SPAN – Small changes to improve lifespan

Combining small changes to Sleep duration, Physical Activity and Nutrition (SPAN) is associated with reductions in all-cause mortality and is likely to be more achievable and sustainable than larger changes in a single behaviour to achieve the same mortality reduction, according to this study using data from the UK Biobank published in *BMC Medicine*. Using sleep and physical activity data from the UK Biobank accelerometer study alongside self-completed food frequency questionnaires, the study explored associations between all-cause mortality risk and different levels of the lifestyle behaviours, both individually and as a group. Compared with the lowest tertile of the three SPAN behaviours (5.5 hours of sleep per night, 7.3 minutes of moderate-to-vigorous physical activity [MVPA] per day and a Diet Quality Score (DQS) of 36.9 out of 100), a significant 10% reduction in all-cause mortality could be achieved by increasing sleep by 15 minutes per day, MVPA by 1.6 minutes per day and improving DQS by 5 points (e.g. by eating an additional one-third of a cup of cooked vegetables per day or adding 1.5 pieces of fruit per day). The optimal SPAN combination (7.2 to 8 hours' sleep per night, 42–103 minutes' MVPA per day and increasing DQS to >50 points) was associated with a 64% reduction in all-cause mortality compared with the lowest tertile of the three behaviours. The paper provides tables which can be used to estimate the impact of an individual's current SPAN and the benefits of small increments of SPAN improvements. If confirmed in future prospective trials, small combined lifestyle changes could be encouraged to support decreased mortality.

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The individual impact of behaviours such as sleep, physical activity and healthy diet on cardiometabolic health and mortality in people with and without diabetes are well documented. Insufficient sleep is associated with insulin resistance, inflammation and disruption of appetite hormones, resulting in increased weight and metabolic risk. The American Diabetes Association previously documented the impact of sleep on diabetes (Davies et al, 2022), and the American Heart Association has published a recent statement on "Multidimensional sleep health" and cardiometabolic risk (St-Onge et al, 2025).

A reduction in all-cause mortality risk of 30–60% can be achieved with guideline levels of physical activity, such as 150 minutes of moderate-to-vigorous or 75 minutes of vigorous activity per week. Likewise, poor diet quality, with high levels of ultra-processed and calorie-dense but nutrient-poor foods, is associated with increased risk of chronic disease and mortality.

Although most people, including ourselves as clinicians, know what to do to maintain and optimise health, we are busy and often unable to juggle the demands of work, family and social life to make time to optimise individual behaviours and meet guideline recommendations. People we see with type 2 diabetes often ask about the minimum behaviour change that will make a difference; however, when changing only one behaviour, significant change is usually required.

Previously, the 45 and Up study, conducted in more than 230 000 Australians, looked at healthy versus unhealthy behaviours, including alcohol, smoking, physical activity, sleep and diet, and identified a 49% higher all-cause mortality rate in those with poor sleep, inactivity and poor diet, compared to those demonstrating optimal behaviours in all these areas (Ding et al, 2015). Similarly, the HUNT study in Norway demonstrated a more than doubling in all-cause mortality risk over an average of 14.1 years' follow-up in those with short-duration sleep, physical inactivity and poor diet when combined with low social participation (Krokstad et al, 2017).
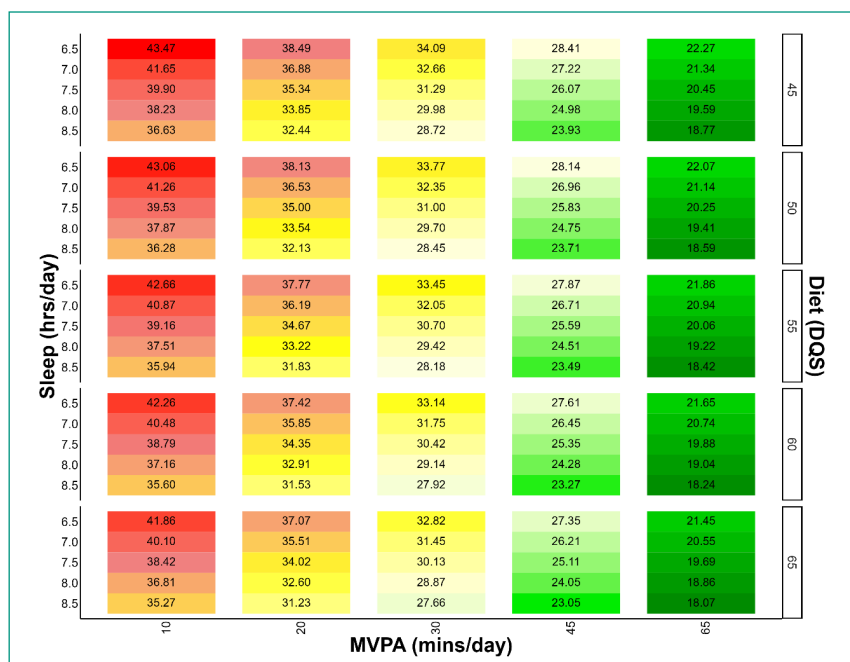
Figure 1. Heat map correlogram of absolute all-cause mortality risk associated with concurrent variations in SPAN behaviours (N=59 078; events=2458).

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These lifestyle behaviours are interrelated; for example, poor sleep can increase appetite for less healthy foods and result in daytime fatigue, making physical activity less likely. Thus, rather than examining them in isolation, exploring the impact of combined changes may be useful. [The present study](#), published in *BMC Medicine*, aimed to identify the minimum and optimal combinations of Sleep, Physical Activity and Nutrition (SPAN) associated with decreased all-cause mortality. No previous study has identified the minimal dose change necessary to make a significant all-cause mortality difference, and it was hoped that quantifying this would be helpful in motivating people to make small changes to improve longevity.

The study

In this prospective cohort study, Stamatakis et al (2025) used data from more than 59 000 participants in the UK Biobank study, aged 40–69 (median 64) years, who wore accelerometers for 7 days to measure sleep and moderate-to-vigorous physical activity (MVPA) in 2013–2015. Diet Quality Score (DQS) was calculated from the self-administered, validated, 29-item food frequency questionnaire completed at enrolment in UK Biobank, looking at intake of vegetables, fruits, fish, dairy, whole grains, vegetable oils, refined grains, processed and unprocessed meats, and sugary beverages. Scores ranged from 0 to 100, with higher scores indicating improved diet quality. The cohort was followed for a median of 8.1 years, correlating lifestyle data and all-cause mortality.

Results

Participants in the lowest tertile of the three combined SPAN behaviours were designated as the reference group, with SPAN activities in this group comprising:

- 5.5 hours of sleep per night.
- 7.3 minutes of MVPA per day.
- DQS 36.9 points.

In contrast, the optimal SPAN combination, in terms of outcomes, comprised:

- 7.2–8.0 hours of sleep per night.
- 42–103 minutes of MVPA per day.
- DQS 57.5–72.5 points.

Over the 8.1 years of follow-up, there were 2458 deaths from any cause. The absolute all-cause mortality rate in the reference group was 49.76 deaths per 10 000 person-years, compared with a rate of 17.95 deaths per 10 000 person-years in the group with the optimal SPAN combination – a 64% reduction.

Relatively modest improvements in combined SPAN activities compared with the lowest tertile were associated with a 10% reduction in all-cause mortality:

- Increase sleep by 15 minutes/day, and
- Increase MVPA by 1.6 minutes/day, and
- Improve DQS by 5 points (e.g. an additional one-third of a cup of cooked vegetables or 1.5 pieces of fruit per day).

Greater improvements in singular SPAN activities were required for the same 10% all-cause mortality reduction:

- Increase sleep by 24 minutes/day, or
- Increase MVPA by 2 minutes/day, or
- Improve DQS by 17 points.

The paper contains a useful chart of combined SPAN behaviour changes associated with different lower all-cause mortality risks (*Figure 1*),

as well as changes in individual SPAN behaviours which could achieve similar reductions, where this is achievable.

Discussion

This study demonstrates the reduction in all-cause mortality associated with choosing to make even small (and potentially incremental) changes in all three SPAN lifestyle behaviours, and suggests these behaviours may act synergistically in their impact. As the authors highlight, recommending that people make changes in only one of these behaviours alone may potentially miss the powerful, and perhaps more sustainable, impact that can be achieved by combining small changes to each.

The study used a novel analytical, three-exposure, joint-association approach, estimating associations between all-cause mortality risk and varying levels of lifestyle behaviours, both individually and combined. Models were adjusted for a variety of variables, including age, sex, ethnicity, smoking and deprivation. Strengths of the study include that the sleep and activity levels were measured using a wearable device; however, the DQS was calculated from a self-completed, albeit validated, food frequency questionnaire.

Limitations include the food questionnaire being completed at UK Biobank enrolment, 3–9 years earlier than collection of the accelerometer data. Despite the exclusion of people who died in the first year and those with self-declared poor health status or high frailty at enrolment, reverse causation and residual confounding remain a possibility. As with all observational studies, the findings are associations only, and the authors could not draw causal conclusions about the behaviour changes and risk reduction; they therefore call for longitudinal and interventional studies to confirm their findings, and to identify sustainability of such combination changes and the duration required for meaningful health benefits.

Implications for practice

The impact of beneficial lifestyle change on morbidity and mortality is important and evidence-based, but it remains challenging to help motivate ourselves or other people to make sustained changes. If we as clinicians find ourselves unable to optimise our lifestyles to consistently achieve behaviours we know will improve our health and lifespan, is it surprising that others also make less healthy choices? People are busy and, when they ask for guidance, they are often dismayed by the scale of an individual behaviour change required to achieve a significant health benefit as, however motivated, they are unable to fit such large changes into their busy lifestyle.

Recommending smaller changes in the three SPAN behaviours, potentially producing a synergistic effect, may be exactly the change in messaging needed to encourage and motivate people to make sustainable behaviour change. Indeed, such an approach is recommended by BJ Fogg, Director of the Stanford University Behavior Design Laboratory, in his book *Tiny Habits*.

Having identified the risks associated with my own current SPAN using the heat map correlogram in the paper and its supplementary materials, I am motivated to make the small changes needed to potentially improve my mortality risk. Read the paper and see if it prompts you to do the same! ∎

Davies MJ, Aroda VR, Collins BS et al (2022) Management of hyperglycaemia in type 2 diabetes, 2022. A consensus report by the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). *Diabetologia* **65**: 1925–66

Ding D, Rogers K, van der Ploeg H et al (2015) Traditional and emerging lifestyle risk behaviors and all-cause mortality in middle-aged and older adults: Evidence from a large population-based Australian cohort. *PLoS Med* **12**: e1001917

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St-Onge MP, Aggarwal B, Fernandez-Mendoza J et al (2025) Multidimensional sleep health: Definitions and implications for cardiometabolic health: A scientific statement from the American Heart Association. *Circ Cardiovasc Qual Outcomes* **18**: e000139

Stamatakis E, Koemel NA, Biswas RK et al (2025) Minimum and optimal combined variations in sleep, physical activity, and nutrition in relation to all-cause mortality risk. *BMC Med* **23**: 111

Minimum and optimal combined variations in sleep, physical activity, and nutrition in relation to all-cause mortality risk

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Practice points

1. Consider SPAN (Sleep duration, Physical Activity and Nutrition) as a useful term in lifestyle discussions.

2. Small increases in all three SPAN behaviours combined appear to have similar or greater benefits than larger increases in single behaviours.

3. Moderate-to-vigorous physical activity includes active (intentional) walking (able to speak but not sing), while vigorous activity includes running (even talking is challenging).

4. Examples of diet quality improvements:
   - Extra 1/3 cup per day of cooked vegetables.
   - Reduce refined grains by 1 serving per week.
   - Reduce processed meat by 1 serving per week.
   - Avoid sugar-sweetened beverages.