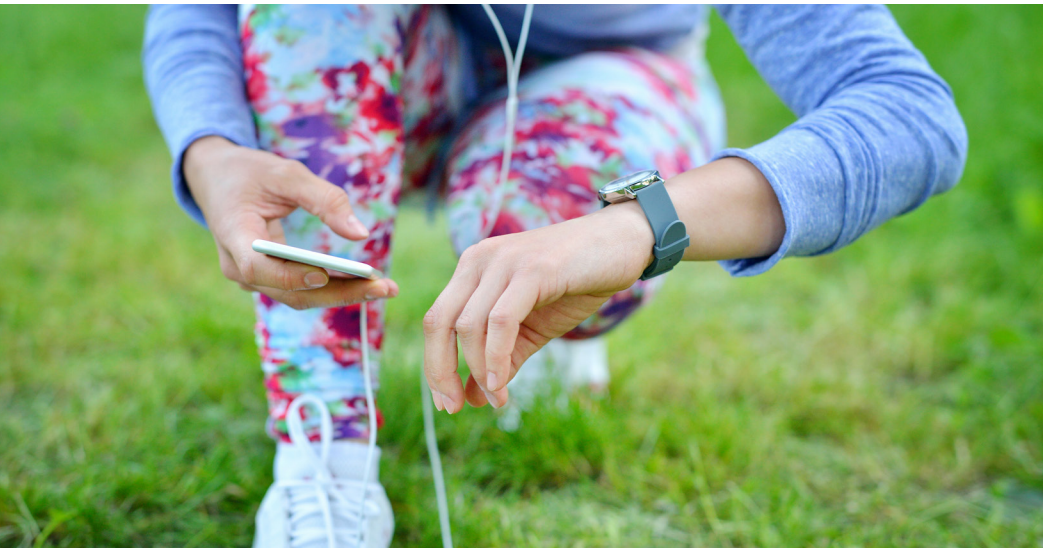
OPTUM®

The Health Score: A summary

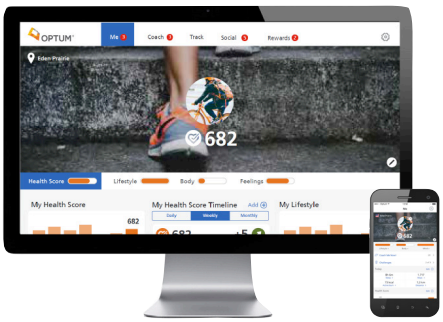


The Health Score

Most of us have an intuitive sense of the difference between being healthy and being unhealthy. However, an accurate measure of the health of an individual, meaning a true health score, is a very difficult task to achieve. It has only been in the last few years that methods have been developed and tested that can achieve this goal.

The Health Score is possible because of the efforts over many years by many researchers throughout the world. In a sense, it summarises the results of medical research acquired from more than 130 million person-years of observation. But it achieves even more than this: it condenses the relative health of individuals into a single number. And even more important, it is a number that is easy to understand and use.

Let's say someone asks you about a friend, "How healthy is Alice?" You can usually answer with some confidence that she's fine or she's not doing so well. A much more difficult question to answer would be "Who is healthier?" Whilst the first question requires only a rough guess in most cases, the second one calls for a much deeper understanding of the concept of health, and the ability to quantify this concept. This is what we mean by relative health, and this is what the Health Score can do for you. Your Health Score tells you how healthy you are by comparing a measure of your health to that of people throughout the world. Health is difficult to measure. Just like temperature or weight, measuring health requires a reference and a scale, and this is what the Health Score achieves.



130 million person-years of observation

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At this point you might be thinking, *So what?* And other than for its academic value, *Why on earth would I want to know my relative health?* The answer is as simple as it is powerful: you need to know your relative health to know if the way you live your life makes you more or less healthy. The central goal is to help guide you in finding ways to improve your health, no matter what you started out with. Of course, most products in the field of health claim to serve the same purpose, but how do you actually measure your progress without measure of what you are trying to improve? Simply put, the Health Score can help you measure your progress against your health goals.

Structure of the Health Score

An accurate and useful way of estimating and representing the health of an individual is to first estimate three health components separately: body, feelings and lifestyle. We evaluate Body Health by using and applying all that can be directly measured, such as blood pressure, height, weight, cholesterol and other things that directly affect one's health. Feelings Health is evaluated by collecting answers to a set of questions. Lifestyle Health is evaluated by tracking or otherwise measuring the most important aspects of how one lives one's life. The first two components are quantitative, and the third leads to an evaluation of how your activities influence your health state.

Our organism is complex, with every one of its parts affecting the behaviour of every other part. The interaction amongst these parts is complicated and not easy to understand. Because of this, while the three components of health that we estimate interact with and depend on each other, the Health Score gives you three separate subscores, one for each component, and evaluates your overall score by simply adding these up. The hope is that this way of describing your health will make it easier to understand how and why your overall Health Score changes over time.

We now describe how these three components are built, and what makes each increase or decrease over time.

Body Health Score

This is the most complex component of the Health Score. It is calculated using more than one hundred models that estimate different aspects of overall risk. These models are built using data from hundreds of clinical studies carried out all over the world.[1] The aim of these studies is to understand how the biomarkers measured at the start of the study, what is called the baseline, correlate with diseases or events observed often many years later. Using statistical methods, the relative importance of the biomarkers measured at the start can be estimated, and models are then constructed to *predict* how the value of each biomarker measured at baseline is likely to affect the various risks of disease over time. To calculate the Body Health Score, we combine the predictions of many such models that have been developed and validated over the past three or so decades.

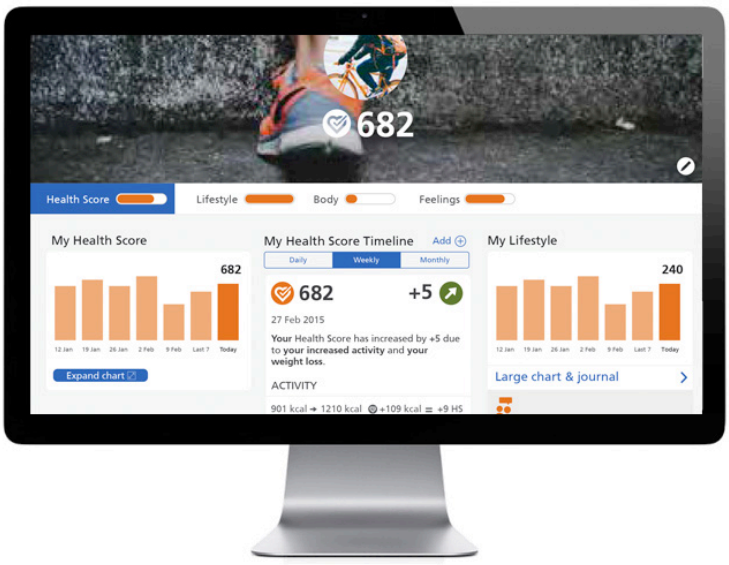
The biomarkers that you are asked to provide to get your Body Score are familiar and easy to obtain. These include several aspects of your medical and family histories, such as whether you have been diagnosed with diabetes or high blood pressure, or whether members of your immediate family have had these diseases. They also include direct measurements of important metabolic and other parameters, such as the concentration of glucose and cholesterol in your blood, your body-mass index, and your blood pressure.

As a rule of thumb, your Body Score will move up or down depending on whether, in what direction, and by how much your biomarkers change. For example, if your fasting glucose or blood pressure increases, your Body Score will go down; conversely, if your total cholesterol or weight decreases, your Body Score will go up. However, we emphasise that these parameters are not independent of each other; it is a particular combination of all of them that determines your Body Score. In fact, perhaps surprisingly, there are circumstances in which a decrease in blood pressure can be a sign of impending disease, and consequently in these cases your Body Score may also decrease.

Feelings Health Score

The relationship between your emotional and your physical health is very complicated. In particular, problems with either one of them can cause, and be caused, by problems with the other. Even if we might not know precisely which is causing which, we do know that often changes in one accompany changes in the other.

To quantify this, several years ago dacadoo ag, a Swiss leader in digital health technology, conducted a survey among health and other professionals. From the results of that survey, dacadoo built models that estimated the levels of various affective conditions, such as stress, anxiety and depression, that have been independently shown in other studies to be directly associated with well-defined aspects of health. These models have been refined over the years using data from the digital engagement platform. The Feelings Score is a combination of the results of those models.



Lifestyle Health Score

Every aspect of your health that plays a direct role in determining your Body Score and your Feelings Score relates with various aspects of your lifestyle. This is especially true of how active you are physically, how and what you eat, and how well you sleep.

The specific factors that affect your Lifestyle Score are smoking, alcohol consumption, quality and length of sleep, levels of chronic stress and anxiety, level and intensity of physical activity, and nutrition characteristics. Thus, the better you eat and sleep, and the better you exercise, the higher your Lifestyle Score will be.

Equalisation

The Health Score is designed to be a *universal score*. This means, among other things, that it is equally valid independently of where you live or what your ethnic background is. But more than that, the Health Score provides a measure of relative health that is independent of sex and age. To achieve this, we developed a process that we call *equalisation*. Equalisation allows the comparison of relative health between individuals of different sex and age. So, for example, a 70-year-old man can compare his Health Score with that of his 28-year-old daughter, and the comparison still makes sense.

Imputation, accuracy and uncertainty

There are only four required inputs: sex, age, height and weight. All other inputs are estimated from all available information using a procedure called *imputation*. This process is accomplished through the use of statistical models that we derived from many very large clinical studies. Of course, this first approximation is not as accurate as it would be if we knew more about you: the more accurate and complete information you provide, the more accurate your Health Score will be.

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1. Models include the Framingham and Framingham Offspring cohorts, MONICA Augsburg and PROCAM cohorts, Reynolds Heart Study, the ATP III Study, FINRISK cohorts, SCORE project, INDIANA study, Chinese Multi-provincial Cohort Study, ASSIGN study and the ASCVD Omnibus project.

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