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REVIEW OF A PH.D. THESIS IN HEALTH AND MEDICAL SCIENCES
IN THE DISCIPLINE OF PHYSICAL CULTURE SCIENCES
WRITTEN BY GERDA DELAUNAY, M.A.
TITLED “APPLICATION OF LOCAL VIBRATION TO STIMULATE COGNITIVE
FUNCTION IN ADOLESCENTS”
WRITTEN AT WROCLAW UNIVERSITY OF HEALTH AND SPORT SCIENCES
SCIENTIFIC SUPERVISOR: PROF. AWF DR HAB. GRZEGORZ ŻUREK

Legal Basis for the Review

This scientific dissertation was reviewed on the basis of the Resolution of the Council of the Scientific Committee of the Wrocław University of Health and Sport Sciences dated 22 September 2022, under which I have been appointed as the reviewer of the doctoral dissertation by Gerda Delaunay, M.A. titled Application of Local Vibration to Stimulate Cognitive Function in Adolescents. This appointment was communicated to me by the Chairman of the Scientific Committee, prof. dr. hab. Krzysztof Maćkała, in a letter dated 10 October 2022.

Relevance of the Topic

In her doctoral thesis, Ms Gerda Delaunay M.A. is addressing a current problem in our increasingly sedentary society, in which children and adolescents, in particular, do not achieve the physical activity goals set by the WHO 2010 guidelines of at least 60 minutes a day. Studies in this area are especially desirable in a situation where remedial measures are being sought to avert this trend.

It should be noted that scientific literature on this topic is growing in terms of both volume and importance. This is evidenced by about 1500 publications per year in the PubMed database for the keywords “physical exercise cognitive functions” as well as “vibration cognitive functions” (25 to 30 publications per year). However, the findings of those studies in the context of physical activity are not homogeneous and relatively rarely address these three issues – physical activity, vibrations, and cognitive functions – at once. This suggests that it is desirable and necessary to conduct further targeted research in this field.

Therefore, the choice of topics (physical activity, vibration, cognitive functions) should be considered relevant and scientifically attractive.

Formal Evaluation of the Doctoral Thesis

The Ph.D. thesis by Ms Gerda Delaunay, M.A. presented in the form of a 91-page monograph (64 pages of computer printout) has a structure typical of scientific dissertations. This includes Introduction (16 pages), Research Aim (2 pages), Materials and Methods (10 pages), Results (25 pages), Discussion (9 pages), Conclusions (3 pages) and References (11 pages) with 112 items. In addition, it includes a list of tables and figures as well as abstracts in Polish and in English.

The findings, collected in tables with appropriate keys provided, are presented in a clear and transparent manner. The figures showing selected research findings are well-designed and contain all necessary information referred to in the main text. The study was approved by the Bioethical Committee.

Substantive Evaluation of the Doctoral Thesis

In the **Introduction**, Ms Gerda Delaunay, M.A. introduces the subject and describes physical activity, sedentary behaviour, and mechanical vibration, including a description of different types and effects of vibration. She also emphasizes that “the storage of knowledge through motor actions and the integration of the environment with the human body is more and more considered as an important factor of learning” and that “considering these findings body activities should be integrated in all subjects in school by educational policies”. It is a pity, however, that the author does not suggest that the subjects themselves – children – should also be educated about the problem by addressing these issues, and the relationship between them, in biology classes.

The problems discussed in the Introduction are supported by well-chosen literature, creating a cohesive whole. I believe the Introduction includes too much basic, textbook information, especially in relation to the neurophysiological aspects of reception and conduction of mechanical stimuli, for a doctoral thesis.

Ms Gerda Delaunay, M.A rightly noted that depending on the parameters (amplitude, frequency) and the type of vibration as well as the kind of exposure of humans to vibration (duration, intensity, parts of the body, etc.), vibration can have negative or positive effects on the human organism. However, the Introduction lacks an objective, and also a critical, view on the effects of using vibrations. The neurophysiological factor, which, judging by the title of the thesis, is an important element of the work, is also insufficiently underlined.

The author writes that vibration can have negative or positive effects on the human organism. It would have been worth including a critical assessment of vibration as a positive input for the body. Fowler et al. (2019 ... Int J Exerc Sci. 2019 May 1;12(3):735-747.) claim in their literature review that “When reviewing the published literature, it is difficult to track the vibration parameters that have positive effects and which have negative or no effects”. This also shows how often effects are studied in physiotherapy without knowing their neurophysiological background.

The purpose of the research has been clearly formulated. Unfortunately, neither the chapter Introduction nor Research Aim contain information about what new this Ph.D. thesis offers or which unresolved aspects of the issue it aims to address.

The chapter **Materials and Methods** contains a detailed description of the research conducted by Ms Gerda Delaunay, M.A. The cognitive tests used in the research: Attention, concentration, accuracy and processing speed – d2-R Test, Verbal fluency - Controlled Oral Word Association Test (COWAT), Verbal working memory and attention - Immediate Free Recall Words (IFRW), Numeric memory - Delayed Serial Recall Numbers (DSRN), Directional hearing and proprioception - Acoustic Test (AT), Sens of touch - Sensitivity Test (ST) are all adequate and used in research practice.

However, the reviewer would like to point out two issues that require clarification: (1) each of the tests used should have been accompanied by information about its validity and reliability indicators obtained in previous studies; (2) according to the reviewer, the experimental model/system used in the research allows only to demonstrate the advantage of the

“vibration + physical activity” program over the “physical activity only” program. It is difficult to capture the effect of vibration alone in this experimental model. Therefore, the title of this thesis should be changed.

To determine the effect of vibration, as suggested by the title *Application of Local Vibration to Stimulate Cognitive Functions in Adolescents*, the classical experimental setup would require four experimental groups: PHYSICAL ACTIVITY (vibration vs. no vibration) and NO PHYSICAL ACTIVITY (vibration vs. no vibration). The experimental setup used in this thesis is more about an analysis of the impact of vibrations on the level of cognitive functions in individuals undertaking physical activity.

The chapter **Results** was devoted to analysing the results obtained from the research conducted. In this most extensive part of the thesis, the Ph.D. student analysed her findings with reference to various benchmarks; in each case, these analyses were conducted for both pre- and post-study results. In addition to clear descriptions, the findings were presented in the form of coherent, well-designed and adequate tables and figures included in the manuscript of the doctoral thesis. In order to collate her findings, Ms Gerda Delaunay, M.A. used selected statistical methods.

Discussion closely followed the thesis expressed at the beginning of this chapter that “not only physical parameters such as overweight and obesity, cardiovascular problems, blood pressure issues, quality of sleep etc. are related to the lack of PA, also mental performance and brain health are linked to a sufficient amount of PA”. It is a pity, however, that also here, just like in the Introduction, there was a lot of basic, textbook knowledge, irrelevant for this chapter.

The Ph.D. student is of the opinion that “stimuli of VGD cannot be isolated, especially from the point of view of stochastic vibration” and that “the whole range of stimuli is acting together and that seems to evoke complex reactions”. Although the above was predictable from an analysis of Figures 6 and 7, it does not rule out the possibility of determining the impact of vibrations on cognitive functions using a different experimental model and a different vibration generator.

I would also like to get clear answers considering two points.

1. It was described that the VGD is a handheld swing-ring system that provides local vibration transmitted by the hands to rest of the body. Would you like to describe

how far from the application site and how strongly this vibration can still be felt by the test person?

2. On several occasions, the Ph.D. student mentioned the effectiveness of the vibration generating device (VGD) in decreasing pain. Would you be kind enough to explain this neurophysiological mechanism?

Conclusions presented by the Ph.D. student correspond to the research objectives set out in the thesis, formulated on page 23 as four research questions.

Nobody is perfect. This statement applies to everyone, both those who are embarking on the scientific journey and those already following this path, including the author of the reviewed doctoral thesis. Even though the text has been most likely read and corrected several times, there are still some missing commas, letters or other minor elements in the graphic design. Statistical differences are not marked in the figures (with asterisks). Also data from the journal Spiegel from 2012 should not be quoted in a Ph.D. thesis.

Summary and Final Conclusion

I consider the dissertation by Ms Gerda Delaunay, M.A. submitted for my review to be an interesting and original study, addressing both scientific and utilitarian aspects of the research problem. The presented findings broaden the scientific knowledge in the field of research on perception in relation to people subjected to physical effort. She skilfully used the potential of selected research, analytical and statistical tools.

Despite my questions or polemics, I have come to the conclusion that this dissertation meets all the requirements for a doctoral thesis contained in the Act of 14 March 2003 on Academic Degrees and Titles in Sciences and in Arts (Journal of Laws of 2016, item 882, as amended). Therefore, I am asking the Council of the Scientific Committee of the Wrocław University of Health and Sport Sciences to admit Ms Gerda Delaunay, M.A. to further stages of the doctoral procedure.

