

**Author’s reply**

Dear Sir,

The aim of our paper was to highlight the apparently widespread misuse of simple fitness tests to assess the ability of personnel to perform occupational tasks that involve external load carriage.

Naturally, we agree that VO2max is a linear function of body mass—more precisely, lean body mass. VO2max is a relatively good predictor of endurance exercise performance during body-weight-bearing activity (e.g. running), only when expressed relative to body mass (ml/min/kg). However, this does not help to predict submaximal endurance performance during tasks that involve external load carriage.

Our objective was to highlight this potential for the misapplication of simple exercise tests. In so doing, we hope to have highlighted rather than perpetuated a ‘fallacy’, and reduced the potential for misuse of such tests in the future.

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Dear Sir,

Ahmed _et al._’s paper [1] on the subject of high-frequency (10–18 kHz) audiometry (HFA) calls for comment on theoretical and practical grounds.

The authors make some statements, based on the results of their study, that appear to be contradictory and are at times confusing.

For example, on the first page (p. 245) they state that ‘multivariate analysis indicated that age was the primary predictor [my italics throughout] and noise exposure the secondary predictor of hearing thresholds in a high frequency range (10–18 kHz)’. They then go on to say that ‘The results of this study suggest that HFA might be used as an early indicator for noise-induced hearing loss and acoustic trauma rather than audiometry at a conventional frequency (4 kHz), particularly for younger groups’.

Here they compared their suggested method HFA, which I think should rather have been called very high frequency audiometry, not with conventional screening audiometry at the frequencies of 0.25 to 6 or 8 kHz, but with audiometry at only 4 kHz. There are many publications about the latter, including one by myself [2], which discuss the merits and demerits of this.

Then, on p. 257, the authors reiterate that ‘HFA proved to be a better tool for the early detection of acoustic trauma [defined as exposure to firing guns] than [audiometry at] the conventional frequency of 4 kHz’.

In the paragraph on this subject on p. 253, they more prudently indicate that their results ‘might be taken as an indicator that HFA is a helpful tool in the early detection of acoustic trauma rather than audiometry at the conventional frequency of 4 kHz, particularly in early age’. Notably ‘noise-induced hearing loss’ is not included in this paragraph.

However, under Conclusion (p. 257), this is again included, where it is categorically stated that the results from this study strongly suggest that [notwithstanding age being the primary predictor here] HFA (at 10–18 kHz) might be used as an early indicator for noise-induced hearing loss and acoustic trauma, and can be performed more reliably than the conventional 4 kHz frequency technique, particularly during the early stages’. Yet, in the preceding sentence, it had been indicated that for the conventional frequency range of 0.25–8 kHz, the effect of noise is more dominant than that of age, as evidenced by such audiometry.

While the authors concede (p. 256) that ‘HFA might be used in the routine audiological evaluation of workers before they are exposed to noise’, presumably for establishing a baseline, they also advocate here that HFA ‘cannot be used as an early indicator for NIHL [noise-induced hearing loss]’.

I suspect that I will not be the only interested reader who finds this discussion of results and the resulting conclusion somewhat confused, as well as confusing.

By themselves, the results of this study are very interesting and stimulating. Perhaps the fact that there are seven authors of this paper may account for the enthusiastic but not always very critically formulated conclusions?

However, there are some more fundamental observations to make on this paper, partly on theoretical grounds, partly on practical aspects.

First, the authors, while discussing exposure to noise (measured as Leq) and using the noise immission level (Burns and Robinson) to characterize exposure to noise for their subjects, do not appear to have considered the effect on hearing of exposure to particular frequencies on cells in the cochlea.
If it is accepted that the adverse effects on these cells show up in hearing thresholds at frequencies from ~0.5 to 1.5 octaves higher than the offending noise, the hearing threshold shifts at the (very) high frequencies they investigated would have been caused by excessive occupational noise at frequencies >6 kHz. It is doubtful whether these frequencies do occur extensively in industrial environments.

Many years ago, noise exposure spectra (intensity at disparate frequencies from 63 Hz to 6 or 8 kHz) were determined for a variety of industrial processes in The Netherlands [3]. At the same time, ‘departmental average audiograms’ were compiled for the exposed populations in an attempt to find correlations.

It was recognized at the time that there were too many confounding variables and missing data to arrive at any valid conclusions. However, the point was made that if one wishes to establish what effects exposure to excessive noise has on hearing, one should also take into account which frequencies of noise (sound in Hz) an employee is exposed to.

According to IEC, ISO, British (BS 4197) and other standards, the determination of occupational noise exposure is performed with sound level meters equipped with a so-called A filter. This attenuates both low and high frequencies but not frequencies in the 1000 Hz range (used as main reference frequency).

This implies that when one measures levels of noise exposure (e.g. expressed as noise immission level), the particular frequency spectrum of exposure is ignored, presumably on the theoretical premise that it is the total amount of energy impinging on the ear that determines the hearing threshold shifts (NIHL).

The ISO N 85 curve criterion is based on the maximum allowable level of exposure over the range of frequencies from 50 Hz to 8 kHz in total. It also indicates values for each discrete frequency, but this aspect is usually ignored when using noise dose meters (Leq) to determine whether noise exposure is excessive.

The salient point here is that measuring a hearing threshold at (very) high frequencies (>10 kHz; only possible in those people who can actually hear these sounds and can respond to the stimulus) may not represent the effect of occupational noise that the individual is exposed to, which is usually mainly at frequency ranges up to 2 or 3 kHz.

It is doubtful whether there are many occupational environments where excessive noise levels at frequencies >4 kHz are generated. This could be an interesting research project.

There is also the problem, mentioned by the authors, that there are no validated ‘normal values’ for hearing thresholds at frequencies >12 or 14 kHz to use as reference values for audiometry, in particular for people >40 years old. The ISO 7029 Acoustics Standard only gives values of hearing thresholds up to the frequency of 8 kHz, with good reason: not everybody can respond to very high frequency sounds as well as dogs do.

With regard to increasing hearing loss with age, the secondary indicator for NIHL in these published results, the vexed question arises whether such ‘presbycusis’ is due only to normal physiological deterioration or also to noise exposure in social life (sociocusis, as discussed by Kryter [4]).

Could exposure to noise at frequencies >4 kHz in the social environment, e.g. music at high frequencies and a high intensity level, perhaps cause the adverse effects shown by audiometry in the (very) high frequencies, rather than these being due to occupational exposure (a potentially confounding factor)?

Added to these theoretical considerations are the practical aspects that arise if it were accepted that screening audiometry at (very) high frequencies (10–18 kHz) is a reliable technique that can be used as an early indicator of NIHL (which has not been proved). If this were indeed a better method than conventional screening audiometry (in the sense of it meeting criteria for sensitivity, precision, accuracy, predictive value, reliability, repeatability or whatever epidemiological terms one wishes to use), would the cost of new instrumentation, discarding older equipment and software, etc. be cost effective, acceptable and worthwhile?

In conclusion, I would suggest that this paper, viewed as a research paper, remains a valuable contribution to our knowledge, but that its discussion and the ‘conclusion’ should have been tempered by more careful and prudent formulation.

Indeed, much further research is needed before any recommendation to implement the method of (very) high frequency audiometry as a screening method can be made.

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References
Authors’ reply

Dear Sir,

We read with interest the letter of J. T. Mets, and thank him for his interest and comments. We address each of his concerns in turn.

Contradiction and confusion

We do not agree there is contradiction between the conclusion that ‘multivariate analysis indicated that age was the primary predictor and noise exposure the secondary predictor of hearing thresholds in a high frequency range (10–18 kHz)’ and the statement that ‘The results of this study suggest that HFA might be used as an early indicator for noise-induced hearing loss and acoustic trauma rather than audiometry at a conventional frequency (4 kHz), particularly for younger groups’, for the following reasons:

1. The conclusion that ‘Multivariate analysis indicated age was the primary predictor and noise exposure the secondary predictor of hearing thresholds in a high frequency range (10–18 kHz)’ was based on the results of the multiple linear regression analysis that was used to determine the most important predictors for the hearing thresholds at the high frequency range (10–18 kHz) of the total subjects (exposed and non-exposed, 472 ears) regardless of their hearing thresholds in the conventional frequency range (Subjects and methods, p. 246; Statistical analysis, p. 247).

2. The conclusion that ‘Results of this study suggest that HFA might be used as an early indicator for noise-induced hearing loss and acoustic trauma rather than audiometry at a conventional frequency (4 kHz), particularly for younger groups’, was based on (i) the results of the t-test that we used to see whether there was any statistically significant difference between the mean of hearing thresholds of the 23 exposed subjects (46 ears) with hearing thresholds for both ears $\leq 20$ dBHTL (normal) in the conventional frequency range (0.25–8 kHz) and that of the 23 non-exposed subjects (46 ears) with hearing thresholds for both ears $\leq 20$ dBHTL (normal) in the conventional frequency range (0.25–8 kHz), with the effect of age as a confounding factor being controlled by stratification. The aim of this comparison was to investigate the role of HFA in the early detection of acoustic trauma, as stated on pp. 246 (Subjects and methods), 250 (High frequency audiometry as an early indicator for acoustic trauma) and 254 (Table 6); and (ii) the audiograms of subjects showing normal hearing thresholds in the conventional frequencies and abnormal hearing thresholds in the high frequencies presented in Figure 4 (p. 255).

3. These two conclusions are not contradictory; furthermore, they should not be compared with each other, because they were based on three different groups of subjects.

4. The statement that ‘HFA might be used in the routine audiological evaluation of workers before they are exposed to noise, but it is advocated that it cannot be used as an early indicator for NIHL’ is not ours, but referenced to Osterhammel (p. 256).

5. HFA was compared with each of the six conventional frequency audiometries tested, including the 4 kHz one (Tables 4–6); thus his statement that ‘HFA should be compared with only 4 kHz’ has no meaning.

Suggestive AND NOT conclusive

We believe that our statement that ‘Results of this study suggest that HFA might be used as an early indicator for noise-induced hearing loss and acoustic trauma rather than the audiometry at a conventional frequency (4 kHz), particularly for younger groups’, is suggestive and not conclusive—which we believe is clear from many statements included in the paper, such as ‘the results might be taken as an indicator that HFA is a useful tool in the early detection of acoustic trauma rather than audiometry at the conventional frequency of 4 kHz, particularly in early age’ (p. 253). In addition, we believe that more research is needed before drawing a conclusive finding in this respect.

Noise exposure levels, noise exposure spectra and noise immission level (NIL)

1. We used a noise dosimeter and a sound level meter with an octave filter to assess the noise exposure. However, since correlating frequencies of noise and noise levels at different frequencies with the hearing thresholds were not objectives of the paper, the results of the measurement of the sound level meter with octave filter were not included.
2. We did not use the NIL to characterize exposure to noise for our subjects as stated. Rather, we used the noise exposure levels expressed in Leq for this purpose.

3. The NIL was used only in the multiple regression analysis when the two variables, duration of noise exposure and age, were found to be highly correlated (pp. 246, Subjects and methods; 247, Statistical analysis).

4. In contrast to his statement ‘It is doubtful whether there are many occupational environments where excessive noise levels at frequencies >4 kHz are generated’, others [1,2] as well as ourselves have reported excessive noise, as summarized in Table 1.

Further research

We agree that problems such as establishing validated normal values for hearing thresholds at frequencies >10 kHz and practical aspects related to the HFA raised need further study. We further agree that frequencies >8 kHz should be referred to as ‘extended high frequencies’ or ‘very high frequencies’, but because most previous researchers used the term ‘high frequency’, we followed this convention.

<table>
<thead>
<tr>
<th>Octave band centre frequency (Hz)</th>
<th>Noise level (in dB) reported by us</th>
<th>Noise level (in dB) reported by Taylor et al. [1]</th>
<th>Noise level (in dB) reported by Ambasankaran et al. [2]</th>
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<tr>
<td>31.5</td>
<td>82</td>
<td>80</td>
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<td>63</td>
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</table>

NM = not measured; NR = not reported.

2. We did not use the NIL to characterize exposure to noise for our subjects as stated. Rather, we used the noise exposure levels expressed in Leq for this purpose.

3. The NIL was used only in the multiple regression analysis when the two variables, duration of noise exposure and age, were found to be highly correlated (pp. 246, Subjects and methods; 247, Statistical analysis).

4. In contrast to his statement ‘It is doubtful whether there are many occupational environments where excessive noise levels at frequencies >4 kHz are generated’, others [1,2] as well as ourselves have reported excessive noise, as summarized in Table 1.

References


Dear Sir,

Chiu and Yu’s article on ‘Colorectal cancer among Chinese restaurant waiters’ [1] provided a good method to estimate the association between the risk of colorectal cancer and working conditions and diet among Chinese restaurant waiters. While the paper used the mortality odds ratio (MOR) of the general male population as a control group, the authors omitted to mention whether all waiters in the exposed group were male. A previous study has shown that both females and males over the age of 50 have an almost equal chance of developing colorectal cancer [2].

It is worth noting that the paper used only ~33% of Chinese restaurant workers in their comparisons. As indicated in the paper, the records from four Chinese-style restaurant workers’ unions were used in the study. These records covered ~88% of unionized restaurant workers and 83% of records indicated the cause of death. However, the unionization rate was only 45% in Hong Kong. This means that only 33% (83% of 88% of 45%) of Chinese restaurant waiters were used for this study. Were the remaining 66% mainly women? We, as women, would like to know the answer.

In addition, we believe that it would make the article easier to follow if the method used for calculating the MOR was given. We also wondered whether geography and weather might play a role in this disease. Do Chinese waiters in American Chinese restaurants have a similar risk of colorectal cancer as these subjects?

The study of the effect of diet and lifestyle on colorectal cancer is very relevant to the public. This cancer is the third leading cancer killer worldwide, and >75% of people who develop it have no identifiable risk factors [2,3].

In summary, we believe this article needs to clarify the information on the sex of the waiters. The cause of colorectal cancer is not a well studied area, and we would really like to see further studies on this topic. If possible, a cohort study on a population of current waiters might give more accurate information, or a meta-analysis of similar studies from around the world might make the result more generalizable.