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1

2

Death by effectiveness: exercise as medicine caught in the efficacy trap!

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Sport and Exercise Medicine (SEM) has had a good run. For a while it was the low-cost magic bullet. With efficacy demonstrated in study after study, the conclusion was clear: 'Exercise is Medicine', a potential public health panacea.

Sadly, the early promise waned. While we continue to be bombarded by original research and reviews extoling the *efficacy* of exercise, there is an apparent dearth of evidence of its *effectiveness*. This fact is highlighted in 2014 reports from the UK Government[1] and Public Health England.[2]

It is often argued that the major challenge to the effectiveness of exercise is adherence. Adherence to exercise, variously reported at between 40% and 50%[3] is no lower than that reported for drugs.[4] However, while there is general confidence that licensed drugs are effective when taken, reports cited above[1 2] suggest that this confidence does not currently extend to exercise.

Confidence in drugs results from their demonstrating efficacy and effectiveness in clinical trials. Efficacy, demonstrated in phases I–III of a trial, refers to "the extent to which a drug has the ability to bring about its intended effect under ideal circumstances".[5] Effectiveness, demonstrated in phase IV studies, refers to "the extent to which a drug achieves its intended effect in the usual clinical setting".[5] Effectiveness is what matters to commissioners and patients.

The requirement for effectiveness (ie, phase IV) studies is well recognised.[6] A substantial volume of social science research has examined real-world exercise interventions and therefore constitutes phase IV research. However, all too often resultant data relate largely or exclusively to exercise behaviour, providing evidence of behavioural or implementation effectiveness but little evidence of clinical or treatment effectiveness.[7] In all exercise interventions, exercise behaviour is the throughput, with health status the output. Outputs are more important to stakeholders.

Furthermore, a recent review[8] identified that many studies examining the treatment effectiveness of exercise in the real world adopt laboratory style methods and controls that would be impractical and uneconomic in real-world interventions. Data resulting from such studies merely add to the efficacy data set.

We argue that despite metaphorically drowning in evidence of efficacy and implementation effectiveness, SEM is yet to provide sufficient evidence of treatment effectiveness. Furthermore, while it is a mistake to confuse efficacy with effectiveness,[9] in lobbying for exercise as a public health tool, we often do just that.

On the basis of the above we believe that SEM risks being side-lined in public health. If we are to provide critical life support to SEM—and arguably to beleaguered health services—that lifeline is the production of high-quality phase IV/effectiveness research.

A phase IV methodology applicable to a wide range of exercise interventions is the

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3

Editorial

Run for your life: tweaking the weekly physical activity volume for longevity

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There is nothing better than exercise but more exercise.

Regular physical activity (PA) and high cardiorespiratory fitness (CRF: aerobic capacity, VO_2 max) reduce all-cause mortality even after adjusting for relevant confounders.[1 2] Large-scale studies indicate an almost linear relationship between increasing CRF and longevity, with no signs of an upper limit.[3] It remains less clear which PA volumes are optimal for a long life. Public health guidelines recommend a minimum of 150–300 min moderate-intensity aerobic PA or 75–150 min vigorous intensity aerobic PA per week to induce general health benefits.[4]

HOW MUCH BANG CAN YOU GET FOR A PA BUCK?

Dr Hannah Arem and colleagues, using pooled data from six studies in the USA and Europe (including 661 137 adults), showed that meeting PA guidelines was associated with a large longevity benefit.[5] And there were even further improvements until the benefit for longevity reached a threshold at a level 3–5 times higher (450–750 min/week) than the minimum recommendations, without adverse effects in those performing PA at ≥10 times that minimum. The maximum all-cause mortality reduction was almost 40% versus relevant differences between moderate and vigorous intensity PA. Men benefited more from vigorous and women more from moderate intensity PA. Generally, PA-related benefits were larger for older individuals. The reduction of mortality from cardiovascular diseases (CVD) was more pronounced than that from cancer; the maximum risk decrease from CVD mortality was reached at exercise doses 3–5 times the minimum recommendations, while that from cancer mortality required doses >5 times the minimum recommendations.[5]

These findings build on those from another large prospective cohort study (416 175 individuals in Taiwan) that highlighted longevity benefits (later death!) starting from brief daily periods (15 min; 14% mortality-risk reduction) of moderate PA up to a threshold of 700 min (100 min daily!) per week.[6] This threshold was already attained after 350 min of vigorous PA accompanied by maximum mortality reduction from all causes by ~45% compared with somewhat above 15% with 700 min of moderate intensity PA weekly. The decrease of cause-specific mortality was most pronounced for diabetes mellitus, followed by CVD and all cancer.[6]

WHAT HAPPENS TO THE RISK DECREASE OF MORTALITY IN INDIVIDUALS WITHOUT MAJOR PRE-EXISTING DISEASES IF YOU REPLACE SITTING TIME WITH EXERCISE OR NON-EXERCISE PA (EVERYDAY LIVING ACTIVITIES)?

A positive association between sitting time and all-cause mortality in those not meeting minimum PA recommendations was demonstrated in a large prospective follow-up study (149 077 individuals). All-cause mortality was ~50% higher in the most sedentary (>8 hours daily sitting time) compared with the least sedentary (<4 hours sitting per day). Negative effects of longer sitting times were almost eliminated at increased PA, especially in the highly active group (≥420 min of moderate-to-vigorous PA per week).[7]

A recent epidemiological study (88 140 individuals),[8] that evaluated dose-dependent effects of a broad variety of leisure activities, showed similar results as reported by Wen and colleagues.[6] All-cause mortality risk was decreased by 42% with total leisure activities of ~700 min/week, without striking changes if activities exceeded 1500 min/week.[8] Benefits were larger for vigorous compared with moderate intensity activities. In this study, an inverse J-shaped association was demonstrated between reduced CVD-related mortality and the amount of leisure activities, up to a maximum benefit at ~500 min/week. The maximum decrease in cancer-specific mortality was reached only at ≥1200 min/week.[8]

A similar non-linear dose–response relation between higher PA, based on accelerometer recordings, and lower mortality, was reported in a meta-analysis (8 studies including 36 383 individuals; mean age 62.6 years).[9] The extent of PA associated with maximal mortality risk reduction decreased with increasing intensity of PA. Respective amounts were >2000 min/week (55% risk reduction) at very light intensity, and 560 min (60% risk reduction) at high light intensity, probably representing rather moderate intensity PA in this cohort of older adults.

What's the bottom line? Is 700 min/week the magic number?

Mortality reduces as PA increases, apparently in a non-linear dose–response pattern. While large amounts of only very light PA are necessary to reduce all-cause mortality as low as it will go, the same benefit accrues from about 700 min of weekly moderate intensity PA. CVD mortality may be minimised with a somewhat lower dose (~500 min/week); the higher doses (up to >1200 min/week) are associated with the greatest reductions in cancer mortality. These volumes of weekly moderate PA (exercise and/or daily living activities) for optimal benefits can be halved when replacing moderate by vigorous-intensity activities and this applies more for men than for women.

In summary, even though 15 min of daily PA is associated with reduced mortality risk in the general population, the optimal volume for longevity is substantially larger but may vary between individuals. For example, depending on age, sex, health status and/or exercise preferences. We exhort consulting doctors to discuss both the optimal and the minimal dose of PA with patients. Inform the patient of his/her options. If good health came in an exercise pill, and the best results came from taking two pills/day, would you (the patient) want to take two or just one? Individually tailored PA volume should provide greater benefits than the very valid public health message of at least 150 min/week.

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Competing interests Both JB and MB believe in the health benefits of PA and they aim to accumulate 700 min of moderate to vigorous PA weekly.

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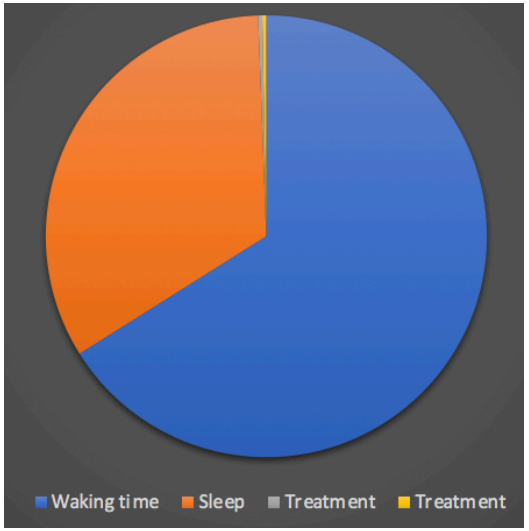
4

Weekly available time for health improvement



5

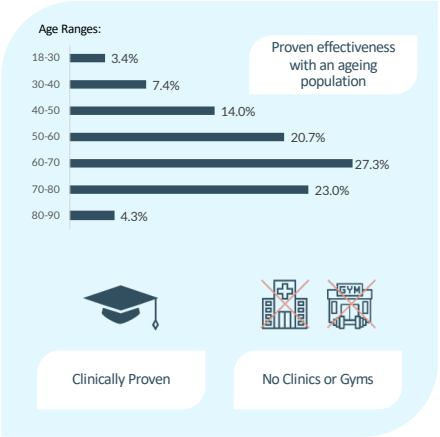
Physical Activity is Multidimensional

- There are *multiple dimensions* of physical activity for harnessing the protective properties that are *independently important to health*.
- Personalised profiling *essential for an accurate assessment* of an individual's physical activity enabling *bespoke strategies for successful behaviour change*.
- Emphasis on sport and exercise
  - *fails to engage* those most at risk and
  - *limits access* for those with chronic disease

6

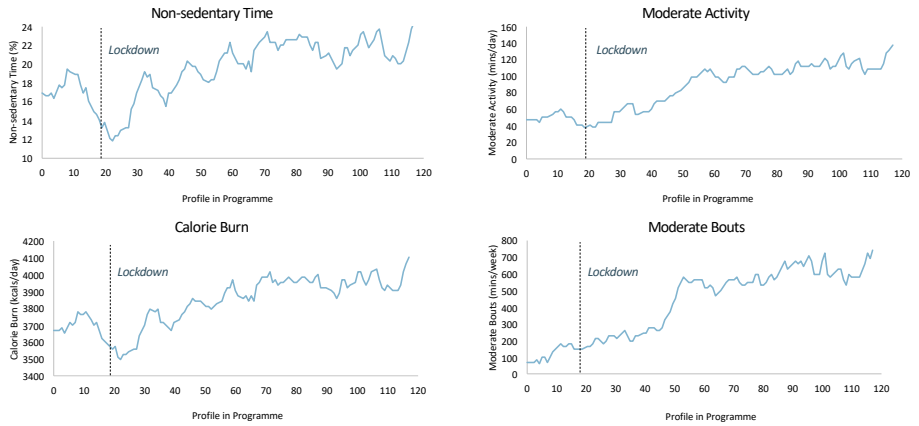
Supporting people to take control

- NHS - LTCs & Rehab self care option
- Much needed alternative to current exercise-based practices.
- Uptake of current care is poor / barriers many
- COVID-19 reframe
- Appetite to self-manage is not limited by age
- *Mentoring* enables people to look after themselves, keep healthy at home, and thrive by being their own experts



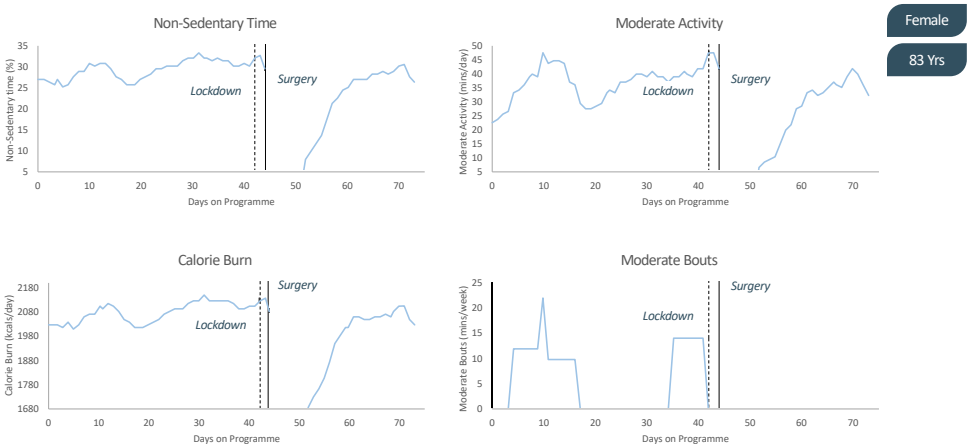
7

User 1080: Physical Activity Over Time - Lymphoedema



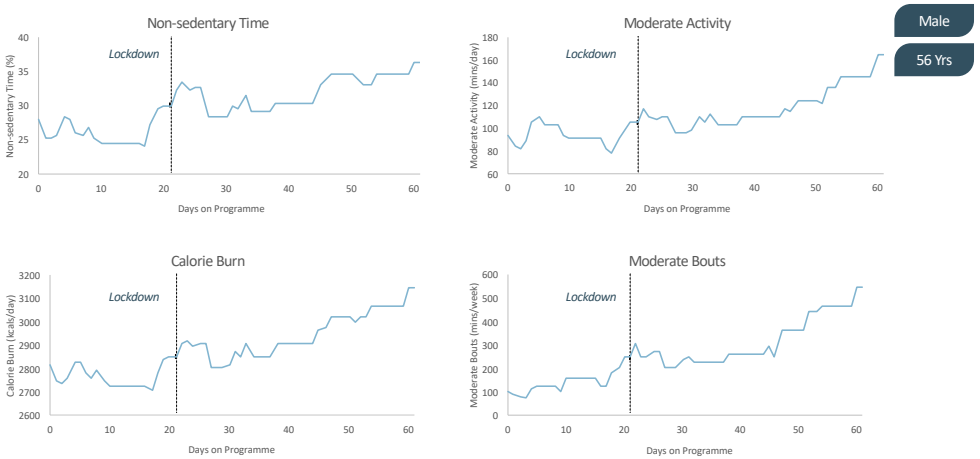
8

User 1054: Physical Activity Over Time – Surgical Pathway



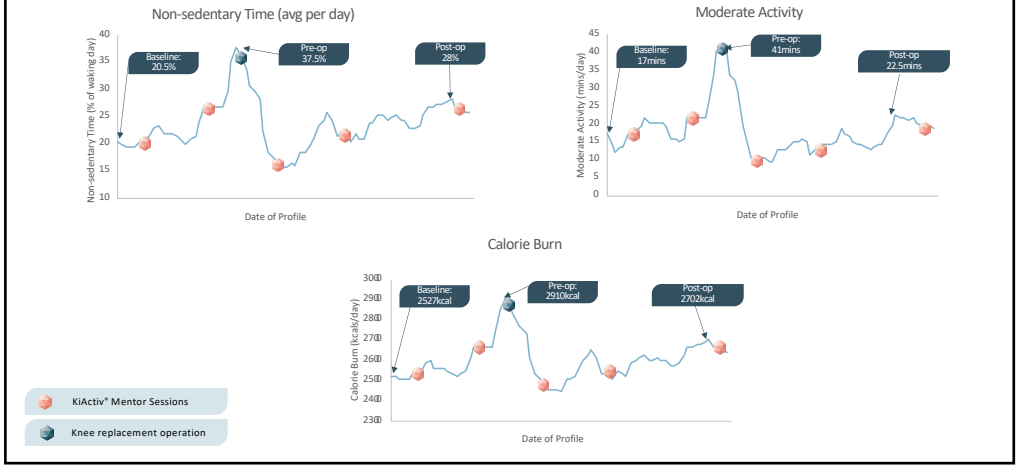
9

User 1074: Physical Activity Over Time – Type 2 Diabetes



10

User 593: Physical Activity Over Time - Type 2 Diabetes & Knee Replacement



11