

# **Prescribing for Hand arm Vibration Syndrome and risk from motorcycle handlebars:**

## **Information Note**

### **Industrial Injuries Advisory Council**

**April 2017**

#### **Background**

1. In January 2017, correspondence was referred to the Council from a claimant reported to have Raynaud's phenomenon secondary to the hand-transmitted vibration incurred when riding a motorcycle at work.
2. Hand-arm Vibration Syndrome, which includes Raynaud's phenomenon arising from vibration exposure, is prescribed under the Industrial Injuries Disablement Benefit (IIDB) Scheme (Prescribed Disease (PD) A11). Prescription relates to a qualifying list of tools and equipment imparting vibration to the hands, but this list does not include motorcycle handlebars.
3. The Council has considered the case for extending the terms of PD A11 to cover such exposures during the course of work. It has also considered the question of whether a more generic approach could be used to define qualifying exposures under this prescription. This Information Note describes the Council's deliberations and its conclusions.

#### **The Industrial Injuries Disablement Benefit Scheme**

4. The IIDB Scheme provides a non-contributory, 'no-fault' benefit for disablement because of accidents or prescribed diseases which arise during the course of employed earners' work. The benefit is paid in addition to other incapacity and disability benefits. It is tax-free and administered by the Department for Work and Pensions.
5. The legal requirements for prescription are set out in The Social Security Contributions and Benefits Act 1992 which states that the Secretary of State may prescribe a disease where he is satisfied that the disease:
  - a. ought to be treated, having regard to its causes and incidence and any other relevant considerations, as a risk of the occupation and not as a risk common to all persons; and

- b. is such that, in the absence of special circumstances, the attribution of particular cases to the nature of the employment can be established or presumed with reasonable certainty.
6. Thus, a disease can only be prescribed if there is a recognised risk to workers in an occupation, and the link between disease and occupation can be established or reasonably presumed in individual cases.

### **The Role of the Industrial Injuries Advisory Council (IIAC) and prescription**

7. IIAC is an independent statutory body established in 1946 to advise the Secretary of State for Social Security on matters relating to the IIDB scheme.
8. Much of the Council's time is spent considering whether the list of prescribed diseases for which benefit may be paid should be enlarged or amended. The Council searches for a practical way to demonstrate in the individual case that the disease can be attributed to occupational exposure with reasonable confidence. For this purpose, 'reasonable confidence' is interpreted as being based on the balance of probabilities.
9. Some occupational diseases are relatively simple to verify, as the link with occupation is clear-cut. Some only occur due to particular work, or are almost always associated with work, or have specific medical tests that prove their link with work, or have a rapid link to exposure, or other clinical features that make it easy to confirm the work connection. However, many other diseases are not uniquely occupational, and when caused by occupation, are indistinguishable from the same disease occurring in someone who has not been exposed to a hazard at work. In these circumstances, attribution to occupation depends on research evidence that work in the prescribed job or with the prescribed occupational exposures causes the disease on the balance of probabilities. In turn, the Council looks for evidence that a particular occupational exposure or circumstance increases the risk of developing the disease by a factor of two or more. (Previous reports of the Council explain why this threshold was chosen.<sup>1</sup>)
10. The health effects arising from occupational exposure to hand-transmitted vibration cannot be distinguished reliably from similar effects that have other causes (see below),

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<sup>1</sup> See also: <https://www.gov.uk/government/publications/how-decisions-are-made-about-which-diseases-iidb-covers>

so the case for prescription rests on research evidence on the causal probabilities.

## **Hand-arm Vibration Syndrome**

### *Raynaud's phenomenon*

11. The disorders of the upper limbs associated with hand-transmitted vibration are collectively called the 'Hand-arm Vibration Syndrome' (HAVS). They include: a form of Raynaud's phenomenon called vibration-induced white finger (VWF) and digital neuropathy (an injury to nerves supplying the fingers and thumbs). Carpal tunnel syndrome (an entrapment of a nerve supplying sensation to the hand) is another well-recognised complication of exposure. Affected individuals may have one or several of these disorders.
12. Raynaud's phenomenon is characterised by episodes of finger-blanching due to temporary interruption of blood flow to the extremities of the digits. During an episode, the extremity becomes cold, numb, and marble white or blue. Typically, attacks are triggered by the cold. During the recovery phase (as the circulation restores), the affected parts become fiery red and tingle.
13. Raynaud's phenomenon caused by substantial exposure to hand-transmitted vibration (VWF) is a fairly common occupational disorder in the UK. However, a similar clinical appearance (primary Raynaud's phenomenon) arises naturally in some 5-10% of men and 10-20% of women, with some variation in disease frequency by race, climate, geography and case definition. Less commonly, Raynaud's phenomenon can be secondary to certain rheumatic diseases, blood disorders and drugs, or can arise from traumatic injury.
14. Clinical diagnosis of VWF is often said to rest on identifying Raynaud's phenomenon in a worker with substantial exposure to hand-arm vibration and excluding other rarer secondary causes of the disease. Such an approach tends to assume that all Raynaud's phenomenon in exposed workers is occupationally caused and none of it is primary (which is simplistic given the background prevalence of the disease, but precautionary in terms of the advice given to affected patients). VWF and primary Raynaud's phenomenon (the common patterns) are not distinguishable with certainty on clinical grounds. In VWF, the area of blanching may be localised to the part of the hand receiving the most vibration,

and in primary Raynaud's phenomenon perhaps more typically bilateral and symmetrical; but such differences are not pathognomic and in many situations, such as that of the motorcycle rider, both hands receive exposures to a similar degree; a further complicating factor is that exposure to multiple vibrating tools or machines is commonplace in British workers (Palmer *et al*, 2000a). Where available, objective tests of finger blood flow, finger blood pressure and finger temperature can strongly support the diagnosis of Raynaud's phenomenon, but they cannot reliably distinguish its cause, other than to confirm the fingers affected. If, however, blanching precedes a person's first exposure to hand-transmitted vibration, then HAVS is not the primary pathology.

### *Sensorineural effects*

15. Transient tingling in the digits is common after use of vibratory tools, but with sufficient exposure, nerve injury (digital neuropathy) can arise. Also, hand-transmitted vibration can cause the nerve entrapment disorder carpal tunnel syndrome (CTS).

### **Prescription of HAVS**

16. The IIDB Scheme recognises VWF, the sensorineural effects of vibration, and vibration-induced CTS in the terms of PD A11 and PD A12(a). In particular in relation to this enquiry, PD A11 recognises "intense blanching of the skin, with a sharp demarcation line between affected and non-affected skin, where the blanching is cold-induced, episodic, occurs throughout the year and affects the skin of [the extremities of a sufficient number of digits]" in occupations entailing the use of a range of vibratory tools well-established to cause HAVS (e.g. chain saws, riveting hammers, swagers, road breakers).

### **Challenges in extending the terms of PD A11**

17. The qualifying list of vibratory equipment in PD A11 was drawn up historically, before the probabilistic reasoning approach to prescription (paragraph 9) was formally adopted by the Council. However, the vibration magnitudes associated with the listed tools were very high and prescription was supported by surveys of long-term user groups with a high prevalence of symptoms, such that the threshold of 'doubling of risk' (although not formally tested) would have been met.

18. It might be supposed that the qualifying exposure for PD A11 could be defined in terms of a *dose* of hand-transmitted vibration rather than a group of *tools or equipment*, since modern control standards assume a specific relationship between dose and risk of VWF. British Standard 6842:1987, for example, suggested that with regular exposure to an A(8) of 2.8 m/s<sup>2</sup> : “... *there may be an occurrence of symptoms of blanching in about 10% of the vibration-exposed population after about 8 years*”, while ISO 5349:1986 also assumed a risk relationship and made predictions for prevalence rates from 10% to 50%; the revised 2001 standard, although not including predictions, provided the basis for the Control of Vibration at Work Regulations 2005 which defines an *Exposure Limit Value* of A(8) of 5 m/s<sup>2</sup> and an *Exposure Action Value* (A(8) of 2.5 m/s<sup>2</sup>. (These represent respectively the level above which an employee should not be exposed in a given day, and a value above which employers must act to reduce exposure and offer health surveillance.)
19. The Council has considered the question whether, in future, prescribing for PD A11 could be on the basis of dose. In practice, however, some major constraints have been identified.
20. One problem is that the relationship between dose and effect is disputed between scientists in the field, and debate on this has continued for several decades; a second problem is that the best metric for assessing exposure is also disputed. Of practical significance, also, is the wide variation in exposure levels recorded between different brands of the same tool, identical tools in different stages of maintenance, tools used in different ways and tools ‘worked’ against different surfaces and materials; errors in reconstructing exposure durations and patterns; and challenges in diagnosing cases of Raynaud’s phenomenon and digital neuropathy and distinguishing their cause.
21. A full account of these challenges is beyond the scope of this Information Note. Suffice it to say that variations in vibration magnitude of up to 5-fold have been reported in studies where families of similar tools were tested, reflecting differences in model type, eras of design, and source of manufacture, as well as differences in the task and fitted accessories (Griffin *et al*, 2006); errors of broadly similar size can be found in estimated daily exposure durations (Palmer *et al*, 2000c); and the prevalence of white finger varied by some 3-fold, and the estimated attributable number of cases of VWF in Great Britain varied substantially, by case definition in a national survey of vibration (Palmer *et al*, 2000b). Objective tests for the diagnosis of Raynaud's phenomenon have reached a high degree of sophistication (Ye & Griffin, 2016), but do not yet assure a diagnosis of VWF as

compared with other causes of finger blanching.

22. In commenting on the scope for prescription of HAVS based on vibration dose, a leading international researcher from the Institute of Sound and Vibration Research, when consulted by the Council, expressed concern about using A(8) alone as an indicator, commenting that “the epidemiological data are not strong and the frequency weighting and time weighting [used to assess vibration magnitude] are ‘convenient’ [for protective purposes] rather than proven”, while “there are still no standard dose-response data for sensorineural symptoms”.
23. A further challenge in practice is that claims are assessed in a high-volume environment without recourse to detailed individual proofs of the kind employed in civil proceedings to address all the uncertainties inherent in dose assessment claim by claim.
24. On balance, therefore, the Council has concluded that extensions to PD A11 should continue to be considered within the current framework, seeking evidence that risks of HAVS are more than doubled under circumstances that can be defined and implemented within the Scheme.

### **Evidence on HAVS in professional motor cyclists**

25. The Council’s Research Working Group has searched for published scientific reports on HAVS and hand-transmitted vibration from motorcycle handle bars. It has also consulted a leading expert from the Institute of Sound and Vibration Research, University of Southampton, which holds a dedicated library of research reports on vibration.
26. In the event, relatively few peer-review studies have been undertaken on the health effects and exposures arising from handlebar vibration. A few case reports were identified involving HAVS in people exposed off-road (e.g. cross-country, where vibration exposures are more extreme) (Stark *et al*, 1990); recreationally, or through speedway racing (Bentley *et al*, 1982); or via the handlebars of snowmobiles (e.g. in reindeer herding in Scandinavia) (Virokannas *et al*, 1984).
27. Most research has come from Japan and has focussed on workers using motorcycles for daily postal delivery (Tominaga 1994a, 1994b, 1995, 1996) and to a lesser extent for traffic police duties (Mirbod *et al*, 1997).
28. In the largest of these surveys, involving over 100,000 mailmen using motorcycles

(Tominaga 1994a), symptoms of white finger were found in 2.1% of subjects (2,131 workers), or 2.8% of the 64,000 letter carriers (Tominaga 1994b, 1995). Higher rates of white finger were reported by those who drove further in a typical working day or had more years of motorcycle experience. In one analysis (Tominaga 1994a), white finger symptoms were about twice as common, and finger numbness about 1.4 times as common in those with  $\geq 15$  years of motorcycle exposure at  $\geq 200$  km/week than in those with  $\geq 15$  years of motorcycle exposure at  $< 200$  km/week (and increased but not doubled in those with 10-14 years of driving). In another analysis, higher symptom rates by daily driving distance ( $> 40$  vs.  $< 25$  km) emerged after about 5 years of motorcycle experience (Tominaga 1994b).

29. A challenge in interpreting these findings is that the prevalence of primary Raynaud's phenomenon increases with age, tending to plateau in a person's 40s or 50s, but older age correlates with more years of exposure; no analysis was conducted to resolve the impact of age versus exposure duration on symptom prevalence. A second concern is that the group driving further were also exposed to colder working conditions while driving on snowy country roads; cold is not a cause of Raynaud's phenomenon, but it is a trigger for attacks and may cause greater awareness of the condition or provoke symptoms more often in those with more occupational exposure to cold.
30. The author of the reports recognised these concerns and, in describing postal delivery by motorcycle in Japan as "an operation combining severe cold exposure with weak-intensity vibration exposure", was inclined to ascribe the reported symptoms largely to primary Raynaud's phenomenon rather than VWF (Tominaga 1994a, 1994b, 1995). He argued that the early onset of symptoms and early plateauing of symptoms were inconsistent with an effect of vibration at the moderate dose measured but more typical of primary Raynaud's phenomenon, and noted further that prevalence rates were similar to those for primary Raynaud's phenomenon in Japanese men as a whole (2.7% among those not using vibratory tools (Mirbod *et al*, 1994)).
31. In a much smaller study, Mirbod *et al* (1997) assessed symptoms of HAVS in 119 motorcycle traffic policemen and 49 male controls. The policemen represented all of those approached but the response rate in controls (hospital staff) was 21%. Controls (but not traffic policemen) were selected because they did not use hand-held vibratory tools; 4% of the motorcyclists reported regular use of vibratory tools. The questions used

to ascertain finger blanching were not given.

32. In all, 5 (4.2%) of traffic police motorcyclists reported finger blanching but no controls. Owing to small numbers, the possibility that this difference arose by chance cannot be discounted. As with the survey of postal men, no formal statistical adjustment was made for age, although the two groups had similar mean ages, or for smoking habits, which were dissimilar between compared groups (64% in motorcyclists vs. 35% in hospital staff). If 2.7% is assumed to be a more robust estimate of the background prevalence of primary Raynaud's phenomenon in Japanese men (Mirbod *et al*, 1994) than the control data in this report, then risks were elevated but not as much as doubled in the study. The Council has found no other peer reviewed studies with risk estimates of HAVS in this occupational group, implying that the evidence base is small.
33. A few reports have been identified which measured vibration magnitudes of motorcycle handlebars, variously in Japanese postal workers, Japanese traffic police and Canadian forestry workers (Tominaga 1994a, 1994b; Mirbod *et al*, 1997; Yokomori *et al*, 1986; Harrison *et al*, 1982). In addition, the Institute of Sound and Vibration Research has assessed such exposures at different times. Vibration levels have been higher for 750cc police motorcycles than for four-stroke single-cylinder engines used by postal delivery men; and have also varied by road surface (worse on unmade roads and in forests) and by era (such that when anti-vibration measures were introduced in Japan around 1980 they reduced exposure magnitudes by about two-thirds). In general, manufacturers have given priority to brand image and performance, rather than vibration control; and the Council has been advised that a wide variation in risk is likely to exist in practice, reflecting a large range of vibration magnitudes between motorcycles and large effects relating to driving speed and road surface.
34. Having said this, in the British National Survey of Vibration, the median vibration magnitude assigned motorcycle handlebars (of  $1.5 \text{ m/s}^2 \text{ a}_{hw}$ ) was well below assumed median values for vibratory tools prescribed already under the IIDB Scheme (e.g.  $12 \text{ m/s}^2$  for rock drills,  $29 \text{ m/s}^2$  for scabblers,  $10 \text{ m/s}^2$  for chain saws,  $16 \text{ m/s}^2$  for needle guns (Palmer *et al*, 2000a)).
35. A vibration specialist from the Institute of Sound and Vibration Research commented that “the scientific literature is rather patchy, but shows that the vibration on the handlebars of bikes can be of sufficient magnitude to anticipate a risk meriting control measures” ...



and also that “the potential for vibration on the handlebars of motorbikes to cause the condition is sufficiently well recognised for it to be a matter that is commonly considered as an alternative explanation for symptoms in civil claims for compensation”. In other words, the hazard is well recognised and cases of HAVS can sometimes arise given the right combination of circumstances.

36. The challenge for the Council, however, lies in the difficulty of distinguishing clinically between primary Raynaud’s phenomenon and VWF, the comparatively high frequency of finger blanching symptoms in men and women in the absence of occupational exposure to hand-transmitted vibration, and whether risks of finger blanching are more than doubled from riding motorcycles in circumstances that can be robustly and practically defined in the Scheme.
37. Present evidence on this would appear too limited to be confident of defining the exposure schedule that should be prescribed. Accordingly, the Council does not recommend adding motorcycle handlebars to the list of vibratory tools specified in the terms of PD A11. It will, however, continue to monitor future research evidence on this and other potential causes of HAVS in case the argument for prescription can be developed.

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**Experts consulted:**

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