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This specialist guide is designed as a tool for health and wellness professionals who utilize long-term heartbeat measurements and the Firstbeat Lifestyle Assessment to promote employee and organizational well-being.

Successful wellness promotion requires thorough evaluation of the client’s current situation, determination of development areas, specification of action points as well as follow-up and evaluation of the project’s effectiveness. Each step should be carried out with consideration to the client’s starting point, life situation and motivation. This guide will outline some important aspects of this type of wellness promotion process.

In the process of wellness promotion, Firstbeat Lifestyle Assessment is usually just one tool, but a rather central one in collecting information about the client’s current status. Thus, it is important to do it properly, with sufficient attention to detail regarding client instructions, optimal performance of the measurement device and the measurement process. Technical aspects of the measurement and analysis process are not the focus of this manual, and if you need more information about that, please refer to the Lifestyle Assessment User Guide in the Firstbeat Analysis Server, under Learning - Guides.

Once the measurement has been carried out successfully, the specialist needs to evaluate the reliability of the results and interpret the reports correctly in order to set appropriate goals and action points together with the client. This manual gives some solutions to common questions that need to be considered in order to make reliable conclusions about the results and determine what kinds of actions can be undertaken to promote client well-being and resilience.
1. From Individual to Organizational Well-Being

1.1. Goals of Firstbeat Lifestyle Assessment

Firstbeat Lifestyle Assessment is a service model that evaluates the effect of lifestyle factors and daily habits on health and well-being. Based on the results, concrete action points are planned to promote the well-being of individuals and organizations. When the employees feel well, the organization can also feel well and is able to function effectively.

Lifestyle Assessment can be used to answer the following types of questions:
• Is there enough recovery in a 24-hour period?
• Does the body get good recovery during sleep?
• Do the resources that are used during the day recover during sleep?
• Is the person’s daily physical activity sufficient to maintain health and/or improve fitness?
• Is the overall load of work, leisure time and physical activity in balance?

The goal is to promote
A) Personal well-being and resilience of the employee
B) Organizational well-being and productivity

Lifestyle Assessment is based on a server-based computer program that analyzes beat-by-beat heart rate and heart rate variability to provide information about different aspects of well-being, such as:
• Recovery and stress
• Exercise
• Physical workload

1.2. Benefits at Many Levels

Employee:
• Promote coping at work, resilience and personal well-being
• Increase self-knowledge
• Illustrate lifestyle-related factors that support well-being
• Personal results serve to awaken and motivate!

Employer:
• Promote employees’ work and functional capacity
• Reduce sick leave-related costs
• Avoid premature retirement
• Improve staff motivation and productivity
• Develop health-supporting work methods and models
(Occupational) health care:
• Tool to guide and support discussions with a client
• Background for medical decisions
• Forms an objective, comprehensive picture of the client’s situation

1.3. **Firstbeat Lifestyle Assessment Step-by-Step**

The Lifestyle Assessment process starts by providing instructions and measurement devices to the client(s). The most important starting point of the assessment is a successful measurement, and thus, it is important to provide clear and detailed instructions about how to use the device and other important aspects of the measurement process.

People will conduct the actual measurement independently on their own time. The recommended duration for a Lifestyle Assessment is 3 days (app. 72 hours), from waking up in the morning to waking up 3 days later. During the measurement, the person keeps a simple journal of the most significant daily events, typically by receiving a link to an electronic journal.

When the measurement has been completed, the client returns the device and other needed documents to the service provider. After this, the service provider analyzes the data and creates desired Lifestyle Assessment reports.

In the feedback session, the reports are interpreted, goals are set to promote well-being and concrete action points are planned for reaching the goals. In addition, possible further meetings and follow-up measurements are agreed on.

**Lifestyle Assessment process:**

1. **MEASUREMENT**
   - 3 days and nights at work and during leisure time

2. **FEEDBACK**
   - Personal reports and feedback by a lifestyle specialist

3. **ACTION POINTS**
   - Personal goals and ways to reach the goals in daily life

4. **LIFESTYLE CHANGES AND FOLLOW UP**
   - Promotion of concrete changes in your life
1.4. Stress as a Daily Phenomenon

Good and bad stress
When interpreting the “stress reports” provided by the Firstbeat Analysis Server, it is important to remember that stress is a normal reaction that allows us to respond to the challenges and demands that the environment presents us. In the short term, stress improves our performance and helps us cope with challenges. Stress becomes harmful when the individual feels that his/her resources are not sufficient to cope with the situation and/or when the overload continues for too long without sufficient recovery.

A stress reaction can be by nature either positive or negative. During positive stress the person feels excited and motivated and he/she is in a positive frame of mind. Negative stress can be either a strong, acute state or a chronic, long-lasting situation during which the person experiences unpleasant negative emotions.

Firstbeat analysis does not separate positive and negative stress because the physiological reaction to each is similar, but by discussing the daily events and experiences together with the client and comparing the result to the journal markings, it is possible to highlight events during which negative or positive stress was experienced.

Stress and recovery from the viewpoint of heartbeat analysis
Stress means an elevated activation level in the body, caused by external or internal stress factors and regulated by the autonomic nervous system and hormonal responses. During a stress reaction sympathetic activity of the autonomic nervous system is dominant and parasympathetic activity is recessive.

When interpreting stress, it is important to remember that we are dealing with a physiological reaction that reflects the activation status of the autonomic nervous system and can be caused by numerous factors. A stress factor can be physical, psychological or social, and is reflected via complex processes of the autonomic nervous system. These reactions are shown as various colored graphs (physiological states) in the Firstbeat Analysis Server reports.

Example 1. Stress and recovery chart and explanations of the colors. In addition to stress, recovery and physical activity, the chart shows work and sleep periods drawn from the person’s journal. The height of the bar indicates the strength of the stress or recovery reaction, but comparisons should only be made to observe changes within a
measurement. Comparing the strength of stress and recovery reactions between different measurements (or different people) based on the height of the colored bars is not purposeful.

**Why measure well-being?**
Firstbeat Lifestyle Assessment can be used to demonstrate and recognize specific lifestyle factors that support or hinder well-being, especially in the area of stress, recovery and physical activity. Personal reports, based on the physiological measurement, act as an excellent tool to discuss the client’s life situation, including both stress-promoting factors and things that promote relaxation and recovery. In other words, objective physiological data can be used to gather valuable subjective information, which should never be dismissed in the context of personal well-being. The charts in the reports illustrate different aspects of people’s lives and can make it easier to see things and put into words even difficult topics.

Firstbeat Lifestyle Assessment moves from the general phenomenon of well-being to personal experience and practical action. The specialist needs to have an understanding of the client’s life situation in order to be able to look at the results through important background factors. This allows the specialist, together with the client, to set concrete goals and help awaken the client’s internal motivation for making daily choices to promote well-being. The goal is to find the most optimal ways for each individual to manage stress, be physically active and recover sufficiently – and foremost, to awaken the personal motivation. Effective stress management, weight control and exercise are ultimately always up to the individual.

### 1.5. Successful Wellness Promotion Process

A successful wellness promotion process includes assessment of the current situation, determination of development areas, planning of specific action points, follow-up as well as evaluation of effectiveness. Each step of the process should be conducted with care, considering the client’s life situation, possibilities and motivation.

![Successful wellness promotion process](image-url)

Figure 1. Successful wellness promotion process.
Assessment of current situation
The specialist’s expert role comes into play once the measurement has been completed, the data downloaded, and the desired reports have been created. Assessment of the current situation is done by interpretation and evaluation of measurement results.

The reports that are created provide objective information to support the assessment of the client’s current situation. In addition to the physiological measurement results, it is important to complete the overall picture by learning about the client’s subjective experience about his/her well-being and health status. This occurs by discussing with the client and also by conducting a pre-questionnaire before the measurement. A 10-question pre-questionnaire is automatically available in the program and can help the specialist form a picture of the client’s situation – to support the information provided by the background information, the journal and the reports.

It is a good idea to start the feedback discussion by letting the client tell in his/her own words about his/her current (and during the previous weeks/months) life situation. If the client has not attended an information meeting about the assessment process – or been otherwise informed about it – some background facts should be covered as well. After that, the different reports can be interpreted and discussed.

Determination of development areas and goals
Conclusions are drawn from the measurement results and development areas are decided together with the client. At this stage the client’s role is crucial. Primarily it should be the client who creates the goals and the specialist's main task is to help plan effective and safe steps for reaching the goals. The goals should be concrete, and not too difficult to reach. It is not good to try to make too many changes at the same time because the person’s resources and motivation can fade, and goals might not be reached in any area.

It is recommended to set some deadlines by which one attempts to reach the goals. Intermediate goals can be set to support more challenging longer-term goals and maintain motivation.

Specification of action points
It is important to focus on the client when planning action points because even the best action points are useless without personal commitment and realistic possibilities to carry them out. The action points need to be such that the client can carry them out in normal daily life, with existing resources.

The specialist should find out from the client what he/she has done earlier. For example in the area of physical activity, it is important not to take too big of steps at one time. The amount and intensity of exercise should be increased gradually regardless of whether the person is a beginner or an experienced exerciser. The body reacts to sudden increases in overall load, which increases the risk of overtraining and/or injuries. If the person doesn’t recognize the symptoms of overtraining in time, he/she can face a long recovery period during which it is not possible to reach set goals.
The same applies to stress management, which should be started with small steps and the new lifestyle should be learned gradually, including for example regular relaxation breaks, personal limits and daily guidelines. Serious exhaustion cases require a different approach, where the action points might have to be more radical, such as medical consultation, medications and/or sick leave.

**Follow-up**
Following up how well the goals have been reached maintains motivation – and the positive pressure can make the client carry on with the plan even when it feels challenging! The follow-up can mean a new 3-day measurement, fitness test, weight monitoring or an interview, depending on the goals and type of assessment package. The follow-up period should not be too long. If the goal is set for six months, it might be good to do some form of intermediate follow-up every couple of months. The follow-up should include discussion about effectiveness, and if needed, changes or adjustments. The newest version of the Firstbeat analysis server also has a questionnaire about how well the client felt he/she had reached the set goals during the follow-up period.

**Evaluation of effectiveness**
When the client’s progress is being monitored, it is also good to evaluate the effectiveness of the program. If desired changes or development cannot be seen, it might be necessary to make some adjustments to the action points. The same action points do not work for all people; individual tailoring is important.
2. Report Interpretation

2.1. Stress Management

The specialist begins the interpretation of results by looking at the reports and forming a preliminary idea of the client’s situation, considering the background information, health status, physical condition and journal markings. This preliminary idea is completed during the feedback discussion. The client tells about his/her days during the measurement and the general life situation. After this, the specialist and client can discuss what kinds of factors help and hinder personal well-being, plan further actions and agree on follow-up meetings and measurements.

Next we will discuss the most important questions that the specialist should try to answer before the feedback meeting. Based on the answers, the specialist can form a basic understanding of the factors that affect the client’s well-being either positively or negatively.

How good is the person’s sleeptime recovery?
Sufficient, high-quality sleep is the basis of health and coping. During sleep, the body is revived, physical fatigue subsides and learned things are saved in long-term memory. After having slept well and sufficiently, a person’s mind is energetic and the mood is positive. Insufficient sleep can cause weight gain and predispose us to many diseases. Insufficient sleep combined with excessive alcohol use also predisposes us to depression.

For stress management, sleep time (during night) is the most important time for recovery, and thus, recovery during sleep should be the main focus when interpreting the stress and recovery graphs. The sleep period is shown in the report as a dark blue line under the stress and recovery chart.

Factors that affect sleep include alcohol, heavy exercise in the evening, stress and diseases. If mostly stress reactions are seen during the sleep period, the following points should be considered:

- Alcohol use. Typically already 2 or more units of alcohol can be seen in the result. Heavier drinking the previous night can still affect the following day’s and night’s results.
- Acute illnesses, for example flu and fever. Pre-onset illness or recovery from an illness can also show as a larger than normal amount of stress during sleep.
- Resting heart rate. If the resting heart rate that was used for analysis is higher than the person’s realistic / true resting heart rate (for example due to alcohol use or being sick), the results look better than they should. See chapter Resting heart rate under Evaluating the reliability of results for discussion on how to take this into consideration! A much rarer situation is if the analysis program has for some reason found (e.g. from measurement error or an exceptional physiological reaction) a lower heart rate than the person’s realistic resting heart rate is, in which case the result looks worse than it should.
Significant overweight combined with bad physical condition and/or a physically strenuous day overloads the body and can result in the body not being able to recover during sleep. Overweight is a chronic stress factor in itself, and when combined with other stressors, it can have a dramatic effect on recovery.

Example 2. 43-year-old healthy man’s (BMI 23.5 / activity class 5) day-off that included several hours of exercise in the afternoon (a walk followed by working in the forest). During sleep (area above the blue line), there is practically no recovery state (green color) present. The explanation for this was much more physical activity than he was used to when considering his training background and fitness, combined with 4 units of alcohol in the evening. As a result, the body remained activated and wired throughout the night.

Example 3. Significant overweight (BMI 34) and bad fitness level (activity class 2) cause significant physical loading and poor nighttime recovery for a 36-year-old warehouse worker. If this kind of overload is present in the long term or repeated frequently, the body is not able to calm down enough to recover even during sleep.

Example 4. A 26-year-old sales assistant who is in good physical condition (activity class 7) felt that she had a normal, fairly slow work day and had not experienced any particular stress at work or during leisure time in the recent months. She felt a bit under the weather in the evening and the next day, after the measurement, she had a fever. The onset of illness probably explains her poor recovery during sleep and lack of any recovery during the day. In general, good physical condition and young age increase the likelihood of having recovery periods during the daytime (during low levels of activity).

Often the factors that cause poor recovery during sleep can be found and pinpointed easily, and the explanations do not necessarily cause too much concern. They can be the body’s
natural reaction to a stressor, such as fighting a pathogen, burning alcohol in the liver or temporarily upset homeostasis due to a heavy exercise session.

Regarding alcohol, it is good to be aware that in the long term, regular alcohol consumption wears out the body’s mental and physical resources, in addition to its other harmful effects. Even with occasional use, it is good to remember the negative effect of alcohol on recovery. People often think that it feels good to “clear the head” with a good party at the end of a work week, but on a regular basis it is not very helpful for physical recovery.

Heavy alcohol consumption affects sleep in many ways. “Passing out” due to heavy alcohol use is not real sleep, but a kind of poisoning state. If registered with an electroencephalogram (EEG), the brain activity does not show normal sleep stages. For example, heavy drinking before bedtime cancels out our REM sleep, which is important for psychological well-being. If drinking continues for several weeks, REM sleep is seen in the morning hours in short bursts. Sleep is restless and broken up with frequent wake-ups. Eventually it can become difficult to fall asleep, or go back to sleep after waking up. Alcohol also loosens the muscles of the upper respiratory tract and throat. In smaller amounts, it can cause snoring and in larger amounts, collapsing of the respiratory tract and interrupted breathing (sleep apnea).

If an obvious explanation is not found for having a lot of stress reactions during all sleep periods, it could be caused by a chronic disease or prolonged stress. The goal should always be to find an explanation. In these cases, the first recommendation is to do a re-measurement during which the client is advised to minimize known / avoidable stress factors. If the results are still worrisome, the client should be given a recommendation to get a health check-up, for example at occupational healthcare.

**How soon does the body begin to recover after going to sleep?**

Frequent and/or excessive stress factors during the day can affect the body so that it is still in overdrive during the first few hours of sleep. Factors that typically disturb the early sleep period include late, intensive exercise, taking a sauna/steam room for a long time, a hectic work day and alcohol.

Example 5. Late evening exercise keeps the body wired during the 1st part of sleep and affects the quality of sleep during the night. Obvious “breaks” (white segments) in the recovery graph often indicate restless sleep.
A physically intensive day delayed the start of recovery during the first couple of hours of sleep.

Relaxation before bedtime can help in being able to start good-quality recovery as soon as sleep starts. Even if the day had been rather busy and intensive, watching mellow TV before bedtime (21-22) had a calming effect on the body, and when the person went to sleep, recovery began immediately.

Are there any breaks that provide recovery during the day?
Short breaks in hectic activity during the day are important because they shut down the production of stress hormones and help charge one’s batteries. Even if nighttime sleep is the most crucial time and might provide good overall recovery, it is also good to take a few breathers during work or leisure time. Even a short recovery break during the work day can have positive effects.

Note!
Even if a person takes a relaxing lunch break, it might not show up in the chart as recovery (green) because digestion - breaking down food stuffs to energy - is one kind of physiological stress on the body. Furthermore, the lunch break might involve walking to and from the eating place and consuming caffeine, both of which activate the body. Thus, the meal break might show up as “stress”, but it is still important to learn to take unhurried lunch and coffee breaks.

Recovery periods during the day do not necessarily need to be long, but for optimal coping and better resilience it is important to have refreshing breaks both during work time and after work.
Example 9. In physical work, the importance of breaks is pronounced. The stress and recovery chart does not necessarily reveal the whole truth. Even if this construction worker’s stress and recovery chart doesn’t show any recovery during breaks (8:00, 10:00 and 12:00), the heart rate graph reveals that the heart rate (and thus VO2) drops significantly during the breaks, thus serving an important purpose in physically demanding work.

During the daytime, it is purposeful to see if there is any recovery when it is possible, i.e. when the person actually has the chance to slow down. If there are no breaks in the day, there might not be any recovery in the graph, and this can be a perfectly normal response during a busy day. If the body reacts effectively and quickly to breaks, when taken (heart rate drops and recovery state is detected), it usually indicates that the overall situation is good. A physically fit and healthy body recovers more easily and reacts to breaks more effectively.

The more stressful the day has been, the more important it is to take a short break after work to recharge oneself for the rest of the day. Physical activity is an excellent way to break up stress and forget work matters. It can be an easy, refreshing walk in the outdoors or a more intensive “stress buster” session. However, if the work day has been physically or mentally very hard, it is best to keep the intensity level of the exercise session fairly low.

How much recovery is there in a 24-hour period?
In order for the resources that we typically use during the day to get built up, there needs to be a sufficient amount of recovery in a 24-hr period. The need for sleep is on average at least 7 hours per night, and this amount is the recommended minimum in Firstbeat’s 24-hour measurements, translating to app. 30% of recovery. If the sleep period is long enough and sleep quality is good (showing up as recovery state in the report), this is normally enough for the consumed resources to recover by the morning. If the sleep period is very short or the quality is very poor, the significance of recovery during the daytime is emphasized. In these cases, it is good to take a longer break during the day or even a nap after work, to allow the brain and the body to recover sufficiently.

Short breaks during the day do not necessarily compensate for poor sleep time recovery, but their role in building up resilience for the rest of the day and refreshing the body and mind can be significant. For this reason, good-quality sleep should be supplemented by regular “recharging” breaks. Taking breaks might require active learning and scheduling because otherwise they are easily forgotten in the daily bustle.
Example 10. Even if the sleep period is almost all recovery, if the duration of sleep is short, the amount of total recovery can be too low (22%). If this occurs frequently, a good solution might be to take a short nap after work or otherwise focus on getting some relaxation moments.

Do the resources that are used up during the day recover during sleep? The body’s ability to react to external and internal stressors is called resources. Resources accumulate when we recover, whereas stress reactions consume our resources. In the Lifestyle Inspection report, the resources graph shows what kind of accumulated effect the measurement period (typically 3 days) has on the person’s resources (Example 11).

Example 11. A rising blue line illustrates accumulation of resources and a falling line consumption of resources. During the day, resources are typically used, but the purpose of a sufficiently long, good-quality sleep period is to accumulate the consumed resources. At the end of the period, the goal is to have the resources line at least back to the starting level (black line) or above it. This is seen in the upper example, whereas the lower example shows a situation where the resources do not accumulate sufficiently during nights 2 and 3 and the line stays below the starting level.
2.2. **Exercise Guidance**

**How much physical activity / exercise is there during the day?**

The health-promoting physical activity chart shows all the physical activity periods during the measurement, from easier activities of daily living to higher-intensity exercise. The table under the chart shows the length of different types of physical activity in hours and minutes. Health- and fitness-promoting physical activity means activity at such an intensity that it has been shown to have positive health or fitness effects. For health-promoting physical activity, the required level is at least 40% of the person’s maximal performance (VO2max) and for fitness-promoting, at least 50%. A positive health effect means that besides maintaining one’s physical condition, it also reduces the risk of many chronic diseases, particularly related to cardiovascular health.

The health-promoting physical activity chart (in a specific report) can be used to show how even short, fairly light physical activity periods during the day can accumulate to provide good health benefits— or to verify the actual intensity of a performed exercise session. The results can be surprising; for example walking the dog or a casual evening walk might not show up as any kind of physical activity. In these cases, to get optimal benefits from the activity, the intensity level should be increased by increasing the speed or for example by choosing a hillier terrain for the walk.

Example 12. A 47-year-old sales clerk mentioned in his journal that he took a walk at 8 am and was doing some yard work in the afternoon for several hours, followed by another walk just after 3 pm. The chart shows some activity peaks and recognizes about two hours of light daily physical activity and physical activity, but only 13 minutes of all the activity was at a high enough intensity to provide the most optimal health benefits (health-promoting physical activity). This is an example of a good, active day, but by increasing the intensity of walking just a little bit, he can get further cardiovascular benefits.

If the results seem very contradictory to the client’s personal experience, it is good to evaluate the following points:

- How high was the heart rate during the exercise?
- Is the client taking any medications that affect the heart rate? E.g. Beta-blockers can significantly affect the heart rate, and thus the results of physical activity analysis!
- Has the person’s maximal heart rate been calculated / estimated correctly?
Example 13. The person took a walk from 10 – 11 am. The heart rate graph reveals that with the exception of a few short moments, heart rate remains very low (mostly below 100 bpm) to be considered aerobic physical activity, and thus this exercise session does not provide sufficient health or fitness benefits.

**Note!**
Firstbeat analysis is based on analyzing the heart rate and evaluating the effect of physical activity on the condition of the cardiorespiratory system! It is not appropriate for analyzing the effects of strength, speed and coordination training. This is important during feedback. For example, if the client has done a maximum strength workout (which can be very strenuous!), the physical activity report will only show the effect of this workout on aerobic fitness, not on strength. Similarly, for example Pilates or Yoga might not accumulate any physical activity minutes or points in the report. This is because most Pilates and Yoga classes do not stress the cardiorespiratory system, despite being excellent training for muscle balance, coordination and mobility.

**How many physical activity points are achieved?**
The physical activity points (0-100 p.) describe how well the physical activity during the measurement fulfilled the general aerobic physical activity goal, considering exercise duration, continuity and intensity. According to common physical activity recommendations, people should be engaged in app. 30 minutes of physical activity on most days of the week. The goal is not to reach 100 points every day; instead, the recommended level has been reached if the points are in the Good level (>60 points) on most days of the week. This can be reached with 30 minutes of exercise at > 40% of VO2max, or a longer duration of slightly lighter exercise. 100 points can be reached with e.g. 60 min of exercise at an intensity of > 40%. Fitness-promoting exercise means an intensity that is over 50% of one’s VO2 max; this kind of exercise not only has good health effects, but also a significant effect on improving one’s fitness level.

**PHYSICAL ACTIVITY**
The total duration of physical activity 26min of which fitness-promoting physical activity 0min.

Physical activity index: 23/100

<table>
<thead>
<tr>
<th>Poor</th>
<th>Moderate</th>
<th>Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-29</td>
<td>30-59</td>
<td>60-100</td>
</tr>
</tbody>
</table>

Example 14. The person from example 13 accumulated 23 physical activity points from 1 hour of walking, which is considered a poor result (because the intensity was so low). If he walked the same duration at a slightly higher intensity, he would fulfill the recommendation (=reach the good level) and gain further health benefits.
During the feedback, it is important to interview the client about his/her typical weekly exercise. It could be that he/she is normally very active with several different exercise sessions, but was not able to exercise during the measurements days. In addition to aerobic, endurance-type exercise (e.g. walking, jogging, biking), it is also recommended to include strength and coordination exercise in the weekly menu, e.g. group exercise classes, weight training or yoga.

3. Evaluating the Reliability of Results

For checking the reliability of results, the following points should be considered:

- Reliable measurement of resting heart rate (during sleep)
- Accurate maximal heart rate
- Accurate background information
- Has the analysis used the same background info between different measurements
- Effect of alcohol
- Medications
- Illnesses and beginning illnesses
- Amount of missing heart rate as %
- Length of measurement

3.1. Resting Heart Rate

Resting heart rate is a key variable in analyzing recovery state, and thus, knowing the person’s personal resting heart rate is important for reliable recovery analysis. The criteria for measuring the resting heart rate reliably include:

- Overnight measurement, preferably at least 2 full nights
- No alcohol consumption before sleep
- No acute illnesses during the measurement
- The person is not suffering from overload or exhaustion
- The day before the night measurement has been mentally and physically “normal”
- The person has avoided extremely strenuous physical activity during the measurement (e.g. competition, tournament or workout that has stressed the person’s maximal capacity; training effect 4.5 or more)
- The person has avoided heavy physical activity, caffeine and heavy meals for 2-4h before going to sleep
- Medications that are known to affect the heart rate have not been taken during the measurement

In reality, it is rarely possible to achieve a situation that is as controlled as the above guidelines suggest because during the measurement, the client is instructed to live his/her normal life! However, it is important to be aware of the effect of the above-mentioned factors on heart rate – and lower the resting heart rate if needed.
If the client has slept poorly, consumed more than two units of alcohol every night or has been sick during the measurement, the resting heart rate should be dropped. For example, if the client has recorded that he/she slept very badly on each measured night, the resting heart rate can be dropped 2—4 beats from the lowest found heart rate value, unless the client has been measured before and there is a reliable resting heart rate value available from that time.

Note! The program will automatically suggest reducing the resting heart rate by 2 beats, if 2 or more units of alcohol has been consumed on all measurement days, if the client has recorded having slept poorly on all nights (or a combination of the previous conditions for all days!) – or if the client has answered the Pre-questionnaire as feeling very stressed and not feeling well (questions 5 and 10). This automatic reduction will make the analysis more reliable.

Example 15. A healthy 49-year-old man participated in a 2-day measurement. He consumed 4 beers both evenings and during these nights, his lowest heart rate was 50 bpm. In a case like this, with more than 2 units of alcohol both evenings and physically a fairly active day, it would be justified to drop the resting heart rate by a few beats.

Example 16. The resting heart rate of the man in example 15 was dropped by 2 beats and the same data was re-analyzed with the new resting heart rate of 48! In example 15, the amount of recovery in a 24-hr period is close to the recommended percent (26%), but after re-analysis with a more accurate resting heart rate, there is only 18% of recovery, which is clearly less than the recommendation. The result served as a wake-up call to the client, who had already been thinking that he should drop his habit of having a few drinks each night. Seeing how alcohol seemed to delay the starting of good recovery during sleep, he was convinced that this was not a good habit on a regular basis.

3.2. Maximal Heart Rate

The maximal heart rate (max HR) that is used in the person’s background information mainly affects the evaluation of exercise intensity, but it also has a smaller effect on the analysis of stress and recovery. Firstbeat analysis uses an age-based formula (210—65% of age) to estimate the person’s max HR, unless a more accurate value is known (for example from a laboratory fitness test). In most cases, the age-based formula is reliable enough, but with
some people, the real max HR can be significantly different from the estimated value, which makes the analysis less accurate.

In an optimal situation, the client has had the opportunity to take a fitness test to measure the max HR, but this is not always practical nor necessary. If the client has performed some kind of exercise during the measurement and the exercise analysis provided by Firstbeat does not seem accurate, the specialist can evaluate the reliability of the age-based max HR, for example by:
- interviewing the client about how strenuous the exercise was and how it felt
- if the client has a heart rate monitor, the specialist can ask how high the heart rate typically gets e.g. during uphills, in ball games or during a very hard exercise session.

Based on the interview, it is possible to adjust the person’s max HR up or down and re-analyze the result with a more accurate value!

3.3. Personal Background Information

Personal background information affects the analysis results, so make sure that it is accurate and correctly filled out. Especially in the case of follow-up measurements, it is important to update for example the person’s weight and activity class, if they have changed.

3.4. Background Information between Different Measurements

If several days have been measured during a very short time span (e.g. a couple of weeks), the specialist should make sure that the analysis has been made with the same background variables for all the measured days. This is especially important with resting heart rate, which is automatically updated when new days are measured and if a lower value is found. In these situations, for optimal accuracy and comparability, it is recommended to re-analyze the earlier measurement period with the newly found, lower resting heart rate. This might change the 1st results a bit (less recovery and more stress because the person was actually a bit farther away from his/her resting level). If the two measurements are a longer period apart (e.g. several months or a year), the person’s situation / physiology can actually have changed, and it is not necessary to go back and update new values to the earlier measurements.
3.5. Effect of Alcohol

Alcohol is one of the most significant factors affecting analysis results. Already a few units of alcohol cause a stress reaction in the body, resulting in poorer recovery. The more alcohol the person has consumed, the greater – and for a longer duration – the effect on the body.

If the person has consumed alcohol on all measurement days/evenings, it is very likely that the lowest found heart rate is not the person’s actual resting heart rate. In these cases, the specialist should lower (or allow the program to automatically lower it!) the person’s resting heart rate by a few beats, depending on the amount of alcohol. There is no absolute truth about what is the “real” resting heart rate, but at least the change is in the right direction, approaching the real value, and the results will be more reliable. If large amounts of alcohol have been consumed on all measured days, the applicability of the results is negligible. For this reason, it is good to remind the clients ahead of time how alcohol affects the results, and preferably to avoid alcohol or at least to have one alcohol-free day.
Example 17. Results of a 34-year-old healthy man of normal weight without alcohol (upper graph) and with 6 units of alcohol (lower graph). Recovery during the first night (no alcohol) was good, with an average heart rate during sleep of 59 bpm and the lowest heart rate of 53 bpm. The second night he consumed 6 units of alcohol: the average heart rate during sleep was 11 beats higher (70) and the lowest heart rate was 59.

3.6. Effect of Medications

Some medications affect the heart rate (and heart rate variability) — and might thus bias analysis results unless they are taken into account appropriately. At least the following medications should typically be considered and can be challenging from the point-of-view of interpretation:

- **Beta blockers** affect the max heart rate → typically the person’s age-estimated max heart rate should be lowered (by 15—20 beats).
- Large doses of diuretics and ACE inhibitors can have an effect (HRV ↓).
- **Asthma and allergy medicines** (large doses of corticosteroids, long-effecting sympathomimetics) HR ↑ and HRV ↓
- **Thyroid medicines**: thyroxin HR ↑ and HRV ↓
- Tricyclic and other activating **antidepressants** HR ↑ and HRV ↓
- Long-effecting **sleep medications** (esp. Benzodiazepan) HR and HRV ↓
- Strong **pain medications (opiates)** HR and HRV ↓
- Antiarrhythmics (tachycardia vs. bradycardia)
- Alzheimer medicines HRV ↓
- Parkinson’s medicines HRV ↓

Especially Beta blockers, most commonly used to treat high blood pressure, usually reduce the heart rate level both at rest and in exertion. This should be considered during data analysis as follows:

- The person’s maximal heart rate should usually be dropped, depending on the dosage and heart rate reactivity, by at least 10 or by as many as 25 bpm.
• If the person has done some exercise during the measurement, analysis results should be compared to perceived exertion → are they in line or is there indication that despite good effort, heart rate was not increasing (because the medication blocked it)?

Example 18. A 50-year-old man had done 1.5 hours of brisk Nordic walking during the 2-day measurement (2x45min). With the age-based max HR of 173, only 6 minutes of physical activity was recognized by the analysis. The man was taking a blood pressure medicine (Hypoloc), which is a Beta-blocker. Due to the Beta-blocker effect, it is unlikely that his HR would get up to 173, and thus, the max HR should be manually dropped.

Example 19. The man’s max HR was dropped to 155 and the data was re-analyzed, after which the program recognized 35 min of physical activity. In this case, the most important message is that he now sees that his exercise had some good health effects and shows up in the report as “real” physical activity – instead of telling him that he should exercise at a higher intensity.

3.7. Illnesses

If the results show a lot of stress and very little recovery, without an obvious explanation, such as alcohol or exceptionally strenuous days, you should make sure that the client was not ill just before, during or after the measurement. The outbreak of an acute illness might be seen in the body’s physiology already before the symptoms break out. Similarly, the body might show signs of the disease even a couple of days after the symptoms have subsided. During a Lifestyle Assessment info, we usually give the following recommendations to potential participants:

If you have a pace maker or a heart transplant, we do not recommend the measurement because the results are unreliable!
If you have one of the following conditions, you can make the measurement, but please note that the results can be difficult to interpret or unreliable:

- Bundle branch block, atrial fibrillation or atrial flutter
- Coronary heart disease with angioplasty or bypass surgery
- Chronic neurologic disease (MS, Alzheimer, Parkinson)
- Uncontrolled thyroid dysfunction
- Serious exhaustion or depression
- Pregnancy
- Fever

Note!
Firstbeat Lifestyle Assessment is used to promote personal well-being, and is not designed for diagnosing illnesses.

3.8. Missing Heart Rate Data (Heart Rate Corrections)

It is normal for the measurement to have some missing data (heart rate corrections / artifacts), which is caused not only by data breaks (when the monitor is off), but also for example by technical problems (related to electrodes, the monitor or excessive movement) or some kind of exceptional functioning of the heart. Isolated error segments here and there do not affect the reliability of the analysis, but if the erroneous signal continues for a long time, throughout the day, it can compromise the reliability of analysis.

If there is a lot of missing heart rate data / noise in the heartbeat signal, analysis results have to be evaluated critically. If there is data missing or if the heart rate level is erroneously high for several minutes, this can also affect the time period immediately after the error, for example physiological state detection or energy expenditure calculation. If there is more than 20—25% of missing data in a 24-hour measurement, it is probably best not to give the results to the client and instead recommend a re-measurement. The percentage of missing heart rate data is shown in the reports by the heart rate graph (as heart rate corrections or missing heart rate data, depending on the report).

If the amount of missing data was high enough for a new measurement to be recommended, it is first good to try to determine the possible cause: make sure the device and the electrodes were attached correctly, the used electrodes were fresh and of good quality and the device itself works as it should. It is preferable to give a new measurement device to the client and test the other one to make sure it works. If the re-measurement also has a high percent of error, and the obvious “technical” reasons have been ruled out, an ECG measurement can be recommended to rule out potential heart irregularities or problems.
Example 18. The missing data percent was 34% and it was present throughout the measurement. In a case like this, a new measurement is recommended.

Example 19. The missing data percent was 14% and it was mainly caused by the measurement break in the middle of the night. At other times there was practically no error and the results can be interpreted reliably.

3.9. Measurement Length

When comparing the results to recommendations or reference values, it should be remembered that most of the reference values are based on full day / app. 24-hour measurements. If the measurement is significantly shorter than 24 hours, and especially if it is completely lacking the sleep period, the recovery percent (in Stress and Recovery and Lifestyle Reports) can be very low and the resource graph might not show any recovery because the most important period for recovery is missing. Thus, it is always recommended to perform the measurements – and make the reports from these periods – from waking up to waking up.
4. Planning of Action Points

4.1. Stress Management is About Making Choices

Physical and mental overload consume the person’s resources and weaken recovery. By addressing the factors that overload us, we can significantly influence the person’s health and quality of life.

Top 5: Factors that have an adverse effect on recovery:
- Hurry, stress, time pressure
- Bad physical condition, overweight
- Alcohol and other drugs
- Personal / self-caused stress factors (e.g. late-evening exercise)
- Illnesses

Positive and negative stress can be compared to an athlete’s physical training. Excessive loading of the body can lead into an overtraining condition, whereas insufficient training does not cause performance improvements. Similarly, properly scaled challenges in (working) life help us develop our skills and make us feel good. We all need challenges – or positive stress – to accumulate our mental resource bank.

4.2. Tips for Better Recovery During Sleep

Being aware of the factors that can disturb sleep allows us to avoid them when we have excessive stress or are in particular need of recovery.

- Avoid strenuous, high-intensity exercise late at night (including heavy physical work and long high-heat sessions in sauna).
- Calm down your thoughts before going to bed. Mental stress, for example thinking about work, reading e-mails, computer games or solving relationship problems can elevate your stress hormone levels.
- Try to go to bed early enough, so you have time to sleep enough (app. 7 - 9h).
- The need for sleep increases when there is a lot of stress or during especially loading periods, so you might need to lengthen your sleep period as needed and reduce other stress factors.
- To make it easier to fall asleep, you can utilize methods that help you relax, for example reading a book, listening to music, making love or relaxation exercises.
- Be aware that alcohol weakens the quality of sleep significantly each time - and also if used repeatedly.
- Avoid heavy meals right before going to sleep.
Note!
Emphasize to your client that sleep problems should be addressed promptly! If the client is using sleep medications, it is good to remember that sleep medications do not compensate good-quality, natural sleep.

4.3. Tools for More Energetic Working Days

- Even short breaks decrease the production of stress hormones.
- Take unrushed coffee and meal breaks. The breaks are important for charging your batteries.
- Short exercise / stretching breaks refresh the body and mind.
- Take care of your fluid balance during the work day. The need for hydration increases in physical work and during especially busy times.
- Close your eyes and take a moment to relax. You will feel better after a few minutes!
- Laugh and joke with your colleagues.
- Make your timetable realistic. Leave some allowance for schedule delays and changes.
- Hold on to your leisure time: set a “no later than” time for leaving from work.
- Limit the amount of work that you do during leisure time. This makes coping at work easier the next day.
- Pace yourself! After a particularly stressful, busy work period, be sure to schedule a lighter period during which you can replenish the consumed resources.

4.4. Ways to Accumulate Resources During Leisure Time

- Doing things that are important to you and that you enjoy enhances recovery and recharges you mentally.
- Spend time with your family and friends.
- Learn to say NO!
- Exercise refreshes your body and mind and promotes physical and mental resilience.
- A physically fit person recovers more quickly and efficiently than an unfit person. Thus, improving your fitness level enhances recovery.
- During leisure time, relaxation exercises, a nap or listening to music, among other things, can enhance your recovery.
- During busy periods it is recommended to reduce other stressors. Don’t burn the candle at both ends!

4.5. What after the Assessment?

The conclusions and agreed action points should be written down together with the client. Ideally, after the Lifestyle Assessment, the specialist and client agree on a follow-up measurement to establish the realization of the set goals. The most important thing is to support the client during the change process, whether via a follow-up measurement, meeting or a follow-up questionnaire about how things are going. The real work starts after the
Lifestyle Assessment, and it is important to support the client in this to make sure their enthusiasm doesn’t fade after the initial weeks.

The timing of the follow-up measurement depends on the goals and action points that were set. In general, half a year is a good interval between the initial and follow-up measurement. Before that, it’s possible to have a few smaller meetings, questionnaires or other measurements (e.g. weigh-ins) to encourage the client. After the initial 6-month follow-up measurement, it’s possible to continue for example with an annual measurement to keep track of the client’s situation.
5. Reporting of Results

5.1. To the Client

The client receives reports of his/her measurement and these reports are interpreted together with the specialist. If the client has filled out a pre-questionnaire, its results should be included in the feedback discussion.

In the feedback meeting, in addition to interpreting the reports together with the specialist, the client will set goals for promoting his/her personal well-being.

5.2. To the Employer

The employer can be provided a general report about the kinds of things that the organization should focus on in the future to promote occupational well-being. The Group Summary Report or Summary of the Firstbeat Assessment provided by the Firstbeat Analysis Server are excellent summary tools if the group size is big enough. It is also possible to make general summaries about the project, for example how many people were given a recommendation to lose weight, improve their stress management or increase their physical activity. However, nobody’s personal results or reports are in any way shared with the employer!

5.3. To Occupational Health

In the ideal situation, the service provider is producing the Lifestyle Assessments together with the client organization’s occupational health provider. If not, it can be a good idea to provide a general summary of the results to occupational health, even if they are not directly involved in the assessment process.
6. Interpreting Specialist Report

Description
The Specialist report has important information for the specialist to consider when interpreting results and giving feedback. The report includes information about daily alcohol use, medications, sleep quality, classification of stress state and reliability of the detected stress state.

The report is meant purely as an interpretation tool for the specialist / professional, i.e. it is not designed to be given to the client! The report summarizes significant information in the area of stress and recovery and acts as a helpful tool during the feedback discussion.

Contents
- Long-term medications and illnesses
- Notification about possible ectopic beats
- Alcohol use and medications during the measurement
- Stress state classification and its reliability
- Quality of recovery (RMSSD)
SPECIALIST REPORT

Case: Kireinen Ahti

Contact information:

Long-term medication and illnesses:

- 

Age (yrs): 47
Resting HR (beats/min): 57
Height (cm): 179
Max HR (beats/min): 199
Weight (kg): 82
BMI: 21.6 (Good)

Activity level:

- 

Notes:

- 

Stress state classification and details:

<table>
<thead>
<tr>
<th>Day</th>
<th>Alcohol</th>
<th>Mediation</th>
<th>Sleep quality</th>
<th>Stress state</th>
<th>Reliability of detected state</th>
</tr>
</thead>
<tbody>
<tr>
<td>01.10.2012</td>
<td>3 units</td>
<td>-</td>
<td>-</td>
<td>Good recovery</td>
<td>Good</td>
</tr>
</tbody>
</table>

Reliability was low because: A moderate amount of alcohol was consumed. (Day 1)

- Good recovery
- Good recovery, but no recovery during the day
- Moderate recovery, but sleep duration is short
- Delayed nighttime recovery
- Weak recovery
- Overload

The purpose of stress state classification is to condense the multifaceted information that the heartbeat measurement provides to a form that is easier for the specialist to interpret. A summary score is calculated - based on various aspects of the measurement - that describes the overall result during the measurement period, for example 3 days. The purpose of stress state classification is not to lessen the role of the specialist in providing feedback, but to act as a helpful tool in understanding the results.

Quality of recovery

Quality of recovery (RMSSD) during the measurement period.

Day: 01.10.2012

<table>
<thead>
<tr>
<th>Average RMSSD</th>
<th>During awake time</th>
<th>During sleep time</th>
<th>Relative difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>85</td>
<td>65</td>
<td>65</td>
<td>1.6 (Good)</td>
</tr>
</tbody>
</table>

RMSSD is a measure of heart rate variability indicating the quality of recovery. Low values of RMSSD during sleep indicate poor recovery. Higher values indicate enhanced recovery. The average RMSSD value should be 17 or greater during sleep (the value is determined based age).
6.1. Personal Information

Description
Shows the person’s background and contact information. The right side of the table shows information about long-term illnesses and medications, if applicable.

Interpretation
In the upper right corner, under long-term medications and illnesses, there is sometimes a red notification (below) that mentions possible ectopic beats.

There is indication that the measurement contains ectopic beats. Ectopic beats are common, further tests are recommended to establish their cause.

Ectopic beats are common and usually harmless; about 50% of people have them at some point in their life. The Firstbeat assessment is not a diagnostic tool, and this notification should be regarded as suggestive of ectopic beats, rather than a diagnosis. The daily number of suspected ectopic beats is shown at the bottom right corner of the Stress state classification and details box. The analysis provides this notification if the relative number (per 24 hours) of suspected ectopic beats is over 800 on at least 2 of the 3 days. An actual ECG measurement (measuring the heart’s electrical activity) will provide more information about the possible causes of possible ectopic beats.

Other
The information in this section comes from the background information that has been provided in the person’s profile. If the person uses medications that affect the heart rate, this should be considered in evaluating the accuracy of the person’s background information values. For example, use of heart rate decreasing Beta-blocker medications often justifies lowering the person’s maximum heart rate from the age-estimated value.
6.2. Stress State Classification and Details

Interpretation

The purpose of the automatic stress state classification feature is to condense the multifaceted information that the heartbeat measurement provides into a form that is easier for the specialist to interpret. It is a summary of several stress and recovery variables. The recognized state can be one of the following:

1. Good recovery
   • Sleep time is recognized mainly as recovery (green); heart rate variability reacts as expected (increased RMSSD during sleep). Some recovery periods present also during the day.

2. Good recovery, but no recovery during the day
   • The difference from state 1 is that there is no daytime recovery.

3. Moderate recovery, but sleep duration is short
   • The amount of overall recovery is moderate or weak due to short sleep duration. However, the % of recovery during sleep and RMSSD value during sleep are at least moderate. A typical example: a person who is busy, but basically in good shape and active, but sleeps too little.

4. Delayed nighttime recovery
   • The first part of sleep is poor quality, but the person’s resources seem to recover by the morning. Recovery at work, during the day and overall is moderate or fair, as is the % of recovery during sleep and RMSSD during sleep. The resources are somewhat weakened when compared to an optimal situation.

5. Weak recovery
   • There is a fair amount of stress reactions at night; however, the amount of heart rate variability is good or moderate. Overall, the amount of recovery is insufficient.
In interpreting this state, it is especially important to take into account the person’s own feeling about their stress and overall load; with some people, the parasympathetic side (RMSSD) can stay quite strong in spite of a lot of stress or overload. Thus, it is important to react and come up with some suggestions if the person feels overloaded. In general, the weak recovery state (5) means that there are more nighttime stress reactions than with states 3 and 4.

6. Overload
   • Recovery is insufficient overall (day and night) and heart rate variability is weak. A large part of sleep time is identified as stress.

7. Physical overload
   • The result shows physical activity state throughout the day, also at times when actual physical activity was not performed. Additionally, there are typically a lot of time periods which are recognized as unspecified “other state”. Heart rate variability and recovery is weak, which increases the risk of long-term overload. The physical overload state (7) is different from the overload state (6) in that there is a lot of physical activity and other physiological states, and thus, the relative amount of stress state can actually be quite low. A typical example: a person who is physically unfit and/or does heavy physical work and/or is overweight.

8. Exhaustion / Physiologically irregular state
   • It is important to find out what might be in the background of this result because many different factors can cause the analysis to come up with this state. In the area of recovery, the result is typically conflicting: the sleep time shows mostly recovery state (green), but heart rate variability is low or very low. Possible explanations can include autonomic nervous system dysregulation or severe exhaustion, in which case the level of both sympathetic and parasympathetic activation is very low (the body is no longer capable of producing stress reactions / increasing its activation status). Furthermore, certain illnesses and strong medications that affect the functioning of the heart can be behind this result.
   • The difference to states 6 and 7 is that even if this is physiologically a “worse” state (sympathetic nervous system is exhausted), there is typically a lot of “green” recovery state in the stress report. Thus, when comparing the different states, this state can seem to be close to State 1 (good recovery), with the difference that heart rate variability (RMSSD) is very low.

9. Non-identifiable
   • Either the measurement data is of poor quality (a lot of measurement error) or the results, based on the range of physiological indicators, are so conflicting that the measurement period was not recognized as any of the States 1-8.
Reliability of detected state:
The reliability of stress state classification tells **how well the automatically determined state (1-9) fits the criteria of that state**. When the reliability is good, it means that the criteria for this state are fulfilled well or very well, whereas if the reliability is low, the determined state is the best possible option even if the criteria wasn’t met in all areas. Reliability is lowered for those days when the measurement length is significantly shorter or longer than 24 hours. Likewise, a high artifact (missing data) percent lowers the reliability for that day. If the person has used a lot of alcohol, the reliability of the analysis drops depending on the number of portions consumed. Use of alcohol is often (but not necessarily) a temporary stress factor, and because of this, we haven’t given it excessive “weight” on these days when forming the overall picture or making the summary of all measured days. Reliability is influenced by:

- Percentage of missing data (i.e. quality of data)
- Number of alcohol doses (different criteria for men and women)
- Accumulated stress state points (how well they fill the criteria of a particular state)
- Measurement length

Other
Information about alcohol use and medications has been taken from the journal that the person has filled out. Sleep quality is also taken from the journal, where the person has had the chance to estimate the quality of each night’s sleep.

Stress state classification evaluates the results of stress and recovery analysis comprehensively, taking into account the whole period and the individual measurement days. In the background of this calculation are altogether 11 stress and recovery indicators, weighted according to their importance. The state that receives the most points relatively is classified as the dominant state.

Indexes that affect stress state classification:

- Share (%) of recovery during sleep time
- RMSSD, or amount of heart rate variability (during sleep time)
- Change in heart rate variability between day and night (sleep)
- Time used for sleeping
- Amount of recovery during daytime
- Amount of recovery during the 24-hour period
- Amount of stress reactions during the 24-hour period
- Amount of other physiological states during the 24-hour period
- Amount of physical activity during daytime
- Percent of recovery of the time used for sleeping
- Time that is takes for recovery to start after going to sleep

How to use

- Additional information to evaluate the client’s result
- A summary of the person’s assessment result (stress and recovery)
• For identifying high-risk cases for possible further follow-up

**Note!**
The purpose of stress state classification is not to lessen the role of the specialist in providing feedback, but to act as a helpful tool in understanding the results. Despite the comprehensive analysis and summary of important variables, it is still very important to take into account the client’s own experience and feelings when interpreting the results with the client.
6.3. Quality of Recovery

Interpretation
The black graph (RMSSD = Root Mean Square of Successive Differences in RR intervals in milliseconds) shows how great the heart rate variability (HRV) is during the measurement, displaying the average level. Each point in the graph shows the average variation in 5-minute periods.

A high index number is related to high activity of the parasympathetic nervous system and good recovery. The red line is drawn at approximately 20 ms (depending on age). If the average level during sleep stays below this line, it can mean an increased risk of exhaustion or overload.

Several factors can cause the heart rate variability level to be low. In addition to prolonged stress, overload and weak recovery, low HRV can be caused for example by diabetes, other sugar metabolism disorders, or various illnesses associated with normal cardiac functioning. Age and poor physical fitness are also known to lower HRV. Personal background variables do not affect the HRV result, so the person’s individual results are comparable between measurements.

During physical activity, heart rate increases and HRV drops, and it is normal for the RMSSD graph to be very low. If the measurement device is off or the data quality is very poor, the graph will not show a result (the value is 0).

On the left side of the graph are shown daily average values during the awake and sleep periods. There is no unequivocal recommendation for what the level should be during the day, but during sleep, RMSSD values should be above the red reference line – and should also increase from the daytime level, to show that the parasympathetic system functions as expected. The daytime to nighttime difference is illustrated with the relative difference value, which is Good if the value is 1.5 or higher, Moderate if the value is 1.0—1.5 and Poor if the value is less than 1 (meaning that the RMSSD level is lower during sleep than during the awake period).

Other
Heart rate variability correlates strongly with age. The picture below is a summary from the Firstbeat database, clearly showing the significant reducing effect that age has on heart rate variability. Heritance is also known to contribute about 30% to the individual’s natural heart rate variability level.
7. Interpreting Specialist Group Report

Description
The report includes a summary page of group results and a list of individual specialist reports. This report is meant as an interpretation tool for the specialist/professional by summarizing significant information in the area of stress and recovery and acting as a helpful tool during the feedback discussion and in follow-up measurements. The report summarizes information about factors that can affect the results in the area of stress and recovery (illnesses, alcohol use, medications, and sleep quality) at group level. Furthermore, the report lists people whose analysis result is such (either poor recovery or identified ectopic beats) that they should undergo further examinations or measurements. After the first page, the report includes the individual specialist reports of each member of the group (identical to the Specialist report available via individual assessments).

Contents
- Background information of the group
- Group notes
- Self-reported sleep quality (distribution)
- Alcohol consumption at group level
- Distribution of Stress state classification
- Attention / notes

Use
- Background information for the feedback session
- As a tool in follow-up measurements and projects
• To help identify individuals with strong signs of problems with recovery or general well-being

Note!
The idea of this report is not to be a diagnostic tool for health problems. However, the report can be utilized in group projects to identify individuals who might have a particular need for further measurements or attention. In these cases, it’s always first important to have a thorough discussion with the client about his/her general life situation and own estimation of health status and well-being. A “bad result” can have a natural physiological explanation, e.g. due to an exceptional situation or event during the measurement days.
7.1. **Distribution of Stress State Classification**

This bar chart shows how the measurement days in this group are distributed to different stress states. The number next to the bar means how many days are included in that particular category. Detailed information about Stress state classification is explained in the previous chapter, under Specialist report.

**Attention**

<table>
<thead>
<tr>
<th>Attention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessments with stress state classification III, II, I or 0 (0/6):</td>
</tr>
<tr>
<td>Assessments with indication of ectopic beats (0/6):</td>
</tr>
</tbody>
</table>

The column on the left side collects the names of all people whose result implies poor recovery. The criterion is the daily stress state result: if the determined state is either Weak recovery, Overload, Physical overload or Exhaustion / physiologically irregular state on each measurement day, it is justified to either do a re-measurement or recommend further tests to make sure that the person’s general health status is ok.

The right side column lists people for whom the analysis has indicated possible ectopic beats. Even if ectopic beats are common, in this case it can be warranted to recommend an ECG check. This topic has been discussed in more detail in the previous chapter: Specialist report.