Vigorous Physical Activity in Youth: Just One End of the Physical Activity Spectrum for Affecting Health?

Abstract: *This article provides commentary on the accompanying manuscript entitled “The Case for Vigorous Physical Activity in Youth” by Owens and colleagues. A major strength of the review was its aim to determine whether vigorous physical activity provides greater benefits with respect to several health outcomes among children and youth while also considering the limitations of the current evidence in terms of number of studies and study design. This commentary presents additional topics to consider, practical applications, and conclusions and recommendations that can be drawn from the current evidence. To expand “the case for vigorous physical activity in youth,” future studies should consider delineating the relative benefits of vigorous physical activity compared not only with moderate physical activity, but also with light and total activity.*

Keywords: commentary; children; accelerometry; vigorous physical activity; health outcomes

The Physical Activity Guidelines for Americans¹ currently recommends that children and youth engage in 60 minutes of moderate-to-vigorous physical activity (MVPA) per day with an added recommendation that children

independently promote moderate versus vigorous activity. The review by Owens et al proposed to tease out the possible enhanced effects of vigorous physical activity (VPA) on health outcomes in youth and reviewed the current

. . . clear recommendations have not been established for the relative volume of moderate or vigorous activity needed to accrue specific health benefits.

achieve vigorous, along with bone- and muscle-strengthening exercise at least 3 days per week. However, clear recommendations have not been established for the relative volume of moderate or vigorous activity needed to accrue specific health benefits. As current US guidelines do not make this distinction, most research studies have focused on interventions that promote MVPA but do not necessarily

evidence for this relationship with regard to body composition (adiposity and muscle mass), fitness (cardiovascular and muscular), cardiometabolic risk factors, cardiovascular function, and cognitive function. This commentary will address the relative strengths and limitations of the review and future research directions that may benefit the “case for vigorous physical activity.”

DOI: 10.1177/1559827616680565. From Program in Nutrition Interventions, Communication, and Behavior Change, Friedman School of Nutrition Science and Policy, Tufts University, Boston, Massachusetts. Address correspondence to Jennifer M. Sacheck, PhD, FACSM, Program in Nutrition Interventions, Communication, and Behavior Change, Friedman School of Nutrition Science and Policy, Tufts University, 150 Harrison Avenue, Boston, MA 02111; e-mail: jennifer.sacheck@tufts.edu.

For reprints and permissions queries, please visit SAGE's Web site at <http://www.sagepub.com/journalsPermissions.nav>.

Copyright © 2016 The Author(s)

Limited Relative Evidence Base

The review included studies from 2011 to 2015 (due to a prior similar review that was published in 2011²) on 32 studies including mostly cross-sectional studies (varying in sample size from 43 subjects to almost 1750 subjects) and a smaller set of prospective cohort studies and randomized controlled trials (RCTs). It is important to note that the review included studies with varied measurements or definitions of what types of physical activity constituted VPA. Objective measures of physical activity by accelerometry also included a broad range of cut-points to define “vigorous.” Evenson et al³ cut-points, which are currently recommended, define VPA as accelerometer counts per minute ≥ 4012 . Notably, only 3 of the accelerometry studies used cut-points around this threshold. Other studies defined intensity via heart rate measurement, running speed, subjective measures of “high intensity,” participation in competitive sports, cycling sprints, and MET (metabolic equivalent of task) values. With these limitations in mind, the authors were able to tease out some relationships between VPA and health outcomes.

Vigorous Physical Activity and Adiposity

The strongest evidence for a relationship between VPA and a health outcome was with adiposity. Several observational studies demonstrated a more positive link between greater VPA and lower adiposity/waist circumference over MPA. Findings from RCTs were mixed: One RCT demonstrated a benefit of either VPA or MPA on adiposity outcomes, while others did not control for workload or “dose,” which limits our ability to draw conclusions. One study controlled for volume with high intensity interval training and found a positive relationship between VPA and decreased body fat not seen in MPA or control groups. An additional study

examined the impact of moderate aerobic exercise versus resistance training to fatigue (VPA). Because of the different modes of exercise, the positive relative impact of each exercise protocol on adiposity is difficult to determine. At present, the weight of the evidence suggests that VPA is superior to MPA for adiposity outcomes though much of the evidence is from cross-sectional studies. A consideration for future studies would be to include measures to control for diet, a factor often ignored in youth physical activity studies despite its relationship with adiposity.

Health Outcomes Expected to Be Affected by PA Intensity

Several of the health outcomes examined benefit from VPA, as would be expected by basic physiology. Both muscle mass and bone health benefit from greater exertional force and/or impact. The reviewed studies that examined muscle mass, however, could not determine if VPA had a greater effect compared with MPA. This may simply be due to the lack of studies among youth. It would seem obvious as well that VPA would have a more powerful impact on bone health (bone mineral density, strength, and mass), given that weightbearing exercise or exercise exerting additional force on bone contributes to bone growth. For this health outcome, the strength of the evidence was much more robust, similar to findings of previous reviews.^{4,6}

The impact of VPA on improved cardiovascular fitness is supported by a recent review Parikh and Stratton,⁹ along with additional studies evaluated in this review. Of note, cross-sectional studies pointed to increased cardiovascular fitness with higher daily VPA compared with MPA, while RCTs demonstrated nearly similar impacts of VPA versus MPA on increased aerobic capacity. The benefit of VPA for improving fitness (and therefore concomitantly enhancing other health outcomes) is that the dose of physical

activity with VPA per unit time is greater than that with MPA. This may, therefore, provide an added benefit when working with children, and especially overweight/obese children.

Unfortunately, the impact of VPA on muscular fitness cannot be isolated from MPA at this time as the research studies examined did not use protocols that would allow us tease out these relationships (eg, using an aerobic exercise for MPA and resistance exercise for VPA whereby the resistance training would clearly have the advantage in enhancing muscular fitness).

Health Outcomes With Limited Evidence or Clear Benefit of VPA

Although research has shown consistently that PA is associated with reduced cardiometabolic risk factors among youth, the studies included in this review did not show a clear benefit of VPA over MPA in terms of blood lipids. However, the benefit seems somewhat more evident for blood glucose and insulin and blood pressure.

The relationship between VPA and cognitive health among youth was only supported by a few cross-sectional studies in this review. Evaluating associations between PA and cognitive health is an active field of investigation, as we and others continue to explore the links with between changes in PA and different cognitive health measures among youth.⁷

Perspective

Although the review by Owens et al highlighted the benefits of VPA over MPA for several health outcomes, it remains unclear what the key review objective was in potentially delineating the benefits of VPA over MPA. Would the authors like evidence for an independent recommendation in the Physical Activity Guidelines for recommended minutes of daily VPA for youth? If so, distinguishing the general benefits of MVPA (the current guideline) versus VPA alone would have been beneficial to understand, if VPA

more strongly drives the positive health relationships. Or was the goal to be more prescriptive, for example, “instead of walking for 30 minutes you should do speed work for 10 minutes to improve blood lipids?”

If the goal was to truly understand the general benefits of VPA, why not compare the benefits of VPA versus total MVPA or even light PA (LPA) and sedentary time? In fact, research has recently highlighted some of the benefits of LPA on health outcomes.⁸ Hatfield et al⁸ used NHANES (National Health and Nutrition Examination Survey) data and found that total PA demonstrated similar or slightly stronger associations with cardiometabolic risk factors, while LPA and MVPA appeared similarly associated with clustered metabolic risk in youth. Unfortunately, many of the studies included in this review were not designed to analyze larger physical activity patterns in these children (ie, with 7-day accelerometry).

This review could also have benefited from giving the reader an understanding of the “baseline VPA” among US youth (daily minutes by different demographics). Furthermore, is there evidence to suggest a decrease in VPA among certain groups that warrants urgent examination of these relationships and the need for future research in this area? Troiano et al⁹ found that VPA ranged from 10 to 16 minutes per day for 6- to 11-year-olds in NHANES 2003-2004. More recently among schoolchildren in Massachusetts, we have found these numbers to be somewhat lower in third to fourth graders, with boys averaging 16.0 minutes per day and girls averaging 11.8 minutes per day, while normal weight children achieve 15.2 minutes per day and obese children achieve 9.7 minutes per day.¹⁰ Presentation of these type of data would help the reader identify realistic goals and the greatest needs for changes in VPA, which may influence certain health outcomes more for some

populations over others. For instance, if VPA is quite different between normal weight and obese youth, we can recommend greater VPA for obese children which may benefit some of their health parameters more so than increasing VPA in a normal weight child. Finally, for future studies and trials, it would be beneficial to examine whether youth who engage in greater VPA are more likely to engage in LPA and MPA and/or are less sedentary as these categories may have independent effects on health outcomes.

Conclusion

Literature on the impact of VPA on specific health outcomes remains extremely limited given the lack of nonobservational studies for the aforementioned health outcomes, and studies specifically examining VPA independent of other intensities or volume of PA. At this time, there appear to be clear benefits of VPA on adiposity, cardiovascular fitness, and bone health. If this article were to expand “the case for VPA in youth,” future research should go beyond comparing the relative benefits of MPA and VPA on health outcomes and incorporate the specific benefits of VPA as compared with sedentary, LPA, and total PA, especially in light of current research highlighting the independent effects of these separate PA categories. The relative practical benefits of VPA are that the dose of PA can be achieved with less time, which may be more attractive/fun for youth and particular populations such as overweight and obese children. Further understanding the relative health benefits of VPA will also be beneficial for PA prescription and programming in youth.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article. **AJLM**

References

1. US Department of Health and Human Services. 2008 Physical Activity Guidelines for Americans. 2008, 2016. <http://www.health.gov/PAGuidelines/guidelines/default.aspx>. Accessed November 8, 2016.
2. Parikh T, Stratton G. Influence of intensity of physical activity on adiposity and cardiorespiratory fitness in 5-18 year olds. *Sports Med*. 2011;41:477-488.
3. Evenson KR, Catellier DJ, Gill K, Ondrak KS, McMurray RG. Calibration of two objective measures of physical activity for children. *J Sports Sci*. 2008;26:1557-1565.
4. Behringer M, Gruetznier S, McCourt M, Mester J. Effects of weight-bearing activities on bone mineral content and density in children and adolescents: a meta-analysis. *J Bone Miner Res*. 2014;29:467-478.
5. Ishikawa S, Kim Y, Kang M, Morgan DW. Effects of weight-bearing exercise on bone health in girls: a meta-analysis. *Sports Med*. 2013;43:875-892.
6. Tan VP, Macdonald HM, Kim S, et al. Influence of physical activity on bone strength in children and adolescents: a systematic review and narrative synthesis. *J Bone Miner Res*. 2014;29:2161-2181.
7. Wright CM, Duquesnay PJ, Anzman-Frasca S, et al. Study protocol: the Fueling Learning through Exercise (FLEX) study—a randomized controlled trial of the impact of school-based physical activity programs on children's physical activity, cognitive function, and academic achievement. *BMC Public Health*. 2016;16:1078.
8. Hatfield DP, Chomitz VR, Chui K, Sackey J, Economos CD. Exploring new relationships between physical activity volume and intensity and cardiometabolic risk in U.S. adolescents. *J Phys Act Health*. 2015;12:1312-1319.
9. Troiano R, Berrigan D, Dodd K, Masse L, Tilert T, McDowell M. Physical activity in the United States measured by accelerometer. *Med Sci Sports Exerc*. 2008;40:181-188.
10. Hubbard K, Economos CD, Bakun P, et al. Disparities in moderate-to-vigorous physical activity among girls and overweight and obese schoolchildren during school- and out-of-school time. *Int J Behav Nutr Phys Act*. 2016;13:39.