DANISH MEDICAL JOURNAL

Original Article

Different training instructions in persons with rheumatic and musculoskeletal diseases

Ernst Albin Hansen[1], Lærke Inge Bachhausen Josephsen[1], Josephine Brohus Jørgensen[1], Brian Clausen[2] & Hemant Juneja[1]

1) Centre for Health and Rehabilitation, University College Absalon, 2) The Danish Rheumatism Association's Rehabilitation Centre, Sano, Denmark

Dan Med J 2025;72(9):A07240454. doi: 10.61409/A07240454

ABSTRACT

INTRODUCTION. People with rheumatic and musculoskeletal diseases are advised to do aerobic exercise for symptom relief and to reduce the risk of cardiovascular disease. Continuous exercise at an intensity causing a rate of perceived exertion of 15, on a 6-20-point Borg scale, exemplifies such exercise. Also, the instruction "*Now you need to increase your heart rate"* is used before aerobic exercise. However, the exercise intensity caused by that instruction is unknown. We tested the hypothesis that intensity during cycling, initiated with the instruction "*Now you need to increase your heart rate"*, is lower than when targeting a Borg scale score of 15.

METHODS. Participants (n = 15) with various types of rheumatic and musculoskeletal diseases cycled at a self-selected power output. Subsequently, we determined the relationship between Borg scale score and exercise intensity (heart rate and power output), including intensity at a target score of 15. Additionally, intensity was measured during 20 minutes of cycling exercise executed after the instruction "*Now you need…"*.

RESULTS. Power output and percentage of maximal heart rate were 89 (± 40) W and 86% (± 9%), respectively, at a Borg scale score of 15, whereas values were 81 (± 33) W and 81% (± 7%) during the instructed cycling exercise ($p < 0.05$).

CONCLUSIONS. Intensity, in the form of power output and percentage of maximal heart rate, during cycling exercise, initiated with the instruction "*Now you need to increase your heart rate"*, was 8 W and 5 percentage points lower, respectively, than during cycling targeting a Borg scale score of 15.

FUNDING. None.

TRIAL REGISTRATION. Not relevant.

Persons with rheumatic and musculoskeletal diseases are advised to perform aerobic exercise to relieve symptoms such as pain, fatigue and reduced joint mobility [1, 2] as well as to reduce the risk of cardiovascular disease [3].

In a position statement [4] on exercise dosage in rheumatic and musculoskeletal diseases, the following recommendation on aerobic exercise can be found: "Aerobic training exercise interventions that utilise intensities of 60-85% of maximum heart rate, a frequency of 3-5 days/week while the time of the exercise session is 20-45 minutes, elicit significant improvements in multiple health-related outcomes, as early as three months". Furthermore, it was stated that engaging in high-intensity exercise is "required to improve cardiovascular health and reduce fatigue, pain, or activity limitation". The training load for the patient group in question should be

Open Access under Creative Commons License CC BY-NC-ND 4.0

built up gradually, in accordance with general training principles [5] to attain progress and prevent inappropriate overloading. However, in clinics, rehabilitation centres or training facilities, the person's maximal heart rate, just like the actual heart rate, is often not accessible during aerobic exercise. Based on clinical experience, many people find it uncomfortable to exercise at maximal effort, which is required to obtain the maximal heart rate and subsequently calculate the relative heart rate. Furthermore, such exercise can be associated with risks for certain patients. It follows that an alternative method of monitoring, instructing and performing aerobic exercise that does not include heart rate measurement is often needed.

Continuous exercise at an intensity that brings about a rate of perceived exertion of 15 on a 6-20 point Borg scale [6] is suggested as a useful example of aerobic exercise [5, 7]. A rate of perceived exertion of 15 entails an exercise intensity of approximately 85% of the maximal heart rate [8]. The Borg scale is a practical and widely recognised scale used for subjective ratings of perceived effort during exercise [9, 10].

For comparison, it is common in, e.g., municipal physical training programmes, to use the instruction "Now you need to increase your heart rate" or in other words "Now you need to raise your pulse" upon initiation of aerobic exercise. A common way of performing aerobic exercise is by cycling on a cycle ergometer. Unfortunately, we do not know how intensively persons with rheumatic and musculoskeletal diseases actually exercise when they are given the instruction "*Now you need to increase your heart rate"* upon initiation of cycling exercise. It is possible that the intensity is lower than during cycling at a Borg scale score of 15. Our lack of knowledge about this challenges our ability to assess and evaluate exercise intensity as well as our ability to achieve quality exercise.

Therefore, the purpose of the present pilot study was to test the hypothesis that exercise intensity (measured as power output and heart rate) during cycling, initiated with the instruction "*Now you need to increase your heart rate"*, is lower than the exercise intensity during cycling at a Borg scale score of 15.

METHODS

Study design

A crossover design was adopted in this study.

Participants

Participants in the present study were persons with rheumatic and musculoskeletal diseases (n = 15) who attended inpatient interdisciplinary rehabilitation at the Danish Rheumatism Association's Rehabilitation Centre, Sano, Denmark. The participants were recruited during a period of one month, and tests were completed during a period of six weeks. The participants suffered from various types of rheumatic diseases, including r*heumatoid arthritis,* juvenile idiopathic arthritis as well as *osteo*arthritis of the hip, knee, hand and/or neck. Persons with fibromyalgia were excluded. The maximal heart rate was estimated for each participant, according to equation 1, developed earlier [11]:

Maximal heart rate (in beats × min^{-1}) = 208 – (0.7 × age in years) (Eq. 1)

Testing

All testing was performed as part of the routine exercise activities that participants engaged in during their rehabilitation at the rehabilitation centre.

The participants reported to the test facility for three sessions on three different days. The three sessions were labelled as familiarisation, reference, and exercise, respectively. The order of the last two sessions was

Open Access under Creative Commons License CC BY-NC-ND 4.0

counterbalanced.

In the familiarisation session, the participant was instructed in using the Borg scale. Furthermore, the participant became accustomed to cycling on the Monark 928 G3 cycle ergometer (Monark Exercise AB, Vansbro, Sweden), the test facilities, the personnel and the procedure of the two subsequent test sessions. To avoid a deliberate influence on the results, the participant was not informed of the exact aim of the study, including the hypothesis.

In the reference session, patients cycled for a total of 20 minutes. Initially, the participant performed two minutes of cycling at an intensity targeted to produce a perceived exertion of 7 on the Borg scale. To do this, the participant adjusted the power output of the cycle ergometer, as preferred. Without delay, this was followed by two minutes of cycling aimed at reaching a score of 8 on the Borg scale. In the same manner, this gradual procedure was continued until the test concluded with two minutes of cycling targeted at a score of 16 on the Borg scale. During the cycling, the heart rate was measured with a Polar H9 chest belt, which transmitted data to an iPad with a Polar Team app (Polar Electro Oy, Kempele, Finland) installed. Power output and cadence, as revolutions per minute (rpm), were measured by the cycle ergometer. Heart rate, power output and cadence were noted at the end of each two-minute period. The participant was blinded to the heart rate. The key data from the reference session were power output and heart rate during exercise at a score of 15 on the Borg scale. The rest of the data may be considered supplementary.

In the exercise session, the participant performed 20 minutes of cycling exercise, which was initiated by the instruction "*Now you need to increase your heart rate*". During the cycling, the participant adjusted the power output of the cycle ergometer as preferred. Heart rate, power output and cadence were documented every two minutes. Again, the participant was blinded to the heart rate. The key data were average values of power output and heart rate, calculated across the exercise session.

Statistics

Data were assessed not to be different from a parametric distribution by the Shapiro-Wilks test performed in SPSS 29.0 (IBM Corporation, IBM SPSS Statistics, Armonk, NY, USA). The Student's paired two-tailed t-tests and calculation of 95% CI were performed in Excel 2016 (Microsoft Corporation, Bellevue, WA, USA) and used to evaluate differences. Results are presented as mean (± standard deviation (SD)), unless otherwise indicated. A $p < 0.050$ was considered statistically significant. A sample size estimation resulted in 15 participants [12]. The estimation was performed on one of the primary outcomes of exercise intensity: heart rate as a percentage of maximal heart rate. The estimation was based on a paired t-test to be performed with an alpha value of 0.05, an expected mean difference of 4% (± 5%) and a power of 0.80.

Ethical consideration

Written informed consent was obtained from all participants. The study conformed to the standards in the Declaration of Helsinki and the procedures proposed by the Danish National Centre for Ethics. In Denmark, quality assurance or quality control studies do not require approval by a research ethics committee.

Data sharing: DOI: 10.6084/m9.figshare.26063350.

Trial registration: not relevant.

RESULTS

Characteristics of the participants are presented in **Table 1**.

TABLE 1 Participant characteristics. N = 15.
Data are presented as mean (± SD) and ratio.

	mean (± SD)	n
Age, yrs	68 (± 12)	-
Height, m	1.70 (± 0.07)	-
Weight, kg	79.1 (± 11.9)	-
Estimated maximal heart rate, beats × min^{-1}	161 (± 8)	-
Sex distribution, women/men	-	10/5

SD = standard deviation

The reference session produced data for heart rate and power output, which are illustrated in **Figure 1**. Mean values of heart rate, calculated as percentage of maximal heart rate during cycling targeting Borg values of 7, 8, and so on to 16, amounted to 67% (± 7%), 69% (± 7%), 72% (± 9%), 75% (± 9%), 77% (± 9%), 78% (± 9%), 83% (± 9%), 86% (± 9%) and 92% (± 9%), respectively. Mean values of cadence, at Borg values of 7, 8, and so on to 16, were 70 (± 11), 71 (± 13), 73 (± 15), 73 (± 15), 74 (± 17), 74 (± 18), 75 (± 18), 78 (± 20), 77 (± 21) and 78 (± 23) rpm, respectively. Key data from the reference session, namely average values of power output and heart rate during cycling targeting Borg values of 15, are reported in **Table 2**.

Open Access under Creative Commons License CC BY-NC-ND 4.0

FIGURE 1 Supplementary data from the reference session. Data points represent average values for all participants. Standard deviation bars are only shown in one direction, for clarity (N = 15).

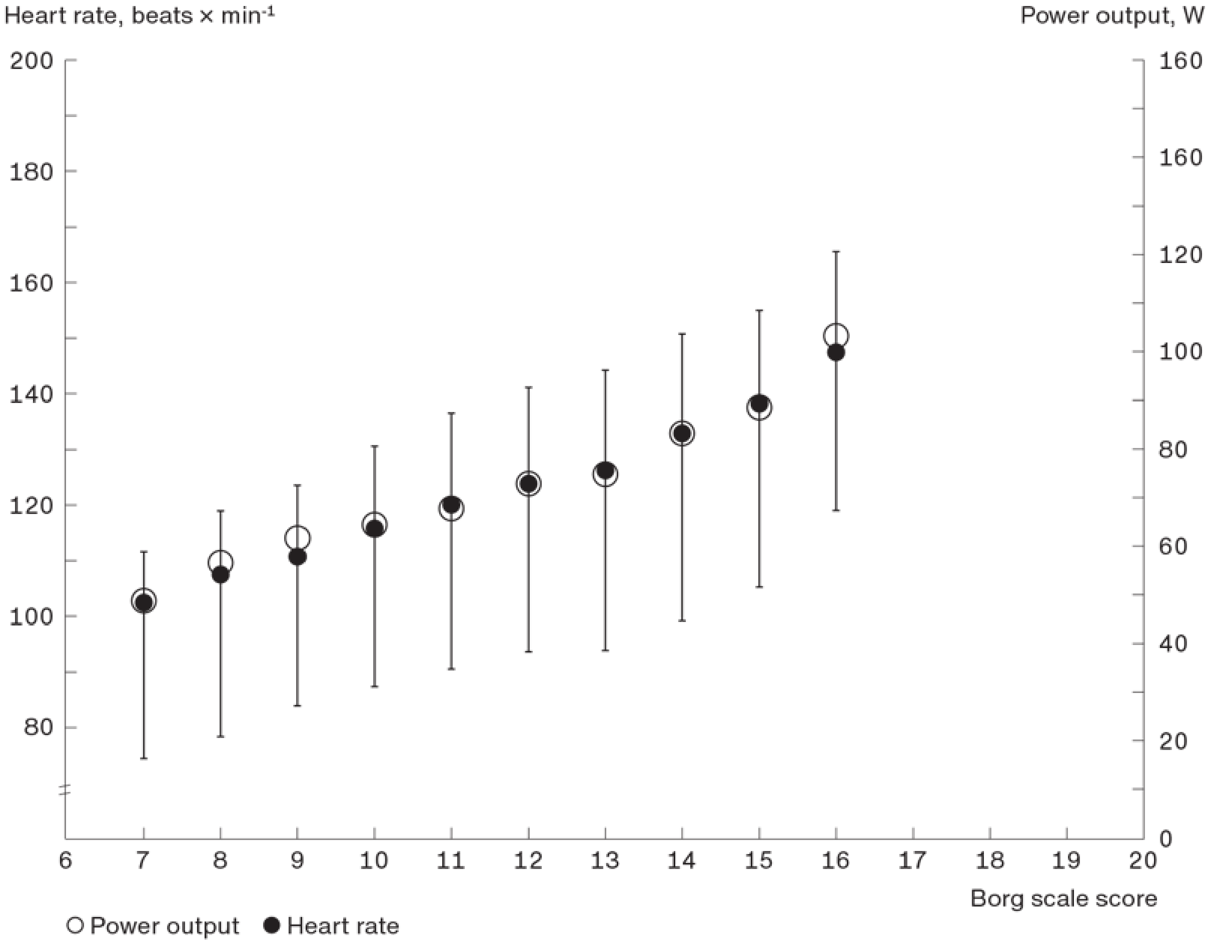


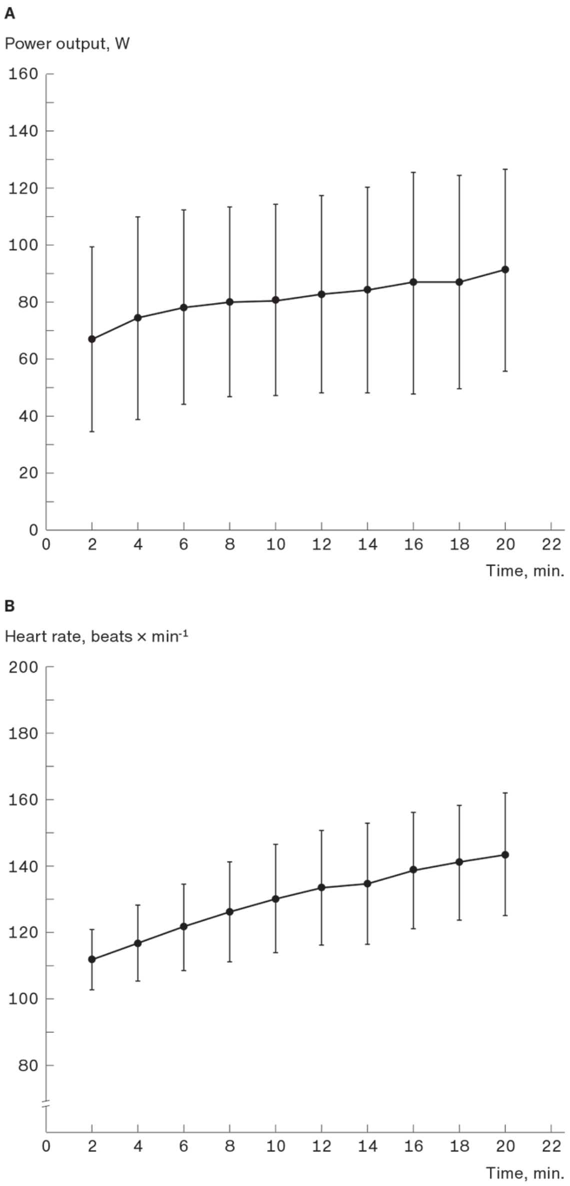
TABLE 2 Key results from the two performed cycling sessions (N = 15).

	Power output, W	Heart rate beats × min-1	Heart rate % of max	Cadence, rpm
"Reference session": data at the point of 15 on the Borg scale, mean ± SD (95% CI)	89 ± 40 (69-109)	138 ± 19 (128-148)	85.8 ± 9.0 (81.2-90.4)	77 ± 21 (66-88)
"Exercise session": data from cycling after the instruction "Now you need to increase your heart rate", mean ± SD (95% CI)	81 ± 33 (64-98)	130 ± 14 (123-137)	80.8 ± 6.8 (77.4-84.2)	77 ± 14 (70-84)
Mean difference between "Exercise session" and "Reference session", mean ± SD [p value]	−8 ± 13 [0.038]	−8 ± 10 [0.006]	−5 ± 6 [0.006]	0 ± 10 [0.983]

rpm = crank revolutions × min-1; SD = standard deviation.

The exercise session produced data for power output, heart rate and cadence, which are illustrated in **Figure 2**, which shows a trend for power output to increase across the 20 minutes of cycling. At the same time, there was a trend for heart rate to increase throughout the cycling session (Figure 2 B). Key data from the exercise session, specifically the average values of power output and heart rate, as calculated over the 20 minutes of cycling exercise, are reported in Table 2.

FIGURE 2 Supplementary data from 20 minutes of cycling in the exercise session following the instruction "Now you need to increase your heart rate" (N = 15). Data points represent average values for all the participants. Average values of power output, heart rate and cadence, calculated across the 20 minutes of cycling, are reported in Table 2. **A**. A trend for power output to increase across the 20 minutes of cycling. **B**. A trend for heart rate to increase throughout the duration of the cycling session.



Regarding a comparison between the reference session and the exercise session: the mean values of power output, heart rate and heart rate as a percentage of maximal heart rate during the 20 minutes of exercise in the exercise session were 7% (± 13%, 95% CI: –14-0), 5% (± 7%, 95% CI: –9-–1) and 5 (± 6, 95% CI: –8-–2) percentage points, respectively, lower than the corresponding values during cycling at a targeted Borg scale score of 15 in the reference session. For p values, please see Table 2.

DISCUSSION

This study confirmed the hypothesis that exercise intensity (measured as power output and heart rate) during

Open Access under Creative Commons License CC BY-NC-ND 4.0

cycling, initiated with the instruction "*Now you need to increase your heart rate"*, is lower than the exercise intensity during cycling at a Borg scale score of 15.

The present study identified a difference between the exercise intensity that is self-selected following the instruction "*Now you need to increase your heart rate"* and the intensity resulting from targeting a value of 15 on the Borg scale for perceived exertion, with the former being significantly lower. The consequence of this deficit was that exercise intensity (measured as percentage of maximal heart rate) following the instruction "*Now you need to increase your heart rate"* could be described as *moderate*, whereas exercise intensity targeting a value of 15 on the Borg scale could be described as *high* [5]. According to the textbook referenced, the demarcation between moderate and high intensity is 82% of the maximal heart rate. The observed difference in exercise intensity is likely to have consequences for the result of the exercise. Presumably, in this case, exercising at high rather than moderate intensity will result in better adaptations, including an increase in the maximal oxygen uptake [13]. Aerobic exercise in itself has been reported to relieve pain [14].

Our findings point towards a number of clinical perspectives and considerations. For example, instruction regarding intensity during aerobic exercise is important. Nonspecific instructions may lead to an intensity that differs from the target intensity, which may, in turn, have consequences for the desired effect of the exercise. The present study highlights a potential for optimising aerobic exercise during continuous cycling. When a Borg scale with a designated target of 15 is used, the exercise intensity is likely to be higher and more effective than if the instruction "*Now you need to increase your heart rate"* is applied.

According to a guideline on physical training as treatment for osteoarthritis [15], there is a high level of evidence that aerobic training, strength training and coordination training or functional training play a role in treating people with osteoarthritis. It is recommended to use aerobic training and/or strength training/coordination training, or functional training to reduce pain and improve physical function. Besides, it is recommended that home and self-training always start with a supervised course to teach participants how to train most appropriately. To achieve an effect on pain and physical function, it is recommended that the supervised training be performed two to three times a week for at least six weeks [15].

The present findings are limited to the studied group of participants with rheumatic and musculoskeletal diseases who attended inpatient interdisciplinary rehabilitation. In other words, we cannot directly extrapolate the results to other groups of persons. There may have been a healthy selection bias that caused the current participants to be less affected by their diseases than is usually the case for persons with the same conditions. As an example, the result might turn out to be different if the present study is repeated with persons with Parkinson's disease. The reason is that Parkinson's disease is a central nervous system movement disorder, presenting itself with bradykinesia, tremors and latency, resulting in reduced coordination and activation of movement and balance [16]. Presentations that differ from those of rheumatic and musculoskeletal diseases may affect the interplay between the understanding of an exercise instruction and the self-selected intensity during aerobic exercise. Besides this, the relatively small number of participants and their sex composition should be considered when interpreting the present results. Thus, it cannot be excluded that a study with more participants would yield a different result. However, it seems unlikely that our findings of a lower power output and heart rate during cycling initiated with the instruction "Now you need to increase your heart rate" should represent a type 1 error. The assessment is supported by the magnitude of the mean differences and the corresponding 95% CI. Finally, if this study is replicated, it would be valuable to expand the test regimen with yet another session in which the participant is instructed to perform cycling exercise for 20 minutes at a Borg scale target value of 15. This would make it possible to confirm that the intensity, which we found during cycling targeting a Borg scale score of 15 in our reference session is the same if the participant is instructed to perform cycling exercise for 20 minutes at a Borg scale value of 15.

Open Access under Creative Commons License CC BY-NC-ND 4.0

CONCLUSIONS

Exercise intensity – in the form of power output, heart rate and percentage of maximal heart rate – during aerobic cycling exercise, initiated with the instruction "*Now you need to increase your heart rate*", was about 8 W, eight beats × min^{-1}, and five percentage points lower than the intensity during cycling targeting a Borg scale score of 15.

Correspondence *Ernst Albin Hansen*. E-mail: erah@pha.dk

Accepted 15 May 2025

Published 7 August 2025

Conflicts of interest BC reports financial support from or interest in the Regional Clinical Quality Programme – Denmark, Health Pool Funds. All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. These are available together with the article at ugeskriftet.dk/dmj

Acknowledgements The participants' participation is greatly acknowledged

References can be found with the article at ugeskriftet.dk/dmj

Cite this as Dan Med J 2025;72(9):A07240454

doi 10.61409/A07240454

Open Access under Creative Commons License CC BY-NC-ND 4.0

REFERENCES

1. Danish Health Auhtority. Fysisk aktivitet. Håndbog om forebyggelse og behandling. Danish Health Auhtority, 2018
2. Hunter DJ, Bierma-Zeinstra S. Osteoarthritis. Lancet. 2019;393(10182):1745-1759. https://doi.org/10.1016/S0140-6736(19)30417-9
3. Drosos GC, Vedder D, Houben E, et al. EULAR recommendations for cardiovascular risk management in rheumatic and musculoskeletal diseases, including systemic lupus erythematosus and antiphospholipid syndrome. Ann Rheum Dis. 2022;81(6):768-779. https://doi.org/10.1136/annrheumdis-2021-221733
4. Metsios GS, Brodin N, Vlieland TPMV, et al. Position statement on exercise dosage in rheumatic and musculoskeletal diseases: the role of the IMPACT-RMD toolkit. Mediterr J Rheumatol. 2021;32(4):378-385. https://doi.org/10.31138/mjr.32.4.378
5. Gjerset A, ed. Idrættens træningslære. 3rd ed. Munksgaard, 2019:354-355
6. Borg G. Perceived exertion as an indicator of somatic stress. Scand J Rehab Med. 1970;2(2):92-98
7. McArdle W, Katch VL, Katch FI. Exercise physiology: nutrition, energy, and human performance. Lippincott Williams & Wilkins, 2009:474
8. Mitchell BL, Davison K, Parfitt G, et al. Physiological and perceived exertion responses during exercise: effect of beta-blockade. Med Sci Sports Exerc. 2019;51(4):782-791. https://doi.org/10.1249/MSS.0000000000001845
9. Stuckenschneider T, Rüdiger S, Abeln V, et al. Rating of perceived exertion - a valid method for monitoring light to vigorous exercise intensity in individuals with subjective and mild cognitive impairment? Eur J Sport Sci. 2020;20(2):261-268. https://doi.org/10.1080/17461391.2019.1629632
10. Scherr J, Wolfarth B, Christle JW, et al. Associations between Borg's rating of perceived exertion and physiological measures of exercise intensity. Eur J Appl Physiol. 2013;113(1):147-155. https://doi.org/10.1007/s00421-012-2421-x
11. Tanaka H, Monahan KD, Seals DR. Age-predicted maximal heart rate revisited. J Am Coll Cardiol. 2001;37(1):153-156. https://doi.org/10.1016/S0735-1097(00)01054-8
12. http://www.biomath.info/power/prt.htm (Jun 2025)

13. Gormley SE, Swain DP, High R, et al. Effect of intensity of aerobic training on VO2max. Med Sci Sports Exerc. 2008;40(7):1336-1343. https://doi.org/10.1249/MSS.0b013e31816c4839
14. Juhl C, Christensen R, Roos EM, et al. Impact of exercise type and dose on pain and disability in knee osteoarthritis: a systematic review and meta-regression analysis of randomized controlled trials. Arthritis Rheumatol. 2014;66(3):622-636. https://doi.org/10.1002/art.38290
15. Danish Health Authority. Fysisk træning som behandling – 31 lidelser og risikotilstande. Danish Health Authority, 2018;Version 1.2
16. Nutt JG, Wooten GF. Clinical practice. Diagnosis and initial management of Parkinson's disease. N Engl J Med. 2005;353(10):1021-7. https://doi.org/10.1056/NEJMcp043908

Open Access under Creative Commons License CC BY-NC-ND 4.0