GENERAL INFORMATION

Title of Dataset: **Alterations in Muscle Contractile Properties, Structure, and Function During 10-Day Bed Rest, Post-Recovery, and Following COVID-19 Lockdown**

Author: Boštjan Šimunič
ORCID: https://orcid.org/0000-0003-1565-7833
Institution: Institute for Kinesiology Research, Science and Research Centre Koper, Koper, Slovenia
E-mail: bostjan.simunic@zrs-kp.si

Author: Martino Franchi
ORCID: https://orcid.org/0000-0003-3165-4536
Institution: Department of Biomedical Sciences, University of Padova, Padua, Italy
E-mail: martino.franchi@unipd.it

Author: Fabio Sarto
ORCID: https://orcid.org/0000-0001-8572-5147
Institution: Department of Biomedical Sciences, University of Padova, Padua, Italy
E-mail: fabio.sarto@unipd.it

Author: Elena Monti
ORCID: https://orcid.org/0000-0002-3767-0855
Institution: Department of Biomedical Sciences, University of Padova, Padua, Italy
E-mail: elena.monti@unipd.it

Date of data collection: August and September 2019; May 2020

Funding:
ARIS J5-4593 Physical inactivity induced neuromuscular impairment: comparison of younger and older adults
ARIS P5-0381 Kinesiology for quality of life

MARS-PRE: Early biological and functional biomarkers of human spaceflight consequences

Keywords: Atrophy, Bed rest, Physical inactivity, Skeletal muscle, Tensiomyography

ACCESS INFORMATION

FILE LIST

- **Readme.pdf**: this file containing general information, description and methodological information of the dataset
- **BR SBI2019 data.xlsx**: excel spreadsheet file containing all measured results with a legend

MATERIALS AND METHODS

Participants

Ten healthy males (aged 22.9 ± 5.0 years, body mass 77.5 ± 10 kg, height 181.2 ± 3.9 cm, body mass index: 23.6 ± 2.5 $kg \cdot m^2$) took part in a 10 days horizontal bed rest study.

Experimental protocol

The protocol included 3 days of familiarization with the study environment and diet during which baseline data were collected (BDC), data collection after 3 hours of bed rest (BR3h) and after i-th day of bed rest (BRi; where i = 2, 4, 6, 8, 9, 10) or after i-th day of recovery (R+i; where i = 2, 30) and data collection after the COVID-19 lockdown period (COVID-19).

The study was conducted in accordance with the declaration of Helsinki and was approved by The National Medical Ethics Committee of the Republic of Slovenia (No. 0120-123/2023/9). All participants were fully informed of the procedures and gave written informed consent. The bed rest was carried out in August and September 2019 in the Izola General Hospital (Izola, Slovenia) and assessment after the 2-month COVID-19 lockdown in May 2020 in the Laboratory of the Institute for Kinesiology Research at Science and Research Center Koper.

The following parameters were collected at all time points: anthropometric features, vertical jumping performance and, tensiomyography of six muscles. Ultrasonography assessment of

four muscles was carried out every two days during bed rest, with data available also following the COVID-19 lockdown for one muscle.

ASSESSMENTS

Anthropometry

Body height and mass were collected using a stadiometer and scale, respectively. While whole body fat and lean mass were collected using bioimpedance analysis (BIA 101, Akern s.r.l., Pisa, Italy). Bioimpedance analysis was performed supine after at least 60-minute rest.

Tensiomyography

The non-invasive TMG method was used to assess the contractile properties of six selected muscles: VL, VM, BFlh, GM, tibialis anterior (TA), and ES. TMG assessment of the VL was limited due to the muscle biopsies performed on that muscle of both legs, with the corresponding analysis outcomes reported elsewhere (Monti et al., 2021). Therefore, we are presenting only data from the BDC and BR10 (just before and 10 days from the VL biopsy). Assessments of BFlh, GM, and ES were performed prone at rest and with a knee angle set at 5 ° flexion; whereas assessments of VL, VM, and TA were measured while supine at rest and with a knee angle set at 30 ° flexion while ankle angle in neutral position. Foam pads were used for leg support to ensure rested muscles and joint angles. The oscillations of the belly muscle in response to an electrically induced isometric twitch were recorded at the skin surface using a sensitive digital displacement sensor (TMG-BMC Ltd., Ljubljana, Slovenia). The sensor was set perpendicular to the skin's normal plane above the belly muscle: at the midpoint of the line between the fibula head and the ischial tuberosity on the BFlh; at 30% of the femur length above the patella on the VL and 20% of the femur length above the patella on the medial side on the VM; at the height of the iliac crest on the ES (longissimus part); at 30% of the muscle length from the most distal part of the muscle on the GM; and 50% of the muscle length on the TA. In all muscles, the reference point was determined at the mid-muscle width and marked daily with a dermatological pen during the bed rest period. The rounded (5-cm diameter) self-adhesive cathode and anode (Axelgaard, Aarhus, Denmark) were set 5 cm distally and 5 cm proximally, respectively, to the measuring point on all muscles assessed (Šimunič, 2019). Electrical stimulation was applied through a TMG-100 system electro stimulator (TMG-BMC Ltd., Ljubljana, Slovenia) with a pulse width of 1 ms and an initial amplitude of 30 mA. During each testing session, the amplitude was progressively increased

by 20 mA increments until there was no further increase in the amplitude of the TMG response (Dm). Rest periods between stimuli of 10 s were given to avoid fatigue and potentiation. From two maximal twitch responses, the TMG parameters were calculated as follows: delay time (Td) as the time from the electrical impulse to 10% Dm; contraction time (Tc) as the time from 10% to 90% Dm, and the average was taken for further analysis.

Ultrasound imaging

Morphology of VL muscle was assessed in vivo at rest by B-mode ultrasonography (Mylab 70; Esaote Biomedica, Genova, Italy), using a linear 4.7-cm probe. VL scans were acquired in the longitudinal plane at 50% of the femur length, determined as the distance between the greater trochanter and the mid-patella point. During image acquisitions, the operator maintained consistent pressure as much as possible. Transmission gel was applied for all scans to enhance acoustic coupling and minimize pressure on the skin. Muscle thickness was measured as the linear distance between the two aponeuroses using ImageJ software (1.52v; National Institutes of Health). BF data has been already reported elsewhere(Franchi et al., 2022).

Lower back pain assessment

A visual analogue pain score (VAS pain score) was assessed during the relaxed supine position. Participants were asked about subjective LBP they experienced in the last 30 minutes of bed rest by 10-point horizontal VAS (0…full absence of pain; 10…very severe pain) (Hawker et al., 2011). The assessment was conducted between 10:00 and 11:00.

Vertical jumping performance

For assessing vertical jumping performance, a KISTLER Quattro jump (Type 9290CD; Kistler Instrument Corp., Winterthur, Switzerland) force platform was used. The vertical jump performance was assessed following the standardized warm-up routine consisting of 6-min of stepping-up and 5 min of whole-body dynamic stretching. After the warm-up routine, 2–3 warm-up countermovement jumps (CMJ) and squat jumps (SJ) were executed, followed by actual 3 maximal jumps. Briefly, the participants stood with their hands on their hips on the force platform. In SJ participants started from the half squat static position with their knees at approximately 90°. In CMJ participants started from a standing position. The participants were told to jump as high as possible in each of the maximal trials. A minute break was between each maximal jump. The highest jump was considered for further analysis. Participants were

also instructed to take off and land at the same spot and to perform a triple extension (hip, knee, and ankle extension) during the flight phase, with the same full extension on landing.

Physical activity habits

A Global Physical Activity Questionnaire (GPAQ) was used to assess physical activity habits at BDC and for 6 weeks during the COVID-19 lockdown period, where an average was taken for further analysis. Daily time participants spend sitting or reclining, overall weekly METs, and classification of their physical activity level (low, moderate, high) were considered.

Software used to process the measurement results

Matlab, Excel, SPSS

References

Franchi, M. V., Sarto, F., Šimunič, B., Pišot, R., & Narici, M. V. (2022). Early Changes of Hamstrings Morphology and Contractile Properties during 10 d of Complete Inactivity. *Medicine & Science in Sports & Exercise*, *54*(8), 1346–1354. https://doi.org/10.1249/MSS.0000000000002922

Hawker, G. A., Mian, S., Kendzerska, T., & French, M. (2011). Measures of adult pain: Visual Analog Scale for Pain (VAS Pain), Numeric Rating Scale for Pain (NRS Pain), McGill Pain Questionnaire (MPQ), Short-Form McGill Pain Questionnaire (SF-MPQ), Chronic Pain Grade Scale (CPGS), Short Form-36 Bodily Pain Scale (SF-36 BPS), and Measure of Intermittent and Constant Osteoarthritis Pain (ICOAP). *Arthritis Care & Research*, *63*(S11). https://doi.org/10.1002/acr.20543

Monti, E., Reggiani, C., Franchi, M. V., Toniolo, L., Sandri, M., Armani, A., Zampieri, S., Giacomello, E., Sarto, F., Sirago, G., Murgia, M., Nogara, L., Marcucci, L., Ciciliot, S., Šimunic, B., Pišot, R., & Narici, M. V. (2021). Neuromuscular junction instability and altered intracellular calcium handling as early determinants of force loss during unloading in humans. *The Journal of Physiology*, *599*(12), 3037–3061. https://doi.org/10.1113/JP281365

Šimunič, B. (2019). Two-dimensional spatial error distribution of key tensiomyographic parameters. *Journal of Biomechanics*. https://doi.org/10.1016/j.jbiomech.2019.05.035