The Need for Differentiating Between Exercise, Physical Activity, and Training

Henning Budde[1,2], Rolf Schwarz[c], Bruna Velasques[4,5] , Pedro Ribeiro[4,5], Martin Holzweg[6], Sergio Machado[7], Marius Brazaitis[8], Felix Staack[1], Mirko Wegner[9]

[1]Faculty of Human Sciences, Medical School Hamburg, Hamburg, Germany
[2]Sport Science, Reykjavik University, Reykjavik, Iceland
[3]Institute of Physical Education & Sport, University of Education, Karlsruhe, Germany
[4.]Bioscience Department, School of Physical Education of the Federal University of Rio de Janeiro (EEFD/UFRJ), Rio de Janeiro, Brazil
[5.]Institute of Applied Neuroscience (INA), Rio de Janeiro, Brazil
[6.]International Council of Sport Science and Physical Education (ICSSPE), Berlin, Germany
[7.]Brain Mapping and Sensory Motor Integration, Institute of Psychiatry, Rio de Janeiro, (IPUB/UFRJ), Brazil
[8.]Department of Applied Biology and Rehabilitation, Lithuanian Sports University, Kaunas, Lithuania
[9] Institute Sport Science, University of Bern, Switzerland

Correspondence: Henning Budde (PhD), henningb@ru.is

MSH Medical School Hamburg,University of Applied Science and Medical University, Am Kaiserkai 1, 20457 Hamburg

Letter to the Editor in response to the article *Juvenile idiopathic arthritis and physical activity: Possible inflammatory and immune modulation and tracks for interventions in young populations* by Rochette et al. [1]

Rochette et al. [1] composed a well written and interesting review examining the relationship between physical activity (PA) and Juvenile idiopathic arthritis (JIA) from the perspective of possible inflammatory and immune modulations. The main finding was that physical activity affects key mediators of JIA pathogenesis, such as cortisol, calprotectin, and miRNA 146a. Additionally physical activity simultaneously induces short-term pro-inflammatory, and short- and long-term anti-inflammatory systemic effects. A third take home message from this review was that both pro- and anti-inflammatory effects depend on the duration and intensity of exercise, and on training of the subject [1]. Rochette et al. [1] did a great job on collecting data on typical moderators of the physical activity-JIA link. However, a review requires that the item under investigation is carefully defined, so that it can be evaluated precisely. In their review, the authors used the terms "physical activity", "exercise", “acute exercise”, “chronic exercise”, “exercise training”, “training”, “prolonged training”, “physical training”, "physical exercise programs", and "physical fitness" [1] which reveals a need for clarification like done by other authors [2-6]. Unfortunately, this review does not provide such appropriate definitions so that there is no framework in which studies can be adequately interpreted and compared. The review should have been more accurate on these different terms, which are often used interchangeably. Blair et al. [6], for example, raised the question: Is physical activity or physical fitness more important in defining health benefits? They found that it is not possible to conclude whether activity or fitness is more important for health. These authors recommend that future studies should define more precisely the shape of the dose-response gradient across activity or fitness groups and evaluate the role of musculoskeletal fitness [6-8].

In a frequently cited article, Caspersen et al. [9] termed physical activity as any bodily movement produced by skeletal muscles which results in energy expenditure (EE). Currently, this definition has been modified by precisely determining the rate of EE from 1.0 to 1.5 MET (Metabolic Equivalent of Task) [10, 11] as the minimum level for physical activity.

Consequently, it is possible to be acutely physically active, which may also have an endocrinological impact [12].

Scheuer and Tipton [13], as well as Tipton and Franklin [14] considered exercise to be a displacement of the homeostasis elicited by muscle contractions resulting in movement and increased energy expenditure. Although, exercise involves large muscle groups in dynamic activities that result in substantial increases in heart rate and energy expenditure[4] it is difficult to distinguish it from PA just from taking into account the intensity of exercise, because there are also heavy physical activities which have detrimental influences on health [15-19]. Thus, the main difference between these terms seems to be that exercise is planned and structured [9]. Additionally, it has to be distinguished between acute and chronic exercise. While acute exercise is the physiological response associated with the immediate effects of a single bout of exercise, the term chronic exercise refers to the repeated performance of acute exercise and is often referred to as training [13]. However, there are also publications in which exercise and training are used synonymously and in which training is defined as a planned, structured, and repetitive process with the aim of improving and maintaining physical fitness [4]. Physical fitness aims at components related to health especially cardiorespiratory endurance, body composition, muscular-skeletal flexibility, and strength [2]. Finally, it is also possible to plan an entire physical activity program e.g. as an intervention for schools which consists of a higher organizational grade with a more complex didactical structure [7, 20].

Due to the missing definition in Rochette et al.'s [1] review it is not possible to know what sort of intervention led to what outcome.

When looking at the "conclusions" this becomes apparent: Here the authors did not use the term "physical activity" at all (as suggested in the headline) - they just used the terms "exercise" or "exercise training", so it remains unclear whether a planned, structured, and repetitive process led to this outcome or just the acute elevated physical activity during the day.

By taking a closer look on the cortisol response to exercise and physical activity which is also stressed in this review adolescents show significant reactivity of the hypothalamic–pituitary–adrenal axis resulting in cortisol increases in response to acute bouts of exercise. For 15- to 16-year-old adolescents, for example, a 12-minute bout with an intensity of 70-85% of the maximum heart rate (HR_{max}) led to an increase in cortisol levels contrasted to a group exercising with moderate intensity (50-65% HR_{max}) [21] or compared to a cognitive stressor, respectively [22]. Another study investigated how cortisol levels of adolescents at the age of 14 react to different stressors [23]. In this study, exercise was induced by running 15 minutes at a medium intensity level of 65-75% $HR_{max.}$. Other than a psychosocial stressor, an acute bout of physical exercise was not able to significantly increase cortisol levels. This was also true for 9 year olds for whom intense exercise of 12 min with a heart rate of 180–190 bpm failed to increase the concentration of cortisol (a joyful movie, however, was able to reduce the cortisol level) [24].

In their conclusions Rochette et al. [1] correctly stated "We therefore need to find the right trade-off between intensity of the exercise, duration of the exercise, level of training, and exercise-program constraints". This is true and supported by the literature [see 21]. However, the terms have to be used carefully. That is, chronic physical exercise can be seen as training when it is planned and structured, repetitive, and purposeful, leading to a change in fitness.

Thus, a reduced hypothalamic pituitary adrenal (HPA) axis activation is found in highly trained sportsmen [25] and, in turn, very fit participants show lower hormone secretion after high intensity exercise [26].

Taken together, the literature shows that it is important to precisely define the target terms in order to be able to explain and adequately evaluate the results, and being able to identify gaps in the literature. For this reason, the results presented by Rochette et al. [1] should be interpreted with caution. In the future, it is essential to classify all relevant terms to being able to control for important moderators of physical activity and its effects on immunity diseases and endocrinological responses.

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