Daytime physical activity pays off at night

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The physiological and mental benefits of physical activity have been well recognized and physical activity is recommended as an important part of healthy aging by the WHO [1]. Physical inactivity is a risk factor for cardiovascular disease, and less active and less fit persons have a greater risk for high blood pressure (BP) [2]. A meta-analysis that included 54 randomized clinical intervention trials, involving 2419 hypertensive and normotensive participants of different geographic regions and ethnic populations, showed that aerobic exercise reduces SBP by almost 4 mmHg [3]. Hence, apart from beneficial effects on chronic conditions such as obesity, diabetes, cancer, depression, premature cardiovascular disease and premature all-cause mortality, an increase in physical activity should be an important component of lifestyle modification for the prevention and treatment of high BP.

The introduction of wrist-worn or waist-worn devices that electronically measures motion, by using acceleration sensors, allows to measure both physical activity and sleep duration objectively and reliably for prolonged periods. When combined with ambulatory BP measurement issues regarding the relation between physical activity and daytime and night-time BP can be addressed. Early studies have shown that physical exercise reduces subsequent BP and that this reduction may sustain for hours [4]. Of the several factors accounting for this postexercise hypotension a decrease in sympathetic tone is probably most important [5].

In an article published in this issue of the *Journal of Hypertension* Yamagami *et al.* [6] investigated in a cross-sectional study the association between physical activity measured with a wrist-worn actigraph (Actiwatch 2; Respironics Inc., Mount Pleasant, Pennsylvania, USA) and nocturnal BP dipping in over 1100 elderly participants (mean age 71.8 years) of whom 44% were on antihypertensive medication. Both activity and ambulatory BP were measured for two consecutive days and relevant data obtained during these two days were averaged. For their analyses the participants were divided in three groups based on tertiles of average daytime physical activity. Their major finding was that daytime SBP and DBP values across the tertiles of physical activity were similar, but night-time SBP and DBP values were lower in the intermediate and high tertiles of daytime physical activity, resulting in an increase in nocturnal BP dipping with increased daily activity. Multivariable regression analysis, adjusting for a number of potential confounders, revealed that per 100 counts/min (cpm) increase in physical activity night-time SBP was 1.2 mmHg and night-time DBP 0.7 mmHg lower. Significantly, this effect was greater for participants without antihypertensive medication (night-time SBP and night-time DBP respectively, 1.6 and 0.8 mmHg lower per 100 cpm increase in physical activity). Sex-specific analysis revealed a similar beneficial effect of physical activity on night-time BP in male and female participants.

A major strength of this study that it has been performed in a large, representative population of elderly normotensive and hypertensive participants. Average daytime physical activity was 417 cpm (range 245–827 cpm) in the high tertile and 193 cpm (45–245) cpm in the low tertile, whereas, the median time above the threshold of daily physical activity of at least 500 cpm was 323 min in the high versus 102 min in the low tertile. These findings strongly suggest that light-to-moderate daytime physical activity for several hours per day is sufficient to lower night-time BP and to increase nocturnal dipping. This is further supported by the observation that the median time of intensive exercise ($\geq$1500 cpm) was only 10 min (4.5–16 min) in the high versus 3.5 (1–8.5) min in the low tertile. Since night-time BP was lower with increased daily physical activity whereas daytime BP was unaffected the degree of BP dipping increased progressively among the three tertiles of physical activity from 12.0 mmHg systolic in the low to 16.1 mmHg systolic in the high tertile.

As it is generally believed that physical activity associates with a lower BP both in normotensive and hypertensive participants, a puzzling observation of the article of Yamagami *et al.* is that daytime SBP and DBP among the three tertiles of daytime physical activity was identical. In part this may be related to the use of antihypertensive medication in a proportion of participants leading to a larger reduction in daytime than night-time BP thereby diluting a potential BP lowering effect of physical activity on daytime BP.

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Moreover, average daytime BP in this elderly normotensive and hypertensive population was with 135/80 mmHg relatively low, likely resulting in less room for a further BP reduction in response to an increase in physical activity.

The cross-sectional nature of this study does not allow to draw conclusions about mechanisms why night-time BP is lower when daytime physical activity is increased. A possible explanation is that participants who are more physically active during the day sleep better. Indeed, it has been well reported that increased physical activity and less sedentary behavior is associated with longer sleep duration and improved sleep efficiency, for example the percentage of time spent asleep while in bed, which likely translates in a lower night-time BP [7]. According to the 'methods' section of the article of Yamagami *et al*. the participants were required to fill out a sleep diary, but unfortunately, information about sleep quality across the three tertiles of physical activity is not reported in the article. Also it is not clear whether sleep duration was based on the diaries or on information derived from the actigraph.

That objectively measured, increased levels of daily physical activity associates with lower night-time BP is a highly relevant finding. Longitudinal observation studies using ambulatory BP monitoring have shown that night-time BP is the best prognostic determinant of cardiovascular disease with minimal added contribution from the night-to-day ratio of BP, dipping status or reading-to-reading variability over and beyond 24-h BP levels [8].

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Conflicts of interest

There are no conflicts of interest.

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