WHITE PAPER

The Vitality Habit Index

Quantifying habits and their impact on health

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In collaboration with

LSE THE LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE

Contents

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Glossary

All-cause mortality/mortality	The risk of death due to cardiometabolic diseases such as diabetes, hypertension and cardiovascular disease, and severe illness such as cancer and strokes. Trauma-related deaths are excluded from the analysis.
Apple Watch Benefit (AW)	As part of Vitality Active Rewards, this incentive offers members an Apple watch that is funded upfront by Vitality. Members must repay the purchase price in 24 monthly instalments. The instalment amount depends on whether the member achieves their VAR goals or not. Members who achieve all their monthly VAR goals are exempt from any repayment, while members who achieve no goals pay the full cost.
Caffè Nero	A rewards programme that rewards members in the UK with a coffee voucher for achieving their weekly VAR goal.
HealthyFood Benefit (HF)	A partnership between Vitality and two of South Africa's grocery retailers that offers Vitality members who sign up a cash rebate of up to 25% on purchases of selected healthy food items.
Vitality active rewards (VAR)	An incentive programme that encourages members of Vitality to meet their weekly physical activity goals through personalised targets and gamification.

Introduction

Despite advancements in medical knowledge and public health initiatives, society continues to grapple with a mounting burden of chronic diseases (Leitzmann et al., 2007; Chakravarty et al., 2012). According to the World Health Organization (WHO), insufficient physical activity and obesity are recognised as leading risk factors for developing illness and for premature death (WHO, 2022). Termed the 'pandemic of physical inactivity' by Kohl and colleagues (2012), this phenomenon has severe global repercussions for individuals, society, healthcare systems and the economy. Against this backdrop, understanding the pivotal role of lifestyle behaviours in shaping health outcomes is crucial.

Four protective lifestyle behaviours, namely physical activity, not smoking, moderation in alcohol consumption, and adequate fruit and vegetable intake, have been estimated to increase life expectancy by up to 14 years (Harrington et al., 2009). The WHO Guidelines, as advocated by the UK Chief Medical Officer, recommend a weekly regimen comprising at least 150 minutes of moderate-intensity activity or 75 minutes of vigorous activity, or a combination thereof, along with strength-building exercises on two days (WHO, 2022; gov.uk, 2022). However, despite these recommendations, approximately 30% of the global population is physically inactive, with high-income nations exhibiting even higher rates of inactivity (Hafner, 2020). This sedentary lifestyle trend, coupled with the consumption of high-calorie, ultra-processed foods, has contributed to the escalating prevalence of obesity (Ng et al., 2014). These trends not only result in increased mortality and morbidity rates and a reduced quality of life but also exert significant economic strain on healthcare systems and productivity (Bolnick et al., 2020).

Recognising the challenges that obesity and insufficient physical activity pose to society, there is a need to not only encourage specific positive changes in behaviour but also ensure that such changed behaviour or activity becomes a consistent and long-term lifestyle habit. Both the breaking and creating of habits are central to behaviour change. Habits are hard to break, and once established, they outlast the motivating factors that started them in the first place. Research indicates that it typically takes individuals five to six weeks of consistent gym workouts to establish new exercise habits (Armitage, 2005). Evidence from this paper suggests that it takes seven to fifteen weeks to build a consistent habit of at least three physical activity sessions per week. Once habits are formed, they tend to guide behaviour even when people might have intended to do something else (Wood and Runger, 2016), because habits are central when willpower is limited (Neal et al., 2013).

Consequently, habits serve as fundamental drivers of health outcomes. Habits such as sedentary behaviour, poor dietary choices, smoking or excessive alcohol consumption significantly compromise longevity and wellbeing, and the challenges associated with changing these habits add to the problem. Conversely, cultivating habits such as regular physical activity and nutritious eating can positively alter a person's health trajectory, increasing the likelihood of enjoying a healthier, longer life. When healthy habits become the chosen behaviour, the chances of having a healthier, longer life increase.

Recognising the pivotal role that habits play in shaping health outcomes, Vitality developed a data-driven tool to quantify habit formation – the Habit Index. This paper aims to fill the existing gap in knowledge surrounding habit formation and its impact on health outcomes. Specifically, the study endeavours to achieve the following objectives:

1. **Highlight the benefits** derived from incremental and sustained physical activity and nutrition habits for both individual health outcomes and the broader spectrum of healthcare.
2. **Explore the underlying mechanisms** that drive habit formation, particularly examining these processes through the lens of the Vitality Shared-value Insurance model.
3. **Provide insights** into creating and maintaining healthy habits that are persistent and practical to maintain, thereby contributing to long-term health and wellbeing.

This paper will explore several key components pertaining to habit formation and its implications studied on the Vitality South Africa (SA) and Vitality United Kingdom (UK) member base. Beginning with the **Vitality programme**, describing its rewards structure and personalised approach to habit formation, the paper will shift to the examination of **habits as the fundamental drivers of long-term behaviour**. The **methodology section** will explain how machine-learning techniques and data from the preceding six weeks are used to predict Vitality members' habits in the seventh week. The paper will then introduce the innovative **Habit Index**, designed to quantify habit formation, and provide detailed presentations of both physical activity and nutrition habit formation. Building on these foundations, the subsequent sections will present **findings and implications**, highlighting the profound impact of positive habits on healthcare outcomes and costs, as well as the enduring nature of habits in the face of external challenges. Furthermore, the discussion will delve into Vitality's role in facilitating habit formation, articulating the drivers of habit formation. The discussion will introduce the concept of habit laddering, emphasising the need for practical and sustainable behaviour changes. Finally, the paper will explore the individual and societal implications of habit formation, offering policy recommendations from varied stakeholder perspectives.

Vitality – Personalising the habit formation cycle

The Vitality programme addresses the impact of noncommunicable lifestyle-related diseases on both individuals and society, with a reach covering 1.5 million members in South Africa and 1.5 million members in the United Kingdom. Over the past decade, Vitality has utilised immediate incentives through initiatives like Vitality Active Rewards, the Apple Watch Benefit, and the HealthyFood Benefit to encourage healthier behaviours and the formation of positive physical activity and nutrition habits.

The Vitality programme extends rewards and incentives to its members for engaging in health-promoting and preventive activities. Rooted in the concept that motivation flourishes as individuals achieve incremental goals, the programme uses a tiered-status system – Blue, Bronze, Silver, Gold and Diamond status – to acknowledge members' activities that promote their wellbeing (Patel et al., 2023).

Vitality's incentives can be defined into two categories: enabling incentives and contingent rewards. Enabling incentives are designed to eliminate financial barriers to adopting healthy behaviours, reducing the immediate costs that often overshadow long-term benefits. For example, the Vitality Gym Benefit provides substantial discounts on gym memberships, making it more accessible for Vitality members to maintain fitness routines. The HealthyFood Benefit, for example, offers cash back for purchasing healthy food items at Vitality-partnered grocery stores in South Africa, making healthy food items visible and more affordable.

Conversely, contingent rewards stimulate ongoing engagement with health-promoting activities, helping Vitality members experience instant gratification for positive health behaviours that usually have long-term benefits. Vitality members accumulate points throughout the year, determining their Vitality status level. Points contribute to macro and micro rewards. The macro reward is a member's annual Vitality status, which resets to Blue status every year to encourage members to earn back their previous or a higher status level (although, during that year, members remain entitled to rewards and discounts based on the status they achieved in the prior year). Elevated statuses yield advantages such as increased travel discounts and financial incentives for insurance policies. Features of the Vitality programme, like Vitality Active Rewards (VARs), encourage members to meet their personalised weekly exercise goals. The micro rewards for achieving these weekly personalised goals include, for example, a coffee voucher in Vitality UK or Discovery miles in Vitality SA which can be redeemed for a coffee or a smoothie with a rewards partner.

Complementing the Vitality Shared-value Insurance model and incentive programme, Vitality has established one of the world's most extensive and multi-dimensional longitudinal behavioural and health status data repositories. The work presented in this report is based on a data set encompassing 1.1 billion device data events; 26.5 million life years of Vitality engagement data, including health checks and assessments; and 48.7 million life years of healthcare utilisation data, including benefit usage, hospital admissions, and pathology and chronic registration data from the inception of the programme until now. The richness and the particular combination of data have paved the way for the modelling and quantification of sustained behaviour change, allowing us to derive insights on the formation of habits over time. This study marks a significant milestone in understanding the profound impact of behaviour change and habit on health and life expectancy, while providing a comprehensive approach to effecting positive behaviour change in populations.

Habits – The foundation of long-term behaviour

The Oxford dictionary defines a habit as a constant, almost automatic, practice acquired by frequent repetition.

All habits in our lives were once a behaviour that, as it was repeated, became almost automatic. That is, for whatever reason, we repeatedly performed an action that aligned with a specific behaviour, driven by some intrinsic or extrinsic desire, until it became habitual.

Charles Duhigg, in his book "*The Power of Habit: Why We Do What We Do in Life and Business*", delves into the science behind habits. He explains the habit loop, which consists of a cue or trigger, a routine or behaviour, and a reward. What is important here is that this cycle is agnostic to how healthy or unhealthy a habit is. We can just as easily form a habit of eating sugary sweets every time we get home as we can form a habit of going for a run. It all depends on which action we perform most often.

This research paper makes six key findings about the impact and drivers of habits and habit formation:

1. **Healthy habits change your life:** Forming new and better physical activity and nutrition habits has a significant impact on mortality and morbidity.
2. **It is never too late to start**: The impact of positive habit formation increases with age.
3. **The paradox of 10,000 steps**: Positive effects are observed at significantly lower levels of exercise, and by 7,500 average daily steps, maximum mortality improvements are already incurred at all ages.

4. **Six weeks to measure, 7 – 15 weeks to form a new habit:** It takes six weeks of data to reliably observe the strength and quality of a habit, but it takes 7 to 15 weeks to establish a new habit that will last, with most people establishing a new habit after 10 weeks.
5. **Habit laddering is the key to healthy habits**: The best way to establish a lasting, healthy habit is through habit laddering, that is, to start with small increments and maintain that behaviour for a period before attempting a new behaviour at a higher intensity.
6. **Habits are expansive:** Healthy behaviours are highly correlated, and a healthy physical activity habit can lead not only to better nutrition and sleep habits but to several other societal benefits as well.

Methodology

Defining habits

Action: An event
An action is a specific, intentional and often conscious activity or task that an individual engages in at a particular moment in response to a specific situation or goal. Actions are determined by looking at event data.

Behaviour: A repeated pattern of actions
Behaviour is a pattern of actions or conduct that is typically guided by a person's attitudes, beliefs or values. It encompasses a range of actions and can be repeated over time. Behaviours can be influenced by emotions, thoughts and environmental factors (such as incentives or hurdles). Behaviour is determined by looking at the pattern of an event or a series of events.

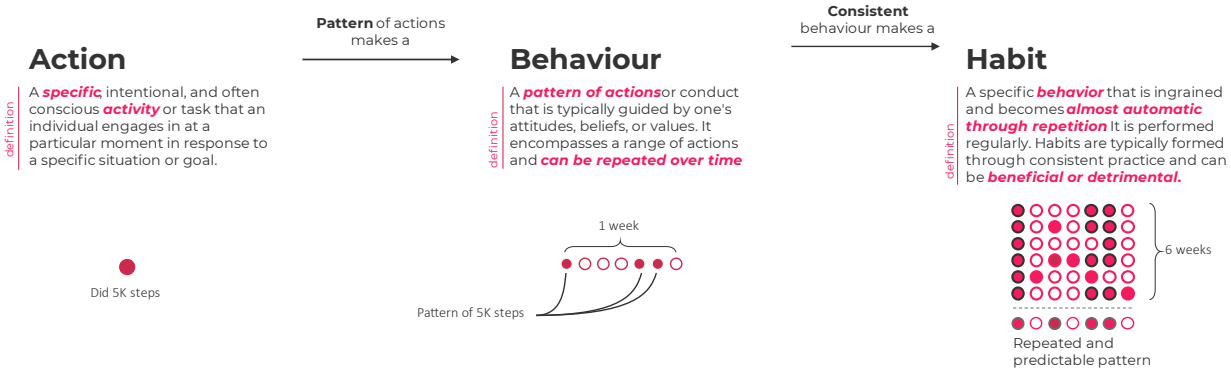
Habits: A predictable pattern of behaviours
Habits, distinct from actions and behaviour, are a specific pattern of behaviours that become ingrained and almost automatic through repetition. They are performed regularly and are typically formed through consistent practice. Habits can be either beneficial or detrimental.

To identify a physical activity habit, we found that we require at least six weeks of data to determine if a particular pattern is consistent and predictable. We label the pattern of behaviour a strong habit when we can predict it with a high degree of accuracy.

We quantified habits using a machine-learning approach, which allowed us to specify details around the pattern of behaviour, such as the consistency of the day of the week on which exercise occurs (i.e., if someone exercises every Monday and Wednesday, then the behaviour is more predictable). Simpler methods are also available.

After some analysis, we settled on quantifying habits based on a six-week history of behaviour. A six-week history or look-back provides the most accuracy in terms of predicting a habit in week seven while also providing the least variation in terms of behaviour. For instance, had we used three months, behaviour would have been influenced by seasonal variations, which does not necessarily accurately reflect the strength of the habit. When a predictability score of above 70% occurs, we regard it as confirming that a habit has been observed over the previous six-week period.

Using a machine-learning model

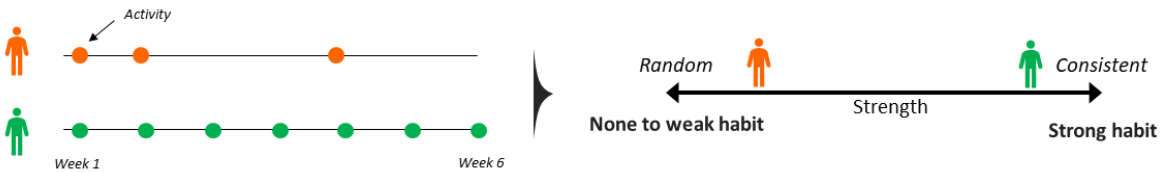


Quantifying habit formation – The habit index model

The aim of this modelling is to quantify and identify existing habits. To achieve this, we have chosen to distil our approach into three dimensions:

- **Action**: This refers to an activity or event that can be objectively observed and verified, rather than relying on self-reported data.
- **Strength**: Strength relates to the consistency and regularity with which the activity is performed.
- **Quality**: Quality assesses whether the action is favourable or unfavourable in nature.

The more consistently an individual engages in a specific action over time, the stronger the habit becomes or is. For example, someone who buys apples every day for six consecutive weeks is considered to have a strong habit. In this case, one can reasonably predict that they will continue this behaviour into week seven. Conversely, if someone sporadically buys apples without a clear pattern, they may be regarded as having a weak or indiscernible habit.



The next dimension to consider is the **quality** of the habit. Continuing the example of purchasing apples, it would be seen as a positive action due to its health benefits, whereas buying a sugary drink would be considered negative or bad as it is detrimental to a person's health.

By combining these two dimensions – strength and quality – we can create a habit grid that categorises an action into one of five distinct habit classes:

- Strong good habit
- Weak good habit
- Medium habit
- Weak bad habit
- Strong bad habit
- No habit

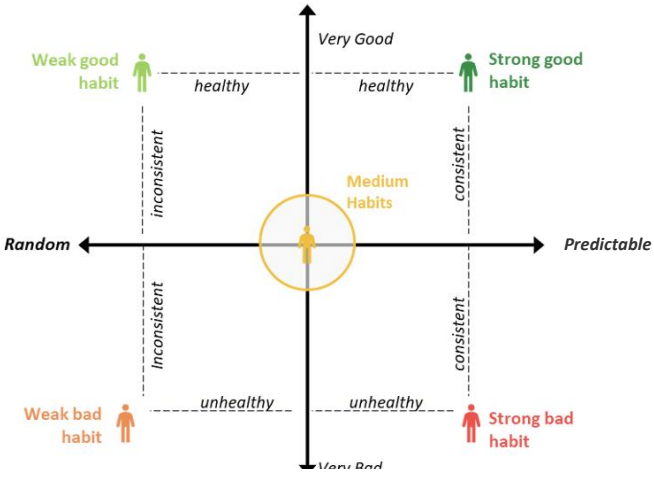


Figure 1: Habit grid

It is essential to note that the time horizon over which we evaluate habits plays a crucial role. Since habit identification relies on historical data and is primarily aimed at predicting future behaviour, using only one week's data lacks predictive power beyond a few weeks. To strike a balance between exposure and predictive accuracy, six weeks was identified as the ideal time horizon.

The physical activity habit model

Within Vitality, exercise tracking employs various methods:

- **Device data**: This includes data from wearable devices, providing insights into exercise intensity and duration, including routine and fitness, linked to the daily number of steps taken.
- **Gym**: This method records exercise sessions at a gym facility where the exact nature of the exercise is unknown.
- **Events**: This method tracks participation in exercise-related events, for example, marathons, triathlons, parkruns and other sporting events.

These methods offer verifiable data to confirm physical activity. When using device data, not only can exercise be verified, but the intensity and duration can also be assessed. We only consider physical activity to have occurred if the individual has done at least 30 minutes of physical activity at a minimum of 60% of maximum heart rate or if the individual has recorded a minimum of 5,000 steps.

- **Event**: An event is the presence of a physical activity, given the minimum requirements, on a day, using any of the verification methods.
- **Strength**: An algorithm is constructed to determine the individual's exercise pattern. Lower variance or high predictability suggests a stronger exercise habit.
- **Quality**: Engaging in high levels of exercise is considered a healthy activity, while not engaging in exercise or doing minimal exercise is seen as unhealthy.

By comparing an individual's predicted exercise pattern with their actual behaviour, we assess predictability using a goodness-of-fit measure. Further analysis considers fluctuations in behaviour over time, as well as the mean physical activity days. This allows us to categorise habits into specific zones, as depicted in Figure 2.

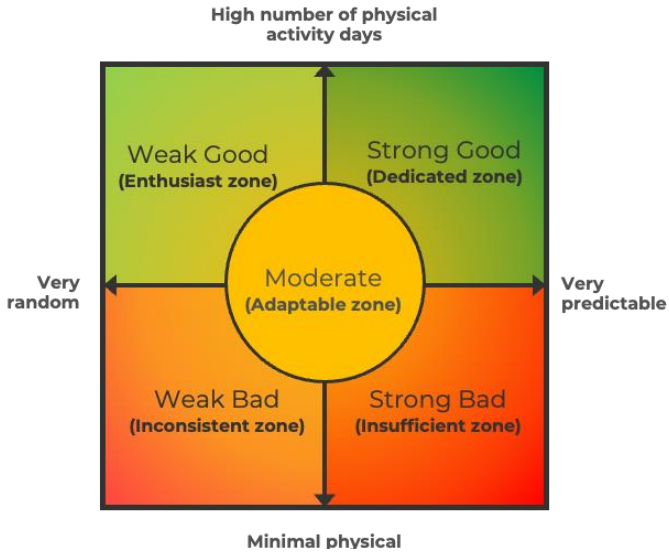


Figure 1: Physical activity zones

This grid comprises five distinct zones, each offering valuable insights.

- **Dedicated zone (strong good habit):** Individuals in this category prioritise exercise and consistently engage in physical activity, exemplifying strong physical activity habits. These individuals exercise on average three or more times a week with high predictability or high consistency.
- **Enthusiast zone (weak good habit):** Individuals in the enthusiast zone predominantly make healthy physical activity choices but may occasionally deviate from their routines. These individuals exercise on average three or more times a week with low predictability or low consistency.
- **Adaptable zone (medium habit):** This group is highly adaptable and open to transitioning between good and bad physical activity habits, making them likely candidates for transformation. These individuals exercise on average more than two and less than three times a week with varied predictability and consistency.
- **Inconsistent zone (weak bad habit):** Individuals in this category maintain moderate to minimal levels of physical activity, although their physical activity patterns may be sporadic. These individuals exercise on average less than two times a week with low predictability or consistency.
- **Insufficient/Poor zone (strong bad habit):** Individuals in this category do very little physical activity, but with a high degree of consistency. These individuals exercise on average less than two times a week with high predictability or consistency.
- **No-habit zone (No habit):** These individuals do no recorded or verifiable physical activity.

The nutrition habit model

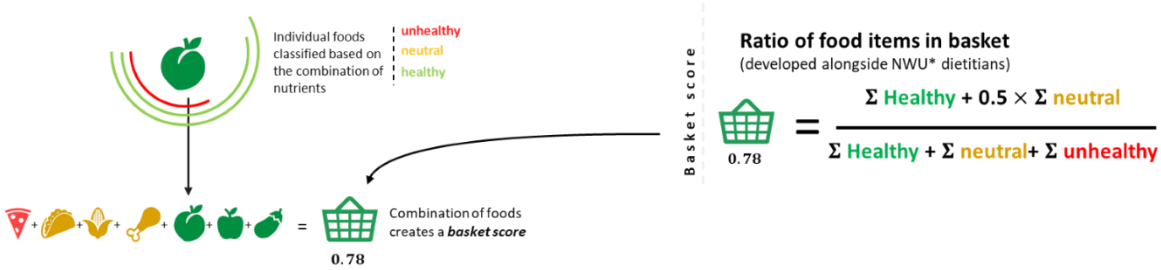
The HealthyFood Benefit, a partnership between Vitality in South Africa and two of the largest grocery retail chains, provides a wealth of data regarding Vitality members' food purchases. This dataset is exceptionally rich and comprehensive, with Vitality members actively engaging in the benefit each day. This data, however, informs us what Vitality members buy and not necessarily what they consume. Furthermore, the data is provided at policy level, which means that a single policy can encompass a family comprising both adults and children.

Nevertheless, because basket composition is tracked over time, we believe it is reasonable to assume that, if someone repeatedly buys a food item over time, they probably do eat it. In most cases, families' eating habits will also be correlated.

In the context of establishing nutrition habits, we interpret the three dimensions as follows:

- **Event:** Purchasing a basket of food, categorised into one of three levels: healthy, neutral or unhealthy
- **Character:** The consistency at which the categorised basket of food is bought
- **Quality:** The number of healthy food baskets compared with unhealthy food baskets bought

Given that a single food basket can contain a variety of items, some items healthy and others unhealthy, the basket score (developed in collaboration with academics from the North-West University in South Africa) measures the overall healthiness of the basket of food. More than three items qualify as a basket, and we ensure that the basket is not included if it is overly representative of one broad food category, i.e., only vegetables or only protein. Each food item in the HealthyFood catalogue is assigned a category (healthy, neutral or unhealthy) based on its nutritional value, as catalogued by Vitality's dieticians. When a Vitality member purchases a basket of food, the ratio of healthy to unhealthy items, with a correction factor (i.e., half the number of neutral items), is attributed to the basket of food, resulting in a score between 0 and 1.



Over a six-week period of food basket purchases, we can estimate Vitality members' nutrition habits by determining their nutrition score for each basket of food and the variation of the nutrition scores of the baskets of food bought over that period.

Using the mean and standard deviations of the basket score over six weeks, we classify a person's nutrition behaviour according to our habit grid as viewed through the lens of nutrition habits, depicted in Figure 3.

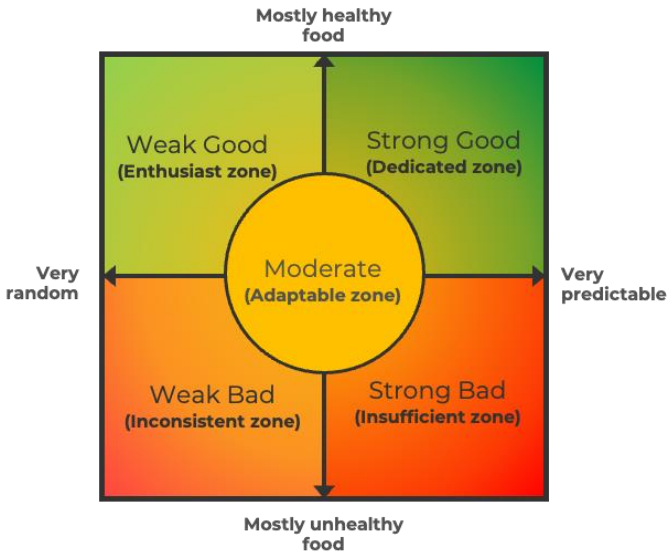


Figure 2: Nutrition habit zones

This habit grid comprises five distinct zones, each offering valuable insights into the different nutrition behaviours:

- **Dedicated zone (strong good habit):** These individuals are health-conscious and prioritise purchasing healthy food items.
- **Enthusiast zone (weak good habit):** These individuals primarily make healthy choices but occasionally indulge in sweet or salty foods.
- **Adaptable zone (medium habit):** This group is most susceptible to transitioning between good and bad habits, making them likely candidates for transformation.
- **Inconsistent zone (weak bad habit):** These individuals frequently indulge in unhealthy foods but still maintain some level of balance in their choices.
- **Insufficient/Poor zone (strong bad habit):** Individuals in this zone consistently choose unhealthier food options, showing resistance to change.

The impact of lifestyle habits on health and longevity

Measuring the causal effect of habit

The impact of healthy lifestyle habits on mortality and morbidity is documented extensively in literature (Harrington et al., 2009; Bolnick et al., 2020). Our aim is to determine the exact causal relationship between sustained behaviour and health outcomes, as observed from our rich, longitudinal data set. In particular, we are interested in measuring how changes in behaviour and changes in habit influence healthcare costs and longevity.

Vitality has, for decades, collected data on lifestyle and wellness on the one hand and on healthcare costs on the other, with detailed treatment and diagnostic data as well as insight into pathology and radiology. Vitality also collects data on longevity as a matter of course. One particularly relevant element of our healthcare data in South Africa is chronicity. Chronic conditions are covered in full by health funders in South Africa, under a Prescribed Minimum Benefit regulatory framework for private health insurance, and this means that we have reliable data on chronicity over time. With wearable devices and the fact that there are step counters on smartphones, combined with the fact that we offer incentives and rewards for healthy lifestyles, we are able to track the physical activity and nutrition of member cohorts over time. These member cohorts share data on wellness and health with us as they receive incentives and rewards from Vitality, and their medical claims are covered by the Health Fund. This, in turn, allows us to investigate the relationship between changes in behaviour and habits and subsequent healthcare costs and mortality. To do this, we employ causal inference.

The use of causal inference models and our rich longitudinal demographic, behavioural and health claims data allows us to study the impact of sustained behaviour change and habit formation on mortality and morbidity risk, adjusted for all relevant risk factors. Although the analysis is based on health and wellness observations in the South African Vitality Health book, these findings can then be generalised to markets outside South Africa. As demonstrated in this report, the findings have been replicated in our data set in the United Kingdom, although we do not, for instance, have complete data on chronicity in the UK.

Causal inference frameworks allow us to establish a baseline level of risk for every individual in a cohort by including data on all the major risk categories that may influence mortality or morbidity, including age, health status, chronicity, socio-economic status and levels of wellness engagement. Also

included are baseline exercise levels and Vitality status, which reflect wellness behaviour and engagement up to the baseline period. Subsequent observations can therefore be adjusted for these variables, which allows us to accurately measure the impact on mortality and morbidity of changes in physical activity after the baseline period, and to apply these insights in other environments which may not have access to such rich clinical data.

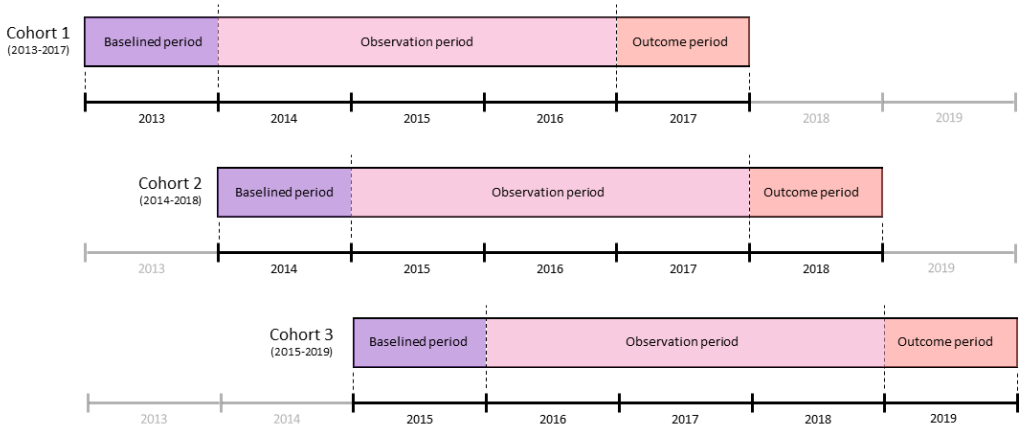


Figure 3: Structure of the data

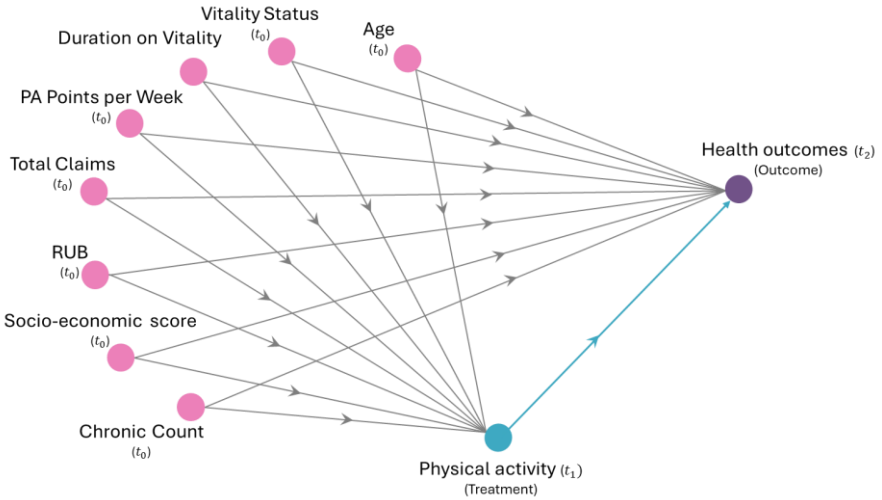


Figure 4: Directed acyclic graph

The impact of physical activity on mortality and morbidity risk

To observe the impact of physical activity and a change in physical activity on health outcomes, we conducted an observational study on a cohort of 502,062 members who continuously held a policy in South Africa's Health and Vitality book between the period 2013 and 2019. We observed members who changed their physical activity behaviour from being unengaged (i.e., recording no physical activity points) to engaging in low, medium and high levels of activity (measured in average physical activity events per week) for three years to determine the impact of habit formation on mortality risk relative to those who remained unengaged.

In this study, a direct treatment cannot be assigned. Therefore, the challenge was to use Vitality members' observed *changes* in physical activity as though it were an explicit treatment. To measure the impact of physical activity on mortality risk, treatment was thus assigned based on the physical activity improvements and, accordingly, physical activity events completed over the observation period.

Vitality members who were counted as unengaged in the baseline period and who then remained unengaged in the observation periods were assigned to the control group, while members who changed their behaviour by engaging in low, medium or high levels of physical activity points were assigned treatments one to three, respectively. The outcome – in this case, whether we observed a death – was then measured in the outcome period.

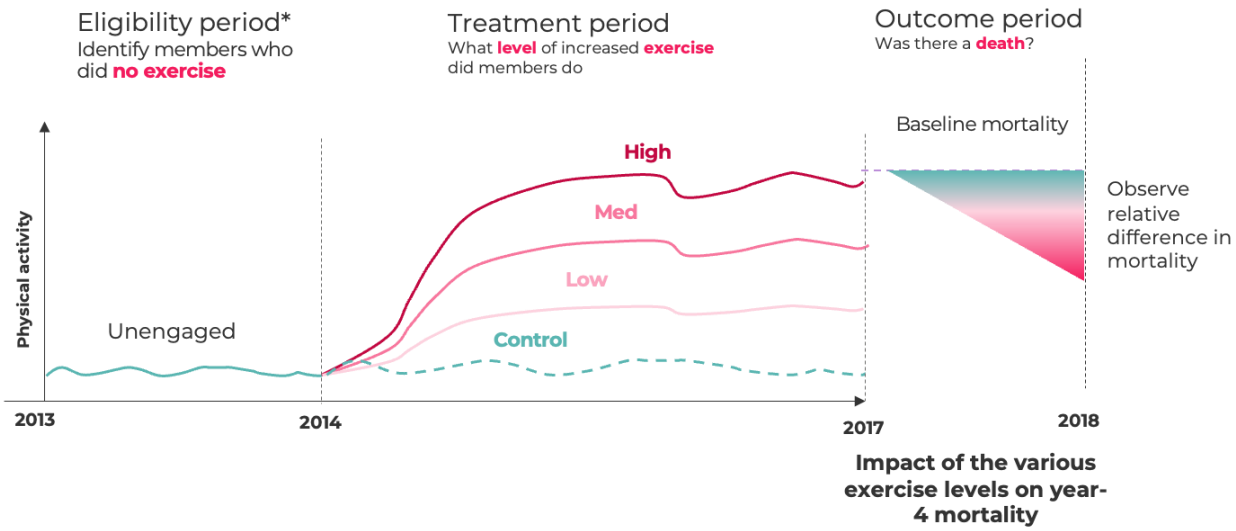


Figure 5: Causal experimentation framework

Findings from the study show that Vitality members across all ages who started off unengaged in the baseline period and then achieved and

sustained up to medium levels of physical activity for three years reduced their risk of mortality by 22%, relative to those members who remained unengaged. Vitality members who achieved and sustained high levels of activity reduced their risk of mortality by 27%, relative to those members who continued to be unengaged. High levels of activity amount to doing 10 000 steps for five days per week for three years.

Table 1: Physical activity table

PHYSICAL ACTIVITY LEVEL	ACTIVITY	SESSIONS PER WEEK
Low	5,000 steps	3
Medium	10,000 steps *7,500 steps for members 65-years and older	3
High	10,000 steps *7,500 steps for members 65 years and older	5

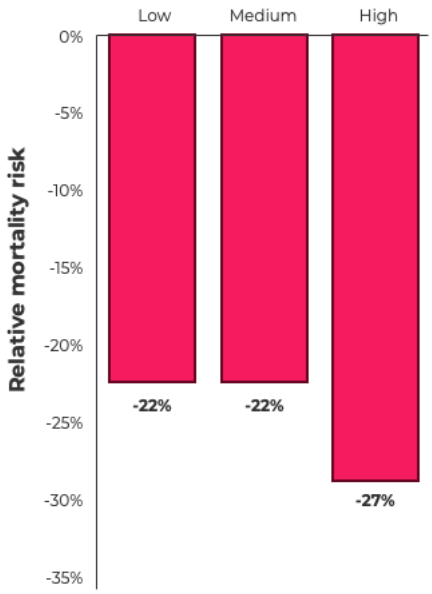


Figure 6: Relative mortality risk reduction

While the study included members of all ages older than 18, the results show that while physical activity is important for people of all ages, the impact is not as significant for younger members between the ages of 18 and 45, particularly when observing physical activity over three years and measuring the impact in the following year.

The results do indicate, however, that behaviour change and maintenance become more important as members get older. The study shows that Vitality members between the ages of 45 and 65 who changed their behaviour from being unengaged to sustaining 10,000 steps for five days per week for three years reduced their risk of mortality by 58%.

The mortality impacts for Vitality members 65 and older show that those who changed their behaviour from being unengaged and then started doing 7,500 steps for an average of three days per week for three years reduced their mortality risk by 52% relative to those (in this age cohort) who continued to be unengaged. This further represents a 15% larger mortality improvement relative to the 45 – 64 cohort, who showed a 38% mortality risk reduction for doing an equivalent three days of 10,000 steps per week. Members in this age cohort experienced the largest mortality improvements when changing their behaviour from being unengaged to sustaining 7,500 steps for five days a week.

These findings suggest that frequency rather than intensity of physical activity produces the largest mortality improvements for Vitality members 45 years and older, and that it is never too late to start exercising. In fact, the older one gets, the more important it is to be more active. However, when doing so, frequency and the regularity of exercise days are more important than the intensity of exercise.

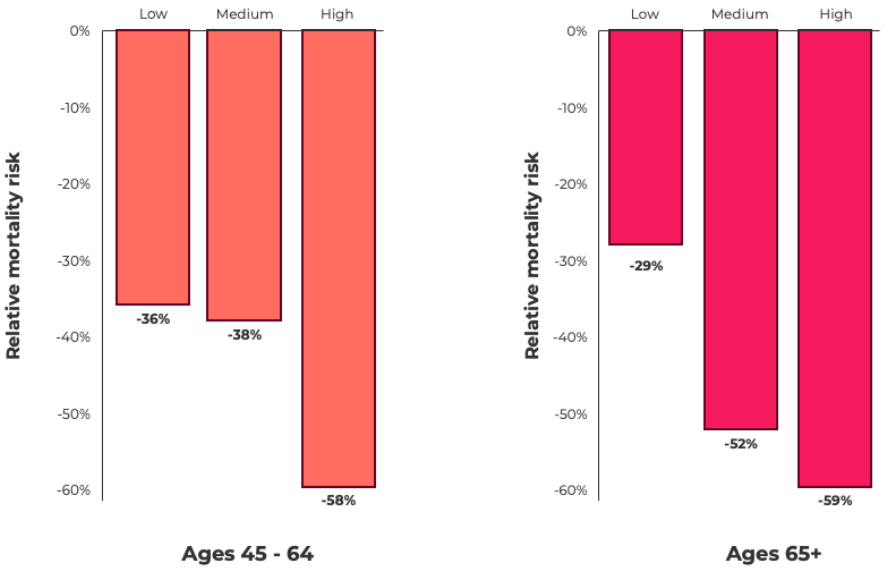


Figure 7: Relative mortality risk reduction by age

This study further highlighted similar effects in morbidity outcomes in the same data set. The results were especially promising with respect to the onset of higher stages of cancer and type 2 diabetes. After adjusting for confounders such as age, baseline levels of Vitality engagement and health

status, as well as prior screenings (for cancer), the results showed that members who changed their behaviour from being unengaged to sustaining at least medium levels of physical activity per week reduced their risk of diabetes by 41% and their risk of stage 3 and stage 4 cancer by 19% and 36%, respectively.

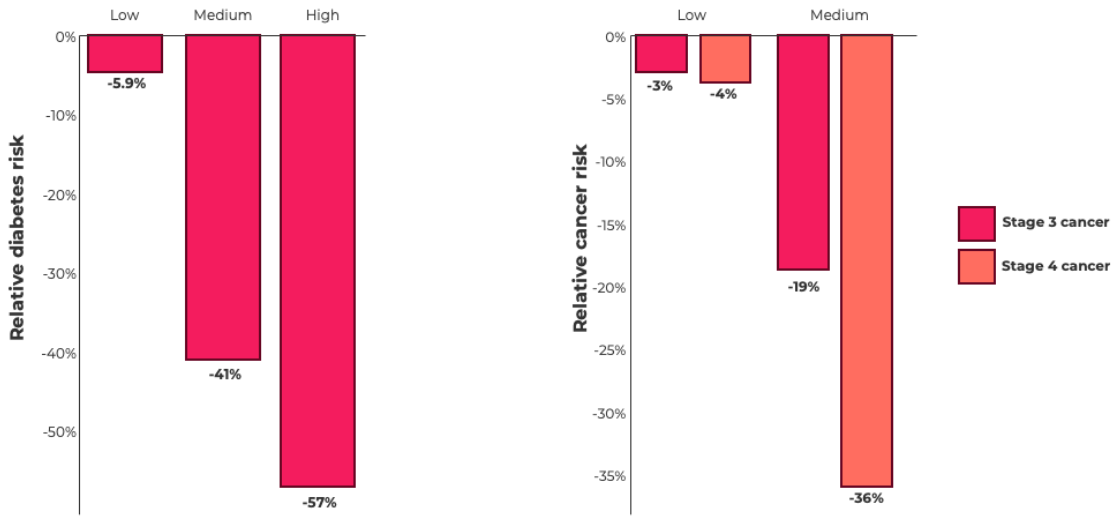


Figure 8: Relative diabetes (left) and cancer incidence (right) risk reduction

The above causal inference results were produced in South Africa because of the richness of health status data in South Africa and, in particular, our insight into chronicity. In the UK, our product does not cover chronic medication and treatment, and this means that we are not able to include all the relevant confounders in a causal inference study related specifically to mortality risk and non-communicable disease morbidity risk such as diabetes risk. However, because the South African causal inference studies adjust for all relevant confounders, these results are generalisable to any other population.

The impact of habit formation on mortality and in-hospital healthcare costs

The mortality improvements highlighted in the study above assume that a member will sustain their improved levels of activity over time. This assumption does not hold true if members do not show evidence of a sustained habit of exercise. The Habit Index thus holds crucial information in quantifying the likelihood that a member will sustain levels of physical activity in future.

To understand the impact of habit formation, we conducted an observational study in the period between 2016 and 2019 on a cohort of 215,201 members engaged in the Vitality Active Rewards (VAR) programme. We observed members who changed their physical activity behaviour from

no habit or from a bad (strong or weak) habit to a strong medium or strong good habit, to determine the impact of habit formation on mortality and in-hospital healthcare costs, relative to those who remained in no habit or a bad habit of physical activity.

Similar to the study previously discussed, a direct treatment could not be applied, thus treatment was assigned based on habit formation and maintenance in the two-year observation period (2017 – 2018), given the baseline period (2016) and the outcome period (2019).

Evidence from the study revealed that members who changed their behaviour by forming and sustaining a strong medium habit (i.e., consistently sustaining an average of two to three physical activity days per week, regardless of intensity) for two years saw a reduction in mortality risk and a 10% reduction in in-hospital healthcare cost in the outcome period. Members who changed their behaviour by forming and sustaining a strong good habit (i.e., consistently sustaining an average of more than three physical activity days per week, regardless of intensity) for two years saw a 27% reduction in all-cause mortality risk and a 13% reduction in in-hospital healthcare costs.

The impact of a sustained physical activity by habit is further replicated in in-hospital healthcare costs. The figures below show the per life per month in-hospital healthcare costs by age group. The per life per month in-hospital costs include claims for in-patient procedures, excluding maternity and trauma claims in South Africa, and only elective procedures in the UK. The impact on healthcare costs of a physical activity habit and particularly having no habit and a strong bad habit (i.e., sustaining no more than two physical activity days each week, regardless of intensity) was lower among the younger age groups. However, the impact becomes more significant for older age groups, particularly from 60 years old and older. The figure below further emphasises the importance of even minimal exercise among older age groups and highlights the importance of frequency and consistency of exercise as people age.

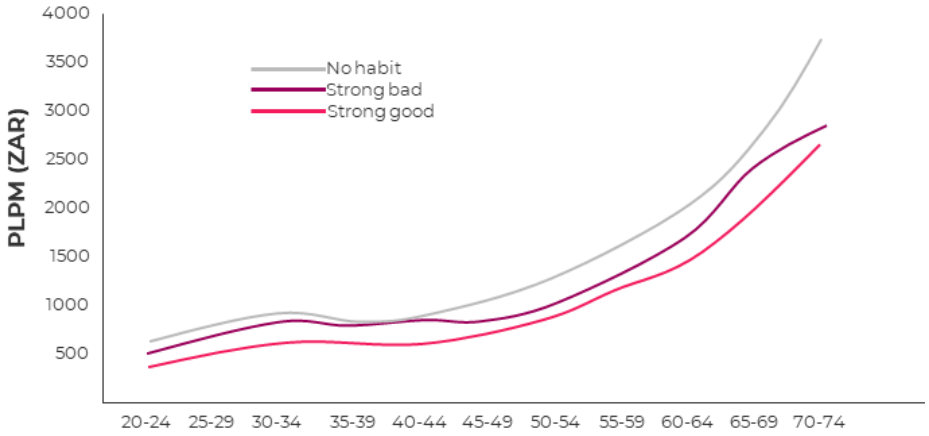


Figure 9: Per life per month (PLPM) by age band and habit (SA)

Evidence from analyses conducted on the UK Vitality Health book shows similar trends: having a strong bad habit, particularly at a younger age, has a marginal impact on healthcare cost, while there is a significant impact for the older ages, particularly for those aged 60 years and older. Analysis shows that members in the UK classified as having no habit often do physical activity without us knowing about it – they simply have not yet linked a device, and we therefore excluded the 'no habit' category from this analysis in the UK. In South Africa, we are more certain that the no-habit category includes only those who genuinely do not exercise. Nevertheless, the in-hospital (IH)cost curve in the UK produced similar effects for those with verified strong bad and strong good habits as in South Africa.

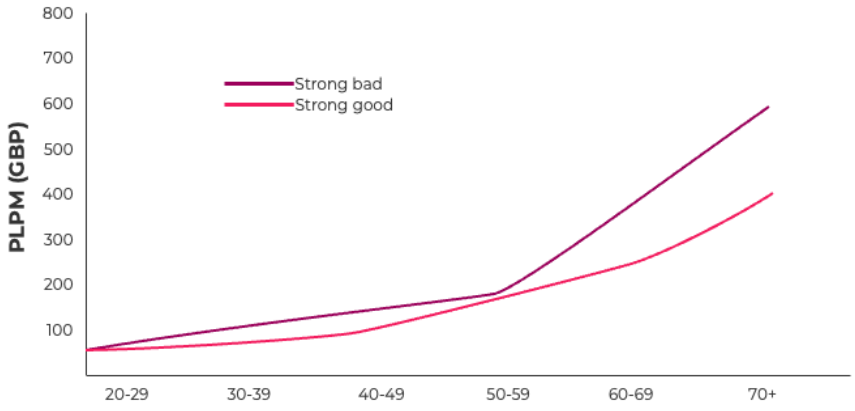


Figure 10: Per life per month (PLPM) by age band and habit (UK)

The impact of physical activity and habit formation on mental health and cardiac claims

The Vitality UK product covers mental health and elective procedures for severe illnesses such as cancer and cardiac treatments. Our causal inference methodology can thus be applied to the impact of habit formation and maintenance on the risk of a severe mental health or cardiac event.

To understand the impact of physical activity on a psychiatric claim, a cohort of 630,000 members in the UK Vitality Health book between 2015 and 2023 were baselined six months before an observation period of 12 months, whereafter the incidence of a psychiatric claim was observed in the outcome period, namely the six months following the observation period. Treatment was assigned based on the level of physical activity points, while control was assigned to those who remained unengaged or did low levels of physical activity. Low levels of activity are defined as doing up to and including two physical activity days per week, while high levels of physical activity are defined as doing more than two physical activity days per week. Psychiatric risk is defined as any psychiatry claim above £1000, or in-hospital treatments related to mental health (excluding genetic-related illness).

The results show that members who do no to low physical activity and seek a clinical intervention such as talking therapies (for instance, cognitive behavioural therapy) see a 9% relative reduction in future psychiatric claims relative to those members who do not. Members who engage in high physical activity levels see a 17% risk reduction in future psychiatric claims, relative to the low and unengaged members. Members who seek clinical intervention through talking therapies and engage in high levels of physical activity see a 19% risk reduction in future psychiatric claims relative to those who do neither.

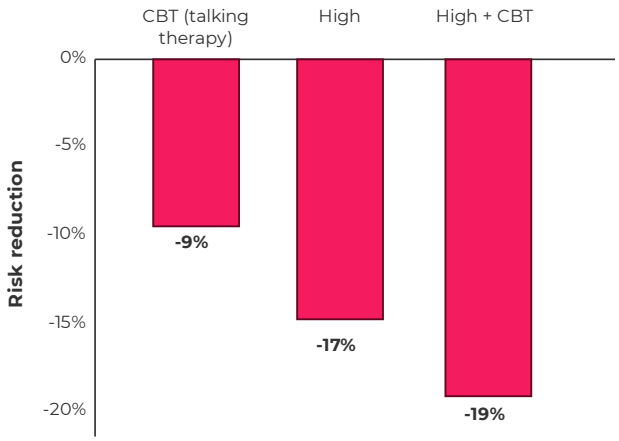


Figure 11: Relative psychiatric claim risk reduction

Every year, for every 10% of the 10% at-risk members that change their behaviour (or every 1% of members engaging) to include high levels of physical activity, the UK saves £510,000 on psychiatric claims. If these members also go for talking therapy, that amount increases to £570,000.

Similarly, the results from a study on a cohort of 165,100 members between 2015 and 2023, where members were observed for two years, indicate that members who developed and sustained a habit of three physical activity days or more per week showed a 25% reduction in cardiac healthcare costs relative to those who continued to maintain fewer than one physical activity day.

The persistency of habits

Habits persist, often outlasting external challenges and disruptions such as pandemic lockdowns. Data shows that 49% of members in Vitality SA and 45% of members in Vitality UK maintained their physical activity habits from before the COVID-19 pandemic one year after the pandemic.

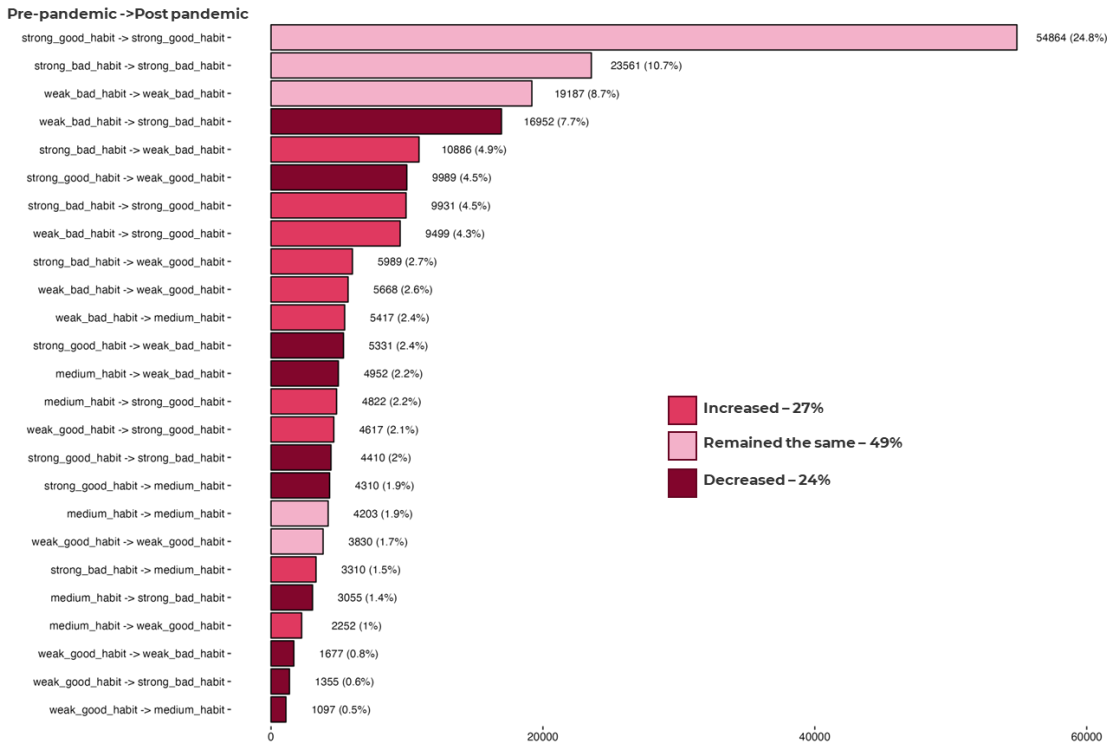


Figure 12: Pre-pandemic to post-pandemic habit transitions (SA)

Insights on how Vitality members transition over time from one habit zone to another reveal that they are most likely to maintain existing habits, regardless of the type. The largest group of people are those who maintain a good strong habit. However, the second-largest group are those who

maintain strong bad habits. In other words, habits are hard to change, and hence members are likely to sustain a habit over time. These trends are true for both physical activity and nutrition habits, as observed in the physical activity and nutrition transition matrices below. The transition probabilities further indicate that strong habits are most likely to persist and that medium habits are the most easily influenced.

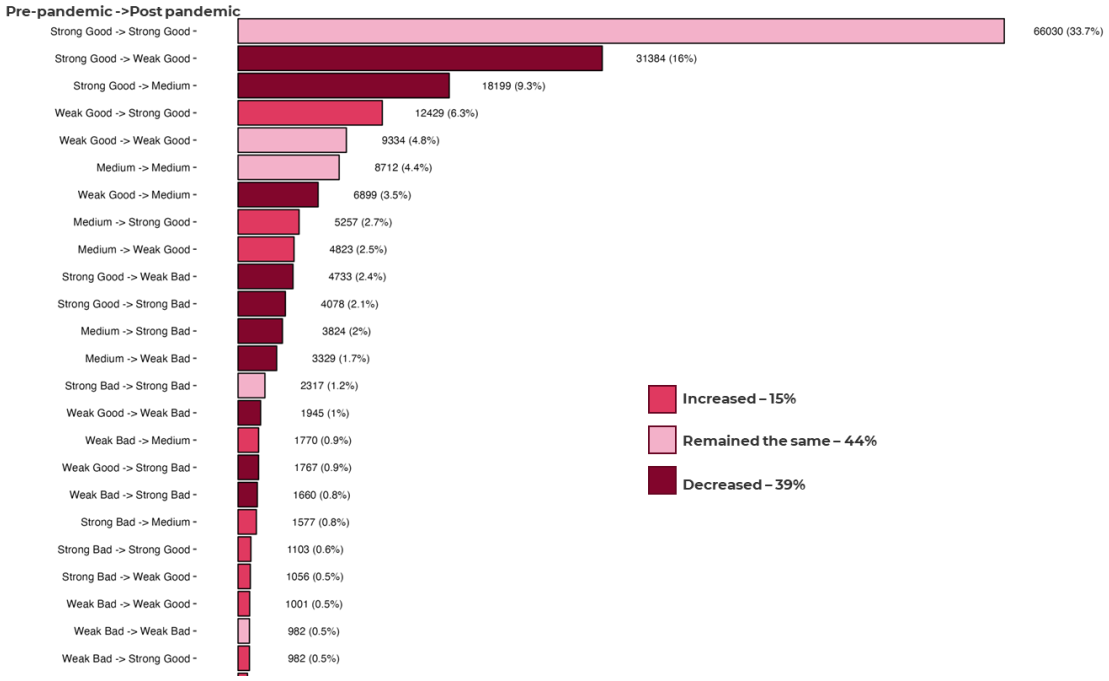


Figure 13: Pre-pandemic to post-pandemic habit transitions (UK)

The largest positive transitions were observed among Vitality members transitioning from a strong bad habit to a strong good habit. As shown in the section on the power of habits, the impact of this change in behaviour is significant and results in reduced mortality, cancer and diabetes risks.

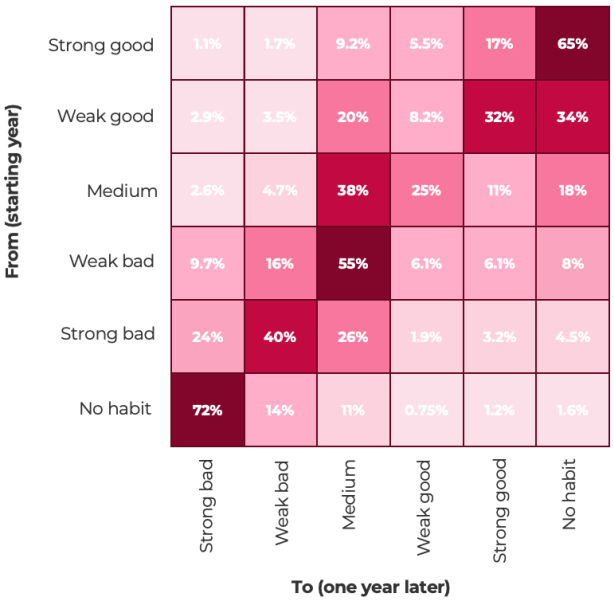


Figure 14: Physical activity habit transition matrix (SA)

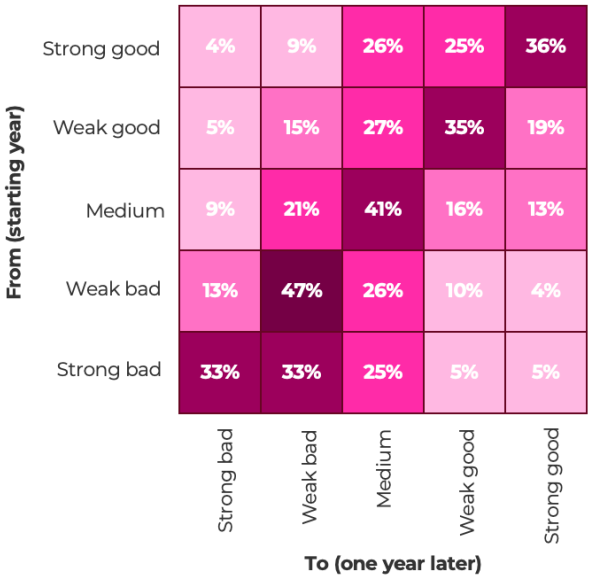


Figure 15: Nutrition habit transition matrix

Further analysis of the half-life of habits in the UK (the period at which 50% of members continue to maintain the habit) shows consistent trends in the persistence of habits, indicating that strong good habits have a half-life of six years.

Table 2: Half-life of habits (UK)

HABIT	HALF-LIFE
Strong good	6 years
Weak good	5 years
Medium	3 years
Weak bad	3 years
Strong bad	3 years

While we have no way of monitoring the formation and transition of habits outside the Vitality population, it is not unreasonable to assume that, in a population without rewards and incentives, people would generally transition out of strong good habits as they grow older. We observe high levels of persistency, which suggests that the Vitality programme, through its incentives and rewards, may provide motivation for members with strong good habits to maintain a healthy lifestyle, more so than in other populations.

The drivers of habit formation

Vitality helps members to form good habits

The Apple Watch Benefit and Active Rewards

The aim of the Vitality programme's benefits, such as Vitality Active Rewards (VARs), the Apple Watch Benefit (AW) and the HealthyFood Benefit (HF), is to incentivise and encourage the formation of good physical activity and nutrition habits.

Vitality members who took up the VAR and AW benefits between 2016 and 2022 (excluding the period of the COVID-19 pandemic, due to distortion in PA patterns because of the effects of strict lockdown periods) were likely to form stronger good habits or improve their baseline habit over time. Vitality SA data shows that 40% of Vitality members formed a strong good physical activity habit by engaging with the VAR or AW benefits, or both.

To determine the impact of the VAR and AW benefits on habit formation, we studied and compared members' habits before and after their take-up of the VAR and AW benefits, respectively. Eligibility for this cohort analysis required that Vitality members had to have had at least six months' exposure to the Vitality programme before the take-up of either benefit, and that they had to have had a device before their take-up of the AW benefit. This enabled us to determine a baseline or 'starting' habit and ensure we were not capturing measurement bias: the effect of recording physical activity through a device. We then compared these members' habits one year after the benefit take-up.

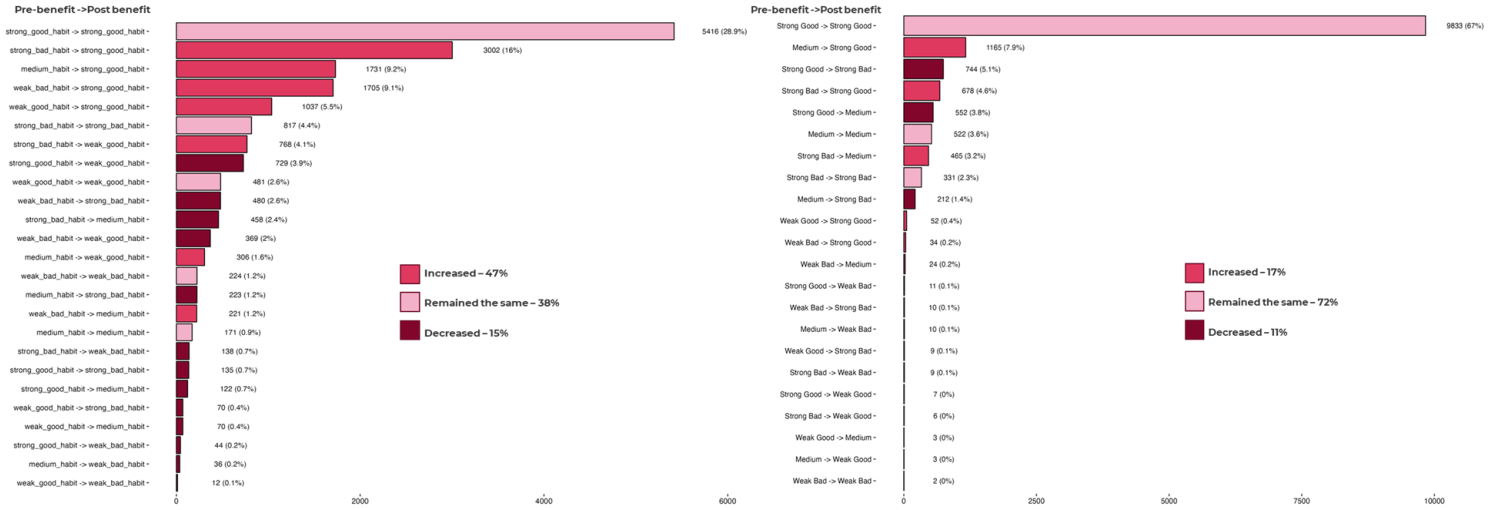


Figure 16: Pre-benefit and post-benefit transition matrix. Left SA, right UK

The analysis on Vitality SA found that 47% of members who took up the AW benefit formed a strong good habit from a strong bad habit, compared to 9% who had taken up AR. Further analysis showed that 99% of members with no habit who took up the AW benefit had improved their physical activity habit in some way a year later. Similarly, in the UK, data shows that 78% of members who started with a strong bad habit and took up the AW benefit improved their physical activity habit.

The Healthy Food Benefit

Analysis on a cohort of 200,000 members using the HealthyFood (HF) benefit also revealed that members with good habits were more likely to maintain their habits than members with bad habits. Below are a number of key insights from our nutrition habit analysis.

1. **Seasonality**
    a. Within each category, the healthiest habits tended to be in the summer months. Vitality members tended to have especially good food basket scores in January. The exception was December, which tended to be the unhealthiest month, most likely due to the holiday season.
    b. In the winter months (June, July and August), members also tended to have lower food basket scores, implying unhealthier eating behaviour.
    c. This seasonal effect was observed regardless of the habit category.
2. **Five-year period transitions (2018 to 2022)**
    a. During the pandemic (2021 and 2022), there was a higher proportion of Vitality members with good eating habits and a lower proportion of Vitality members with bad eating habits.
    b. In 2022, eating habits reverted to pre-pandemic levels, with the proportion of people with good nutrition habits decreasing and the proportion of people with bad nutrition habits increasing. This suggests that there were positive shifts in nutrition habits during the pandemic.
3. **Demographic associations with nutrition habit**
    a. Vitality members 65 years and older are more likely to have good nutrition habits. Almost 63% had good nutrition habits. This is about 20% more than members between 45 and 65 years old and 25% more than members 30 to 45 years old.
    b. Single Vitality members and couples without children are the most likely to have good nutrition habits.
    c. Vitality members whose policy changed from having no children to having children were 1.27 times more likely to

decrease the quality of their nutrition habit than members who did not change their policy.

4. **Physical activity and nutrition habits**
    a. The HealthyFood Benefit helps Vitality members build and maintain good physical activity habits. Up to 36% of Vitality members who took up the HealthyFood Benefit developed a better physical activity habit, while 39% of these members maintained their existing habit 12 months after the benefit take-up.
    b. Eighty-nine per cent of Vitality members who took up the HealthyFood Benefit sustained good nutrition and physical activity habits for up to 12 months.
    c. Exercise and nutrition habits are positively correlated. Vitality members who had a good physical activity habit were 11% (additive) more likely to have a good nutrition habit.

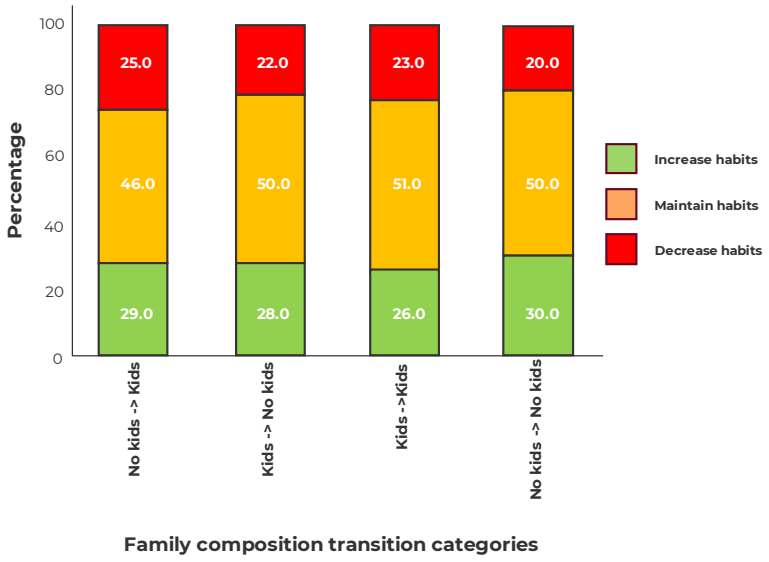


Figure 17: Nutrition habit changes by policy change

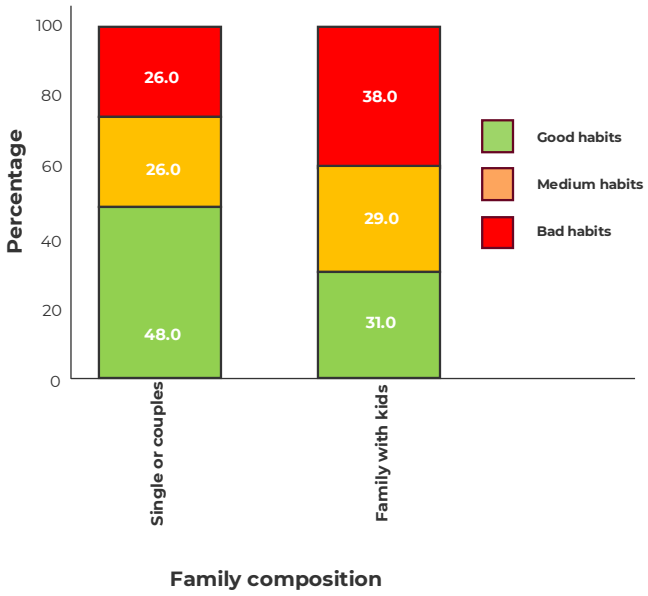


Figure 18: Nutrition habits by family composition

The role of micro and macro incentives in habit formation

Vitality members are incentivised to form and sustain healthy habits through rewards which stimulate ongoing engagement with physical activity and the purchase of healthier food options.

The first type of rewards is the micro or weekly rewards associated with Vitality members achieving their VAR goals for the week. Vitality members are allocated a gameboard play on the Discovery app for achieving their physical activity goal for the week. Members can wait and redeem their gameboard play on the specified day by choosing a tile on the gameboard which earns them rewards that can be redeemed for, at minimum, a coffee or a smoothie at a rewards partner.

To understand the impact of gameboard play allocation and redemption on habit formation, we studied the impact of a change in the rate of gameboard redemption (the proportion of gameboard plays redeemed to those allocated) in the period between 2017 and 2018 on habit formation at the end of 2018.

The results show that:

1. Vitality members who formed a strong good physical activity habit from no habit increased their gameboard redemption rate by 25%.

2. Vitality members who formed a strong good physical activity habit from a strong bad or weak bad habit increased their gameboard redemption rates by 12% and 7%, respectively.
3. The largest changes in gameboard redemption rates were associated with the greater habit improvements, moving from no habit to strong good physical activity habits. Smaller redemption rates were associated with smaller habit shifts, moving from weak good to strong good physical activity habits.

Figure 19: Change in gameboard redemption rate by habit transition

Similarly, in the UK, members sign up for the Caffè Nero benefit and are required to meet a standardised VAR weekly goal of 12 points (i.e., four sessions of 7,000 steps). Members who meet their goal receive a voucher for a free coffee at Caffè Nero. Evidence from the data shows that 18% of members who sign up and use the Nero benefit have improved their habit six months after benefit take up.

The second type of reward is a macro reward in the form of an annual Vitality status, which resets to Blue status and zero Vitality points every calendar year to encourage members to earn back their higher status level. A higher Vitality status offers enhanced travel and other discounts. To determine the impact of macro rewards on habit formation, we studied the impact of the number of flights booked using the travel discount in the period between 2017 and 2018 on habit formation in 2019. The study only considered Vitality members who had not booked any flights in the baseline year (2016).

The results showed that:

1. Vitality members who formed a strong good habit from no habit used three times more flights at discounted rates than those who remained in no habit.
2. Vitality members who formed a strong good habit from a strong bad or weak bad habit used twice the number of flights at discounted rates than those who remained in a bad habit.

Figure 20: Relative number of flights used by habit transition

This suggests that the travel discounts used in the previous years, which are associated with Vitality status levels, correlated with members maintaining or increasing their physical activity habit in the following year.

Breaking bad habits

Physical activity

Our data suggests that active engagement with the Vitality programme provides a strong foundation for the formation and maintenance of good physical activity and nutrition habits. This dataset further provides the opportunity to understand how Vitality members changed their behaviour from strong bad habits to strong good habits, by specifically looking at which activities Vitality members engaged in to transition from a strong bad habit to a strong good habit.

The analysis of Vitality members who changed their behaviour from a strong bad habit to a strong good habit revealed a consistent trend. These members engaged in two weekly sessions of 5,000 steps each, accompanied by one moderate-intensity workout session.

Our data further showed that members who transitioned from a strong bad habit to a strong good habit took seven to fifteen weeks to build a strong good habit.

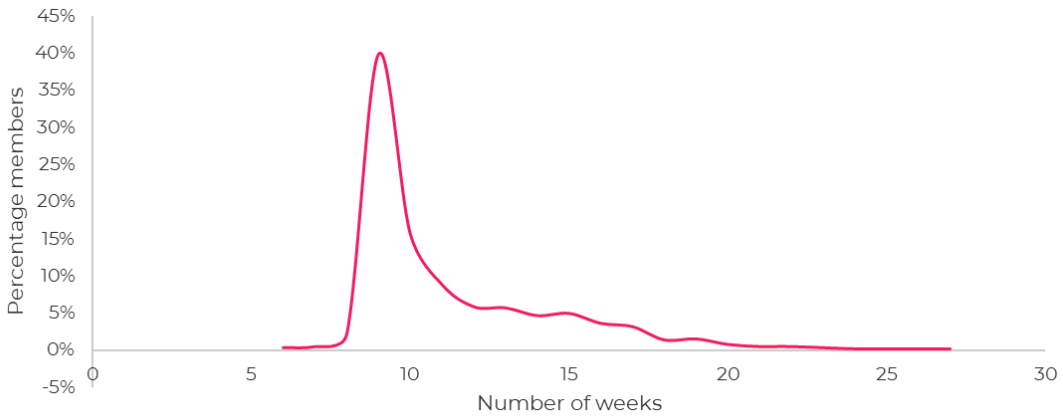


Figure 21: The distribution of the number of weeks taken to form a habit

Similarly, those Vitality members moving from a medium habit to a strong good habit increased their physical activity routine by adding an extra 5,000-step session and another moderate-intensity workout each week.

An analysis of Vitality UK members who changed their behaviour from a strong bad habit to a strong good habit in winter showed that they went from doing mostly one 7,000-step workout per week in summer to doing three or more gym sessions per week in winter, while those members who built strong good habits in summer went from doing one session of 7,000 steps per week or one gym session per week in winter, to doing at least three gym workouts per week or a combination of three or more 7,000-step days with at least one day of 10,000 steps.

This highlights the importance of gradual, sustained efforts in building strong good habits. The key lies in consistently integrating manageable, low- to moderate-intensity workouts over time rather than commencing with a sudden, intense exercise routine.

Insights from physical activity data in Vitality SA and Vitality UK show that habits built around low-intensity and short moderate-intensity workouts and step workouts such as 5,000 steps and 10,000 steps have an average half-life of 13, 9 and four years, respectively.

Table 3: Half-life of habit-building activities

OVERALL	SA	UK
Short moderate intensity	13 years	5 years
Low intensity	9 years	-
Long moderate intensity	6 years	3 years
10,000 steps	5 years	3 years
7,500 steps	4 years	2 years
5,000 steps	3 years	-

Personalised step threshold experiment

Our data shows that there is an opportunity to help people who have no habit or a bad habit to form positive physical activity and nutrition habits.

Using this insight, a randomised controlled trial was run on a cohort of Vitality UK members for a period of eight weeks. The aim was to test whether engagement increased at various step thresholds, compared to the standard Vitality Active Rewards goals, which require Vitality members to walk a minimum of 7,000 steps to earn points.

Just over 20,000 adult Vitality members who had linked a device and uploaded activity data but had not met their weekly points goal (walking 7,000 steps four times in the week) more than once in the previous three months were eligible for this trial.

Members were split into the following groups:

1. **Control**: Given the standard activity goals of 12 points each week
2. **Treatment 1-1**: Lower step thresholds with a fast progression
3. **Treatment 1-2**: Lower step thresholds with a slow progression
4. **Treatment 2-1:** Lower step thresholds with a fast progression, and two extra points for the first four weeks
5. **Treatment 2-2:** Lower step thresholds with a slow progression, and two extra points for the first four weeks

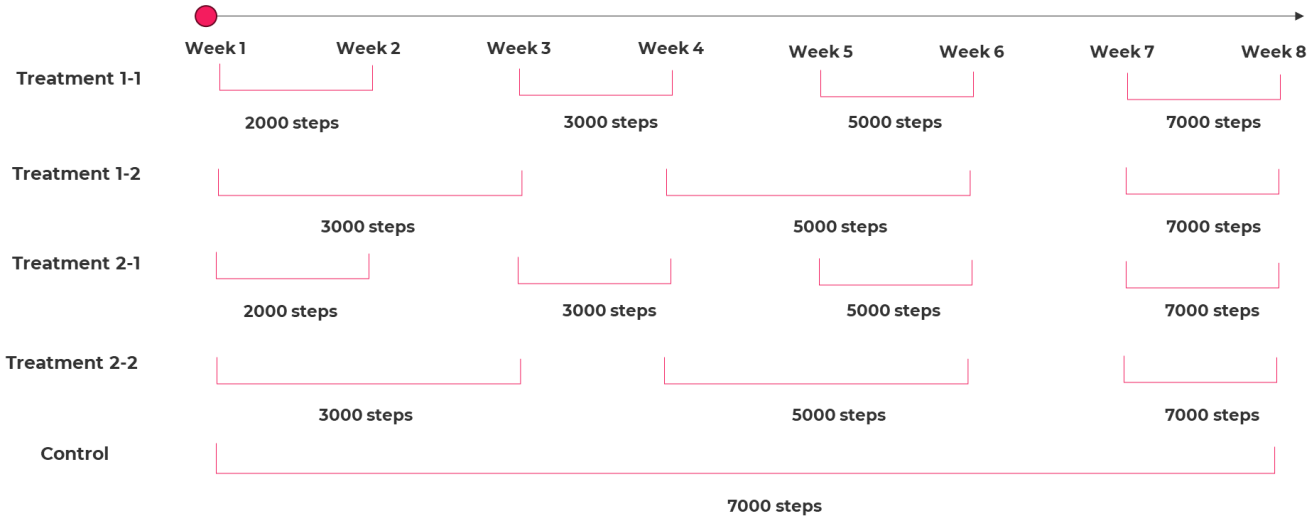


Figure 22: Variable step experiment design

Each group had to walk their daily step threshold a minimum of four days a week to earn 12 points for the week and redeem a £5 Amazon voucher. The results from the experiment showed that Vitality members in the treatment groups had a significantly higher goal achievement rate compared with the control group, suggesting that the gradual steps threshold progression was effective at getting members to engage. Treatment 1-2 showed the highest level of achievement and the lowest drop rates, indicating that lower daily step thresholds with slower weekly progressions were effective in helping to build habits.

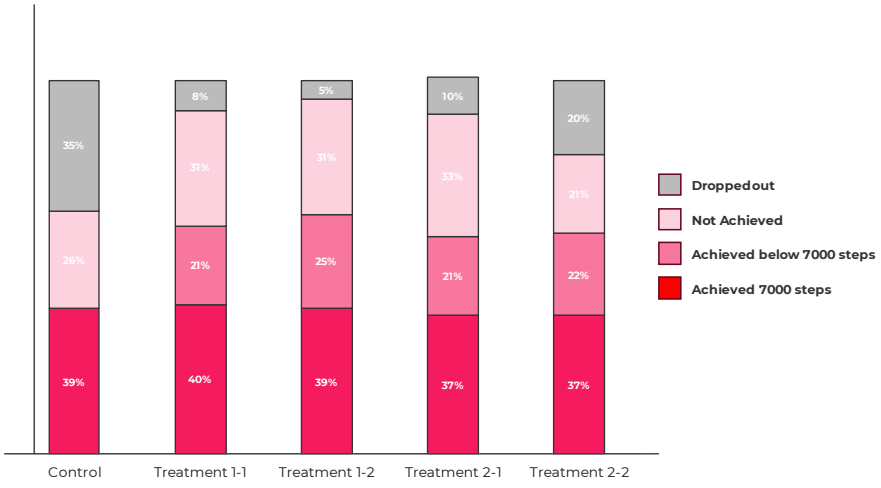


Figure 23: Achievement and drop-out rate results

The comparison between physical activity before and during the experiment showed that previously inactive members became more active. In both the control and treatment groups, members who had previously recorded 5,000 or more steps fewer than once a week increased to recording 5,000 steps

close to three times a week, on average, improving their engagement by two extra days a week.

The follow-up findings (nine weeks after the experiment, and after the removal of the Amazon vouchers) showed that the two least engaged treatment groups increased their 5,000-step days by 73% and 35%, respectively. All treatment groups increased their 7,000-step days relative to what they were achieving prior to the experiment, with 46% of participants improving their physical activity habits after the experiment compared to before. Additionally, participants were 31% more likely to be engaged nine weeks after the experiment.

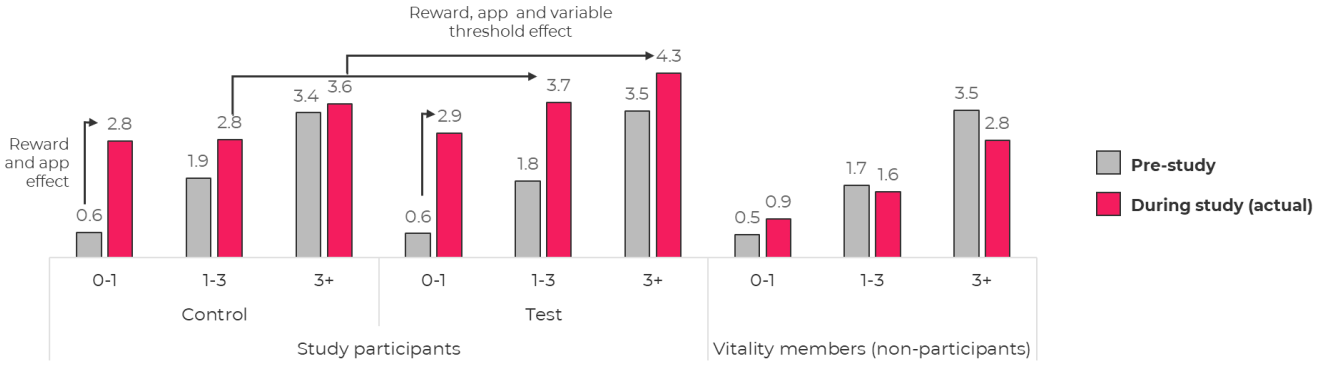


Figure 24: Comparison of average number of 5,000-step days per week before and during study

This study confirmed what had been emerging in our observational analyses on habit formation and transitioning from bad habits – that gradual and consistent behaviour change is key to forming strong, good habits.

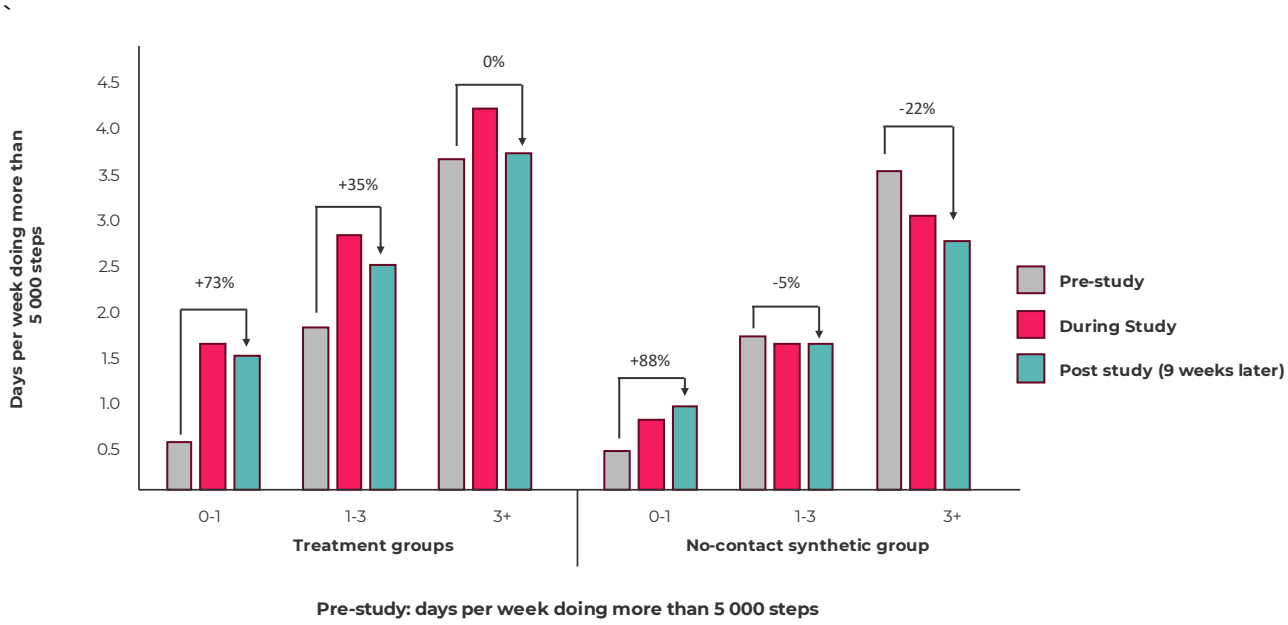


Figure 25: Comparison of average number of 5,000-step days per week before and after study

Nutrition

An analysis of our nutrition data shows that Vitality members with good nutrition habits have roughly twice as many vegetables, legumes and fruits in their food baskets, compared with members with weak, bad habits. These members with good, strong habits also tend to purchase half as many unhealthy starches, convenience meals and confectionaries.

Vitality members who changed their nutrition habits from a medium or weak habit to a good habit tended to increase their fruit and vegetable items and reduced unhealthy starches, convenience meals and beverages. There was no observable change in the dairy and protein items purchased.

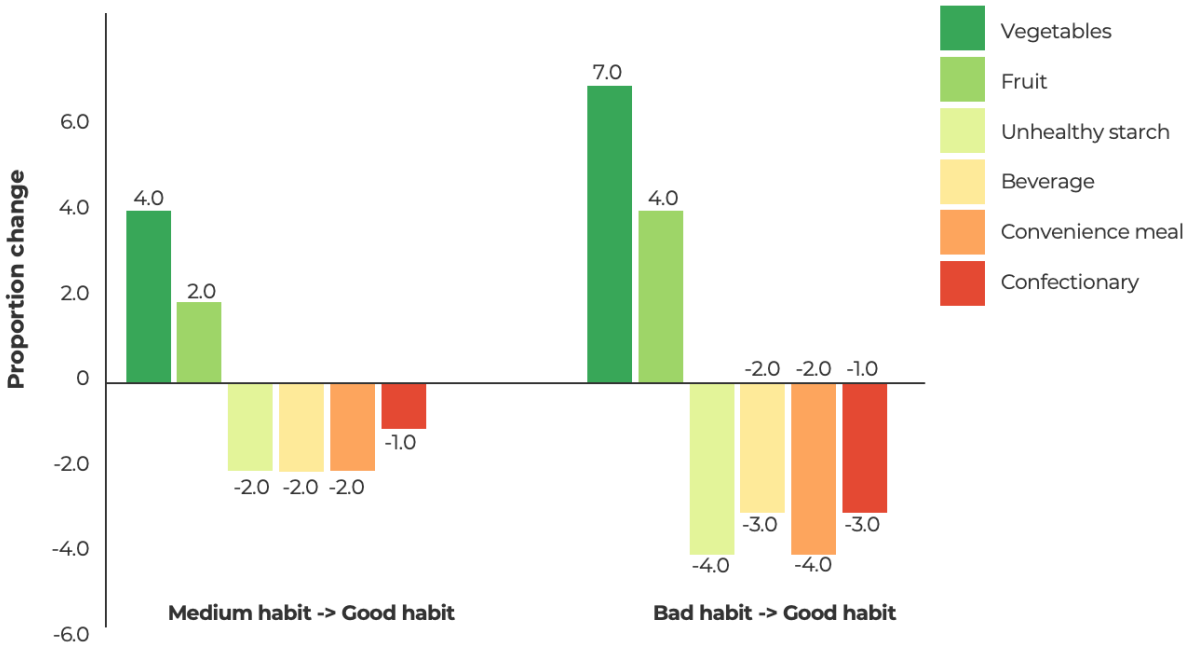


Figure 26: Proportion of item changes by nutrition habit change

How to create new, healthy habits

Findings from the discussion on the impact and drivers of habit formation reveal three key trends on how individuals can create new, healthy habits that are impactful, persistent and practical.

1. The impact of moderate levels of physical activity, done frequently and consistently
2. The importance of low to moderate levels of physical activity when attempting to form a good habit that is persistent
3. The importance of gradual and small increases in intensity over time to reach a desired physical activity target

The purpose of this section is to synthesize these findings into actionable and practical recommendations for individuals to create healthy habits, regardless of context.

The paradox of 10,000 steps

Striving towards walking 10,000 steps daily has become the gold standard of physical activity goals. The origins of this seemingly innocuous number come from a Japanese company that created a device called a 'Manpo-kei' as a marketing tool, which directly translates to '10,000-step meter' (Harvard, 2019; Lee et al., 2019).

Reaching an average of 10,000 daily steps is a difficult target for most people. Vitality SA data shows that members who record activity for at least five days of the week reach an average daily target of 5,230 steps.

Evidence from our causal inference study suggests that moderate levels of physical activity can lead to significant improvements in mortality and morbidity. We show that at least three sessions of 10,000 steps per week, which is 5,714 average daily steps if these members do only 2,500 steps on the other four days of the week, can lead to significant mortality and morbidity improvements.

The investigation then turned to understanding the optimal number of daily steps required to reach maximum mortality improvements. We accordingly studied a cohort of 604,516 members who recorded daily steps in the periods 2017-2019 to determine the impact of their average daily steps on mortality in 2019, and 2022.

Adjusting for gender and age, we plot a locally weighted regression function to the data. The graph below suggests that mortality benefits reach a maximum at between 7,500 and 8,000 average daily steps and begin to diminish beyond that point. The graph further indicates that this point yields a mortality reduction of 50% relative to those members who record no steps or do no activity.

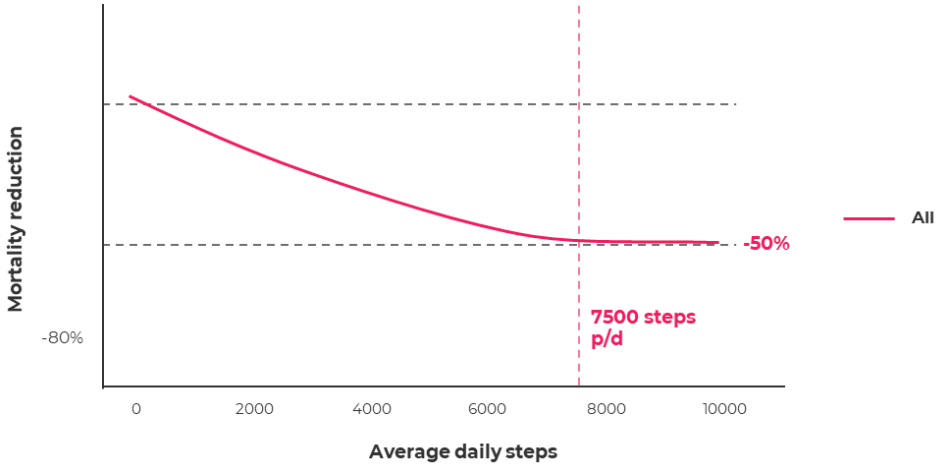


Figure 27: Mortality reduction as a function of average daily steps

These effects are further amplified when stratifying on members 65 years old and older. The graph shows that for older people, just doing a minimal amount of physical activity such as 2,500 average daily steps can give a mortality reduction of 20%. The tapering off of the marginal returns on mortality improvements further occurs at 6,400 average daily steps, a lower threshold than the larger population.

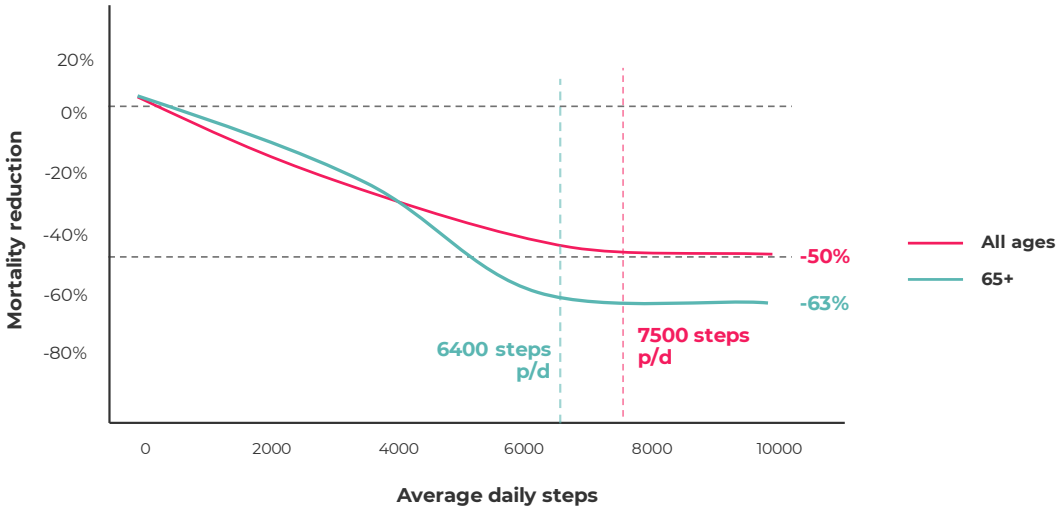


Figure 28: Mortality reduction as a function of average daily steps (65+)

Three rules for building practical, persistent and powerful habits

Vitality's data and the discussion in the above chapters emphasise the importance of gradual and small increments in intensity over time to reach a desired physical activity target.

We confirmed our hypothesis by studying members who had built a habit of walking 7,500 average daily steps, in that we observed that those who tried to build it too quickly (increasing the amount they walked every week) tended to drop off more often than those who made smaller, more gradual increments.

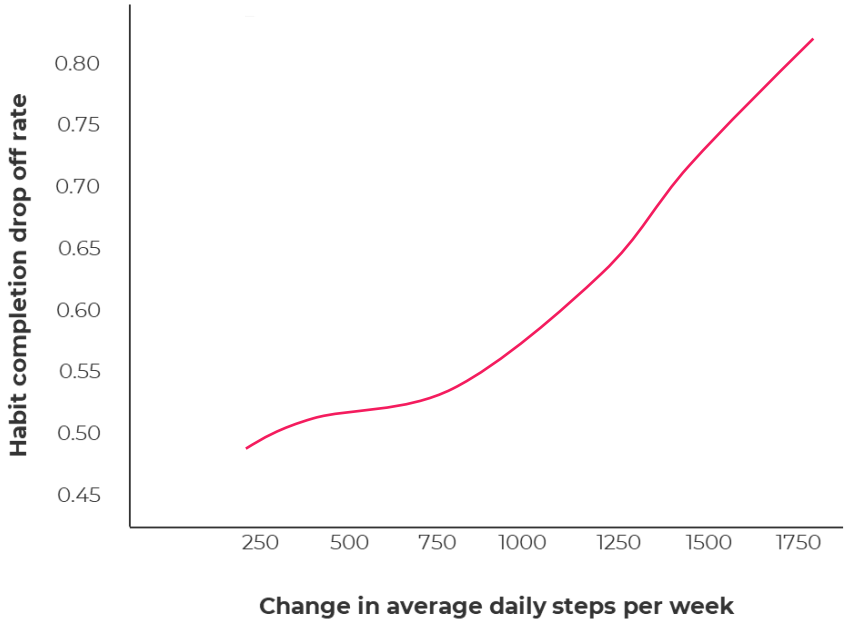


Figure 29: Drop-off rate as a function of change in average daily steps per week

This insight into the importance of moderate physical activity daily or in three to five sessions per week, and making small and gradual increments when forming a habit of walking either 5,000 or 7,500 steps, surfaces the concept of 'habit laddering' and the three rules to habit laddering.

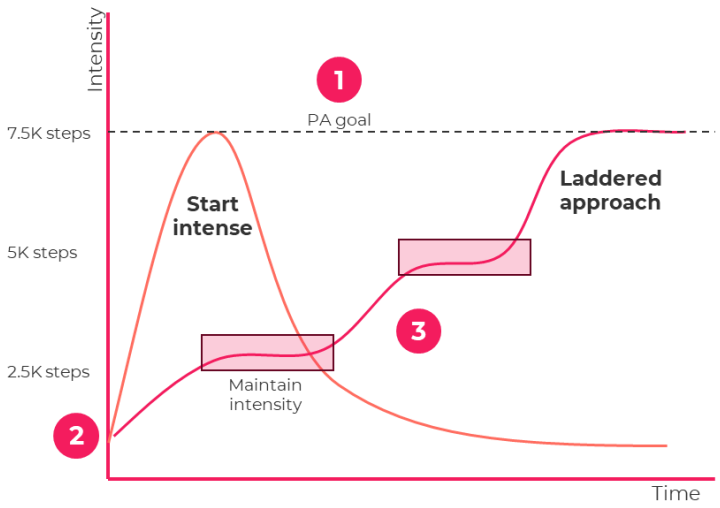


Figure 30: Habit laddering

Rule 1: Set a target from your baseline.

Activity targets are dynamic and evolve as existing activities change into habits. For example, when inactive, starting with 2,500 steps three to five times a week is practical and serves as the 'first step on the ladder', while doing 5,000 steps will be higher up. However, for someone habitually doing 5,000 steps three to five times a week, advancing to 7,500 steps becomes the practical next step. The key is to establish a habit at the current, most practical activity before intensifying it or increasing its frequency.

Rule 2: Start low and slow – don't be too ambitious.

Start small, and always increase intensity in small practical amounts – practical is relative to your current exercise stage. For beginners, the key is to start with low- to moderate-intensity physical activity at a low frequency, avoiding excessive demands. Research and our findings reveal that individuals with minimal experience should set small and achievable goals and focus on building frequency and consistency.

Rule 3: First focus on consistency, then on intensity.

Focus on building frequency and consistency of a specific action before increasing intensity. Repeat a specific action consecutively for six to eight weeks before increasing intensity. For example, if you want to build a habit of doing 5,000 steps three days every week, repeat this action for six to eight

weeks to form a habit of it. Thus, increase frequency first, then your intensity, and don't increase your intensity by more than 800 average daily steps a week when forming a new habit.

The relationship between healthy habits and behaviours

Our findings demonstrate the reinforcing nature of healthy habits. There is a strong correlation between healthy physical activity and nutrition habits, and sleep behaviour. We found that once an individual establishes a healthy physical activity habit, it has positive repercussions for their broader health and wellbeing.

Our data shows that physical activity habits are highly correlated with good nutrition and sleeping behaviour. We found that maintaining a strong good physical activity habit is associated with a 10% improvement in eating habits and one month of extra sleep per year relative to individuals with no physical activity habit or a strong bad physical activity habit.

Looking at a cohort of 4,000 members who had no physical activity habit or a strong bad habit in 2017 and then changed to having a strong good physical activity habit in 2018, we found that 50% of these members also developed a strong good nutrition habit in the following year (2019), and improved their sleep by two hours on average per night relative to those who persisted with no habit or a strong bad physical activity habit.

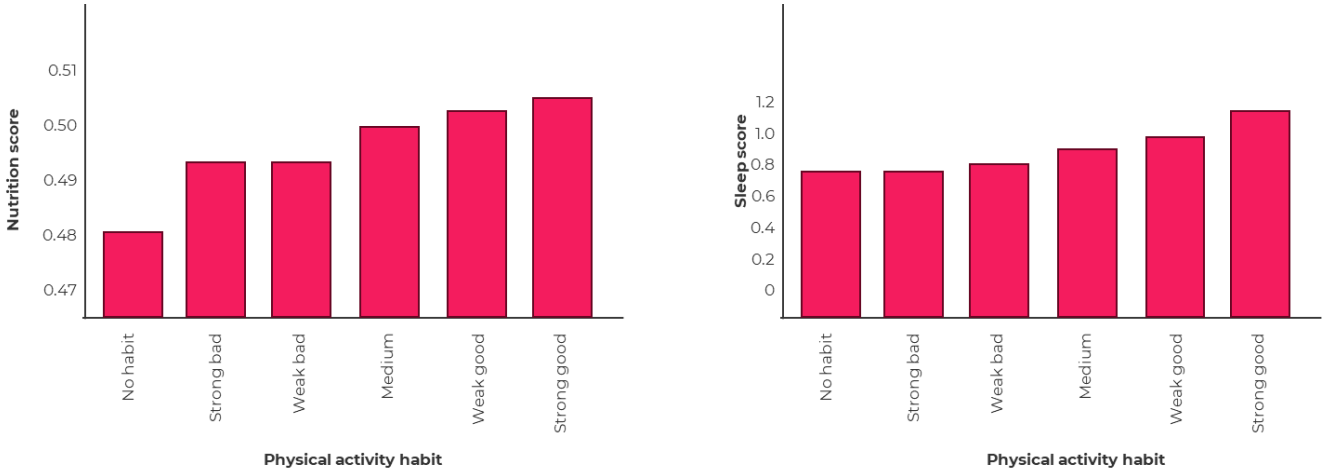


Figure 31: Nutrition score (left) and average sleep hours (right) by physical activity habit (unengaged base)

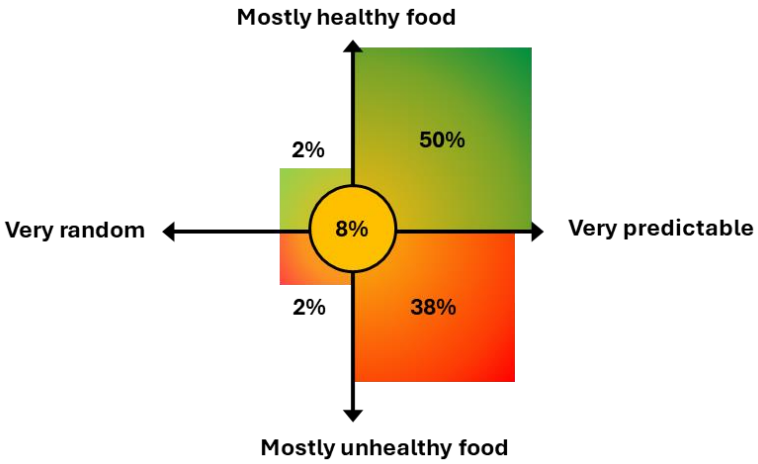


Figure 32: Nutrition habits of members who formed a strong good PA habit (excluding no habit)

Impact on society

The purpose of this section is to determine the impact of moderate increases in physical activity on in-hospital health care utilisation and costs, and the estimated impact that this change can have on a society.

To determine the impact of habit on in-hospital use and cost, we assigned habits to each individual member the year prior to the year in which we observed their individual in-hospital healthcare costs. Thus, we observed habits in 2017 and in-hospital costs in 2018 and did the same for the years 2018 and 2019, and 2022 and 2023, respectively. We excluded the COVID-19 years to avoid the distortion in patterns of exercise and healthcare costs observed during the pandemic.

Using the causal inference techniques discussed earlier in this report, the average impact on in-hospital costs over these three years was then estimated. For this analysis we only considered the no habit, strong bad habit and strong good habit categories and thus quantified the impact of a change in habit from:

1. No habit to strong bad
2. No habit to strong good
3. Strong bad to strong good habit.

The dataset consisted of 718,000 members of whom 24% were classified as having no habit and were thus not even achieving 5,000 steps once a week. For the purposes of the analysis, we only considered the 172,000 members with no habit, the 79,000 members with a strong bad habit and the 132,000 members with a strong good habit.

The figure below shows the average cost per person (life) per month (PLPM) by habit and age band. Consistent with the hypothesis that physical activity reduces the intensity of hospitalisations and, hence, the costs of in-hospital care, we found that the frequency of in-hospital costs increased with the age of the individual, although the increase was steeper for the no habit group compared to the active groups. However, as expected, the effect of rising hospitalisations emerged among the older age groups, particularly affecting individuals 60 years old and older.

Furthermore, we identified an extra gap between those individuals from good exercise groups compared to bad (poor) exercise groups. This indicates that the main effect on hospitalisation is driven by the extent to which individuals have an established habit or not.

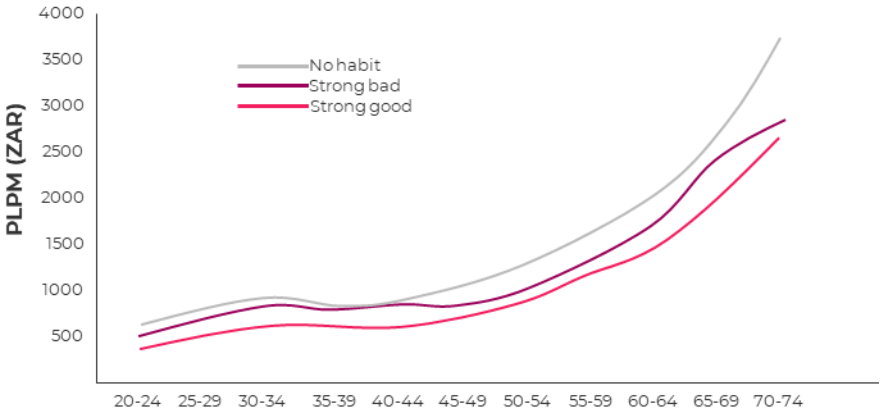


Figure 33: Per life per month (PLPM) by age band and habit

More specifically, the table and graph below show the percentage reduction in cost relative to the no habit group by individual age bracket. The reduction in in-hospital healthcare cost is found among all ages, but it appears to increase with age among those with a strong bad habit and to exhibit a steeper reduction in costs for younger age groups for those with a strong good habit, although at older ages the reduction reveals a clear non-linear effect. The picture that emerges from these results is twofold. First, strong habits reduce in-hospital costs, but the effect is significantly stronger among those that have a good exercise routine in addition to strong habits.

Table 4: Relative per life per month (PLPM) in-hospital cost reduction

	STRONG BAD HABIT	STRONG GOOD HABIT
20-24	-3.0%	-35.0%
25-29	-11.8%	-38.3%
30-34	-8.9%	-36.8%
35-39	-10.0%	-33.7%
40-44	-9.1%	-33.1%
45-49	-13.6%	-36.6%
50-54	-13.3%	-28.2%
55-59	-16.0%	-27.2%
60-64	-12.2%	-25.6%
65-69	-11.7%	-36.2%

70-74	-16.9%	-21.8%
75-79	-17.6%	-22.0%
80-84	-13.7%	-26.5%
>=85	-17.8%	-22.9%

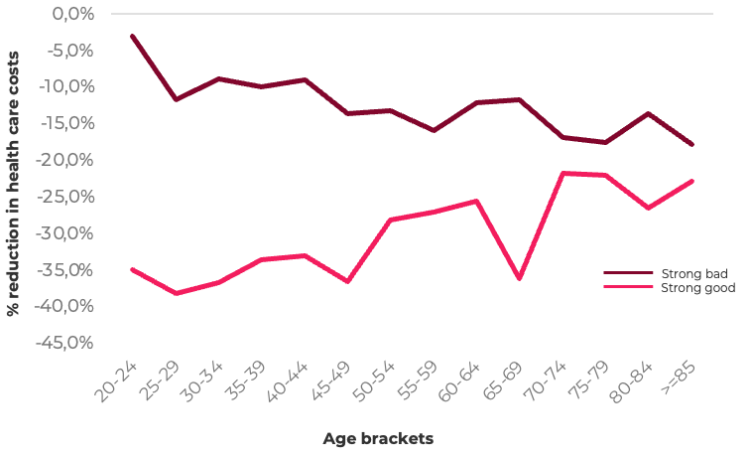


Figure 34: The percentage relative cost reduction

The Discovery data shows that 24% of adults fall into the no habit group. While it is difficult to obtain UK data using a similar definition of exercise, a Rand Europe study (Guthold et al., 2018; Hafner et al., 2020) estimated the prevalence of insufficient physical activity in the UK to be 31.5% for males and 40.0% for females, although the definition used for physical activity was more onerous. We believe that an assumption that 35% of the adult UK population falls into the no habit status would thus be reasonable.

If one assumes that the same percentage savings as set out in Table 1 can be achieved for the UK population, then if only half of the inactive UK adult population could be incentivised or encouraged to become more physically active, and those that are inconsistently exercising attain a habit of moderately higher average daily step counts, the in-hospital cost saving that can be achieved is £15bn. This is based on:

- The estimated NHS hospital spend in 2021 for adults of £96 billion
- Half the inactive population in the UK walking at least 5,000 steps once a week

- The insufficiently active population (those with weak habits of exercise or achieving 5,000 steps or more only once a week) changing their physical activity habit to three events of at least 5,000 steps per week.

This is a material saving, and it can only be realised if new habits of exercise are established and maintained. However, as we demonstrated in this report, it is possible to do so with the right incentives, and it is certainly worth aiming for, given how material the impact would be on the NHS and on the quality of people's lives.

Recommendations for policymakers and further studies

These recommendations aim to provide actionable strategies for stakeholders to promote habit formation and improve health outcomes, drawing inspiration from successful initiatives worldwide. By prioritising habit-based interventions, policymakers and stakeholders can contribute to a healthier and more resilient population.

For regulators and policy makers

Promote prevention in public health: Implement policies that prioritize behaviour change and habit formation as a means of disease prevention and reducing the healthcare burden. Increase prevention budgets to enhance public health interventions strengthening the importance of healthy habits in preventing chronic diseases. Utilize evidence-based approaches that have the potential to enhance the link between healthy habits and reduced healthcare costs. Distinguish evidence-based interventions, like the one in this paper, which uses verified physical activity data to show the causal relationship between healthy habits and health outcomes. These findings are supported by studies, which have shown that regular physical activity and healthy nutrition significantly reduce the risk of developing non-communicable diseases such as heart disease, diabetes, and certain cancers, thereby decreasing healthcare expenditures (WHO, 2022).

Evidence from this study suggests that public health promotion should acknowledge that while exceeding 150 minutes of moderate-intensity physical activity weekly offers significant benefits, even lower levels of exercise are highly advantageous too. That is, *every minute of exercise contributes to better health.* This approach helps to overcome obstacles to starting physical activity, especially when the perceived challenge seems overwhelming. By starting with manageable and gradual steps, individuals can lay the groundwork for developing enduring healthy habits, as evidenced by the habit laddering approach. Supported by evidence from 'Small Steps, Strong Shield', individuals engaging in even minimal physical activity demonstrated better COVID-19 outcomes compared with those who

were sedentary. This underscores the significant protective effect of even moderate levels of physical activity (60 to 149 minutes each week).

Promote walkable cities initiatives: Invest in urban planning that prioritises walkability and accessibility, and integrate considerations for an active population into the design of transport systems, with the aim of fostering environments where individuals can effortlessly reach a minimum of 5,000 steps a day. Examples such as the 'Healthy Streets' initiative in London could serve as models for urban development. By promoting active lifestyles through infrastructure improvements, governments can reduce the incidence of sedentary-related diseases and associated healthcare costs (Healthy Streets, 2024).

Develop occupational health programmes: Collaborate with employers to implement occupational health programmes focusing on habit formation, particularly by promoting physical activity during work hours. Actively participate in shaping the future of support for health and disability in the workplace, aligning with the green paper's focus on improving employment outcomes and preventing disability-related job losses**.** The Finnish Institute of Occupational Health provides research-based expertise and services to improve the wellbeing of employees and productivity for employers. They collaborate with employers to integrate health promotion programmes into the workplace, addressing both physical and mental wellbeing. The Finnish government supports these initiatives through policies that encourage a healthy work environment and provide incentives for companies to invest in employee wellbeing.

Intersectoral collaboration: Intersectoral collaboration is paramount, as the policy recommendations intersect across various sectors. Governments must prioritise occupational health programmes, emphasising collaboration with employers to promote long-term health benefits that positively impact welfare across society. Employees must actively engage in these initiatives to reap individual benefits, thereby contributing to a more productive, content and healthy workforce, which ultimately enhances societal wellbeing and economic prosperity. This cyclical process underscores the government's responsibility to ensure sufficient support for both employers and individuals in fostering healthy habits and lifestyles, thus reducing healthcare burdens and bolstering the economy. Therefore, intersectoral collaboration is not only inevitable but also essential. Policy alignment among stakeholders is crucial to optimise resource utilisation and achieve the most effective outcomes. Regular evaluation and adjustment of strategies can be performed based on evidence, and new incentives can be piloted to help adjust individuals' physical activity to their needs and promote the long-term enhancement of their healthy habits.

The Liveable City Initiative in Singapore exemplifies the importance of intersectoral collaboration in fostering a healthy and vibrant urban environment. Through this initiative, the government collaborates with various sectors to create sustainable infrastructure, promote green spaces and ensure efficient transportation systems, all of which contribute to the wellbeing of its citizens. One key aspect of this initiative is the prioritisation of occupational health programmes, which underscores the government's commitment to the long-term health and welfare of its workforce. By strengthening collaboration with employers, the government aims to create a supportive environment that encourages employees to actively engage in health-promoting activities. This collaborative effort not only benefits individuals by enhancing their overall health and wellbeing but also contributes to a more productive and content workforce. Moreover, by reducing healthcare burdens and fostering healthy habits and lifestyles, this initiative ultimately leads to societal wellbeing and economic prosperity. Intersectoral collaboration is therefore essential to ensuring the success of such initiatives, as it allows stakeholders to align policies, optimise resource utilisation and achieve the most effective outcomes. Continuous evaluation, guided by evidence, further enhances the efficacy of initiatives, ultimately promoting sustained improvements in physical activity levels and healthy habits among individuals (Kiyota & Loo Lin, 2023).

For employers

Productivity and mental health support: Integrate physical activity initiatives into workplace wellness programmes, recognising the link between strong physical activity habits and improved mental health. Consider initiatives that promote active lifestyles among employees, such as offering subsidised gym memberships, providing standing desks or organising walking meetings. By prioritising employee health and wellbeing (sleep and lower stress), employers can improve motivation and productivity and reduce absenteeism (while increasing presenteeism), ultimately contributing to overall economic prosperity (Schultz et al., 2012).

Importantly, this links to government's role in promoting the establishment of occupational health programmes: governments and employers alike need to focus on support for health and disability in the workplace. Drawing inspiration from initiatives like Vitality's 'Britain's Healthiest Workplace' can improve business outcomes such as productivity and retention, ultimately contributing to a more prosperous economy. A notable example is Experian, which secured the third position in the Large Business category of the Vitality Healthiest Workplace Survey. Experian demonstrates a steadfast commitment to enhancing individuals' mental health and wellbeing while fostering an environment conducive to the flourishing of each employee (Pitchford, 2023).

A traditional ‘one size fits all’ plan is not sufficient, and rarely works. Yet most businesses struggle to adopt a flexible, personalised approach, often putting in several interventions in the hope that they will support the whole employee base. Data enables businesses to understand their employees and the unique health and wellbeing challenges of each of them. Businesses need a health and wellbeing strategy with relevant and targeted interventions, developed around the data and their specific business needs. Data and regular reporting also enable businesses to monitor progress and understand what is having the most positive impact.

For insurers

Incentivising healthy behaviours: Offer insurance incentives for individuals who systematically engage in healthy habits such as regular physical activity and healthy nutrition. Implementing reward programmes akin to Vitality's can effectively drive behaviour change, leading to reduced healthcare claims and hospital admissions.

For individuals

Start small, build consistency: Encourage individuals to start with manageable goals and gradually increase intensity over time, focusing on consistency in habit formation. Provide guidance on habit-laddering techniques to support sustained behaviour change. Emphasis ought to be placed on habit laddering to ensure that people start with manageable goals that can grow with experience, as opposed to doing sporadic exercise in response to motivation (which inevitably wanes over time). This is the best, evidence-based way to build lasting healthy habits. Think of it as a ‘New Year’s resolution’ becoming a ‘new life resolution’.

Promoting active ageing: Emphasize the importance of physical activity for individuals of all ages, particularly older adults. Research indicates that regular physical activity is associated with improved cardiovascular health, better muscle mass and a reduced risk of falls in older adults. Programmes tailored to seniors, such as group exercise classes, walking clubs and community gardening initiatives, can promote active ageing and enhance quality of life (Langhammer et al., 2018). Lifestyle changes carry substantial impact, especially among older age groups. Sabia and colleagues (2012) discovered a notable association between increased physical activity levels and reduced mortality risk, even in later stages of life. This highlights the substantial benefits that adopting healthier lifestyle behaviours, such as boosting physical activity, can offer older individuals, emphasizing the universal relevance of such changes. Further supporting this notion, Pahor and colleagues (2014) investigated the correlation between physical activity

and survival in individuals aged 70 to 79 years. Their findings revealed a marked decrease in mortality risk over a two-year follow-up period among those who maintained higher levels of physical activity, underscoring exercise's pivotal role in enhancing longevity and overall wellbeing among older populations.

Healthy nutrition education: Provide accessible resources and education to assist individuals, especially young families, in making healthier food choices. For example, community-supported agriculture programmes or nutrition education workshops can promote healthier eating habits without relying on specific government initiatives. Additionally, programmes like Vitality which offer healthy food education and rewards are innovative examples of how to target individual-level behaviours.

For society as a whole

Prioritising initiatives that encourage active lifestyles and good habit formation not only improves individual health outcomes but also has far-reaching social implications. These initiatives contribute to stress reduction, cognitive enhancement, improved sleep quality, increased socialisation, enhanced self-esteem and overall feelings of wellbeing among society members. Investing in such initiatives fosters a healthier, happier and more cohesive community (Mahindru et al., 2023; Sallis et al., 2015).

Reducing stress: Engaging in regular physical activity is associated with decreased levels of perceived stress and an overall improvement in mental wellbeing. Studies have demonstrated that participation in exercise routines triggers the release of endorphins, the body's natural mood elevators, leading to a reduction in stress levels (Mikkelsen, 2017).

Enhancing cognitive abilities: Numerous studies have shown that exercise itself positively impacts various aspects of cognitive function, including memory, attention and processing speed. Erickson and colleagues (2019) investigated the effects of aerobic exercise on cognitive function in older adults. The results demonstrated that participants who engaged in a structured aerobic exercise programme showed significant improvements in memory and executive function compared to a control group. This evidence emphasises the importance of incorporating physical activity into daily routines to maintain cognitive health.

Improving sleep quality: Regular participation in physical activity has been shown to enhance sleep duration, efficiency and quality. Exercise promotes the release of neurotransmitters like serotonin, which regulates sleep-wake cycles, leading to more restorative sleep patterns (Yang et al., 2012).

Boosting self-esteem: Engagement in habitual physical activity is closely associated with increased self-esteem and feelings of wellbeing. Individuals who maintain active lifestyles often report higher levels of self-confidence and a more positive self-perception, contributing to overall psychological wellbeing (Tremblay, 2000; Tikac et al., 2022).

Promoting socialisation: Participating in group physical activities provides opportunities for social interaction and the development of meaningful interpersonal relationships. These interactions foster a sense of belonging and community cohesion, strengthening social bonds and enhancing overall social wellbeing (Sallis et al., 2015).

Conclusion

The aim of this research paper was to study the impact and drivers of habit formation on the Vitality South Africa (SA) and Vitality United Kingdom (UK) member base. We showed the development of a machine-learning and statistical methodology to identify and quantify physical activity and nutrition habit formation, using **six weeks of verifiable data** to determine the presence of a habit in the seventh week.

Evidence from this study revealed that **healthy habits can change an individual's life**. Forming new and better physical activity and nutrition habits has a significant impact on mortality and morbidity. The observational study on the Vitality SA member base shows that the formation and maintenance of a strong, good physical activity habit is associated with a mortality reduction of 27% and up to a 36% reduction in the risk of severe cancers. Results from the Vitality UK member base further emphasise the protective nature of strong, good physical activity habits by showing that high levels of physical activity coupled with talking therapies can reduce the risk of a future psychiatric claim by 19%.

The impact of a sustained physical activity habit by age emphasises the importance of positive behaviour change as well as positive behaviour change maintenance as individuals get older. Our findings suggest **it is never too late to start**. The impact of positive habit formation increases with age. Evidence from this study shows that moderate levels of physical activity can be beneficial for individuals up to 65 years and older, with mortality reductions of up to 59%.

The significant impact of doing moderate levels of physical activity indicates that there **are marginal mortality improvements to be gained from doing 10,000 daily steps on average.** Positive effects are observed at significantly lower levels of exercise, and by 7,500 average daily steps, maximum mortality improvements are already incurred at all ages.

Good habits are created through gradual, sustained efforts. When building strong, good habits, rather than relying on a sudden and intense exercise routine, the key lies in consistently integrating manageable, low- to moderate-intensity workouts over time. **Thus, it takes 7 – 15 weeks to form a new habit** that can last, with most people forming sutainable new habits in 10 weeks.

The best way to establish a lasting, healthy habit is **through habit laddering**: starting with small increments and maintaining a new behaviour when a new level of behaviour is achieved for a period, before attempting the next step up in frequency or intensity.

Finally, this paper shows that strong, good physical habits can lead to better nutrition and sleep habits. We show that healthy behaviours are highly correlated. This ripple effect of habits and, particularly, strong, good physical activity habits extend multiple benefits to the individual and society.

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Appendix

Case studies

A 30-year-old avid cyclist who maintains a strong good habit by cycling at least three times a week reduces their all-cause mortality risk by 27% relative to all other Vitality members who do little to no exercise. Our data shows that this member is likely to maintain both a strong good physical activity and nutrition habit for four consecutive years.

A 55-year-old Vitality member with type 2 diabetes who changes their behaviour from little-to-no physical activity and sustains a habit of 5,000 steps three times a week reduces their mortality risk by 40% relative to those Vitality members with type 2 diabetes who continue to remain sedentary or engage in little to no exercise. This member is also likely to sustain this habit for three consecutive years. Our data suggests that the impact of behaviour change and sustained physical activity is profound for Vitality members with chronic conditions and older Vitality members due to the increased risk of mortality in this cohort.

A 65-year-old member who sustains a habit of walking 7,500 steps for four days a week reduces their mortality risk by 52% relative to Vitality members who are 65 years old and older who remain sedentary or do little to no physical activity. Our data suggests that as members age, the frequency rather than the intensity of physical activity becomes important. For Vitality members who are 65 years old and older, the largest mortality improvements are observed from lower intensity workouts at increased frequency and consistency.

Table of mortality and morbidity results

Risk	Physical activity level	Relative mortality rate reduction	Relative mortality rate reduction upper bound	Relative mortality rate reduction lower bound
Mortality overall	Low	-22%	-25%	-19%
Mortality overall	Medium	-22%	-28%	-16%
Mortality overall	High	-27%	-34%	-21%
Mortality (45-64)	Low	-36%	-49%	-34%
Mortality (45-64)	Medium	-38%	-58%	-19%
Mortality (45-64)	High	-58%	-76%	-39%
Mortality (65+)	Low	-29%	-38%	-19%
Mortality (65+)	Medium	-52%	-68%	-34%
Mortality (65+)	High	-59%	-67%	-51%
Diabetes	Low	-6%	-13%	4%
Diabetes	Medium	-41%	-57%	-24%
Diabetes	High	-57%	-79%	-35%
Stage 3 cancer	Low	-3%	-35%	23%
Stage 3 cancer	Medium	-19%	-81%	38%
Stage 4 cancer	Low	-4%	-17%	6%
Stage 4 cancer	Medium	-36%	-57%	-18%

THE LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE

PRIVACY DISCLAIMER

Privacy is a top priority at Vitality, and we are committed to maintaining the highest level of confidentiality with all of the information we receive from our members.