

Response to Invited Commentary

Lim et al. Respond to “Measurement Error and Physical Activity”

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We appreciate the thoughtful comments by Arem et al. (1) on our study about measurement error in self-reported physical activity levels (2). They have raised a valid concern about a limitation of accelerometer measurements. In our discussion, we also acknowledged that accelerometers cannot measure water activities or stationary activities. As a result, physical activity levels measured using accelerometers might be lower than the true levels. Despite this limitation, we believe that comparing self-reported physical activity levels with accelerometer-based measures can improve our understanding of measurement error in self-reported data.

Because accelerometer-based measurements are objective and independent of bias associated with self-reporting (e.g., recall bias), they can be used to quantify and correct this type of bias. Although the bias correction model could either overcorrect or undercorrect bias in self-reported data, our findings point to the latter. Physically active persons were more likely to underreport physical activity levels, which in turn led to incomplete removal of bias in self-reports (i.e., undercorrection of bias). If accelerometers captured true levels (i.e., no underreporting in accelerometer-based measurements), the association between physical activity and health conditions would be likely to be further strengthened. Although they do not allow for complete bias correction, we believe that accelerometer-based measurements contribute to an understanding of the direction of bias in self-reported physical activity levels.

In addition, underestimation of accelerometer-based physical activity levels in our study might not be substantial for 2 reasons. First, participants were asked to time-stamp their daily accelerometer usage and record minutes for swimming and biking, and according to these physical activity logs, swimming and biking minutes represented a very small portion of total weekly physical activity minutes (less than 1%). Second, although the National Health and Nutrition Examination Survey cut points of 2,020 counts for moderate-to-vigorous physical activities might not capture many valuable forms of light activity, our aim was to match self-reported moderate-to-vigorous physical activity with the same levels

measured by accelerometer. Because of this, potentially underestimated light activities might not substantially influence our findings.

Along with comments on the limitation of accelerometer-based measures, Arem et al. have suggested alternative methods to correct the measurement error. Although we appreciate these practical suggestions, we would like to point out an important limitation of the test-retest method. That method allows for measuring reliability of responses, but it does not address systematic errors (3). For example, if recall bias is associated with respondents' characteristics, topics, or questionnaire design, it is likely to invariantly influence survey responses across 2 time points (i.e., test and retest), which will be completely canceled out in test-retest differences (4). We agree that current work to improve accelerometer-based measurement is promising, and we look forward to future studies that quantify bias in physical activity levels measured by conventional accelerometers. While improving deficiencies of accelerometer-based measurements, it will further enhance the value of self-reported physical activity information that Arem et al. have discussed.

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