—In recent years there has been increasing concern that exposures to non-ionising electromagnetic fields have adverse reproductive effects.^{1,2} It is well established that in men, many forms of non-endocrine disease are associated with low testosterone, or high gonadotrophin concentrations, or both.³ There is very substantial evidence that

such a hormone profile predisposes men to sire a disproportionate number of daughters.⁴ Moreover there are several forms of occupational exposure which are known or suspected to be associated with such a hormone profile in men with low sex ratios (proportions male) in their offspring. For instance, such hormone profiles and sex ratios have been reported for professional divers, applicators of the nematocide DBCP,⁵ and men exposed to dioxin,⁶ vinclozolin,⁷ and borates.⁸ They may also be suspected in carbon setters⁹ and in professional drivers and men engaged in the alcohol trade.¹⁰ I suggest that there is now enough evidence to warrant such concern about exposure to non-ionising radiation.

Knave *et al.*¹¹ cited studies documenting fatigue, headaches, dizziness, impaired memory, nausea, loss of strength in limbs, respiratory difficulties, sleep disturbances, and reduced libido in workers exposed to electric fields. Exposure to microwaves is reportedly associated with a reduction in sperm count in humans,¹² and exposure to electrical fields (50 Hz, 5kV/m) was reportedly associated with a significant reduction of viable sperm in adult rats.¹³ Lastly, Free *et al.*¹⁴ reported significantly reduced plasma testosterone in rats exposed to strong (60 Hz) electric fields.

The table reproduces data on the sexes of offspring of people exposed to various forms of non-ionising radiation.

(1) The data on men exposed to high voltages suggest a low offspring sex ratio. This in turn suggests a hormone profile of non-specific pathology. Men engaged in such work should have their hormone concentrations assayed, especially those complaining of such symptoms as are outlined above.

(2) The two sets of data on female physiotherapists are in conflict. Larsen *et al.*¹⁵ reported a highly significant dose related excess of daughters born to exposed women but Gubéran *et al.*¹⁷ failed to replicate this finding. The disparity could be due to methodology. In both studies the women were questioned about exposure after conception, but the relevant exposure may precede conception. Both authors were assuming that if radiation affects sex ratio, it does so by causing early sex related foetal mortality. However, radiation may affect sex ratio by altering maternal hormone concentrations preconceptionally.

(3) Little is known about the effects on the sex ratio of offspring of women exposed to potential pathogens. Some forms of maternal exposure are reportedly associated with an excess of daughters—for example, to high frequency electromagnetic radiation,¹⁵ strong static and low frequency electromagnetic fields,¹⁸ and (possibly) dioxin.¹⁹ It is not known whether these excesses of daughters are hormonally caused. It would be interesting to know whether women in these categories who produce excess daughters complain of non-specific malaise (as described by Knave *et al.*¹¹ for men) or whether they report a sense of wellbeing.

(4) If confirmed, the effects of non-ionising radiation are different from those of ionising radiation. If ionising radiation were to cause sex linked lethal mutations, then exposed fathers could produce an excess of sons, and exposed mothers an excess of daughters.²⁰ The data of Cox²¹ and of Dickinson *et al.*²² suggest that this expectation is fulfilled.

(5) The low sex ratio of children in the vicinity of a radiolocation system²³ is sugges-

tive if only because the authors could think of no explanation for it. Attempts should be made to confirm this finding in eastern Europe and elsewhere.

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Table 1 Sexes of offspring of controls and of people exposed to various forms of non-ionising radiation

Reference	Exposed		Controls		P value*
	M	F	M	F	
Men working in high voltage power stations or substations:					
Nordström <i>et al.</i> ²⁴ †	67	73	357	298	0.2
Knave <i>et al.</i> ¹¹ ‡	12	22	30	27	0.2
Mubarak and Mubarak ²⁵ §	8	54	—	—	0.0000
Female physiotherapists exposed to shortwave radiation:					
Larsen <i>et al.</i> ¹⁵	15	36	107	71	0.0002
Gubéran <i>et al.</i> ¹⁷	263	245	640	633	NS
Parents exposed to radiation from a radiolocation station:					
Kolodynski and Kolodynska ²⁶ ¶	254	355	171	186	0.08
Parents exposed to strong static and low frequency electromagnetic fields:					
Irgens <i>et al.</i> ¹⁸	Exposed men sired offspring with a slightly reduced sex ratio. Exposed women produced offspring with a significantly and substantially reduced sex ratio				

*The P values correspond to the results of two sided 2 × 2 χ^2 tests.

†In the data of Nordström *et al.*²⁴ the controls were pregnancies sired by men who were less exposed or unexposed in the same environment.

‡In the data of Knave *et al.*¹¹ the controls were the pregnancies sired by the men before exposure.

§Mubarak and Mubarak²⁵ provided no control data, but if their sex ratio is contrasted with an expected²⁶ white live birth sex ratio of 0.514, the value of the resultant χ^2 is well beyond tabled values.

¶The data of Kolodynski and Kolodynska²³ are not of live births but of children registered in schools. The exposed children lived within 20 km of the radiolocation system. The controls lived in a nearby region unexposed to the system. Both areas are reportedly without major point sources of pollution. The difference between the sex ratios of the exposed and the controls in these data is only suggestive (P=0.08). But if the sex ratio of the exposed is contrasted with an expected²⁶ live birth sex ratio of 0.514, then P<0.00001. If boys do not leave school earlier than girls in this region, then an explanation is lacking, and should provisionally be suspected in the radiolocation system.

|| The raw data of the study of Irgens *et al.*¹⁸ will become available on publication of their paper.