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Attenuated Heart Rate Recovery in Mercury-Exposed Individuals

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Dear Editor,

We read with great enthusiasm the article by Yilmaz et al. [1] that investigated the heart rate recovery (HRR) of mercury-exposed individuals. They reported that HRR at the first (HRR1), second, and third minute were attenuated in mercury-exposed patients when compared to normal subjects. Interestingly, there were no significant correlations between blood, urine, or hair mercury levels and heart rate recovery at these time points. Furthermore, the duration of mercury exposure was not associated with HRR. Collectively, these findings suggest that, when toxic enough, mercury might lead to long-lasting or even permanent damage to the autonomic nervous system. HRR1 was purely vagal, meanwhile HRR at 2 and 3 min were under the control of both parasympathetic and sympathetic systems [2, 3]. Thus, mercury-induced damage is likely to be a double-edged sword to the autonomic nervous system. Is there any explanation to this in the authors' perspectives? Are there any cut-off values for mercury to be considered toxic?

The authors further reported that exercise testing was terminated (cessation of exercise) abruptly with the patient in the standing or sitting positon (with no 'cool down' period) or the patient kept walking at a predetermined speed and incline (cool down period). Abnormal HRR1 is usually defined as a heart rate that declines ≤12 beats/min in the first minute after exercise for protocols that use a cool down after exercise, or ≤18 beats/min in the first minute after exercise for protocols that stop exercise abruptly [2–4]. Since the authors did not use a post-exercise cool down protocol, HRR1 ≤18 beats/min should have been assumed to be abnormal in this case. Thus, their definition of abnormal HRR1 as <12 beats/min is not correct. It would be informative to know how many subjects had abnormal HRR1 in each group in this regard.

Finally, the authors defined heart rate reserve as the change in heart rate from rest to peak exercise during exercise. However, heart rate reserve is actually the difference between the attainable heart rate at peak exercise (220 – age in years) and resting heart rate [2, 5]. Meanwhile, the heart rate reserve is calculated as a percentage as: (peak heart rate – resting heart rate in beats per min)/([220 – age in years] – [resting heart rate in beats per min]) × 100 [2, 5]. Heart rate reserve as a percentage is also considered to indicate the chronotropic response. A heart rate reserve below 80% is considered to be evidence of an impaired chronotropic response, which is a powerful indicator of mortality [3]. Therefore, it would be interesting to know if there was any difference between the mercury-exposed group and control subjects in terms of heart rate reserve in percentages.

References

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Reply

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Dear Editor,

We would like to thank Abdullah Tekin for his valuable comments. In our report the heart rate recovery (HRR) index was evaluated in individuals who were exposed to mercury. This was lower when compared with the control group and discussed based on this finding [1]. The heart rate decline after exercise was due to the combination of sympathetic withdrawal and parasympathetic reactivation. Both Simoes et al. [2] and Milioni et al. [3] have suggested that mercury can cause parasympatholytic effects via reducing choline uptake and acetylcholinesterase activity at the central level, sympathomimetic effects with a stimulatory effect on the sympathetic ganglia, and sympatholytic effects due to axonal injury and demyelination in peripheral sympathetic nerves. In our study the decrease of all 3 HRR parameters, when compared with the control group, confirmed the parasympatholytic and sympathomimetic effects of mercury. Another contentious issue is that there is a threshold value relating to the toxic effects of heavy metals on the human body. One of the important guidelines for this is that of the American Conference of Governmental Industrial Hygienists (ACGIH), which states a blood mercury level of 15 μg/L (at the end of the final shift of the working week). In our center 10 μg/L was accepted as the limit, representing a value similar to that used in our study. Values beyond this limit are viewed as 'affections which may cause a health hazard'. Another important point is that the evaluation of affected individuals in terms of clinical toxicity lies beyond these limits. Clinical manifestations of mercury intoxication can vary depending not only on its concentration, but also its form, route of ingestion, and the duration of exposure [4]. Acute but high-dose exposure can cause devastating effects, but long-term, low-dose exposure can be asymptomatic. While exposure by inhalation can cause systemic effects, only gastrointestinal effects can be seen when taken orally.

Although HRR values are slightly clearer, they share the same fate as heavy metals. As the author mentioned, the normal-abnormal threshold for HRR can vary according to how the recovery was achieved. Generally, 12 or 18 beats/min for HRR1 and 42 beats/min for HRR2 are accepted [5]. In our study neither the exposure nor control groups had HRR1 values lower than 18 beats/min. Therefore, a cut-off value for HRR1 of 12 or 18 would not have affected the results of our study. The patient group in our study consisted of individuals who did not have any known cardiovascular disease or risk factors. Therefore, individual and average HRR values below normal/cut-off values were not expected in such a low-risk group. However, a significant decrease in HRR values when compared with the control group is important for providing information about the health of autonomic function in this population beyond the identified cut-off values. As such, it can be more accurate to make comments in comparison with the control group.

The heart rate reserve ($HR_{reserve}$) concept indicates whether there is a sufficient increase in HR with exercise. In the review by Brubaker and Kitzman [5], $HR_{reserve}$ was formulized as:

$$HR_{reserve} = HR_{peak} - HR_{rest}.$$

According to this, there is nothing wrong with the $HR_{reserve}$ definition used in our study. As a result of a new analysis following the author's comments, no significant difference was detected between the mercury exposure and control groups in terms of exercise parameters. However, the primary aim of our study was to compare HRR after exercise.

Editor's Note

Only U.N. Karakulak and O.H. Yilmaz are responsible for this response.

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