



# Resting Heart Rate

## What is Resting Heart Rate?

Resting Heart Rate (RHR) is defined as the number of times the heart beats per minute when an individual is not active, and is measured in beats per minute or bpm. The traditional normal range for RHR is 50 to 100 bpm and has significant value both as a key biometric marker for assessing health and as an input variable for many calculated health metrics.

It is important however to consider RHR in the context of the environment in which it is measured as a number of factors influence measurements such as: time of day, meals and medication taken, recent exercise, who is taking the measurement and even stress levels of the person being tested. For this reason a relatively wide range of different results for the same person may be observed, and understanding this and accounting for it is critical in developing a RHR solution.

The LifeQ solution has the benefit of having access to near continuous heart rate for most of every 24 hour period in addition to considerable contextual data in terms of the users activity, recovery and sleep during the 24 hours. Consequently LifeQ has been able to develop a RHR solution with multiple outputs that are useful for different use cases.

## What RHR Outputs are provided by LifeQ?

The LifeQ RHR solution includes the following as part of the output:

- **Basal Resting Heart Rate** reflects a user's HR when in a highly stable and relaxed state. This is a critical value both to track over time to spot changes in health, and is also a key input in many of LifeQ's metabolic metrics such as Calories and VO2max. LifeQ provides this value for each 24 hour period for which data is available.
- **Daily Resting Heart Rate** uses HR measured throughout the day when the user is awake, selecting only suitable values (e.g not during or immediately after activity) and creating a daily value that represents the most accurate version of the user's RHR on that day. This is extremely useful as a way of helping users see not only daily variations but also track changes over time.
- **Default Resting Heart Rate** is the RHR that is calculated from the user profile when a measured RHR is not available. The Default RHR takes the individual's age, gender, height and weight into account and is based on population averages. This is only used to enable various calculations that require a RHR input when no measured input is available.
- **Nurse Proxy Resting Heart Rate** provides an estimate of what a user's 'nurse measured' resting heart rate would be. It is well known that an individual's RHR tends to be somewhat elevated when measured within a clinical environment due to a number of confounding factors induced by the setting. This however the main way that RHR is measured and hence many health and insurance industry metrics account for this - so LifeQ has provided an estimate of this. This is only available through the LifeQ Cloud based solution as it requires multiple days of data and smoothing.

## Accuracy

The LifeQ Continuous Heart Rate solution has been designed and optimised to work across all major silicon and sensor platforms. The consistency of the LifeQ Daily RHR output will be largely

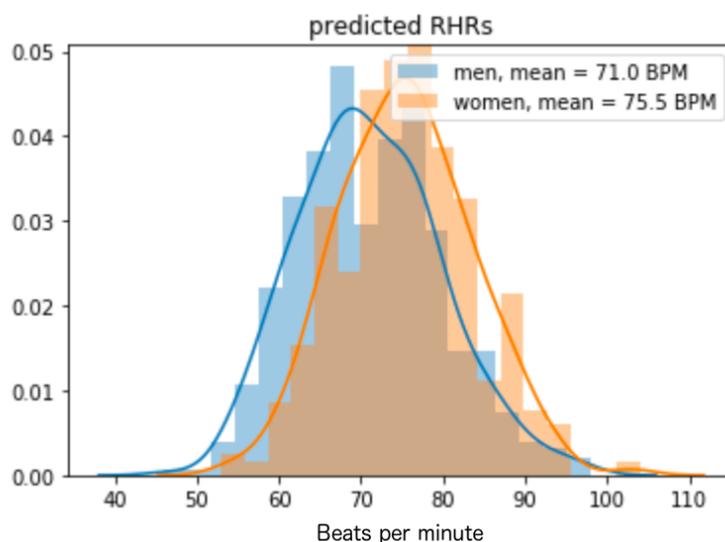
dependent on the accuracy of LifeQ HR solution. Accuracy and validation of the LifeQ Continuous Heart Rate solution is available in the [LifeQ HR Validation document](#).

Furthermore, LifeQ has also validated the NHANES Resting Heart Rate using the data from two research pilots LifeQ conducted with large insurance companies. Furthermore these results have been compared against data from the US National Health and Nutrition Examination Survey (NHANES) where 35 000 individuals had clinically measured RHR taken.

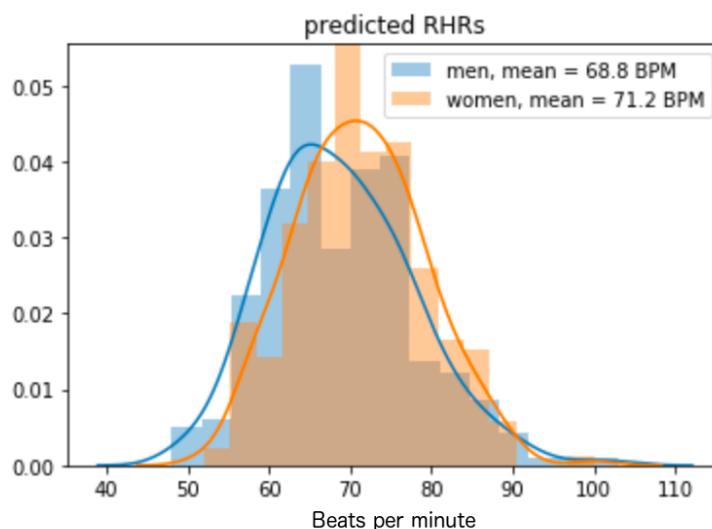
**Table 1: Non-invasive Resting Heart Rate Expected Performance compared to the NHANES study**

Survey	Number of Participants	Men		Women	
		RHR (mean bpm)	SD	RHR (mean bpm)	SD
NHANES	35 000	71	9-13	74	9-13
LifeQ Pilot 1	935	71.0	8.7	75.5	8.2
LifeQ Pilot 2	634	68.8	9.0	71.2	8.0

It is important to note that the average Age and BMI of the second cohort was lower than the first, producing as expected an average RHR a little lower than big NHanes study.



**Figure 1 - Cohort distribution of LifeQ predicted Non-invasive Resting Heart Rate for Pilot 1**



**Figure 2 - Cohort distribution of LifeQ predicted Non-invasive Resting Heart Rate for Pilot 2**

## Constraints in measuring RHR accurately

Regardless of the protocol followed or device used for measurement, individual point-measurements of Resting Heart Rate made on individuals can exhibit significant variance due to a variety of confounding factors such as circadian rhythm, stress levels, body temperature, physical and/or mental stimuli to name but a few. LifeQ's solution is built to minimise these factors and provide an accurate and consistent representation of a person's RHR that can be used to assess and track health status and also to enable accurate calculation of other health indicators. However, it is always important to contextualise the RHR measure and use that which is most appropriate for the application.