Appendix A. Glossary of Transcranial Magnetic Stimulation Outcomes

Term	Definition
Cervicomedullary evoked potentials (CMEP)	Electrical stimulation of descending axons of the corticospinal tract at the level of the cervicomedullary junction provides an indication of motoneuron excitability and the resultant evoked potential is typically measures in mV.
Intracortical facilitation (ICF)	Assessed using paired-pulse TMS with a 10-15 ms interstimulus interval. A subthreshold conditioning stimulus is followed by a suprathreshold stimulus, and the resultant conditioned MEP is expressed as a percentage of the single pulse MEP (see below) (>100% indicates facilitation). ICF is thought to reflect the activity of glutamatergic circuitry in the motor cortex.
Motor evoked potential (MEP)	Synchronised action potential in response to a single suprathreshold (i.e., greater than RMT or AMT) stimulus over the motor cortex. Typically, the MEP amplitude is measured (mV) via electromyography from the target muscle but MEP area is also sometimes reported in the literature.
Resting motor threshold	Lowest stimulator intensity required to evoke a detectable electrical response (0.05mV) in the target muscle via electromyography.
Active-motor threshold (AMT)	Lowest stimulator intensity required to evoke a detectable electrical response (0.2mV) in the target muscle via electromyography during a submaximal contraction – usually 5-10% of maximum.
Short-interval intracortical inhibition (SICI)	Assessed using paired-pulse TMS with a 2-3 ms interstimulus interval. A subthreshold conditioning stimulus is followed by a suprathreshold stimulus, and the resultant conditioned MEP is expressed as a percentage of the single pulse MEP (see above) (<100% indicates inhibition). SICI is thought to reflect the activity of gamma-amino-butyric-acid (GABAa) circuitry in the motor cortex.
Silent period (SP)	Reflects the period of minimal/no electrical muscle activity following transcranial stimulation during active contraction. The SP duration is typically measured in ms from the stimulus to the return of voluntary muscle activity. The first 50 ms attributed to spinal mechanisms and the latter portions attributed to cortical inhibitory mechanisms.
Voluntary activation (VA)	VA measurement methodology varies across literature encompassing electrical peripheral motor nerve or muscle stimulation techniques. Stimulation is superimposed during voluntary contraction, and sometimes also at rest also for comparison. VA generally describes how well the brain and nervous system can drive the muscle to produce maximal muscle force, with a value of 100% representing full activation.

Appendix B. Search strategy

Number	Combiners	Region	Terms
1	Problem of Interest	Title/ Abstract	Osteoarthritis OR arthritis OR arthrosis
2	Outcome	All fields	Transcranial magnetic stimulation OR TMS OR motor evoked potential OR MEP OR resting motor threshold OR RMT OR active motor threshold OR AMT OR short-interval intracortical inhibition OR SICI OR silent period OR intracortical facilitation OR ICF OR cervicomedullary evoked potentials OR CMEP OR voluntary activation
3			#1 AND #2
	Limitations		Human, peer-reviewed

Appendix C. Search Strategy Documentation

Source:	Date of search	Search strategy used (keywords & Boolean)	Search Limits or filters (e.g. dates, language)	# results found	Comments
PUBMED	30/12/2022	(Osteoarthritis[Title/Abstract] OR arthritis[Title/Abstract] OR arthrosis[Title/Abstract]) AND (Transcranial magnetic stimulation OR TMS OR motor evoked potential OR MEP OR resting motor threshold OR RMT OR active motor threshold OR AMT OR short-interval intracortical inhibition OR SICI OR silent period OR intracortical facilitation OR ICF OR cervicomedullary evoked potentials OR CMEP OR voluntary activation)	Humans	485	Exported to End Note
CINAHL (Full Text)	30/12/2022	TI (Osteoarthritis OR arthritis OR arthrosis) AND TX (Transcranial magnetic stimulation OR TMS OR motor evoked potential OR MEP OR resting motor threshold OR RMT OR active motor threshold OR AMT OR short-interval intracortical inhibition OR SICI OR silent period OR intracortical facilitation OR ICF OR cervicomedullary evoked potentials OR CMEP OR voluntary activation)	Humans, peer-reviewed	163	Exported to End Note
EBSCO (Medline)	30/12/2022	TI (Osteoarthritis OR arthritis OR arthrosis) AND TX (Transcranial magnetic stimulation OR TMS OR motor evoked potential OR MEP OR resting motor threshold OR RMT OR active motor threshold OR AMT OR short-interval intracortical inhibition OR SICI OR silent period OR intracortical facilitation OR ICF OR cervicomedullary evoked potentials OR CMEP OR voluntary activation)	Humans, peer-reviewed	319	Exported to End Note
CENTRAL	30/12/2022	Osteoarthritis OR arthritis OR arthrosis in Record Title AND Transcranial magnetic stimulation OR TMS OR motor evoked potential OR MEP OR resting motor threshold OR RMT OR active motor threshold OR AMT OR short-interval intracortical inhibition OR SICI OR silent period OR intracortical facilitation OR ICF OR cervicomedullary evoked potentials OR CMEP OR voluntary activation in All Text - in Trials		96	Exported to End Note
SportsDISCUS	30/12/2022	TI (Osteoarthritis OR arthritis OR arthrosis) AND TX (Transcranial magnetic stimulation OR TMS OR motor evoked potential OR MEP OR resting motor threshold OR RMT OR active motor threshold OR AMT OR short-interval intracortical inhibition OR SICI OR silent period OR intracortical facilitation OR ICF OR cervicomedullary evoked potentials OR CMEP OR voluntary	Peer-reviewed	108	Exported to End Note

		activation)			
Web of Science	30/12/2022	Osteoarthritis OR arthritis OR arthrosis (Title) AND Transcranial magnetic stimulation OR TMS OR motor evoked potential OR MEP OR resting motor threshold OR RMT OR active motor threshold OR AMT OR short-interval intracortical inhibition OR SICI OR silent period OR intracortical facilitation OR ICF OR cervicomedullary evoked potentials OR CMEP OR voluntary activation (all fields)		407	Exported to End Note
Key Journals	30/12/2022			0	N/A
				TOTAL	1578

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2 **Appendix D. Quality assessment criteria**

Item Number	Item Definition	Criteria for a judgement of 'YES'
1	Were the criteria for inclusion in the sample clearly defined?	Clear inclusion criteria were defined for both the osteoarthritis and control groups in sufficient detail to allow replication of the study.
2	Were the study subjects and the setting described in detail?	Participants and setting of the study described in sufficient detail to allow replication of the study.
3	Was the exposure measured in a valid and reliable way?	The study reported, or referenced, the validity of transcranial magnetic stimulation and reported measures taken to ensure the conditions were comparable for all participants.
4	Were objective, standard criteria used for measurement of the condition?	The study reported clear diagnostic criteria for lower-limb osteoarthritis that, in the absence of a gold-standard for diagnosis, appear to accurately quantify participants as having osteoarthritis.
5	Were confounding factors identified?	Confounders of transcranial magnetic stimulation were identified and reported.
6	Were strategies to deal with confounding factors stated?	Confounders were managed appropriately: exclusion of the participants; including the confounding variable in the statistical model; performing sensitivity analysis.
7	Were the outcomes measured in a valid and reliable way?	The study reported, or referenced, the validity of quantification of transcranial magnetic stimulation metrics [motor evoked potential (MEP); resting motor threshold (RMT); active motor threshold (AMT); short-interval intracortical inhibition (SICI); silent period (SP)] and reported the reliability of the assessors performing the transcranial magnetic stimulation.
8	Was appropriate statistical analysis used?	Appropriate statistical analysis, accounting for relevant covariates, were conducted.

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5 **Appendix E. Study by study exclusion rationale**

Author	Year	Title	Exclusion Reason
Fitzgerald	2004	Quadriceps activation failure as a moderator of the relationship between quadriceps strength and physical function in individuals with knee osteoarthritis	Wrong study design (no comparator)
Marques	2022	Motor event-related synchronization as an inhibitory biomarker of pain severity, sensitivity, and chronicity in patients with knee osteoarthritis	Wrong study design (no comparator)
Berger	2012	Quadriceps neuromuscular function and self-reported functional ability in knee osteoarthritis	Wrong study design (no comparator)
Pietrosimone	2012	Changes in voluntary quadriceps activation predict changes in quadriceps strength after therapeutic exercise in patients with knee osteoarthritis	Wrong study design (no comparator)
Rafsanjani	2017	Immediate effect of common peroneal nerve electrical stimulation on quadriceps muscle arthrogenic inhibition in patients with knee osteoarthritis	Wrong study design (no comparator)
Mizner	2005	Early quadriceps strength loss after total knee arthroplasty. The contributions of muscle atrophy and failure of voluntary muscle activation	Wrong study design (no comparator)
Pietrosimone	2009	Immediate effects of transcutaneous electrical nerve stimulation and focal knee joint cooling on quadriceps activation	Wrong study design (no comparator)
Da Graca-Tarrago	2019	Intramuscular electrical stimulus potentiates motor cortex modulation effects on pain and descending inhibitory systems in knee osteoarthritis: a randomized, factorial, sham - controlled study	Irrelevant outcome measure
Pietrosimone	2010	Effects of disinhibitory transcutaneous electrical nerve stimulation and therapeutic exercise on sagittal plane peak knee kinematics and kinetics in people with knee osteoarthritis during gait: a randomized controlled trial	Wrong study design (no comparator)
Da Graca-Tarrago	2016	Electrical Intramuscular Stimulation in Osteoarthritis Enhances the Inhibitory Systems in Pain Processing at Cortical and Cortical Spinal System	Wrong study design (no comparator)
Bowen	2022	Unilateral Strength Training Imparts a Cross-Education Effect in Unilateral Knee Osteoarthritis Patients	Irrelevant outcome measure
Pietrosimone	2020	Using TENS to Enhance Therapeutic Exercise in Individuals with Knee Osteoarthritis	Wrong study design (no comparator)
Elboim-Gabyzon	2013	Does neuromuscular electrical stimulation enhance the effectiveness of an exercise programme in subjects with knee osteoarthritis? A randomized controlled trial	Wrong study design (no comparator)
Yoshida	2017	Comparison of the Effect of Sensory-Level and Conventional Motor-Level Neuromuscular Electrical Stimulations on Quadriceps Strength After Total Knee Arthroplasty: A Prospective Randomized Single-Blind Trial	Wrong study design (no comparator)
Simis	2021	Increased motor cortex inhibition as a marker of compensation to chronic pain in knee osteoarthritis	Wrong study design (no comparator)
Callaghan	2014	Factors associated with arthrogenous muscle inhibition in patellofemoral osteoarthritis	Wrong study design (no comparator)
Scopaz	2009	Effect of Baseline Quadriceps Activation on Changes in Quadriceps Strength After Exercise Therapy in Subjects With	Wrong study design (no

		Knee Osteoarthritis	comparator)
Kean	2010	Minimal detectable change in quadriceps strength and voluntary muscle activation in patients with knee osteoarthritis	Wrong study design (no comparator)
Callaghan	2016	The Effect of Knee Braces on Quadriceps Strength and Inhibition in Subjects With Patellofemoral Osteoarthritis	Wrong study design (no comparator)
Davison	2017	Lean muscle volume of the thigh has a stronger relationship with muscle power than muscle strength in women with knee osteoarthritis	Irrelevant outcome measure
Berth	2007	Strength and voluntary activation of quadriceps femoris muscle in total knee arthroplasty with midvastus and subvastus approaches	Wrong study design (no comparator)
Mairet	2008	Neuromuscular and architectural alterations of the vastus lateralis muscle in elderly patients with unilateral knee osteoarthritis	Wrong study design (no comparator)
Hurley	1998	Improvements in quadriceps sensorimotor function and disability of patients with knee osteoarthritis following a clinically practicable exercise regime	Wrong study design (no comparator)

6 **Appendix F. Assessment Information**

Study	Assessment	Assessment Region	Assessment Procedure (directly exported from manuscript description)
Berth. 2002 *^	VA	Quadriceps	Linear extrapolation at 5 twitch-torque levels (25%, 50%, 75%, 90%, 100% of MVC force) to the twitch-torque intercept at theoretical muscle relaxation.
Gapeyeva. 2007 *^	VA	Quadriceps	VA of the QF muscle was estimated by twitch interpolated technique. Subjects were instructed to reach their maximal force level in approximately 3 s and to maintain it after the supramaximal stimulus was delivered and until they were told to relax. Visual feedback provided by the display of strain gauge amplifier. The total duration of this contraction was approximately 5s.
Hassan. 2001 ^	VA	Quadriceps	The degree of QF activation was estimated by superimposition of an electrical current given through two electrodes consisting of aluminium foil covered in cloth dampened in 0.9% saline. These were placed on the anterior thigh. The device was set to deliver a current of 1 A with stimulation duration of 50 ms. The voltage was adjusted to achieve approximately 20% QF activation. Once the voltage was set, the subject received a set of three stimulations while at rest (baseline “twitches”). The subject was then asked to perform maximal contractions and to sustain this. Three further currents were delivered with an interval of one second between each. The per- centage activation was calculated according to Bigland-Ritchie Reproducibility of the instrument for assessment of MVC and QF activation.
Heiden. 2009 ^	VA	Quadriceps (Vastus Medialis and Lateralis)	The trial with the strongest recorded torque for each muscle group was used in determining stimulus amplitude and target line values for the failure of VA testing described below. The amplitude of the stimulation was adjusted to produce a torque equivalent to 25% of MVC when applied to the resting muscle of each subject. Initial stimuli began at low amplitudes and were increased over 3 or 4 trials until a sufficient response (20% to 25% of maximum torque) was elicited. Following stimulus familiarization and amplitude determination, the subjects were instructed to undertake an MVC and aim for a visual target line on the computer screen in front of them. The visual target was adjusted between trials as needed, to ensure that subjects were continuing to work at a maximum effort in each trial. During the MVCs, the stimulus (amplitude, 100-150 V; pulse duration, 600 microseconds; pulse interval, 10 milliseconds; train duration, 100 milliseconds) was delivered automatically by computer 350 milliseconds after the visual target line had been reached. The trial was not used if a subject did not reach the visual target line. Each subject completed 3 extension MVC trials with the stimulus superimposed over the QF.
Hurley. 1997 ^	VA	Quadriceps (Proximal and Distal aspects of Anterior thigh)	A train of about 10 electrical stimuli (frequency 1Hz, pulse width 50 μs, 400 volts, and 375 mA) were delivered through these electrodes. The amplitudes of five electrical stimuli delivered to the resting muscle were recorded (mean amplitude approximately 20–25% of the MVC), then the patient was instructed to perform a four/five second MVC as described above, while the stimuli train continued.
Kittelson. 2014 ^	ICF	Quadriceps	Paired-pulse measurements were used to quantify intracortical excitability using a sub-threshold conditioning

		(Vastus Lateralis)	stimulus (80 % RMT) followed by a suprathreshold test stimulus (120 % RMT). Pulses separated by 15 ms have been shown to produce a facilitatory effect on the test stimulus (ICF)
	RMT	Quadriceps (Vastus Lateralis)	The RMT was defined for all participants as the mini- mum stimulator intensity required to produce 5 of 10 MEPs whose peak-to-peak amplitudes exceeded 50 μV and were at least two standard deviations above resting EMG signal.
	SICI	Quadriceps (Vastus Lateralis)	Paired-pulse measurements were used to quantify intracortical excitability using a sub-threshold conditioning stimulus (80 % RMT) followed by a suprathreshold test stimulus (120 % RMT). Pulses separated by 3 ms have been shown to produce an inhibitory effect on the test stimulus—known as SICI
	VA	Quadriceps (Vastus Lateralis)	VA of the QF muscle was assessed using the twitch interpolation technique, where a supramaximal stimulus was applied directly to the contracting QF muscle during an MVC and again immediately after- ward, when the muscle was at rest (stimulus parameters: 1-pulse, 500-μs pulse duration, 400 V).
Lewek. 2004 ˆ	VA	Quadriceps (Proximal Vastus Lateralis and Distal Vastus Medialis)	Real-time visual feedback of force generation was made available during the test, and all subjects were encouraged to reach a visual target force that was set 25% above the level achieved during the near-maximal warm up contractions. If the subject reached the target during any contraction, the target was raised to continually provide the motivation for as strong a contraction as possible. During the test, vigorous verbal encouragement was provided as each subject produced a four second maximum isometric contraction. Approximately two seconds into the contraction a supramaximal burst of electrical current (100 pulses/s, 600 μs pulse duration, 10 pulse tetanic train, 130 V) was sent through the electrodes to fully stimulate the QF.
Machner. 2002 *	VA	Quadriceps (Middle of the quadriceps muscle and and distal quadriceps muscle 10cm above the patella)	The patients were instructed under intense encouragement to fully extend their knee (5 s) to determine the MVC and for maximal potentiation of the twitch response. Immediately after twitch potentiation, the subjects performed isometric contractions with 90%, 70%, 50%, 35% and 100% of their maximal voluntary contraction by matching the visualized torque level to the line on the monitor of the desired torque level. When the torque was kept stable three single stimuli were applied to the muscle generating additional torque that was measured online.
Pap. 2000 ˆ	VA	Quadriceps	Linear extrapolation at 5 twitch-torque levels (25%, 50%, 75%, 90%, 100% of MVC force) to the twitch-torque intercept at theoretical muscle relaxation.
Pap. 2004 ˆ	VA	Quadriceps (Middle of the quadriceps muscle and distal	subjects were instructed under intense encouragement to fully extend their knee (5s) for determination of the MVC and for maximum potentiation of the twitch response. Immediately after twitch potentiation. the subjects performed isometric contractions with 90%, 75%, 50%, 25% and 100% of their MVC by matching the visualised torque level to the line on the monitor of the desired torque level. When the torque was kept stable three single stimuli were applied to the muscle generating additional force (twitch).

		quadriceps muscle 10cm above the patella)	
Petterson. 2008 *	VA	Quadriceps (Rectus Femoris - Proximal and Vastus Medialis - Distal)	an electrical stimulation unit administered a burst of electrical impulses (100 ms, 100-pps stimulation train at 135 V) approximately 4 s into an MVC. A noted increase in force when the electrical impulses were administered signified insufficient muscle recruitment. The testing procedure was repeated up to a maximum of three times. The trial with the largest MVC production was used for data analysis.
Petterson. 2011 *	VA	Quadriceps (Rectus Femoris - Proximal and Vastus Medialis - Distal)	A Grass S8800 stimulator with a Grass model stimulus isolation unit (Grass Instruments, West Warwick, RI) was used to deliver a 100-Hz, 12-pulse (pulse duration = 600 Ks) stimulus train at 135 V. The stimulus train was delivered during the plateau in force of a maximal voluntary contraction using custom written software (LabView 4.01; National Instruments, Austin, TX). Force augmentation at the time of the electrical stimulus indicated incomplete voluntary muscle recruitment. If force augmentation was present, indicating incomplete VA, the testing procedure was repeated up to three times on each leg to ensure the reduced activation was not due to motivation. Subjects were given 5-min rest period between contractions to minimize the effects of muscle fatigue.
Stevens. 2003 *	VA	Quadriceps (Rectus Femoris and Vastus Medialis)	QF activation was estimated by superimposing a supramaximal electrical stimulus on a MVCMVC. testing began by having the patient perform a 3-5 s MVC. During the con- traction, a supramaximal, 10-pulse, 100 pulse/s train of electrical stimulation was delivered to the muscle to assess muscle activation level (i.e. burst-superimposition technique).
Suetta. 2007 *	VA	Quadriceps (Vastus Lateralis, Vastus Medialis, Rectus Femoris)	Before the MVC, a maximal baseline twitch (Pt) was defined where a stepwise increment in current delivered every 30 s resulted in no further increases in force. Following a short rest, three voluntary contractions (with 2-min rest between each contraction) were performed with the addition of supramaximal single pulses. The subject was asked to push as hard and fast as possible and maintain the contraction for 3–5 s. The force recording of each contraction was viewed on a computer screen in real time, which enabled stimuli to be triggered manually on top of a MVC.
Tarrago. 2016 ^	ICF	Right Hand (FDI)	The paired-pulse measurements included the SICI with interstimulus intervals of 2milliseconds and the ICF with interstimulus intervals of 12 milliseconds. To define the individual MT, the first subthreshold stimulus was set at 80%, whereas the suprathreshold stimulus was set at 130% of the MT. The intensity of the supra-threshold test stimuli was adjusted to elicit the test stimuli with peak-to-peak amplitude of approximately 1 mV. At the level of the primary motor cortex, the reduction of the test MEP elicited by TMS is considered to reflect inhibition and the increase of the test MEP elicited by TMS is considered to reflect facilitation at the level of the primary motor cortex.

			Thirty recordings (10 for each ICI, ICF, and the test stimulus) were produced in a random order with an interval of approximately 8seconds between each pulse.
	MEP	Right Hand (FDI)	Right Hand (FDI). Single-pulse measures including the MEP and the SP were recorded at an intensity of 130% of the MT. The MEP value was the elicited evoked potential with a 1-mV peak-to- peak amplitude. The mean of 10 consecutive trials were recorded.
	RMT	Right Hand (FDI)	The MT was defined using the lowest stimulus to induce 50% of the evoked potentials of the resting FDI. To ensure constant placement of the coil throughout the TMS assessments, the site was marked with a soft-tipped pen. Firstly, the MT was determined using the lowest stimulus to elicit evoked potentials in the resting FDI, with a minimum amplitude of 50 mV peak-to-peak, in at least 5 of 10 (at least 50%) of successive trials).
	SICI	Right Hand (FDI)	The paired-pulse measurements included the SICI with interstimulus intervals of 2milliseconds and the ICF with interstimulus intervals of 12 milliseconds. To define the individual MT, the first subthreshold stimulus was set at 80%, whereas the suprathreshold stimulus was set at 130% of the MT. The intensity of the supra-threshold test stimuli was adjusted to elicit the test stimuli with peak-to-peak amplitude of approximately 1 mV. At the level of the primary motor cortex, the reduction of the test MEP elicited by TMS is considered to reflect inhibition and the increase of the test MEP elicited by TMS is considered to reflect facilitation at the level of the primary motor cortex. Thirty recordings (10 for each ICI, ICF, and the test stimulus) were produced in a random order with an interval of approximately 8seconds between each pulse.
	SP	Right Hand (FDI)	Single-pulse measures including the MEP and the SP were recorded at an intensity of 130% of the MT. For the SP, patients were instructed to perform isometric voluntary contractions with approximately 10% of maximal contraction of the FDI. The transient silence during the isometric voluntary EMG activity was elicited in the tonically contracting FDI muscle at approximately 10% of the maximal voluntary contraction, and the SP was preceded by the MEP. Ten consecutive trials were recorded.
Thomas. 2010 ˆ	VA	Quadriceps (Proximal Rectus Femoris and Distal Vastus Medialis)	Three repetitions of a knee extension MVC were performed with 2-min rest provided between repetitions to limit the effects of fatigue on the measurement. Using the burst superimposition technique, a supra- maximal electrical stimulus (100 pps train, 600 ms pulse duration, train duration 100 ms, and maximum voltage of 130 V) was delivered to the participants while they performed the previously described knee extension MVC.
Vahtrik. 2012 *	VA	Quadriceps	Twitch-interpolated technique was used to estimate VA of the QF muscle. The subjects were asked to reach their maximal force level during 3 s (the total duration of contraction was approximately 5 s) and to maintain it after the supramaximal stimulus was delivered and until they were asked to relax. Visual feedback was provided by the display of strain-gauge amplifier. When the subject's QF muscle was completely activated, additional force was generated by superimposed twitches. Additional force produces extra activity for incompletely activated motor units during the stimulus. The subjects performed three trials with the interval of 2 min, and the trial with the greatest pre stimulus voluntary force was taken for further analysis. The VA > or = 95% was used as the definition of full activation of the QF muscle.

Ventura. 2019 *	VA	Quadriceps (Vastus Lateralis).	For the realization of the gradual MVCs, subjects were instructed to contract their knee extensors “as hard as possible”, with a progressive torque build up. Online visual feedback and strong verbal encouragement were consistently provided by the same experimenter. When the MVC torque was attained (2–3 s after contraction onset), paired electrical stimuli were delivered to evoke a superimposed doublet response. Participants were requested to hold the MVC for another 1–2 s after the stimulation and then to fully relax. Approximately 2 s after the end of the MVC, paired electrical stimuli were delivered to induce a (resting) potentiated doublet response, from which the evoked torque was quantified. For the assessment of VA, the superimposed doublet torque was expressed as a function of the evoked torque obtained from the resting potentiated doublet, as follows: VA=(1−superimposed doublet torque/evoked torque)×100.

Legend: voluntary activation (VA); intracortical facilitation (ICF); motor evoked potential (MEP); motor threshold (MT); resting motor threshold (RMT); short-interval intracortical inhibition (SICI); silent period (SP): maximal voluntary contraction (MVC); First Dorsal Interosseus (FDI); Hz (Hertz); V (Volts); A (Amps); pps (pulses per second); s (second). Where the region of the quadriceps (e.g., rectus femoris) was not defined these data were not reported in the original study.

10 **Appendix G. Funding Information**

Study	Funding
Berth. 2002	Supported by the Deutsche Forschungsgemeinschaft (grant nos. AW 5/2-1, AW 5/2-2, AW 5/2-4).
Gapeyeva. 2007	This study was supported by the Estonian Ministry of Education and Science, project No 0182130S02 and Estonian Science Foundation, grants No. 6214 and 6218.
Hassan. 2001	Ministry of Higher Education, Sultanate of Oman for the research scholarship for BH.
Heiden. 2009	Funding from the University of Western Australia.
Hurley. 1997	Arthritis and Rheumatism Council for their financial support of this project
Kittelson. 2014	Support for this study was provided by the National Institutes of Health (R01- HD065900; K23-AG029978, KL2-TR000156, T32 AG000279) and the Foundation for Physical Therapy (PODS I award).
Lewek. 2004	Funding was provided by the National In- stitutes of Health (5ROlHD037985-02, lP20RRO16458- 010003), and the Foundation for Physical Therapy Promotion of Doctoral Studies Program.
Machner. 2002	This work was supported by Deutsche Forschungs- gemeinschaft AW 512-1 and AW 512-2.
Pap. 2004	This work was supported by Deutsche Forschungs- gemeinschaft AW 512-2, AW 512-4 and NE 50514-2.
Petterson. 2008	Funding was provided by the National Institutes of Health (R01HD041055 and T32HD07490).
Petterson. 2011	This study was supported by the National Institutes of Health (grant No. R01-HD041055; ClinicalTrials.gov identifier: NCT00224913).
Stevens. 2003	NIH T32 HD07490, NIH ROlHD041055-01, Foundation for Physical Therapy Scholarships (McMillan, PODS 1 and PODS 2).
Suetta. 2007	NR. (The costs of publication of this article were defrayed in part by the payment of page charges. The article must therefore be hereby marked “advertisement” in accordance with 18 U.S.C. Section 1734 solely to indicate this fact.)
Tarrago. 2016	Funding: The present research was supported by the following Brazilian agencies: research grant—National Council for Scientific and Techno- logical Development-CNPq (I.L.S. 302345/2011 – 6 Torres and W. Caumo WC-301256/2013–6); Brazilian Innovation Agency (FINEP) process number—1245/13. Postdoctoral grant—Committee for the Development of Higher Education Personnel (CAPES) —PNPD/ CAPES, GL, and process number (No: 71/2013).
Thomas. 2010	This study was supported by The Michigan Arthritis Founda- tion grant #N007718 (Palmieri-Smith).
Vahtrik. 2012	This study was partly supported by the Estonian Ministry of Education and Research project No SF0180030s07 and Estonian Science Foundation project No 7939.
Ventura. 2019	No funding received for this study.

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13 **Appendix H. Methodological quality of included studies**

Author	Were the criteria for inclusion in the sample clearly defined?	Were the study subjects and the setting described in detail?	Was the exposure measured in a valid and reliable way?	Were objective, standard criteria used for measurement of the condition?	Were confounding factors identified?	Were strategies to deal with confounding factors stated?	Were the outcomes measured in a valid and reliable way?	Was appropriate statistical analysis used?	Overall quality
Berth. 2002	Yes	No	Unsure	Yes	No	No	No	No	Low
Gapeyeva. 2007	Yes	Yes	No	Yes	No	No	No	No	Low
Hassan. 2001	Yes	No	No	Yes	No	No	No	No	Low
Heiden. 2009	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Low
Hurley. 1997	Yes	No	Yes	Yes	No	No	No	No	Low
Kittelson. 2014	Yes	No	Unsure	No	Yes	No	Yes	No	Low
Lewek. 2004	Yes	No	No	Yes	Yes	Yes	Yes	No	Low
Machner. 2002	Yes	No	No	Yes	No	No	No	No	Low
Pap. 2000	Yes	Yes	Yes	Yes	No	No	No	No	Low
Pap. 2004	Yes	No	Yes	Yes	No	No	No	No	Low
Petterson. 2008	Yes	No	Yes	No	No	No	No	No	Low
Petterson. 2011	Yes	No	Yes	No	No	No	No	No	Low
Stevens. 2003	Yes	No	Yes	Yes	No	No	No	No	Low
Suetta. 2007	Yes	No	Yes	Yes	Yes	No	No	No	Low
Tarrago. 2016	Yes	No	Yes	Yes	Yes	No	Yes	No	Low
Thomas. 2010	Yes	Yes	Unsure	Yes	No	No	Unsure	No	Low
Vahtrik. 2012	Yes	No	Yes	Yes	Unsure	Unsure	Unsure	No	Low
Ventura. 2019	Yes	No	No	Yes	No	No	No	No	Low