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## Commentary

### Can weight loss be accelerated if we exercise smarter with wearable devices by subscribing to Personal Activity Intelligence (PAI)?

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Whether exercise can help people lose weight has always caught the media's attention, because most people who tried have encountered variable degrees of frustration. A paper published in this issue by Kieffer et al. tracked the changes in body weight of 68,000 participants free from cardiovascular diseases from Norway, spanned more than two decades with three rounds of follow-ups, and assessed their associations with levels of physical activity [1]. The Personal Activity Intelligence (PAI) health system reported in this paper uses heart-rate monitoring watches to encourage us to engage in smarter, more "vigorous" exercise for better weight loss. It concluded by saying that adhering to a high level of exercise can attenuate excessive body weight gain. The conclusion has good news and bad news. The good news is that exercise can reduce body weight gain. The bad news is that, despite years of exercise at a high level, most people gained weight, with merely "less weight gain" compared to inactive people. Disappointing as it may seem from this European study, it is consistent with another large study (U.S. Women's Health Study), which also showed "less weight gain", despite 60 min a day (420 min/week) of moderate physical activity over 13 years [2]. Subjuncts in these studies, spanned over several decades, became older and gained weight, an overlooked reality. With metabolism slowing down, loss of muscle mass is the most striking effect of aging, up to 8% per decade, and replaced by fat [3]. So even if we're eating exactly the same way as we were younger, age-related changes lead to accumulation of fat depots and favor weight gain. In theory, one would have to eat less and exercise more but permanent change in diet that would last for decades is difficult to achieve. In contrast, changing our exercise habit, which may stick with us, is entirely possible, and has more health advantages than those from dietary changes.

Historically, we have been measuring our exercise by the amount of time we spend exercising. For example, the current recommendation is 30 min/day or 150 min/week of physical activity. However, we often overlook the intensity of exercise. While any amount of exercise is better than none, given the same amount of physical activity, health outcomes are far better if activities could come more from vigorous than moderate ones [4,5]. While doing more vigorous exercise is desirable but easier said than done. The PAI health system is specifically designed to encourage more vigorous activities and quantify them.

When we exercise hard, our heart beats faster. PAI health is based on this known concept that "the more vigorous (exercise) one accomplishes, and the faster the heart rate, the better health attainment." [4] Through the use of a digital watch tracking one's heart rate, PAI emphasized the importance of heart rate changes during exercise as much as the duration of exercise. The PAI algorithm awards a better score when exercising at a higher heart rate. The daily PAI score, downloaded easily from its mobile APP, is posted on one's cell phone. Seeking a higher PAI score, a human instinct, becomes a powerful challenge and reinforces for more "vigorous" exercise.

To maintain a long-term weight loss is not easy, requiring grit and perseverance. Compared with restricting caloric intake, exercise engagement is more versatile. Regardless of whether weight loss is realized, increasing exercise will attain a better overall health, and extend one's life expectancy [5,6]. This current weight study confirmed such arguments by showing that those participants engaged in  $\geq 100$  PAI/week, not only had "less weight gain" but also a 24% reduction in cardiovascular disease (CVD) mortality and extended life expectancy by 5–8 years [7].

How can "vigorous" provide a better health in exercise? This is because "vigorous" exercise slows down resting heart rate, by making the heart more efficient and requiring less work as seen in marathon runners who have heart rates as low as 50–60 beats/min. A slower resting heart rate, measured after a 10-minute rest, reflects a better cardio-respiratory fitness status [8]. It is a paradox, called the "heart rate paradox", that rapid heart rate during exercise is required to achieve a slow heart rate during rest. As one gets more fit, heart rate becomes slower and less PAI is awarded, pushing one to work harder for the

same number of PAI. To maintain  $\geq 100$  PAI/week for weight loss or for CVD mortality reduction, one needs to sustain or continuously increase the amount of exercise, creating a feedback process generating further health benefits. In the field of athletic training, this cyclic effect has been well recognized, with coaches updating goals for the athletes. Clearly, PAI has advantages in tracking physical activity over the use of steps (from pedometers) or exercise duration (from smartphones).

How or whether PAI health system can be promoted in the clinical settings remains to be seen, even though it has attracted attention globally [9]. It can work best among conscientious exercisers, but may encounter resistance among current inactive or uninterested people. However, significant benefits are also reported for low-to-moderate PAI levels, and adhering to these may be helpful for transitioning from a sedentary state to some level of activity which is associated with favorable mortality outcomes. Further, the requirement of wearing a smart watch to monitor heart rate, a not-so-inexpensive device for the PAI health, is another important barrier from economic standpoint. During this time of pandemic, however, the wearable devices have gained popularity and are projected to increase by five folds in the next five years [4].

In summary, PAI system has two major advantages: First, PAI score is an objective, science based metric tracking physical activity, in contrast to self-reported exercise history, that is likely to be biased and difficult to verify. Second, the emphasis by PAI on encouraging vigorous exercise is unique, and, compared with existing ways of exercise promotion, PAI is designed to be superior in achieving overall health, including weight reduction. Promoting this system by the clinicians or health policy is in line with "Exercise is medicine" global initiative advocated by the medical societies [10].

#### Author contribution

CPW drafted the first manuscript. CPW, JPMW, CHC, and WG critically reviewed the manuscript for important intellectual content. All authors gave the final approval of the manuscript.

#### Conflicts of interest

We declare that we have no conflicts of interest.

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