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Influence of water-filtered infrared-A (wIRA) on reduction of local fat and body weight by physical exercise

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Abstract in English, German

Aim of the study: Investigation, whether water-filtered infrared-A (wIRA) irradiation during moderate bicycle ergometer endurance exercise has effects especially on local fat reduction and on weight reduction beyond the effects of ergometer exercise alone.

Methods: Randomised controlled study with 40 obese females (BMI 30-40 (median: 34.5), body weight 76-125 (median: 94.9) kg, age 20-40 (median: 35.5) years, isocaloric nutrition), 20 in the wIRA group and 20 in the control group. In both groups each participant performed 3 times per week over 4 weeks for 45 minutes bicycle ergometer endurance exercise with a constant load according to a lactate level of 2 mmol/l (aerobic endurance load, as determined before the intervention period). In the wIRA group in addition large parts of the body (including waist, hip, and thighs) were irradiated during all ergometries of the intervention period with visible light and a predominant part of water-filtered infrared-A (wIRA), using the irradiation unit "Hydrosun 6000" with 10 wIRA radiators (Hydrosun Medizintechnik, Müllheim, Germany, radiator type 500, 4 mm water cuvette, yellow filter, water-filtered spectrum 500-1400 nm) around a speed independent bicycle ergometer. MAIN VARIABLE OF INTEREST: change of "the sum of circumferences of waist, hip, and both thighs of each patient" over the intervention period (4 weeks). Additional variables of interest: body weight, body mass index BMI, body fat percentage, fat mass, fat-free mass, water mass (analysis of body composition by tetrapolar bioimpedance analysis), assessment of an arteriosclerotic risk profile by blood investigation of variables of lipid metabolism (cholesterol, triglycerides, high density lipoproteins HDL, low density lipoproteins LDL, apolipoprotein A1, apolipoprotein B), clinical chemistry (fasting glucose, alanin-aminotransferase ALT (= glutamyl pyruvic transaminase GPT), gamma-glutamyl-transferase GGT, creatinine, albumin), endocrinology (leptin, adiponectin (= adipo Q), homocysteine, insulin). All variables were at least measured before and after the intervention period. Ergometry (ECG, blood pressure behaviour, lactate curve with power at 2, 3 and 4 mmol/l) before the intervention period. In addition: nutrition training ahead of and during the intervention period with a nutrition protocol over one week for assessment of the daily energy intake; calculation of basic metabolic rate and total energy requirement. Assessment of undesired effects. Only methods of non-parametric statistics were used, both descriptive (median, percentiles of 25 and 75 (= interquartile range), minimum, maximum) and confirmatory (two-sided Mann-Whitney U test for unpaired samples for the only one main variable of interest). Total error probability: .05 (5%). An intention to treat analysis ITT with last observed carry forward method was used preferably (presented results) and in addition an on treatment analysis OT. Only 2 (treatment group) and 4 (control group) drop-outs occurred (mostly due to lack of time).

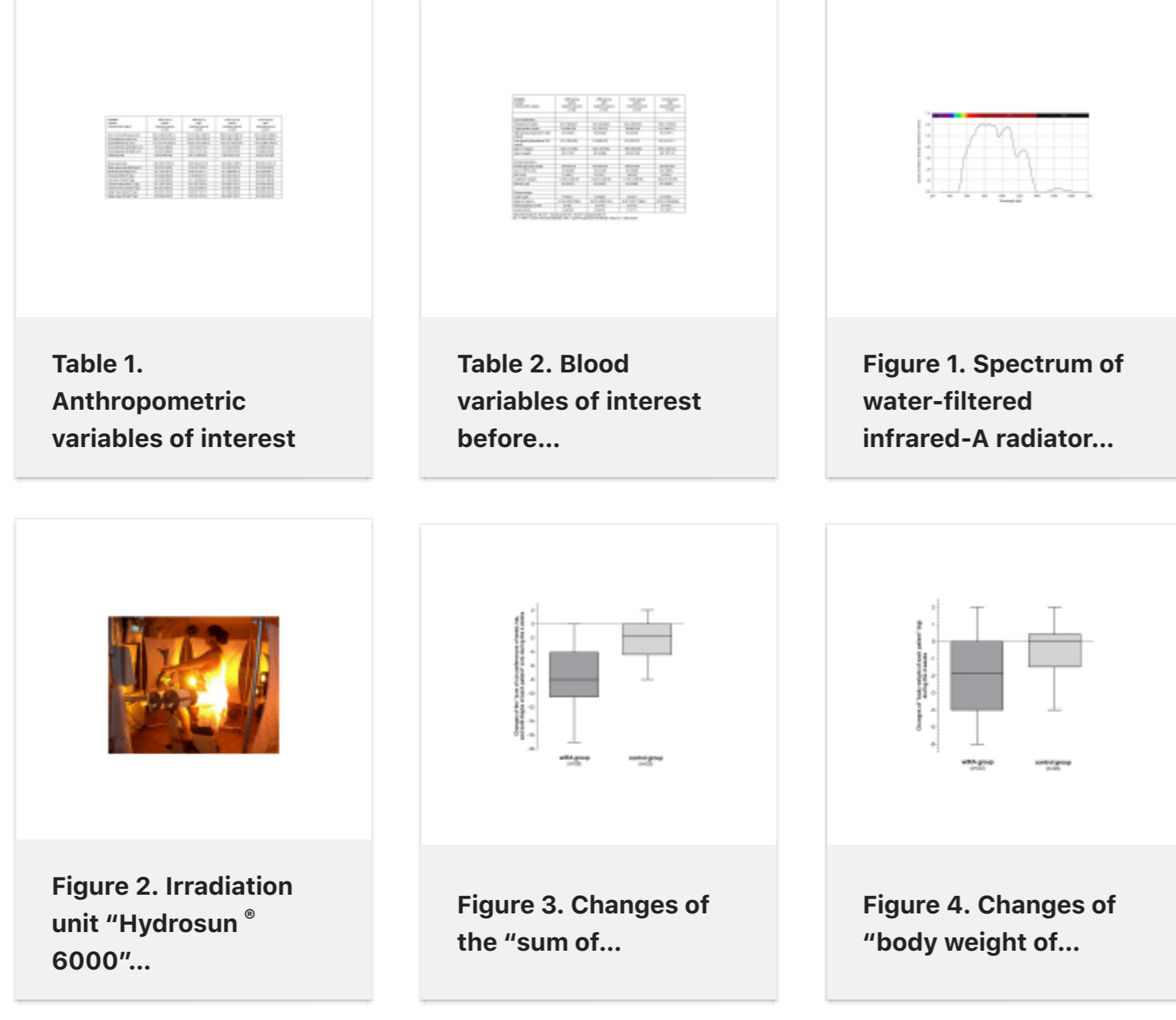
Results: The "sum of circumferences of waist, hip, and both thighs of each patient" decreased during the 4 weeks significantly more (p<.001) in the wIRA group than in the control group: medians and interquartile ranges: -8.0 cm (-10.5 cm/-4.1 cm) vs. -1.8 cm (-4.4 cm/0.0 cm). As well "body weight of each patient" decreased during the 4 weeks markedly more in the wIRA group than in the control group: medians and interquartile ranges: -1.9 kg (-4.0 kg/0.0 kg) vs. 0.0 kg (-1.5 kg/+0.4 kg); median of body weight changed from 99.3 kg to 95.6 kg (wIRA) vs. 89.9 kg to 89.6 kg (control). A similar effect showed the body mass index BMI. Blood variables of interest remained unchanged or showed some slight improvements during the treatment period, concerning most variables with no obvious differences between the two groups; insulin showed a slight trend to decrease in the wIRA group and to increase in the control group. Undesired effects of the treatment were not seen.

Discussion: The results of the study suggest, that wIRA - during moderate bicycle ergometer endurance exercise as lipolytic stimulus - increases local lipolysis with a local fat reduction (thighs) in the otherwise bradytrophic fatty tissue. The presumably underlying mechanisms of wIRA have already been proven: wIRA acts both by thermal effects and by non-thermal effects. Thermal effects of wIRA are the generation of a therapeutic field of warmth with the increase of tissue temperature, tissue oxygen partial pressure, and tissue blood flow, and by this regional metabolism. As fatty tissue normally has a slow metabolism (bradytrophic and hypothermic tissue) with a low rate of lipolysis, wIRA can increase lipolysis in fatty tissue and the mobilized fats are burned in musculature during the ergometer exercise.

Conclusion: The results of the study indicate, that wIRA irradiation during moderate ergometer endurance exercise can be used - in combination with an appropriate nutrition - to improve body composition, especially local fat distribution, and the reduction of fat and body weight in obese persons.

Keywords: analysis of body composition; bicycle ergometer endurance exercise; body mass index BMI; body weight; cholesterol; high density lipoproteins HDL; intervention trial; lactate; lipid metabolism; lipolysis; local fat reduction; low density lipoproteins LDL; randomised controlled study; tetrapolar bioimpedance analysis; triglycerides; water-filtered infrared-A (wIRA); weight reduction.

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