

Firstbeat

Lifestyle Assessment

Report Interpretation Guide

February 2016

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1. Background information

🚶 Person: Ellie Example				Measurement:	
Age	43	Activity Class	4.0 (Average)	🕒 Start time	Thu 23.02.2012 09:09
Height (cm)	164	Resting heart rate	45	🕒 Duration	22h 6min
Weight (kg)	60	Max. heart rate	175	❤️ Heart rate (low/avg./high)	50 / 67 / 132
Body Mass Index	22.3	Additional information: Alcohol 4 units			

Description

The background information includes important basic information about the person being assessed and about the measurement period.

Contents

Person's background information

Person's name

Age

Height

Weight

Body mass index

Activity class (0–10)

Resting heart rate

Maximum heart rate

Measurement data

Start time

Duration

Heart rate (low/average/high)

Additional information (alcohol use and medication)

Purposes of use

Presentation of basic information relevant to the measurement.

Note!

Before providing any feedback, make sure that the background information is correct, the measurement time is accurate and the same resting heart rate and maximum heart rate values are entered for each measurement day, if the measurements have been conducted within a short time period (e.g. one week)

1.1. Personal information

Interpretation

Age

Person's age in years.

Height

Person's height in centimeters.

Weight

Person's weight in kilograms.

Body mass index (BMI)

The body mass index is a ratio for the estimation of the proportion of body height and weight. The value is defined as the body mass divided by the square of the body height. For example, the index for a person who weighs 90 kg and is 188 cm tall is calculated as follows: $90/1.88^2 = 25.5$ (slight overweight)

Activity class

A value describing a person's physical activity level (0–10) / fitness level. The activity class is divided into four ranges:

0–2 Poor

3–5 Moderate

6–7.5 Good

8–10 Top condition

Resting heart rate

The heart rate when a person is resting, in other words, the lowest heart rate level that the person reaches during the measurement period. The resting heart rate is calculated as an average of the lowest heart rate values detected during the measurement period (50 consecutive heartbeats). For measurements around the same time point, the same resting heart rate should be used. The resting heart rate can either be the lowest measured heart rate or a heart rate re-estimated by the specialist performing the analysis. According to the Firstbeat database, the average resting heart rate is approx. 50 beats/min, and a few beats lower for men than for women. A low resting heart rate is usually associated with good physical condition, whereas a high resting heart rate (more than 65 beats/min) can indicate poor fitness or weaker recovery.

Maximum heart rate

The maximum heart rate during maximal physical effort. The exact maximum heart rate can be determined, for example, in a maximal fitness test (VO₂ max test). If the maximum heart rate is not known, which is typical with most people, the Lifestyle Assessment software estimates the rate on the basis of the person's age ($210 - [\text{person's age} * 0.65]$). The fitness level has no effect on the maximum heart rate.

Other information

Body mass index classes:

< 18.5	Underweight
18.5—24.9	Normal weight
25—29.9	Slight overweight
30—34.9	Obesity
35—39.9	Severe obesity (class II)
> 40	Severe obesity (class III)

1.2. Measurement data

Interpretation

Start time

The time point when the measurement was started on the first day of recording or, respectively, the time of waking up as recorded in the journal during the following measurement days.

Duration

The length of data contained in the relevant report, usually the length of one day + night.

Heart rate (low/average/high)

The lowest, average and highest heart rate recorded during the period. The lowest and highest heart rate has been calculated on the basis of the average of the lowest and highest consecutive 50 heartbeats during the measurement day. The lowest and highest heart rate can never be smaller or greater than the resting heart rate and maximum heart rate values entered in the person's background information.

Additional information

The amount of consumed alcohol marked in the journal by the person being assessed and the medication recorded for the day.

Other information

The person's heart rate during the period (low, average and high) functions as a basis for evaluating the need to make changes to the person's background information. For example, a high average heart rate during the work day can indicate an unusually high heart rate level, and this might require raising the person's maximum heart rate as recorded in the background information.

2. Lifestyle Assessment report

Description

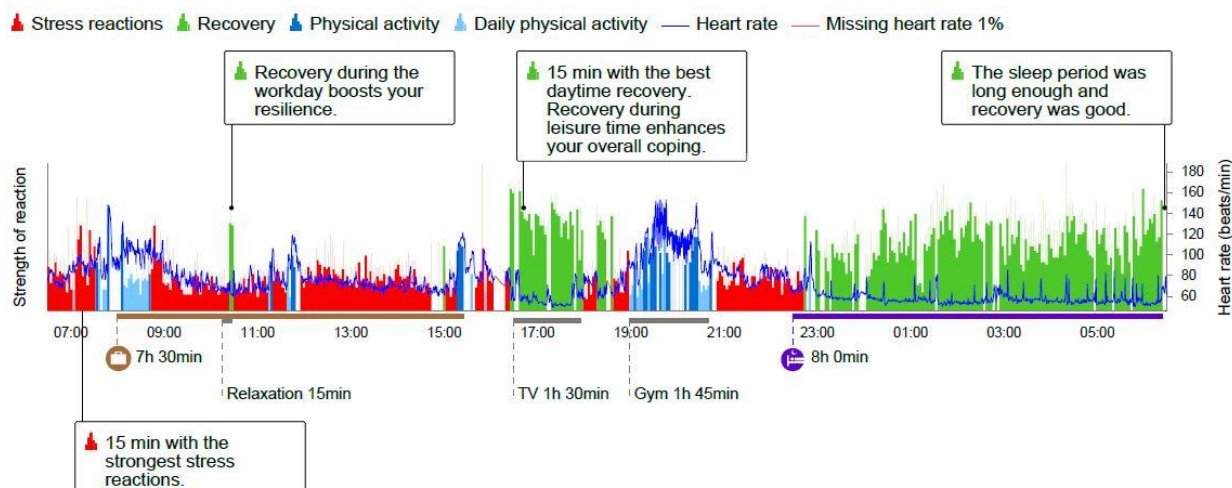
The report compiles the results from each day for stress, recovery, physical activity and energy expenditure. All the most relevant data for the client is recorded on one page and the results are assessed in relation to the recommendations set for each variable.

Contents

- Graph on stress and recovery
- Stress and recovery
- Work
- Sleep
- Physical activity
- Energy expenditure

Purposes of use

- Identification of stress reactions and recovery moments
- Assessment of the sufficiency of recovery
- Assessment of the amount and quality of sleep
- Assessment of the sufficiency of exercise regarding health and fitness benefits.
- Assessment of the total energy expenditure and energy expenditure via physical activity



2.1. Stress and recovery graph

Interpretation

The diagram presents the occurrence of stress and recovery during the measurement period. The measurement journal completed during the recording is an efficient way of visualizing the connection between physiological states and daily events. The entries recorded for the day are shown below the diagram. The boxes present the most stressful and the most restoring time periods during the day, sleep evaluation, and other interesting observations about the day. In the analysis phase, it is important to make sure that the work and sleep periods have been marked in the journal (shown under the diagram as brown and blue lines). By associating the time with an occurred state (such as recovery) in the diagram, it is possible to form an impression on how different activities affect a person's physiological reactions.

The diagram does not differentiate between “good” and “bad” stress; the red color indicates sympathetic dominance and an elevated level of alertness. The red stress state can be a result of negative reactions, such as stress or protracted load, or it can just as well be a reaction to positive excitement or focusing on a demanding situation. The state describing recovery (green) indicates a reduced level of activation and situations where physiological reactions that restore the body's resources have occurred.

Physical activity describes the points in time where oxygen consumption has been greater than 30% of the person's maximal oxygen uptake. The time points when oxygen consumption has been greater than 20–30% of the person's oxygen uptake are recognized as daily (light) physical activity.

Physical activity disturbs the body's inner balance and resembles a stress reaction physiologically. After a very strenuous exercise performance, the body's homeostasis, or balance state, has been shocked, and it is natural that recovery may only start many hours after going to bed. However, regular exercise that stresses the body moderately produces positive effects with regard to stress management.

Other state refers to time periods where the state of stress, recovery or physical activity could not be reliably determined. This state can be, for example, an “in-between” state between two states. Other state also describes periods where the identification of physiological states was

not possible due to weakness or lack of a heart rate signal (such as while taking a shower or bathing). In addition, directly after strenuous physical activity, the body is in a state of physical stress. This is a time when EPOC (see section on Training Effect Report) is still elevated, but no actual physical activity is being performed, and it is shown as other state in the report.

Usually there are more stress reactions during the day than recovery. The share (%) of recovery during a 24-hr period is recommended to be more than 30%.

An absolute comparison of stress and recovery levels between two persons cannot be performed due to individual differences in the functioning of the autonomic nervous system. Instead, intra-individual comparison of the strength of different states within a day is possible. Stress and recovery reactions have been scaled separately for each day, so comparison of the peak values between different measurement days is not recommended.

A good starting point for the evaluation of recovery is to examine whether recovery occurs during events when it is meaningful and appropriate (especially during the night and during breaks and relaxing moments). The body's ability to recover, or an overall stress situation, can also be evaluated by examining how quickly the body starts to recover after going to bed. In a balanced situation, the body reacts efficiently to moments of recovery and recovery starts quickly at bedtime, or preferably even slightly earlier. If the delay between going to bed and the start of recovery is several hours, this often suggests an elevated level of stress and a weakened ability to recover.

The blue line in the diagram indicates the person's heart rate during the measurement and the scale from the resting heart rate to maximum heart rate can be seen along the Y axis. The heart rate graph further illustrates the body's ability to recover: in a stress situation, the heart rate remains high long after going to bed and might even increase during the first hours of sleep. In restful and restorative sleep, the heart rate drops quickly towards the person's resting heart rate level and remains there without any prolonged activity spikes during the sleep period.

Note!

The purpose is not to make the days completely stress-free: the essential thing is to see whether recovery occurs when it is meaningful and possible (such as breaks, relaxing moments, and especially during sleep).

Other information

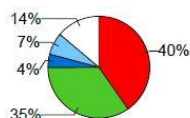
For training sessions that the analysis identifies, the boxes under the diagram indicate the training effect and the consumed energy during the relevant session. More information on the training effect can be found in the *Training Effect Report* section.

The percent share of missing heart rate due to poor signal quality or measurement breaks is shown in the upper right corner. In a good-quality measurement, there is less than 5% of missing heart rate. 5–15% of missing heart rate is still considered a moderate result, whereas over 15% is considered a significant amount of breaks or data interruptions.

For more detailed information on the analysis stages and state recognition, refer to <http://www.firstbeat.com/science-and-physiology/white-papers-and-publications/> (Stress and Recovery Analysis Method Based on 24-hour Heart Rate Variability)

🚦 STRESS AND RECOVERY

- Stress reactions (9h 40min)
- Recovery (8h 19min)
- Physical activity (1h 1min)
- Daily physical activity (1h 41min)
- Other state (3h 19min)



🚦 % of stress reactions:



🟢 % of recovery:



2.2. Stress and recovery

Interpretation

The pie chart on the left indicates the distribution of stress, recovery, physical activity, daily physical activity, and other states. The shares are indicated in both time (h min) and proportion (%).

On the right-hand side, the share of stress and recovery are assessed in relation to recommendations. The reference values are the same for all persons. For stress, the result is more than usual (red) when the share of stress exceeds 60%. For a normal (40–60%) or less than usual result (under 40%), the color of the box is green.

For recovery, a good result is greater than or equal to 30% and a moderate result is when the share of recovery is between 20–30%. If the share of recovery is less than 20%, the result is considered poor. With regard to time, the result is considered poor when the amount of recovery per day is less than five hours.

Other information

The intensity of the reaction is not considered in the result. The only determining factor with each identified state is its temporal occurrence. Defining the different states is explained in more detail in the report's definitions page, in the *Lifestyle Assessment Guide for Specialists* and in a more scientific manner in the White Paper found on our website under *Science*.

📅 WORK

Length of work periods: **8h 0min**

Amount of recovery during work: **18min**



2.3. Work

Interpretation

The diagram indicates the duration of the work day and the amount of recovery during that time. The color of the box is determined on the basis of the category where the person's result falls. The person's background information does not affect the values of this scale; it is generic for everyone.

Other information

The duration of work day is obtained from the time recorded in the journal by the person being assessed. If no working time has been recorded, this section is left blank in the report. There can be significant differences in the results in accordance with the person's background information, the nature of their work and their method of working. Thus, the values in the scale are only indicative. For the sake of the overall picture, recovery occurring at night during sleep is the most important factor.

SLEEP



2.4. Sleep

Interpretation

This section presents the self-reported quality of sleep, the length of the sleep period, and the amount (%) and quality of recovery during sleep. The color of the box is determined on the basis of the class in which the person's result falls.

The result is based on the duration of the sleep period recorded in the journal. The classification of the self-reported quality of sleep has five increments. The green smiley faces indicate a good sleep period, the yellow ones a moderate sleep period, and the red ones a poor or very poor sleep period.

The scale for the length of the sleep period is static, and it's good to keep in mind that due to individual differences, there can be significant fluctuations in the sufficient amount of sleep. The amount of recovery indicates the percentual share of recovery during the sleep period. During restful sleep, most of the sleeping time should be identified as recovery, and in order to receive a good result, there must be at least 75% of recovery. The result is poor when the percent of recovery remains under 50%. Only time periods when the data was of good enough quality for our analysis is taken into consideration when calculating this result. In other words, if there was a break in the data during sleep, due to for example an electrode becoming loose, the result will be calculated only from the time periods with a good-quality signal.

The quality of recovery (RMSSD) describes the amount of heart rate variability during sleep. The scale is based on the person's reference group in accordance with his or her age. The result is poor if the night's average is in the weakest 10% of the respective age group. The result is moderate when it is between the lowest 10%-50% of the respective age group. In order to reach a good result (green bar), the person must be above the average (>50%) of his or her reference group. The Specialist Report section includes a more detailed description of the

RMSSD variable, reflecting quality of recovery.

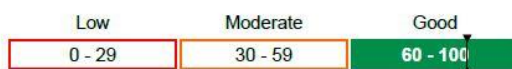
Other information

There are significant individual differences in the length of sleep and in the quality of recovery. This is why particularly the quality of recovery values should mainly be compared with the person's own, previously conducted measurements.

PHYSICAL ACTIVITY

The total duration of physical activity **53min** of which fitness-improving physical activity **46min**. In addition, there was **22min** of daily physical activity.

Physical activity index: **88/100**



2.5. Physical activity

Interpretation

This section presents the amount of physical activity during the period. The total duration of physical activity indicates the time periods during which the oxygen consumption exceeded 30% of the person's estimated maximal oxygen uptake. Fitness-improving physical activity means physical activity during which the oxygen consumption exceeded 50% of the person's estimated maximum. Daily physical activity includes the time periods during which the oxygen consumption was 20–30% of the person's oxygen uptake.

Physical activity points describe how well the amount of physical activity and the intensity level fulfil the recommendations set for health promotion. The recommendations are adapted on the basis of exercise targets by the ACSM (American College of Sports Medicine). The recommended target has been attained when the result is 60 points or more. This result can be achieved, for example, by performing moderate-intensity physical activity for 30 minutes, or by performing lighter physical activity for a longer period of time. According to the Firstbeat database, the average is 48 points.

Other information

The strenuousness of exercise is assessed in relation to the person's fitness level. This means that an identical workload can mean a very different result for two people of varying fitness levels, with regard to the effects produced by the exercise session.

An assessment based on heart rate variability cannot directly consider the positive effects produced by physical activity directed at improving muscular strength, mobility, or body control. The result will also not do justice for those performing aquatic exercise because the Firstbeat Bodyguard device cannot be used in water.

The main focus is, thus, on the health effects produced by physical activity targeted at the respiratory and cardiovascular system.

🔥 ENERGY EXPENDITURE

Total energy expenditure:



2.6. Energy expenditure

Interpretation

This section presents the total energy expenditure during the measurement period and the additional effect brought on by physical activity and daily physical activity. The orange color in the diagram shows the contribution to total energy expenditure during physical activity ($>30\%VO_{2max}$), the yellow during daily physical activity ($20-30\%VO_{2max}$), and the white indicates all other energy expenditure ($<30\%VO_{2max}$). More information on calculating the energy expenditure can be found at <https://www.firstbeat.com/science-and-physiology/white-papers-and-publications/>

Other information

A person's gender and weight has a significant effect on his or her level of energy expenditure. If the person is using medication that significantly affects the heart rate or he or she has a heart rate that is unusually reactive, the measurement result must be assessed critically.

3. Lifestyle Assessment Summary

Description

The report is a summary of the Lifestyle Assessment measurement result. The report summarizes the measurement results from 1–7 days, indicating the results for recovery, stress and physical activity in relation to the recommendations and reference values of the person's own reference group. The report also indicates the energy expenditure and number of steps taken during the period.

Contents

Resources

Stress and recovery

Balance between stress and recovery

Amount of recovery

Sleep

Length of sleep period

Amount of recovery during the sleep period

Physical activity

Physical activity points

Energy expenditure

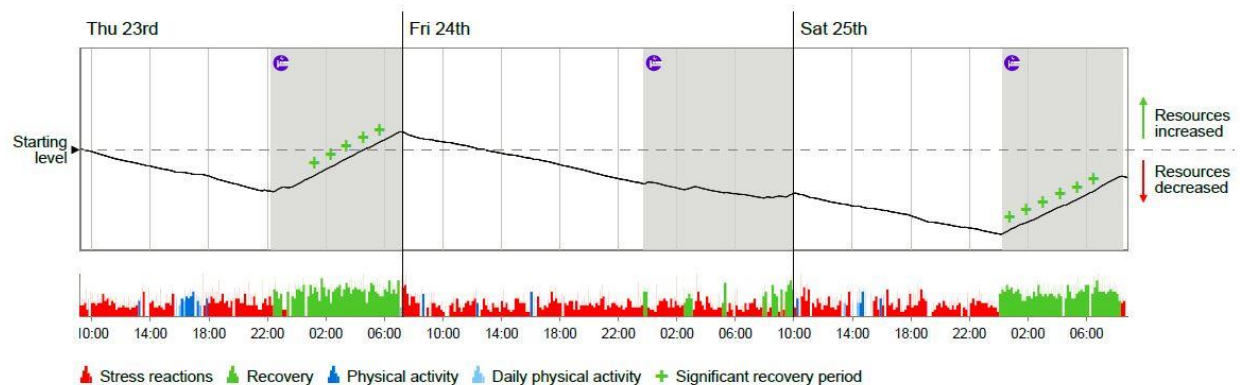
Energy expenditure (kcal)

Number of steps

Purposes of use

The report functions as a summary for the balance between stress and recovery, and for physical activity and energy expenditure.

BODY RESOURCES



3.1. Resources

Interpretation

The diagram shows a resource diagram for the entire measurement period. The starting point of the diagram is always on the left, in the middle of the scale. The starting level, which the graph of the resource diagram can be compared to during the period, is presented as a horizontal dash line running through the middle of the diagram. An averaged indication of stress and recovery reactions during the entire recording period is presented below the diagram.

The resource diagram ascends during time periods when recovery is present. During stress and physical activity, the resource diagram descends. The form of the diagram is also affected by the intensity of the reaction: the stronger the recognized reaction (stress or recovery), the more rapidly the graph ascends or descends, depending on the recognized state.

The basic principle for a balanced result is a situation where during the sleep period (the area marked in grey), the resource diagram ascends above the starting level, i.e., the level of the previous morning, or higher. The target situation is not a continuously ascending graph, but a graph that descends during the days when the level of alertness is high, and also partly due to positive stress, and then ascends and returns to the same level or preferably slightly above the starting level during the night. Due to the different nature of days, it is typical that there is not enough recovery on every measurement day and that the result can be negative when compared to the previous morning's result (according to the Firstbeat database, approximately a fifth of all measurements have a negative balance). This naturally emphasizes the significance of the other measurement days in maintaining a balanced situation.

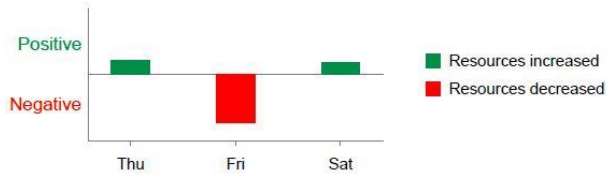
Other information

The green + signs above the resource diagram indicate periods of good, consistent recovery. The most significant periods of recovery are usually during sleep, but recommendations state that some recovery should also occur during the time when a person is awake.

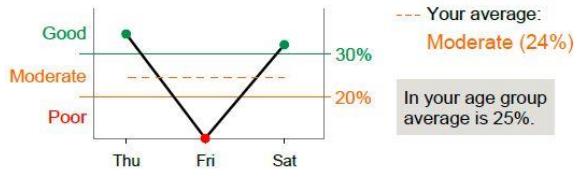
Due to graphic presentation and averaging, the physiological state diagram under the resource graph might look slightly different than the day-specific diagram, which is drawn with a higher resolution. However, this carries no significance for the variables to be calculated for the period.

STRESS AND RECOVERY

STRESS AND RECOVERY BALANCE:



% OF RECOVERY:



3.2. Stress and recovery

Interpretation

The section includes two separate variables: stress and recovery balance and amount of recovery.

The upper diagram indicates the daily result of the resource graph (the top part of the report). The balance is positive and the resources have increased when the end point of the relevant measurement period (typically a day from waking up to the next time the person wakes up) is higher than the starting point. The result is negative, and indicates a decrease in resources, when the end point is lower than the starting point of that day. The color and direction of the bar indicates the result for the day in question.

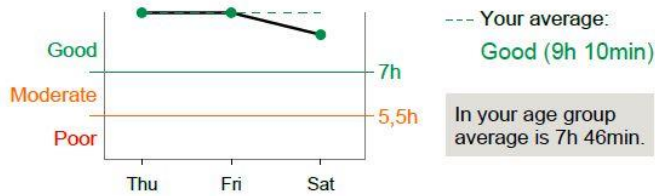
The lower diagram indicates the amount of recovery during each measurement day. With regard to recovery, the recommendation for a good result is more than 30% and for a moderate result, more than 20%. A person's average for the entire period is presented in the color of the result in the box to the right of the diagram.

Other information

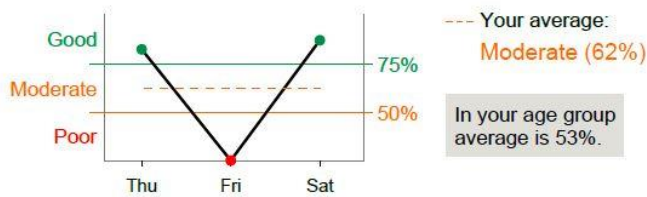
The average for the person's reference group with regard to recovery is presented below the box on the right.

SLEEP

LENGTH OF SLEEP:



% OF RECOVERY DURING SLEEP:



3.3. Sleep

Interpretation

The section includes two separate variables: Length of sleep and amount of recovery during sleep.

The upper diagram indicates the length of the sleep period during each measurement day. The length of the sleep period is obtained from the person's journal entries, so it is not a direct indication of the actual duration of sleep. The person's average for the entire period is presented in the color of the result in the box to the right of the diagram.

The lower diagram indicates the amount of recovery during the sleep period. The recommendation for a good result is more than 75% and for a moderate result, 50%. The person's average for the entire period is presented in the color of the result in the box to the right of the diagram.

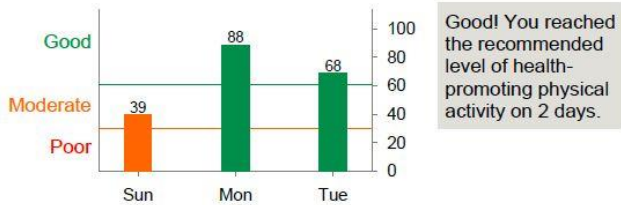
Other information

The average of the person's reference group for both variables is indicated in the grey box to the right of the diagram.

If the sleep period includes measurement interruptions / breaks (the heart rate graph is a straight red line), the analysis will take this into consideration by showing the share of recovery in proportion to the total duration during which data quality is good enough for analysis. If the device has, for example, become loose during the night and a measurement segment has been cut-off during the analysis, this must be taken into consideration when interpreting the results.

PHYSICAL ACTIVITY

PHYSICAL ACTIVITY INDEX:



The measurement included 2 workouts with a fitness-improving Training Effect.

3.4. Physical activity

Interpretation

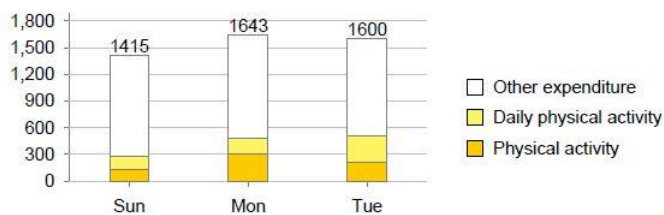
This section presents the physical activity points for each day. To the right of the diagram, there is a short summary of the amount of physical activity compared to the general recommendations.

Other information

With regard to the physical activity points, the purpose is not to attain full points for every day. A sufficient level is if the points reach the good (green) level on two measurement days out of three.

ENERGY EXPENDITURE

ENERGY EXPENDITURE (kcal):



3.5. Energy expenditure

Interpretation

The section on energy expenditure indicates the consumed calories during both daily physical activity and physical activity. The figure below indicates the amount of total energy expenditure.

Daily physical activity indicates the amount of energy expenditure when the oxygen consumption has been on a level of 20–30% VO_{2max} . The energy expenditure during physical activity consists of the time points when the oxygen consumption has been above 30% VO_{2max} .

Other information

The general health recommendation for the number of steps to be taken daily is 10.000 steps. If a person's initial situation is very passive, it is good to increase the number of steps toward the recommended level gradually. The analysis only recognizes a consecutive series of steps, so if you are pacing in place or taking steps backwards or to the side, the analysis will not take these steps into consideration for the period.

The amount of consumed calories presented in the report may differ significantly from the actual level if a person's background information, especially with regard to maximum heart rate is incorrect or the effect of certain medications on the heart rate level has not been considered (such as beta blockers). This will typically cause the energy expenditure results to be too low in comparison to the actual situation.

4. Training effect report

Description

The report verifies the effect of exercise on the maximal performance of the respiratory and cardiovascular system. The recommendation is to create this report from individual workout sessions, rather than from an entire day.

The report is suited for all persons interested in physical activity who wish to gain more specific information about the effect that training has on endurance characteristics. Suited both for athletes in individual and team sports that require endurance characteristics, and for beginning exercisers for the purpose of determining suitable intensity levels.

When providing feedback, it is good to note that due to the diversity of different sports and different demands, the report is not designed to guide training in any specific direction. The report provides an assessment about the improvement of endurance characteristics (especially maximal aerobic power). The reliability of results is significantly improved if the person's maximum heart rate and oxygen uptake are known based on a reliable fitness test conducted previously.

Contents

- Training effect chart
- Training effect assessment
- Training classification

Purposes of use

- Assessment of training effect and load
- Determination of an appropriate training level
- Analysis and comparison of different types of exercise
- Comparison of workouts of different level of intensity and duration

4.1. Training effect chart

Interpretation

The heart rate graph is shown in blue in the diagram. The scale for the heart rate graph is shown on the Y axis on the left.

The dark red graph indicates the EPOC accumulation during the session. EPOC is a physiological measure that describes the disturbance of the body's balance (homeostasis) caused by training. During recovery periods, EPOC will decrease. The scale for EPOC is on the Y axis on the right. The black point on the red graph indicates the peak EPOC level and time point (X axis). Training effect, i.e. the achieved training effect category, is shown in the chart as a numerical figure marked in bold. The training effect is divided into five categories (1–5) in accordance with how much the exercise improves maximal aerobic power and resistance to fatigue during an endurance workout. The closer the figure is to 5, the more intensive the workout has been. The levels of training effect from the lightest to the most intensive are:

1. Easy recovery workout
2. Fitness-maintaining workout
3. Fitness-improving workout
4. Highly improving workout
5. Temporary overreaching / overload

TRIMP (Training impulse) is another variable for assessing the training load.

The TRIMP accumulation graph is designed to indicate the exponential accumulation of lactate as the intensity level of the training increases. The formula for calculating TRIMP is as follows

$$\text{TRIMP} = T \times \left[\frac{(\text{HR}_{\text{ex}} - \text{HR}_{\text{rest}})}{(\text{HR}_{\text{max}} - \text{HR}_{\text{rest}})} \right] \times 0.64e^{1.92 \left[\frac{(\text{HR}_{\text{ex}} - \text{HR}_{\text{rest}})}{(\text{HR}_{\text{max}} - \text{HR}_{\text{rest}})} \right]}$$

T = duration of exercise
 HR_{ex} = heart rate during exercise
 HR_{rest} = resting heart rate
 HR_{max} = maximum heart rate
 e ~ 2.718

The biggest difference in comparison to the EPOC value is that TRIMP does not accumulate during recovery periods, and is thus the most appropriate measure to indicate the load of an interval workout. Based on measurement data gathered from top football, ice hockey and rugby players, the following types of values can be recommended for indicating workout load in a 75–90-minute workout.

- Intense workout: TRIMP > 140
 Medium intensity workout: TRIMP 40—70
 Light workout: TRIMP < 40

Other information

In the report, the effects produced by training are primarily examined in relation to aerobic training. This means that with regard to performance, workouts that improve muscle strength, speed or mobility do not necessarily produce an improving effect in the training effect graphs. For the purpose of improving fitness, the aim is not always to reach a maximum training effect level; an optimal workout for improving one's performance can also have a restorative (1) or

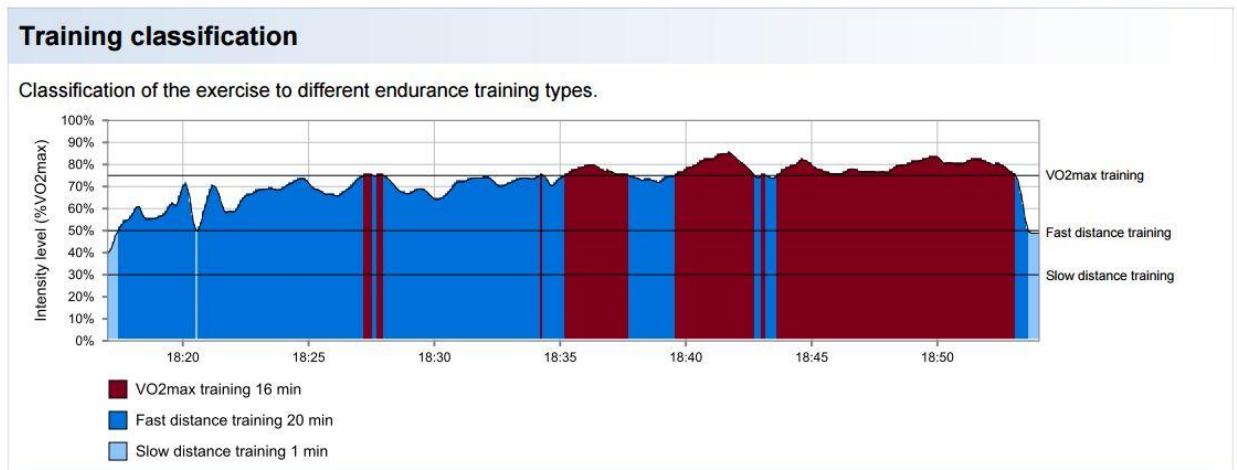
maintaining (2) training effect. The same workout can have very different effects, depending on the person's physical condition and background variables. And even if for example stretching after a workout slows down the EPOC decrease somewhat, stretching does promote recovery from physical activity and is thus recommended.

More information about EPOC and the calculation of training effect can be found at

<https://www.firstbeat.com/science-and-physiology/epoc-and-training-effect/>

and in the white paper section at

<https://www.firstbeat.com/science-and-physiology/white-papers-and-publications/>



4.2. Training classification

Interpretation

The diagram indicates changes in the level of intensity (load) over time. The Y axis on the right side of the diagram indicates training classification and the Y axis on the left indicates the intensity level (%VO₂max).

In easy recovery workouts, the workout should mostly consist of periods within the light blue area of basic endurance. If the body reacts strongly to even a small load and “light exercise” shows up in the red maximum endurance (VO₂max) category, this suggests poor physical condition or, possibly, accumulated overload. If the heavy overload has existed for a long time, the body may be in a chronic, so-called parasympathetic overload state. In this situation, the heart rate and oxygen consumption do not increase to the maximum endurance range even during more intensive exercise, and performing intensive workouts is not sensible or beneficial.

Other information

The intensity levels of endurance training are categorized as follows:

slow distance training	30–50% VO ₂ max
fast distance training	50–75% VO ₂ max
VO ₂ max training	75–100% VO ₂ max.

Especially with endurance athletes, the limit (cut-off) values for the different intensity levels can be significantly higher than these default values.

5. Physical workload report

Description

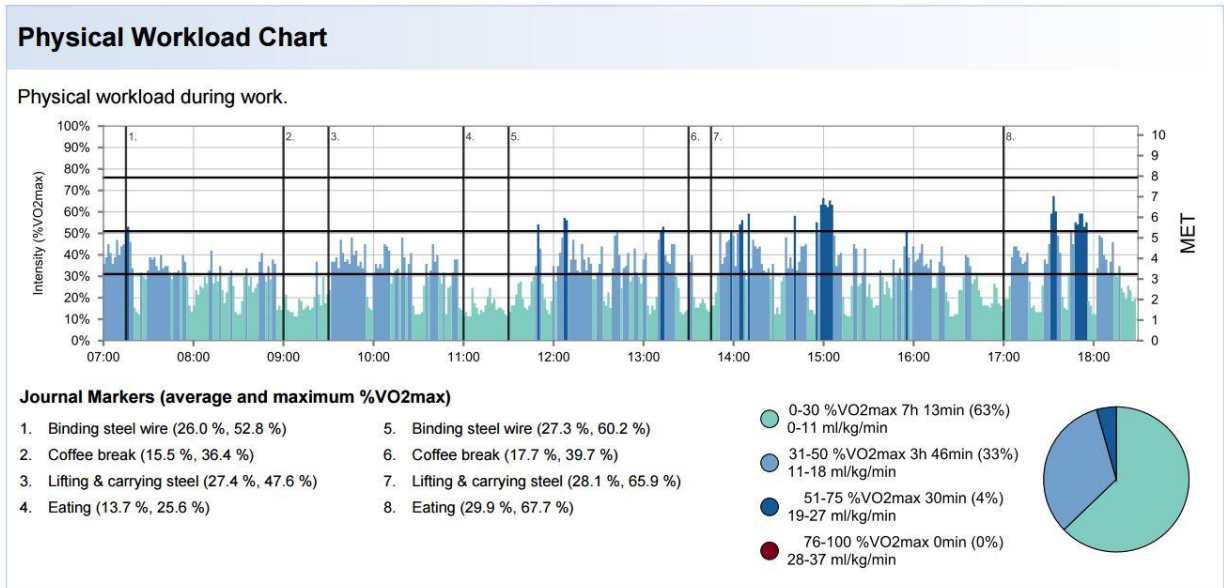
The report verifies the amount of physical load and the load level, using key figures and diagrams related to physical workload. The report is especially suited as a tool for occupational physiotherapists for assessing the physical workload of work tasks, in order to verify the load caused by various tasks.

Contents

- Physical workload chart
- Distribution of the physical workload into different load levels (pie diagram)
- Physical workload analysis
- Physical workload key figures
- Heart rate variability index (RMSSD)

Purposes of use

- Evaluation of the physical load of work tasks
- Analysis of individual work tasks
- Comparison of different work methods
- Comparison of work tasks with different levels of intensity and duration
- Assessment of recovery from physical workload



5.1. Physical workload chart

Interpretation

The diagram enables the analysis of physical workload during the time period. The chart is divided into four ranges in relation to the intensity level (0–30%VO₂max, 31–50%VO₂max, 51–75% VO₂max, 76–100%VO₂max).

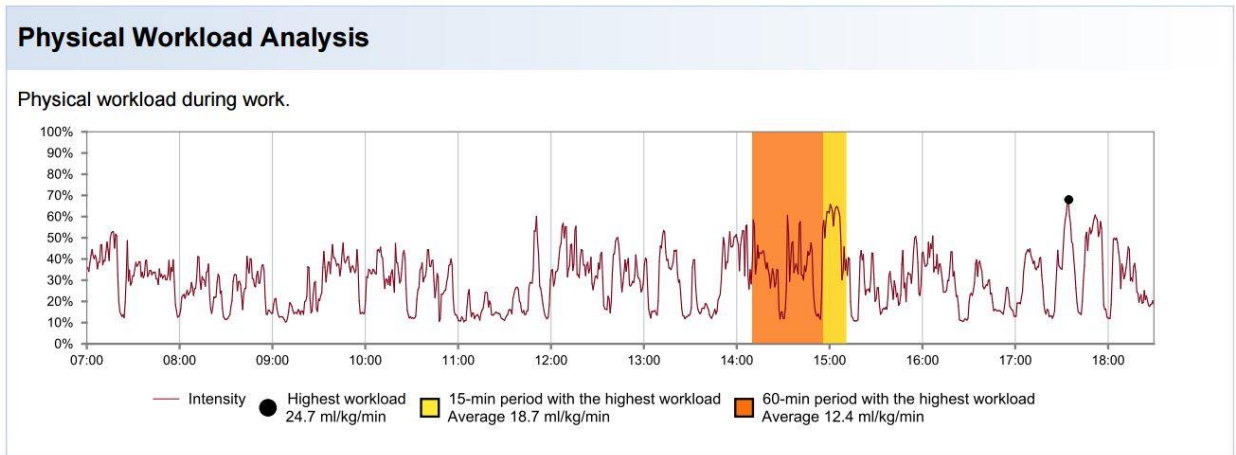
The scale indicating the intensity of the physical workload is presented on the Y axis on the left. The Y axis on the right indicates the person's MET level (1 MET is roughly equivalent to the energy cost of sitting quietly).

Other information

The peak MET values of a person in good physical condition are better than those of a person in poor condition. The MET value is indicated either in the person's background information (optional) or the value is estimated based on other background information (such as age, gender, and activity class). The personal MET value is calculated by dividing the person's oxygen uptake by 3.5.

The oxygen consumption levels (ml/kg/min) matching the limit values are indicated under the chart, next to the pie diagram.

In order for the work tasks to be shown in the report, they need to be entered via the *Journal* function before the report is created.



a. Physical workload analysis

Interpretation

With regard to physical workload, the diagram indicates the most significant

- single time point with a black dot
- 15-minute period with an area colored in yellow
- 60-minute period with an area colored in orange

The black dot indicates the time point when the physical workload was the highest with regard to oxygen consumption. The colored 15- and 60-minute periods indicate the time periods when the physical workload was the highest for the duration of time in question.

Other information

The figures for the *Highest workload* time point indicate the maximum oxygen consumption values (ml/kg/min and %VO_{2max}) during the period. The values for the 15- and 60-min periods indicate the average values for these variables during these time periods.

Physical Workload Indexes

Heart rate parameters	Average	Range	Other	Average	Range
Heart rate (bpm)	109	79 - 141	Energy expenditure (kcal/min)	4	1 - 10
Heart rate (%HRmax)	60 %	44 % - 78 %	Ventilation (l/min)	25	6 - 63
%HRR	47 %	26 % - 71 %	Respiration rate (breaths/min)	19	12 - 32
			RMSSD	27	12 - 49
Oxygen consumption	Average	Range	Cumulative values		
VO ₂ (ml/kg/min)	9.7	3.3 - 24.7	Energy expenditure (kcal)	2730	
%VO _{2max}	27 %	9 % - 68 %	EPOC _{peak} (ml/kg)	21	
MET	2.8	1 - 7.1			

5.2. Physical workload key figures

Interpretation

Heart rate (bpm)

The heart's pulse rate as beats per minute.

Heart rate (%HRmax)

Percent of heart rate from the maximum heart rate.

%HRR

Percent of heart rate from the pulse reserve.

Energy expenditure (kcal/min)

Energy expenditure in calories per minute.

Ventilation (L/min)

Pulmonary ventilation in liters per minute.

Respiration rate (breaths/min)

Rate of inhalations and exhalations per minute.

RMSSD

Figure indicating the amount of heart rate variability.

VO₂ (ml/kg/min)

Oxygen consumption

%VO₂max

Percentual share of oxygen consumption from a person's maximal oxygen consumption.

MET

Figure indicating the energy expenditure rate (1 MET = basic metabolic rate).

Energy expenditure

Value indicating the cumulative total calorie consumption.

EPOC_{peak} (ml/kg)

Load accumulation which indicates the disturbance of the body's homeostasis. EPOC_{peak} indicates the highest EPOC value during the period, so it is not necessarily located at the end of the period.

Other information

If the period contains a large amount of incorrect heart rate data (with artefacts), the physiological key figures may be distorted. If you want to use the above-mentioned key figures for examining the average load during the work day, you need to ensure that the length of the measurement period corresponds with the desired time. If the report created from the measurement also includes sleep periods and leisure time, both the lowest and average values of the range will be distorted considering work time.

Note!

In addition to oxygen consumption, there are recommendations that are based on a person's heart rate and energy expenditure during the work day. The following presents a few examples of such recommendations:

- the average heart rate during an 8-hour work day must not exceed 100 bpm
- the week should only have 6 hours of work during which the heart rate exceeds 140 bpm
- regular health examinations are recommended for people whose heart rate is elevated to an average of more than 120 bpm during an 8-hour shift or even momentarily to more than 150 bpm

Recovery heart rate:

the work tasks have too much load, if

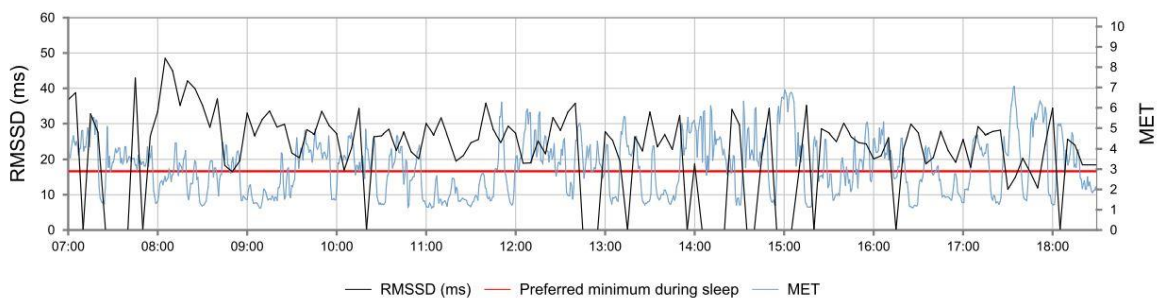
- the heart rate is more than 110 bpm one minute after the work has ended
- the heart rate does not drop to a value of 90 bpm during the first three minutes after the work has ended

The time-weighted energy expenditure during work should be

- less than 2.9 MET for women
- less than 3.3 MET for men

The load level of the physical workload should not increase to more than 60%VO₂max for more than 19 minutes
more than 70%VO₂max for more than 7 minutes

Heart Rate Variability Index



RMSSD (Root Mean Square of Successive Differences in R-R intervals) reflects the function of the parasympathetic nervous system. The index can be used to determine recovery from physical workload. High index values are related to increased activity of the parasympathetic system, and low values indicate poor recovery from physical work.

5.3. Heart rate variability index (RMSSD)

Interpretation

A high index value is associated with elevated activity of the parasympathetic nervous system

and efficient recovery. If the index value remains very low after physical activity, no recovery occurs.

The red reference line indicates the (risk) level, during sleep, under which an average of 10% of people are in their own reference group results. It is natural that the RMSSD value decreases during physical activity or heavy load because the heart rate increases and heart rate variability decreases (sympathetic activation). For the purposes of interpretation, the red line is only meaningful during the sleep period.

With regard to recovery, the RMSSD value should be approximately 1.5 times higher during sleep than during the time when the person is awake.

Other information

If heart rate data includes a lot of error or the measurement has been completely interrupted, the RMSSD value will not be shown and it will not affect the calculation of the average and range values of the key figures. Because RMSSD is calculated from five-minute average values, occasional level drops may occur due to interruptions in night-time measurements. This is why it is good to monitor the MET diagram at the same time.

- 1) Is the MET elevated due to physical activity, when the heart rate is clearly elevated and RMSSD is thus lower?
- 2) Is the MET level a straight line at the bottom of the diagram due to the above-mentioned contact interference?

In such situations, interpretation of these reference values is not sensible.

RMSSD values are directly based on the amount of heart rate variability, so resting and maximum heart rates, which are essential for identifying stress and recovery, do not affect the result.

Note!

When interpreting the RMSSD values and other variables related to physical workload and stress, the situation should be assessed comprehensively. Various illnesses relating to the function of the autonomic nervous system and some medications may cause abnormal results.

6. Lifestyle Assessment Follow-up

Description

The report provides information about the changes in essential Lifestyle Assessment variables at individual level. The report is an easy way to demonstrate how the essential results related to stress, recovery and physical activity have changed. In addition to physiological changes, the report also lists changes in background information (resting heart rate, activity class, body mass index, and the well-being experienced by the person). Up to four separate measurements (assessments) can be selected to be compared in the follow-up report.

Contents

- Background information
- Stress and recovery
- Sleep
- Physical activity

Purposes of use

- Follow-up tool
- Indication of changes occurring at individual level
- Long-term follow-up of the most essential variables

Seuranta Case			
Date	Thu 14. - Mon 18.05.2015	Sat 31. - Wed 04.11.2015	Tue 15. - Mon 21.12.2015
Resting heart rate	49	48	49
Activity Class	4.0 (Average)	↗ 6.0 (Good)	6.0 (Good)
Body Mass Index	23.2 (Normal weight)	↘ 21.6 (Normal weight)	21.6 (Normal weight)
"I feel well at the moment."	😞 Partially disagree	😊 Partially agree	😄 Completely agree

6.1. Background information

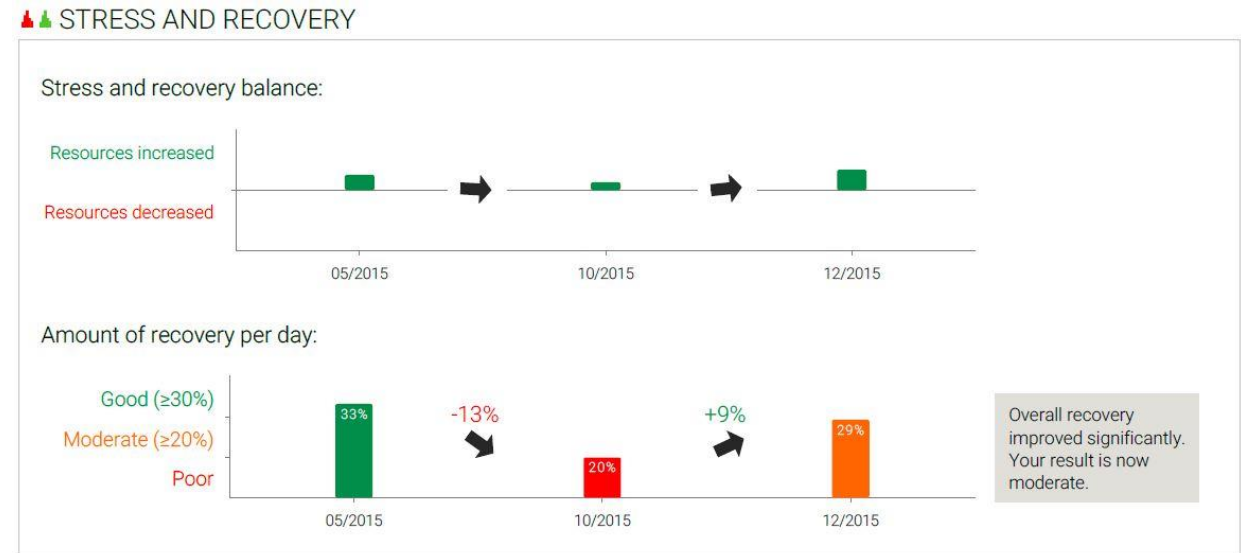
Interpretation

The table indicates the most essential background information values and the direction of change for each measurement event. The followed variables are measurement time, resting heart rate, activity class, body mass index, and the last question in the pre-questionnaire, "I feel well at the moment".

A positive development would include a lower resting heart rate, an elevated activity class, placement of body mass index within the normal range (20–25), and a positive feeling about one's own health.

Other information

A maximum of four measurement events can be included in the follow-up report. The Lifestyle Assessment user manual describes the stages related to the technical implementation of the report in more detail.



6.2. Stress and recovery

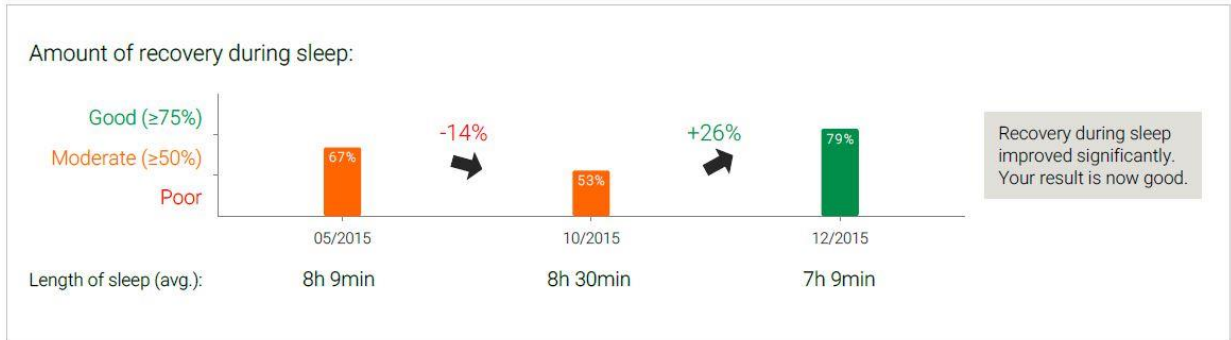
Interpretation

Stress and recovery balance during the day indicates whether the resource balance described in the Lifestyle Assessment Summary was increasing or decreasing. A green result, rising above the line, is reached when the average result of the individual days was positive. A red result, remaining below the line, is reached when the average of the individual days was negative. The *Amount of recovery per day* indicates the average amount of recovery for the measurement periods (days+ nights) included in the assessment. The scale is presented in the left border of the diagram (Poor <20%, Moderate 20–30%, Good >30%).

Other information

The arrow between the measurement events indicates the direction of change and its percentual amount (the latter only for the lower section on recovery). The steeper the angle of the arrow, the more significant the occurred change. The box on the right contains a short verbal summary and feedback on the occurred change.

SLEEP



6.3. Sleep

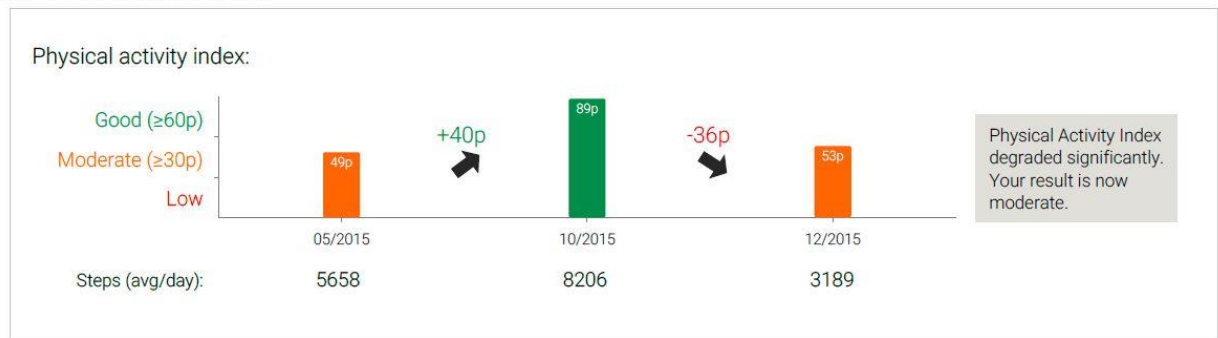
Interpretation

The *Sleep* section indicates the average amount of recovery during sleep for the measurement periods (days) included in the assessment. The scale is presented in the left border of the diagram (Poor <50%, Moderate 50–75%, Good >75%).

Other information

The arrow between the measurement events indicates the direction of change and its percentual amount. The steeper the angle of the arrow, the more significant the occurred change. The box on the right contains a short verbal summary and feedback on the occurred change.

PHYSICAL ACTIVITY



6.4. Physical activity

Interpretation

The *Physical Activity* section indicates the average number of physical activity points for the measurement periods (days) included in the assessment. The scale is presented in the left border of the diagram (Low <30 p, Moderate 30–60 p, Good >60 p).

Other information

The arrow between the measurement events indicates the direction of change and its percentual amount. The steeper the angle of the arrow, the more significant the occurred change. The box on the right contains a short verbal summary and feedback on the occurred change.

7. Specialist report

Description

The Specialist report is designed to be a collection of important information that the specialist can take into consideration when interpreting the results and giving feedback. The report includes information about daily alcohol consumption and medication, sleep quality, stress state classification and its reliability.

The report is intended for the sole use of the specialist, and its purpose is to provide additional information that is significant for the interpretation of the results in the feedback discussion.

Contents

- Contact information
- Long-term medication and illnesses
- Alcohol consumption and medication during the measurement
- Stress state classification and its reliability
- Diagram on the quality of recovery (RMSSD) and key figures for the measurement periods

Purposes of use

- Background data for the specialist to use during the feedback session.
- A tool for initial, follow-up and final measurements.

SPECIALIST REPORT				Page 1(1)
Case Laborer 1		Contact information:		Long-term medication and illnesses:
Age (yrs)	37	Resting HR (beats/min)	43	-
Height (cm)	178	Max HR (beats/min)	186	-
Weight (kg)	80			E-mail
Activity class	6.0 (Good)	Body Mass Index (BMI)	25.2	Notes: -

7.1. Personal information (upper section)

Interpretation

In addition to the basic background information, this section includes information on whether the person belongs to a specific group, and an e-mail address provided by the person. The follow-up recommendation suggests a suitable time interval for a repeat measurement. The alternatives are:
 Red / 1 month, orange / 2–6 months, and green / 6–12 months. If data quality or measurement duration do not enable a reliable assessment, the software will provide a notification on this during the reporting phase, and the relevant section will state “Repeat”. The follow-up recommendation can include an estimate on how acute the situation is. If the result is very weak regarding recovery throughout the measurement, the follow-up recommendation is one month. The need for a repeat measurement is then more acute and the main goal is to find out if the situation is related to an exceptionally poor measurement time point or something more chronic. Already a few weeks will provide more information on whether the recovery situation has started to correct itself. When the follow-up recommendation is 6–12 months, the recovery situation is good in all respects. This information is included only in the Specialist report, so the decision on implementing a follow-up measurement will always be left to the specialist and client to agree upon together.

Stress state classification and details					
Stress state classification and details:					
	Alcohol	Medication	Sleep quality	Stress state	Reliability of detected state
Day 1: 15.09.2011	-	-		Delayed nighttime recovery	Good
Day 2: 16.09.2011	-	-		Good recovery	Good
Day 3: 17.09.2011	3 units	-		Delayed nighttime recovery	Moderate

Reliability was low because: - A moderate amount of alcohol was consumed. (Day 3)

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

- Physical overload
- Exhaustion / Physiologically irregular state
- Non-identifiable

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.

491 | 248 | 38 |

7.2. Stress state classification and details

Interpretation

The purpose of stress state classification is to condense the multifaceted information that the heart rate variability measurement provides to a form that is easier for the specialist to interpret. The classification is a summary of several stress and recovery variables. The identified alternative states are:

1. Good recovery
 - The night is mostly recovery and heart rate variability reacts normally. There is some recovery also during the day.
2. Good recovery, but no recovery during the day
 - The difference to state 1 is that there are no recovery moments during the daytime.
3. Moderate recovery, but the sleep duration is short
 - The total recovery time is weak or moderate due to the short nighttime sleep. The night's resource balance and RMSSD (heart rate variability), however, are at least moderate. Typical example: a person in good condition who sleeps too little.
4. Delayed nighttime recovery
 - The first part of sleep is poor (stress), but resources are restored by the morning. Recovery at work, during the day and in total is moderate. The night's resource balance and heart rate variability is moderate.
5. Weak recovery
 - A considerable amount of stress reactions during the night, but still a good or moderate amount of heart rate variability. As a whole,

recovery is insufficient. When evaluating this state, one should particularly consider the person's own feelings on stress: for some, the parasympathetic function (RMSSD) can remain quite good, despite a stressful situation. There is a need to respond if the person feels stressed or overloaded. With weak recovery state, there are more nighttime stress reactions than in states 3 and 4.

6. Overload

- As a whole, recovery is insufficient and heart rate variability is poor. The night period mostly shows up as stress.

7. Physical overload

- The result shows physical activity at other times than during actual exercise. In addition, the number of periods identified as other physiological state have increased. Heart rate variability and recovery are poor, which leads to an increased risk of long-term stress. Differs from state 6 in that this state includes a lot of periods identified as physical activity or other state, and this will lead to a relative decrease in the total amount of stress state. Typical example: a person in poor physical condition and/or an overweight person performing hard work.

8. Exhaustion / Physiologically irregular state

- It is important to examine the background particularly with this state because a range of factors could explain this state. Characterized by an inconsistent recovery result: mostly recovery during the night, but very low heart rate variability. Possible explanations for this could be a regulation disorder of the autonomic nervous system or a severe case of exhaustion, which results in low activation of both the sympathetic and parasympathetic nervous systems (the body no longer initiates stress reactions). Underlying causes can include certain illnesses and strong medications that affect the heart function.

The difference to state 6 and P. is that even if the state is physiologically weaker (sympathetic nervous system is fatigued), there is also a great deal of "green" present. Thus, the result can look close to state 1, with the difference, however, that RMSSD is very low

9. Non-identifiable

- Either the measurement data is of poor quality or the results are inconsistent with regard to the physiological variables to the extent that the measurement cannot be identified as any of the first eight states.

Reliability of the stress state:

The reliability of the stress state indicates how well the automatically determined state corresponds to the classification criteria. When reliability is good, the state-specific criteria are fulfilled well or extremely well. When reliability is moderate, the factors only describe the identified state in part or there are factors mentioned later that might weaken the reliability. When reliability is weak, the determined state is the strongest of the alternatives, but the definitions regarding the state are not completely fulfilled.

The day-specific reliability of a state is reduced on days where the measurement duration is clearly under or over 24 hours. Similarly, frequent occurrence of measurement errors also decreases the reliability of a state. If a person has consumed a lot of alcohol, the reliability of the result decreases with every unit of alcohol. Consumption of alcohol is often more of a temporary stress factor, and this is why the importance of those days is not weighed so heavily when establishing a general view on stress status. Possible factors that decrease reliability are listed under the diagram (a maximum of three).

Factors that affect reliability:

- State-identification points (how well they fulfill the criteria for the relevant state)
- Percentual share of measurement errors, i.e. heart rate data quality
- Number of alcohol units (gender differences taken into consideration)
- Duration of measurement (if not comparable to day-specific reference values, based on app. 24 hours)

Other information

Use of alcohol and medication has been obtained from the person's journal entries. Sleep quality is obtained from the subjective estimation marked in the journal.

The bottom row of the summary indicates the total number of consumed alcohol units. With regard to sleep, the bottom row indicates the average result for the measured days.

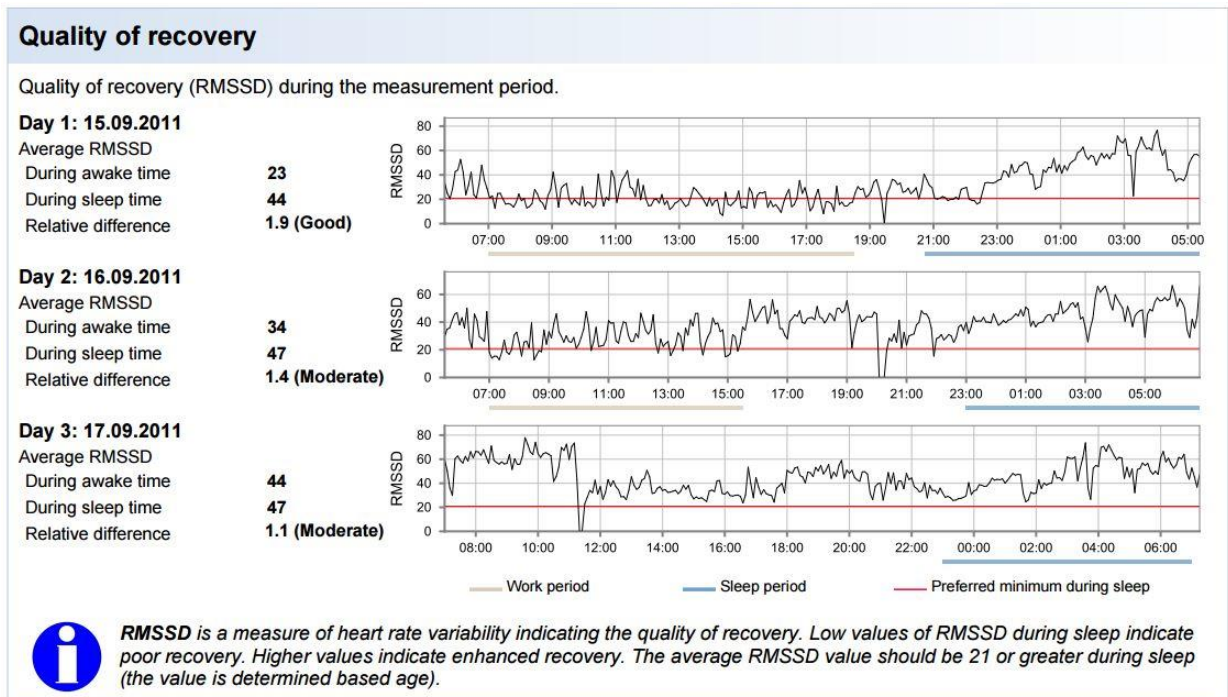
Stress state classification provides an overview of the stress and recovery result with consideration to the entire period and each individual measurement day. Behind the identification, there is a total of 11 differently weighted stress and recovery variables based on which the state that receives the largest relative number of points is selected as the stress state.

Variables affecting the stress state classification:

- Resource balance (during sleep)
- RMSSD, i.e. the amount of heart rate variability (during sleep)
- The difference in heart rate variability between the day and night
- Time spent sleeping (as recorded in the journal)
- Amount of recovery during the day
- Amount of recovery during the day and night
- Amount of stress reactions during the day and night
- Amount of unidentified state during the day and night
- Amount of physical activity during the day
- Share of recovery during the time spent sleeping
- Time spent on recovery that starts after going to bed

Note!

The purpose of stress state classification is not to decrease the role of the specialist in providing feedback, but to act as a helpful tool in understanding the results. Despite comprehensive examination of reports and information, it is still vitally important to consider the client's personal experience and feelings when interpreting the results during the feedback discussion.



7.3. Quality of recovery

Interpretation

The black graph (RMSSD=Root Mean Square of Successive Differences in RR intervals) indicates the amount of heart rate variability during the measurement period. The diagram shows the average heart rate variability during the period. Each individual point in the diagram indicates the heart rate variability as a 5-minute average value for that time point. For a good result, it is not so relevant that the graph should include large spikes; instead the focus should be on the overall level of the graph, especially during the night. If the measurement has been interrupted or the heart rate signal has not been found sufficiently reliably, the graph will not be drawn for those time periods.

A high index value is connected to elevated activity of the parasympathetic nervous system and good recovery. The red cross-line indicates a level that expresses an increased risk of overload or fatigue, if the result during sleep remains under this line. This level indicates the value under which 10% of the results in the relevant age category are found.

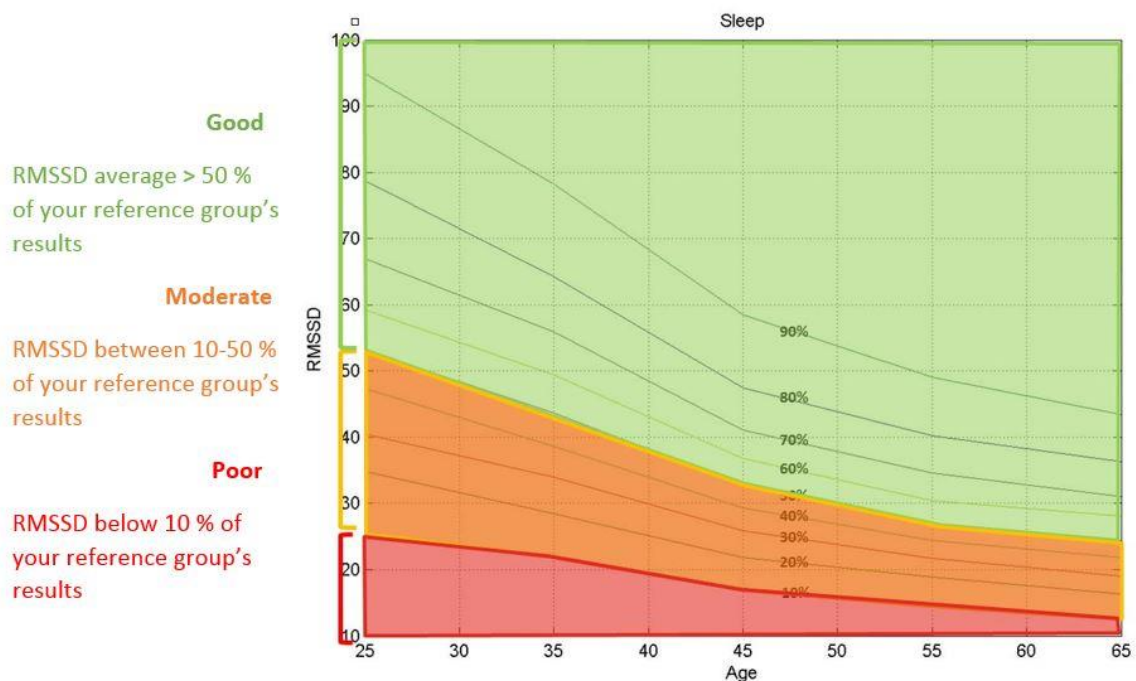
Different factors can cause decreased heart rate variability. In addition to accumulated stress, overload or weak recovery, for example diabetes or another regulation disorder related to glucose metabolism can explain low heart rate variability. Several diseases related to heart function have also been found to be connected to reduced heart rate variability. Age and poor physical condition are known to reduce heart rate variability. Resting and maximum heart rate values do not affect the result, so the results between different measurements are comparable with one another.

During physical activity, the heart rate increases and heart rate variability decreases, which is a natural explanation of very low heart rate variability during those time periods.

On the left side of the diagram, the day-specific averages are indicated for times when the person is awake and asleep. There are no specific recommendations for daytime variability, but during sleep, variability should increase higher than the red cross-line. The red cross-line indicates the level under which the sleep time results for the lowest 10% of the person's reference group are. It is also a positive result when heart rate variability is higher during the night than during the day, considering normal functioning of the parasympathetic nervous system. The relationship between the night and day values can be examined with the Relative difference variable.

Other information

Heart rate variability correlates strongly with age. Below is a summary compiled from the extensive Lifestyle Assessment database, which presents the significant effect that age has on the reduction of heart rate variability. Genetics is also recognized as having a significant effect on the amount of heart rate variability.



The effect and distribution of age on heart rate variability (RMSSD) in different age groups.

8. Specialist group report

Description

A summary of the individual specialist reports for a specific group. The report is intended for the sole use of the specialist. The purpose of the report is to compile information that is significant with regard to stress and recovery and to function as an aid in making conclusions. The report gathers information about factors that can have an effect on the stress and recovery results (such as illnesses, alcohol consumption, medication and sleep quality) at group level. In addition, the report also includes a list of persons who, on the basis of the assessment result, are recommended to undergo more thorough measurements or further tests, for example due to very poor recovery. After the front page, the report includes each person's individual Specialist report (the same as the individual Specialist report).

Contents

- Group's background information
- Group notes
- Distribution of self-reported sleep quality
- Alcohol consumption
- Distribution of stress state classification
- Attention

Purposes of use

- Background data for the specialist to use during the feedback session.
- As a tool for initial, follow-up and final measurements in projects.
- To identify the persons with signs of poor recovery for further action.

Note!

The purpose of the report is in no situation to function as a diagnostic tool. However, the report can be utilized in group projects to identify the people whose results indicate a need for more specific examinations or tests.

If an individual person's results indicate clear signs of weakened recovery on each day, it is good to discuss possible further actions together with the client. When interpreting the result, it should be noted that the result is based purely on the physiological reactions that occurred during the recording days. Abnormal events during the measurement and changes in general health status can have a strong effect on the results, as assessed by the stress state classification.

Firstbeat case 2014 (19 assessments: m:12, f:7)

	Average	Range	Measurement information:	
Age (years)	44	21 - 59	Measurements	39
Body Mass Index	25.9	20 - 37	Average meas. length (h:min)	09:26
METmax	14.3	14.3 - 14.3	Measurement lengths (h:min)	03:45 - 31:59
Activity class	4.2	1 - 7		
Resting HR (bpm)	46	33 - 60		

8.1. Group's background information (upper section)

Interpretation

Conveys general information about the group

- number of included assessments (there can be several assessments from one person)
- number of measurements (typically measurement days)
- age (average)
- body mass index (average)
- range of measurement lengths

Possible group-specific notes are on the right-hand side of this field.

Other information

The figures are generated on the basis of the group's journal markings.



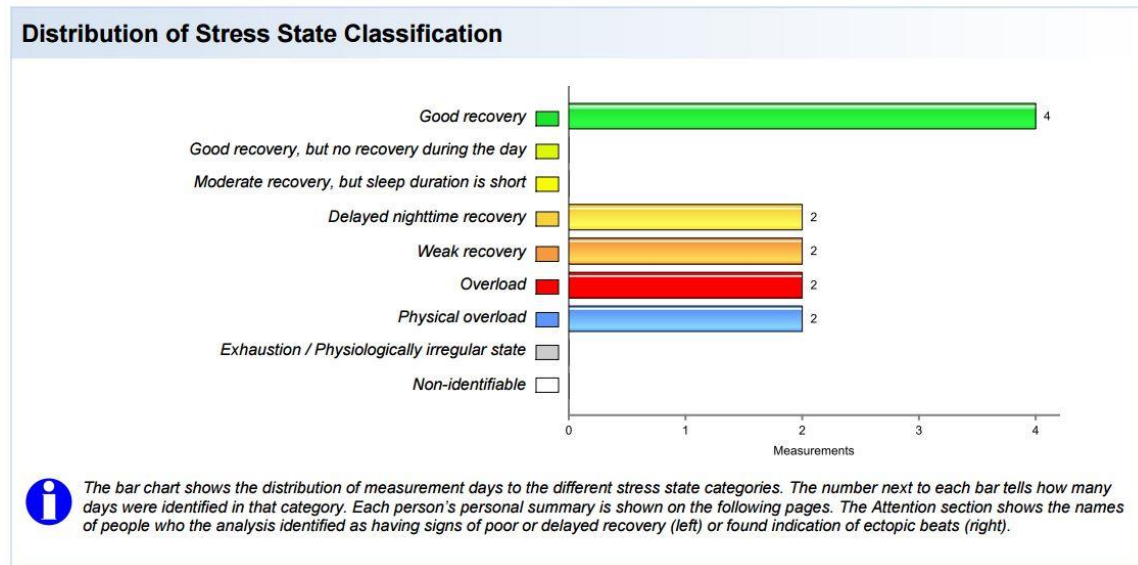
8.2. Distribution of sleep quality and consumption of alcohol

Interpretation

The distribution of sleep quality shows how the group's subjective sleep quality values from the measurement days are distributed. The subjective assessment of sleep quality is based on the "score" that the person entered in the journal. If the distribution is concentrated towards the left half of the diagram, the experienced sleep was on average good. If, on the other hand, the distribution is concentrated towards the right half of the diagram, the people in the group had, on average, rated their sleep as not good or poor.

Alcohol consumption is presented as a percentual share of days when the persons in the group had consumed alcohol. The section also indicates the average number of units for the relevant days.

Because the entries were made by the users themselves, they should be considered critically, with this in mind.



8.3. Distribution of stress state classification

Interpretation

The bar chart shows the distribution of measurement days to the different stress state categories. The figure next to the bar indicates the number of measurement days in that category. More detailed background of the information in this section is discussed in chapter 7, Specialist report.

Attention

Assessments with stress state classification ■, ■, ■, ■ or (1/4): Assessments with indication of ectopic beats (0/4):
 - Busy Manager ■ ■

8.4. Attention

Interpretation

The left-hand column lists the names of persons whose results indicate obviously weakened recovery. The criteria set for this is based on the day-specific result of the stress state classification: if the classified state is either 5, 6, P, E, or N/A on each day of the period, it is recommended to perform a repeat measurement and/or conduct more detailed examinations to assess the person's general health status.