Effects of high-altitude trekking on body composition

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Abstract

Sojourns at high altitude are often accompanied by weight loss and changes in body composition. The aim was to study body composition before and after 40 days high-altitude exposure. The subjects were four women and six men, non-smoking, healthy and active students and a scientist from Mid Sweden University in Östersund with a mean (SD) age of 26 (10) years. All subjects volunteered for a six-week trek to the Mount Everest Base Camp via Rolwaling in Nepal. Before the sojourn subject’s height was 177 (10) cm and weight was 71.9 (10) kg. Body composition was measured with Lunar iDXA at the Swedish Winter Sports Research Centre in Östersund before and after the trek. Total body mass (SD) decreased from 71.8 (10.0) kg before to 69.7 (9.4) kg after the trek (P=0.00). Total fat mass decreased from 14.7 (5.9) kg to 13.8 (4.6) kg (P=0.01). Fat percent decreased from 21.6 (7.9) % to 21.0 (7.2) % (P=0.03). Total lean mass decreased from 54.0 (10.0) kg to 52.9 (9.7) kg (P=0.01). Bone mineral content was unchanged, 3.04 (0.5) kg before and 3.03 (0.5) after (P=0.13). Thus both total body mass and total lean mass had decreased after a six week trekking in Nepal.

Key words: extreme environment, fat-free mass, hypoxia, iDXA, mountaineering, weight loss
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Definitions

**BMI:** a measurement obtained by dividing body mass by the square of height. BMI=kg/m² (FYSS 2008).

**Body composition:** is used to describe the percentages of bone, fat, muscles and water in the human body ([www.miun.se](http://www.miun.se), Lunar iDXA GE Healthcare).

**BMC:** Bone mineral content; measures the density of the human skeletal. BMC=g/cm² ([www.miun.se](http://www.miun.se), Lunar iDXA GE Healthcare).

**High altitude:** altitudes over 2500 m above sea level (Burbaker 2005).

**Hypoxia:** environmental reduction of oxygen. Oxygen molecules are less numerous at high altitude than at sea level (Baker 1969).

**iDXA:** Intelligent Dual Energy X-ray Absorptiometry, a body composition scanner that measures skeletal muscle mass, body fat mass and bone density ([www.miun.se](http://www.miun.se), Lunar iDXA GE Healthcare).

**Obesity:** is a medical condition in which excess body fat may have negative health problems defined by a body mass index of above 30 kg/m² (FYSS 2008).
Introduction

In sojourn at high altitude (> 2500 m above sea level) the human will be exposed to hypoxic surroundings. A hypoxic surrounding includes deficiencies in oxygen where the human body has difficulties to provide its systems with oxygen when there are less oxygen molecules at higher altitudes. At higher elevations (> 2500 meters above sea level or more), the partial pressure of atmospheric oxygen is approximately 40% below the values at sea level (Baker, 1969) while the atmosphere contains 21% oxygen. However the low partial pressure limits oxygen uptake. This leads to a deficiency of oxygen, which may produce a multitude of physiological changes in sea level living among men and woman of all ages.

In deficiency of oxygen people that are used to living at sea level will be differently affected, depending on the ability to acclimate and adapt to the new environment. Many times this leads to physiological changes in those exposed. This can be manifested by reduced body weight, reduced body fat and reduced muscle mass. This may also create a negative energy balance due to a reduced capability to intake food (Brubaker, 2005; David et al., 1998; Kayser et al., 1993; Westerterp-Plantenga et al., 1999b). During sojourn at high altitude subjects may be affected by acute mountain sickness (AMS), high altitude anorexia and food intake may be greatly reduced for several days (Kayser, 1992). Symptoms of AMS like nausea, headache, fatigue and vomiting play a key role in weight loss due to decreased food intake. By proper acclimatisation subjects may minimize the risk of AMS, weight loss and high-altitude anorexia and thereby extend their sojourn (Kayser, 1992; Askew, 2002). This effect has been observed in hypoxic environments in both humans and rats (Schankenberg et al., 1971).

Several studies have found an association between weight loss and changes in body composition when staying at high altitude (> 2500 m above sea level, asl), or extremely high altitude (> 8000 m asl) (Burbaker, 2005; Bales et al., 1976; Kayser, 1992; Kayser & Verges, 2013; Westerterp-Plantenga et al., 1999a; David et al., 1998; Mawson et al., 2000; Westerterp, 2001; Westerterp-Plantenga et al., 1999b and Kayser et al., 1993). This may produce a multitude of changes as a
result of difficulties in maintaining appetite and body weight at high altitude. Changes in body composition occur in both women and men (Hannon et al., 1976).

According to Kayser et al., (1993) and David et al., (1998), energy deficiency and weight loss are caused by a lack of palatable and nutritional food in an uncomfortable, and sometimes cold, environment. Food that is unfamiliar to the subject has a large influence on how much nutrition a person can ingest, which is important for maintaining the balance between intake and consumption. A certain part of the weight loss may be due to the fat-free mass and fat mass is reduced as much as up to 1-2 kg/week at altitude (Kayser et al., 1993; David et al., 1998). Although decreased hunger, lack or loss of appetite and people being unaccustomed to the food culture that exists in the country in question, the availability of food is a contributing factor. Weight loss can also be due to the basal metabolic rate increasing by the level of activity increases. At a higher level of activity, ventilation is enhanced whereby fluid loss increases (Kayser et al., 1993; David et al., 1998).

Obesity associations with acute mountain sickness have been observed under a study in 2003 (Ri-Li et al., 2003). Their conclusion was that obesity seems to be associated with the development of AMS, which increased more rapidly in obese men than normal weight individuals.

In altitudes up to 5000 m above sea level, weight loss and body composition changes can be avoided by adequate nutrient and energy intake and acclimatization (Kayser, 1992; Westerterp-Plantenga, 1999b).

Nowadays, several people around the world expose themselves to high altitudes through work, pleasure trips or expeditions. Through better knowledge and preparation, excessive weight loss can be prevented and thereby general well-being and performance can be maintained, both during and after the sojourn. Through proper planning and a thoroughly scheduled fluid and food intake, this can be avoided (Westerterp, 2001). Also, moderate altitude may provide an
effective means of weight loss when needed, which makes it interesting to study these effects further.

**Purpose:** The aim of this study was to describe the effects of high altitude trekking on body composition in otherwise healthy individuals before and after a six-week trek.

**Hypothesis:** We hypothesize that total body mass will decrease in all subjects after six week trekking at high altitude. We also hypothesize that a loss of fat mass will occur, with limited or no loss of muscle mass.

**Methods**

**Subjects**

The subjects of the study were ten (four women and six men) non-smoking, healthy and active students and a scientist from Mid Sweden University (www.miun.se) living in Östersund (elevation 312 m). All students and the scientist volunteered for a six-week trek to the Mount Everest Base Camp via Rolwaling in Nepal. Anthropometrics are presented in Table 1. Inclusion criteria for the study were that the subjects should be healthy, non-smoking and active. The subjects were in general training (SD) 6.4 (10.4) times a week with low intensity training, high intensity training 1.5 (0.5) and 1.7 (0.6) times strength six to eight weeks before the sojourn and exclusion criteria for the subjects were not to weight too little (BMI <19) or too much (BMI >30).
Table 1. Participant’s (n=10) anthropometrics as mean values and ± SD values.

<table>
<thead>
<tr>
<th></th>
<th>Women (n=4)</th>
<th>Men (n=6)</th>
<th>Total (n=10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>30.7 (12.2)</td>
<td>23.6 (4.3)</td>
<td>26.4 (9.1)</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>166.9 (5.1)</td>
<td>183.9 (4.5)</td>
<td>177.1 (9.6)</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>62.6 (8.1)</td>
<td>78.0 (5.4)</td>
<td>71.8 (10.0)</td>
</tr>
</tbody>
</table>

Ethical considerations

The Human Ethics Boards in Umea, Sweden and Kathmandu, Nepal, respectively, approved the study and no conflict of interest was declared. All tests were voluntary and before all tests the subjects were asked if they would like to participate (Appendices 1, 2) and informed about the conditions and could at any time terminate its participation according to the Declaration of Helsinki 1964 (www.wma.net) after which they signed informed consent forms.

Procedures

Body composition was measured pre and post trek with Lunar iDXA GE Healthcare ME+200200 (Figure 1.) at the Swedish Winter Sports Research Centre (www.ostersund.se, www.miun.se). Pre-tests were made in February, 18 days before the expedition and post-test three days after the return back to Östersund. All participants were given a subject number and were placed into a sequence and were measured by the same time schedule both pre and post expedition. The subjects were also tested for anaerobic capacity (Wingate 30 sec), spirometers and spleen size on the first of two test days for other projects.

Body composition measurements were carried out on the second test day and started at 07.00 am. Participant’s height and weight (Lunar iDXA GE Healthcare ME+200200) were measured before the iDXA scan pre and post expedition. Jewellery or other metal objects such as underwire bras, piercings, buttons and clothes, except shorts/briefs and a sports bra, were removed before the measurements. All subjects were informed not to eat 8 h or drink 5 h before the
tests. The days before the tests the subjects were asked not to do any new form of training and to avoid physical activity 3 h before the test or the day between the tests. The iDXA scanning was not performed on pregnant women or injured individual which none of the subjects were at time for the measurements.

Subjects were placed on the bed under the iDXA x-ray scan and were told to stay absolutely still. Subjects feet were tied together with a small strap not to fall out of line and arms were placed near the trunk with fingers slightly spread. Average temperature was +20.5°C (range, +20-21°C) in the room for the tests. The iDXA scan measures whole body composition in grams and percentage including BMC, fat mass (FM) and skeletal muscle mass (SMM). The iDXA measurement lasts for about 15 min in total.

![Figure 1. Measurements of body composition of the iDXA scan.](Photo by www.munksgaard.nl)

**Data analysis**

The data from the body composition measurements were collected from the Lunar iDXA GE Healthcare ME+200200. Differences of total mass, total fat mass, fat %, lean mass and BMC in pre-expedition and post-expedition were described as group mean, normal distribution, standard deviation and a Student’s two-tail paired t-test was carried out on pre and post expedition data to reveal any
significant changes. Significant differences were accepted if P=0.05. The iDXA scan is one of the most reliable and valid methods for body composition measurements.

Results

Whole body composition

Total body weight had decreased in 9 of 10 subjects. Mean (SD) body weight was 71.8 (10.0) kg before and 69.7 (9.4) kg after the trek (P<0.01; Figure 2). The range in weight change was -0.1 to -4.9 kg and only one subject showed a increase (0.1 kg). Males had changes from mean 77.9 (5.4) kg to 75.8 (5.8) kg and females from 62.6 (8.1) kg to 60.8 (7.7) kg (P=0.01).

Mean (SD) total fat mass was 14.8 (5.9) kg before and 13.8 (4.6) kg after (P<0.01; Figure 2). Mean body fat percent (SD) was 21.6 (7.9) % before and 21.0 (7.2) % after the trek (P=0.34; Figure 2). Females decreased from 29.2 (4.7) % to 28.1 (3.4) % and men 16.6 (6.2) % to 16.3 (4.8) % after the trek.

Lean body mass (SD) decreased from 54.0 (10.0) kg to 52.9 (9.7) kg (P=0.01) for the whole group (Figure 2).

BMC showed no changes, 3.04 (0.5) kg before and 3.03 (0.5) after the trek (P=0.13).
Figure 2. Total changes including total mass, lean mass, fat mass, fat percent and BMC (n=10).

The right and left side of the body showed symmetric changes after six weeks trekking.

Upper and lower body composition

The total arm mass (SD) decreased from 4.6 (1.0) kg to 4.3 (0.3) kg (P<0.01) and the arms fat mass (SD) had decreased during the trek, from 0.9 (0.4) kg to 0.8 (0.4) kg (P=0.04; Figure 3).

Lean arm mass (SD) was 3.5 (1.1) kg before and 3.3 (1.0) kg after the sojourn (P<0.01). There were no significant differences between right and left arms (P=0.50).

Arms and torso are included in the upper body. Total mass (SD) of upper body decreased from 21.2 (8.4) kg before to 20.2 (8.4) kg after the trek (P=0.08). Total fat mass was 4.2 (1.7) kg before and 3.7 (1.5) kg after (P=0.40). Fat percent was similar at 41.6 (20.4) % before to 40.4 (17.7) % after altitude trekking (NS; P=0.83). Total lean mass from upper body decreased from 16.3 (6.6) kg before to 16.1 (6.7) after (NS; P=0.50). No significant change was observed in BMC, 0.6 (0.1) kg before and 0.6 (0.1) kg after the trek (NS; P=0.50).
The legs had decreased in fat mass (SD) from 2.8 (1.0) kg to 2.7 (0.8) kg (P<0.01). No significant changes were found in percent fat mass 24.0 (8.8) % before and 23.9 (8.9) % after the trek (NS; P=0.09).

Lean leg mass was 9.0 (1.6) kg before and had decreased to 8.4 (2.4) kg after the trek (P=0.01).

BMC was 0.6 (0.1) kg before and after the trek (NS; P=0.09; Figure 3, Figure 4).

### Upper part of the body

<table>
<thead>
<tr>
<th></th>
<th>PRE</th>
<th>POST</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tot mass</td>
<td>25.0 (5.0)</td>
<td>24.5 (5.5)</td>
<td>P&lt;0.01</td>
</tr>
<tr>
<td>Tot fat mass</td>
<td>10.0 (4.0)</td>
<td>9.8 (4.5)</td>
<td>P=0.02</td>
</tr>
<tr>
<td>Fat %</td>
<td>35.0 (8.0)</td>
<td>34.5 (8.5)</td>
<td>P=0.05</td>
</tr>
<tr>
<td>Lean mass</td>
<td>9.0 (1.0)</td>
<td>8.8 (1.5)</td>
<td>P=0.01</td>
</tr>
<tr>
<td>BMC</td>
<td>0.6 (0.1)</td>
<td>0.6 (0.1)</td>
<td>NS</td>
</tr>
</tbody>
</table>

**Figure 3. Arm and Torso changes (n=10).**

### Lower part of the body

<table>
<thead>
<tr>
<th></th>
<th>PRE</th>
<th>POST</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total mass</td>
<td>25.0 (5.0)</td>
<td>24.5 (5.5)</td>
<td>P&lt;0.01</td>
</tr>
<tr>
<td>Tot fat mass</td>
<td>10.0 (4.0)</td>
<td>9.8 (4.5)</td>
<td>P=0.02</td>
</tr>
<tr>
<td>Fat %</td>
<td>35.0 (8.0)</td>
<td>34.5 (8.5)</td>
<td>P=0.05</td>
</tr>
<tr>
<td>Lean mass</td>
<td>9.0 (1.0)</td>
<td>8.8 (1.5)</td>
<td>P=0.01</td>
</tr>
<tr>
<td>BMC</td>
<td>0.6 (0.1)</td>
<td>0.6 (0.1)</td>
<td>NS</td>
</tr>
</tbody>
</table>

**Figure 4. Changes in lower parts of the body, before and after a six-week trek (n=10).**
Torso composition

Total mass of torso was 16.6 (2.7) kg before and 16.2 (2.4) kg after the trek (difference 0.4 kg; P<0.01). Total fat mass decreased from 3.3 (1.8) kg before to 2.9 (1.3) kg after (P<0.01) and BMC was 0.4 (0.1) kg before and 0.4 (0.1) kg after (P=0.20). Total lean mass of the torso showed no significant changes, 12.8 (2.4) kg (P=0.99; Figure 5).

Figure 5. Changes in pre and post measurements of the torso (n=10).
BMI

Subjects mean BMI (SD) had decreased from 22.7 (2.1) kg to 22.1 (1.5) kg (P<0.02; Figure 6).

![Figure 6. Changes for BMI for each individual (n=10) have been showed in pre and post trek (P=0.05). BMI is measured in kg/m².](image)

**Discussion**

The aim of this study was to describe the effects of high altitude trekking on body composition in otherwise healthy persons before and after a six-week trek.

Our result showed that total body mass was reduced after trekking, which is in agreement with earlier studies (Burbaker, 2005; Bales et al., 1976; Kayser, 1992; Kayser & Verges, 2013; Westerterp-Plantenga et al., 1999a; David et al., 1998; Mawson et al., 2000; Westerterp, 2001; Westerterp-Plantenga et al., 1999b and Kayser et al., 1993). We hypothesised that total body mass would decrease after altitude trekking and our results showed significant changes. Both total body mass and all measurement variables were reduced (total mass, total fat mass, fat percent and lean mass; P=0.05) showing that the loss of total mass is affecting tissues.
This study showed that total body mass decreased as in previous studies (Burbaker, 2005; Bales et al., 1976; Kayser, 1992; Kayser & Verges, 2013; Westerterp-Plantenga et al., 1999a; David et al., 1998; Mawson et al., 2000; Westerterp, 2001; Westerterp-Plantenga et al., 1999b and Kayser et al., 1993) and the BMI decreased from 22.7 before to 22.1 after the trek. Changes were significant but the small differences may be a result of the generous and palatable food and that the subjects had time to recover, stayed healthy and kept their appetite to a high degree during the trek. This may result in greater differences in longer sojourns than six weeks and according to Kayser et al., (1993) and David et al., (1998) where body mass loss can be prevented by maintaining proper balance between energy intake and expenditure.

The upper body showed a decrease in total mass before the trek and the total fat mass decreased. But in the arms, fat percent increased 0.9 kg and lean mass decreased with 0.3 kg. The lower part of the body also showed decreases in total mass -0.4 (P=0.00). Through a greater reduction in muscle mass in the upper body versus lower body, we suggest that the causes is that the lower part of the body is more physically active than the upper part during six weeks of trekking. This despite a great load of motion and weight bearing in rough and physically demanding terrain.

High-altitude anorexia is mainly a result of lack of hunger at high altitudes (< 5000 m asl) (Morrison & Tschöp, 2001). The degree of weight loss depends on altitude attained and how long the sojourn will be prolonged. Also the physical activity, adaptive thermogenesis and basal metabolism may all contribute to the total energy expenditure depending on individual status (Morrison & Tschöp, 2001). Exposure to high altitudes could very likely be used as a weight-loss program for overweight individuals, but subjects for studies like this should not be too overweight or obese (BMI<30) due to high activity, greater exposure to hazards and stress on the subjects body by hypoxia, cold environment and uneven terrain. According to Re-Li et al., (2003) obese individuals may be more affected than non-obese individuals by AMS. Obese persons may have greater difficulties with hypoxia, high-altitude and sleep disorder leading to greater problems breathing then at sea-level living (Re-Li et al., 2003). This may lead to even
greater problems at high altitudes and it must therefore be properly consider if it is appropriate to expose obese individuals to this environment.

The subjects from this study were all fairly young, and trained and that might be the reason why the weight loss was not greater. Studies have shown that 70 % of weight loss comes from fat up to altitudes of 5000 m als (Boyer & Blume, 1984; Morrison & Tschöp, 2001). If fat no longer will be available as the premier fuel source, the human body will therefore burn energy from muscles to provide its systems. The subjects from this study achieved altitudes around 6000 m als, but the subjects sleep altitude was at the city of Na, with an altitude of 4200 m asl. All subjects in the study were normal healthy volunteers and not extreme mountaineering climbers.

Westerterp-Plantenga et al., (1999a; 1999b) demonstrated that the greater decrease in weight loss results from a reduction in food intake during sojourns and exposure to high altitude. This seems to occur when AMS is greater and leads to reduction in food intake and nibbling food patterns (Westerterp-Plantega et al., 1999b). Findings of increased secretion of the appetite regulating hormone leptin in the presents of hypoxia may be directly involved in the findings of high-altitude anorexia and weight loss (Morrison & Tschöp, 2001). More studies are needed for better knowledge about leptin involvement in high-altitude anorexia.

**Conclusion**

Despite the limited number of subjects the study indicates that high altitude trekking for six weeks in healthy, active students and scientists leads to significant loss of total body mass and changes in total body composition. This change was due to reductions in both total fat mass and total lean mass. Through a greater reduction in muscle mass occurred in the upper body versus lower body it can be concluded to be due to that the lower part of body is more physically active than the upper part of the body during six weeks trekking.
Acknowledgments

The author would like to acknowledge the subjects of the study, supervisor Erika Schagatay for her mentorship, Harald Engan for valuable feedback and Sanna Lind Forsman, Linn Nybäck and Elin Degerström for feedback, help and happy cheers.
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FYSS Statens Folkhälsoinstitut , 2008; 4: 454-455


www.miun.se

www.munksgaard.nl

www.astersund.se

www.wma.net
Appendix

1. Consent form

_____ Informerat samtycke

Namn:_________________________ Födelsedatum (år-mån-dag):____________________

Epost:__________________________

Längd:______(cm) Vikt:_______(kg) Blodtryck:_______(mmHg) Fettprocent:_______(%)

B-Hb:_______(mmol/l) EVF:_______(%) B-Glukos:_______(mmol/l) B-laktat:_______(mmol/l)

Vänligen fyll i och besvara följande frågor inför testet:

Ja □ Nej □ Har din läkare avrätt dig från fysisk aktivitet?

Ja □ Nej □ Får du bröstsmärtor vid fysisk aktivitet?

Ja □ Nej □ Har du senaste månaderna haft bröstsmärtor fast du inte varit fysiskt aktiv?

Ja □ Nej □ Blir du lätt yr och tappar balansen vid fysisk aktivitet?

Ja □ Nej □ Har du led- och/eller ryggproblem som kan förvåras vid fysisk aktivitet?

Ja □ Nej □ Har du högt blodtryck? (systoliskt >140 mmHg och/eller diastoliskt >90 mmHg)

Ja □ Nej □ Har du diabetes? Om ja, vilken typ?________________________

Ja □ Nej □ Har du någon form av astma? (ex. köld-/ansträningsastma)

Ja □ Nej □ Åter du några mediciner? Om ja vilken/vilka?________________________

Ja □ Nej □ Känner du till något annat skäl till varför du inte skall utföra fysisk aktivitet? Om ja, vilka/vilket skäl?________________________

Härmed ger jag mitt godkännande att frivilligt delta i testet för att kunna fastställa min fysiska arbetskörning och hälsostatus. Min tillstånd att delta i testet ges frivilligt och jag förstår att jag kan när som helst avbryta testet om jag så önskar.


____________________                      ______________________
Datum                             Underskrift deltagare

____________________                      ______________________
Datum                             Underskrift målsman (om under 18 år)

Referenser
American College of Sports Medicine (ACSM)
Canadian Society of Exercise Physiology (CSEP)
Förhållningsregler för tester inför ”Nepalstudien”


OBS!! TESTERNA GENOMFÖRS EJ VID SJUKDOM!!

Allmänna råd:

• Du är själv skyldig att meddela testledare angående eventuella hälsoproblem och sjukdomsdiagnoser
• Om smärta eller obehag upplevs under något av testen är det ditt ansvar att snabbt meddela testledare så att testet kan avbrytas
• Du är skyldig att ge en fullständig rapport över läkemedelskonsumtion
• Testen genomförs inte på gravida
• Test sker på egen risk
• Träning
  o Ingen ny form av träning veckan innan test
  o Undvik träning dagen före test
  o Undvik fysisk aktivitet på själva testdagen

DAG 2: Kost testdag med iDXA + Bioimpedans (kroppssammansättning)

• Ät normalkost dagarna före test
• Inget kostintag 8 h före test
• Inget intag av vätska 5 h före test

Vid frågor, kontakta:

Martina Höök
Martina.hook@miun.se
063-16 55 14 alt 070 – 293 64 85
DAG 1:

Konditionstest

Utrustning:
Träningskläder, vattenflaska, trekkingstavar (liknande de du ev. planerar använda i Nepal).

Bakgrund:
Ju mer syre kroppen kan ta upp under arbete, desto mer energi kan bildas genom s.k. aerob metabolism. Med en god förmåga att ta upp syre kan en högre tävlingsfart hållas utan att mjölksyra bildas. En hög maximal syreupptagningsförmåga (VO\textsubscript{2max}) är därför en viklig variabel inom uthållighetsidrott. På Vintersportcentrum mäter vi VO\textsubscript{2max} med teknik av högsta mättnadsklart.

Procedur:

Testet är mycket ansträngande och det är därför mycket viktigt att du är fullt frisk vid testtillfället.

Under testerna vill vi helst se att ev. medföljande anhöriga inte befinner sig i testrummet då detta kan påverka resultatet.

Beskrivning av testet:

Submaximalt test:
Du kommer här att gå under 4 min på 4 olika arbetsbelastningar. Var 4:e minut är det en paus på 1,5 min där vi tar en del prover innan du fortsätter att gå på en något högre arbetsbelastning. Testet bryts när du överstigit en arbetsintensitet som är strax över 4 mmol/L i laktat (mjölksyra).

VO\textsubscript{2max} test:
DAG 2:

Lunar iDXA


Förhållningsregler iDXA

- Matintag får senast ske 8 h innan mätning
- Vätska får senast intas 5 h före testning
- Ingen fysisk aktivitet får ske inom 3 h före test (passiv transport till NVC)
- Inga metallföremål får bäras vid test (Piercing, örhängen, knappar, bygel-bh osv)
- Testet utförs i träningskläder som ej får innehålla metall alternativt i underkläder
- Test utförs ej på gravida

Mätningsprocedur


Frukost

Efter iDXA-mätning intar FP frukost på avsatt tid. Tidpunkten för frukost är standardiserad för att öka tillförlitlighet på efterföljande test. Frukost ska vara intagen senast 1 h före styrketest. Frukost bör ge idrotten tillräckligt med energi för att klara av de följande fysiskt krävande testerna. Ex. 4 dl havregrynsgrot,ägg,bröd och pålägg, vätska.