

timer with their foot. Two trials were performed with the left and right foot in that exact order. Foot reaction time was recorded for each foot and both scores for each foot were then averaged as the mean score for each foot time.

**Results:** Pearson correlations (SPSS ver. 28) showed EOSS and ECSS balance scores had no significant relationship to the BMI or foot reaction time with the participants. There however was a negative relationship ( $r = -0.72$ ;  $p = 0.20$ ) between the right foot reaction time vs BMI of the participants.

**Discussion:** Our investigation did not show statistical significance. This may be due to low power based on a smaller sample size even though a strong negative correlation was discovered with the right foot reaction time and BMI. This study attempted to determine if there was a significant correlation between BMI, foot reaction time, and balance scores in elderly women. Compared to previous studies concluding that high BMI increases CoP scores, this study did not reflect past findings. Also, dominant foot reaction time was slower for those participants with higher BMI scores. A higher sample size could have increased the power of the study.

**Application to the field:** Reduction in body fat percentage have been known to improve mobility, decreasing postural sway. In elderly women, these variables could impact the chances of reducing falls and potential injuries.

All co-authors have no conflict of interest towards the relevance of this submission

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(P100009)

### No measures of fear-avoidance following concussion can be recommended for use: a systematic review using the COSMIN Criteria

L. Sherwood<sup>a</sup>, V. Korakakis<sup>b</sup>, L. Forthington<sup>c</sup>, A. Mosler<sup>d</sup>, M. Murphy<sup>a,e</sup>

<sup>a</sup>Nutrition and Health Innovation Research Institute, School of Medical and Health Sciences, Edith Cowan University, Australia

<sup>b</sup>Department of Population Health Sciences, School of Life Course & Population Sciences, Faculty of Life Sciences and Medicine, King's College London, United Kingdom

<sup>c</sup>School of Medical and Health Sciences, Edith Cowan University, Australia

<sup>d</sup>La Trobe Sport and Exercise Medicine Research Centre, La Trobe University, Australia

<sup>e</sup>National School of Nursing, Midwifery, Health Sciences & Physiotherapy, The University of Notre Dame Australia, Australia

**Introduction:** Concussion is a global concern across various populations. Fear avoidance behaviour is a prognostic risk factor for chronicity for musculoskeletal pain conditions, and is present in people with persistent post-concussion symptoms. Various patient-reported outcome measures (PROMs) have previously been used to quantify fear-avoidance behaviour in people following concussion. However, before being used, PROMs should be evaluated to ensure that they accurately measure the construct that they aim to quantify. The aims of this study were to: 1) identify PROMs that have assessed fear avoidance behaviour following concussion, and 2) assess the measurement properties of all identified PROMs.

**Methods:** A systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. A search of seven online databases was performed from database inception to 5 November 2021. We included cross-sectional and longitudinal interventional or

observational studies published in peer reviewed journals that evaluated tool(s) that measure fear avoidance behaviour in participants with concussion. Two authors independently screened all articles and extracted relevant data. Assessment of methodological quality for included PROMs was performed following the COSMIN guidelines. The quality of the evidence was assessed using the GRADE approach. The assessment of PROM methodological quality and the quality of the evidence was assessed by two authors independently before a final consensus judgement was confirmed by the authorship team. This systematic review was prospectively registered on PROSPERO (CRD42021287565).

**Results:** A total of 1,397 records were identified by our search strategy, with 39 studies reported to have measured some aspect of avoidance behaviours. Only three PROMs had sufficient evidence to qualify for quality assessment: 1) modified Fear-Avoidance Beliefs Questionnaire (FABQ), Fear Avoidance Behaviour after Traumatic Brain Injury Questionnaire (FAB-TBI) and the Paediatric FAB-TBI Questionnaire (PFAB-TBI). There were no development studies identified for any of these PROMs. Both the modified FABQ and FAB-TBI had very-low level evidence of insufficient content validity and sufficient structural validity. The PFAB-TBI had very-low level evidence of insufficient content validity and the structural validity could not be assessed.

**Conclusion:** Quantifying fear avoidance behaviours in patients following concussion may help identify patients who require alternative management strategies. However, no current PROM can be recommended to assess fear-avoidance behaviours in a concussion population due to insufficient quality and very low levels of evidence. The development of PROMs that measure fear-avoidance behaviours in concussion, and are developed according to the COSMIN guidelines, are needed before the importance of fear-avoidance can be quantified.

**Impact and application to the field:** This review highlights that existing outcome measures to quantify fear-avoidance behaviours following concussion cannot be recommended for use due to either insufficient validity and/or a very-low-level of evidence. Furthermore, due to the poor quality of current measures, existing studies that have used these measures to quantify fear-avoidance behaviours following concussion are at risk of erroneous conclusions.

**Conflicts of interest:** The authors declare no competing interests.

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### Three-year durability of pain and disability improvements in patients treated with Restorative Neurostimulation for chronic mechanical low back pain

B. Mitchell

Metro Pain Group, Australia

**Introduction:** Mechanical chronic low back pain (CLBP) can be caused by impaired neuromuscular control and degeneration of the multifidus muscles, the most important stabilizers of the lumbar spine. An implantable Restorative Neurostimulation system (ReActiv8® by Mainstay Medical) bilaterally stimulates the medial branches of the L2 dorsal rami to override underlying multifidus inhibition to facilitate motor control restoration. The ReActiv8-B randomized sham-controlled pivotal trial provided published evidence of safety, effectiveness, and durability of this therapy ([clinicaltrials.gov/show/NCT02577354](https://clinicaltrials.gov/show/NCT02577354)). Here we will report the three-year durability results.

**Methods:** Eligible patients had activity limiting mechanical CLBP with Visual Analog Scale (VAS)  $\geq 6$ cm; Oswestry Disability Index (ODI)  $\geq 21$  points despite medical management, including at least

medication and physical therapy. They had evidence of impaired multifidus motor control (positive prone instability test) and no indication for spine surgery. Participants delivered stimulation for up to 30 minutes twice daily causing repetitive tonic multifidus contractions and remain in long-term follow-up.

**Results:** At baseline (N=204), participants were  $47\pm 9$  years of age, had a history of  $14\pm 11$  years of backpain, average LBP-VAS of  $7.3\pm 0.7$  cm, ODI of  $39\pm 10$ , EQ-5D of  $0.585\pm 0.174$  points and had pain on  $97\pm 8\%$  of days in the prior year prior. Despite limited effectiveness, 37% of participants were using opioids at baseline.

At 3 years (N=129), average LBP-VAS had improved by  $4.9\pm 2.4$  cm (68.1%), ODI by  $22.9\pm 15.2$  points (58.9%) and EQ-5D by  $0.220\pm 0.196$  (All  $p<0.0001$ ); 77% of participants had a  $\geq 50\%$  LBP-VAS improvement; 68% reported LBP-Resolution (LBP-VAS $\leq 2.5$  cm); 64% had a  $\geq 20$ -point ODI improvement and 86% of participants were "definitely satisfied" with the treatment. As pain and disability are interdependent symptoms, treatment success is determined by both: 83% had an improvement of  $\geq 50\%$  in LBP-VAS and/or  $\geq 20$  points in ODI, and 57% had these improvements in both. Of participants using opioids at baseline, 72% had voluntarily discontinued (51%) or decreased (21%) consumption. The overall safety profile is favorable compared to other neurostimulation systems and no lead migrations were observed. During the third follow-up year, 6 participants requested device removal citing resolution of pain.

**Discussion:** Overall trial results demonstrate effectiveness, durability, and safety. Progressive long-term improvements are consistent with the restorative mechanism of action.

**Impact and application to the field:** Restorative neurostimulation should be considered in patients with intractable mechanical CLBP associated with multifidus control impairment refractory to specialist physical therapy.

**The Author declares no conflict of interest**

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(P100019)

### Relationship between ventilatory efficiency and salivary mitochondrial DNA copy number in aerobically trained adolescent athletes

N. Yasuda<sup>a</sup>, T. Tanioka<sup>b</sup>, K. Nakazawa<sup>c</sup>

<sup>a</sup>Okayama Healthcare Professional University, Japan

<sup>b</sup>Showa University, Japan

<sup>c</sup>The University of Tokyo, Japan

**Introduction:** It has been reported that endurance exercise training improves cardiorespiratory fitness levels (e.g., peak oxygen uptake:  $VO_{2peak}$ ) and mitochondrial function. On this matter, one study has shown that ventilation efficiency may be directly related to salivary mitochondrial DNA copy number (as an index of mitochondrial content) in healthy subjects with relatively low aerobic capacity ( $33$  ml/kg/min  $VO_{2peak}$ ). However, the causal relationship for these indices in adolescent athletes is not yet clear. The purpose of this study was to clarify the relationship between ventilatory efficiency and salivary mitochondrial DNA copy number in aerobically active adolescent athletes.

**Methods:** Adolescent male and female athletes with similar fitness levels (Males; n=12, age:  $15.2\pm 1.6$  years,  $VO_{2peak}$  [peak oxygen uptake relative to fat free mass]:  $77.2\pm 9.8$  ml/kg FFM/min; Females; n=11, age:  $15.1\pm 0.8$  years,  $VO_{2peak}$ :  $72.3\pm 5.7$  ml/kg FFM/min [mean $\pm$ SD]) were recruited as the participants. All participants executed an incremental cycling exercise until volitional exhaustion to measure ventilatory efficiency, including ventilatory threshold and peak oxygen uptake on an electromagnetically braked cycle

ergometer. Each participant conducted a cycling exercise at an initial power output of 0 W for three minutes, which was increased by 25 W every 1 min until exhaustion. Pedaling frequency was 60 rpm. Expired gases and heart rate were continuously analyzed with using a respiratory monitor system and electrocardiograph. Ventilatory efficiency was assessed with the lowest minute ventilation per unit carbon dioxide production ( $VE/VCO_2$ ). Prior to maximal cycling exercise, salivary samples were collected for the later analysis of salivary mitochondrial DNA copy number quantified with real-time polymerase reaction. Correlation analyses were consequently performed to clarify the relationship between ventilatory efficiency and salivary mitochondrial copy number.

**Results:** No significant correlation was observed between ventilation equivalent and salivary mitochondrial DNA copy number in adolescent male ( $p=0.379$ ) and female athletes ( $p=0.672$ ).

**Discussion:** Previous investigation has shown that ventilatory efficiency may correlate with salivary mitochondrial DNA copy number in healthy people with relatively low aerobic fitness. On the other hand, the results of our study showed no significant differences between these indicators. This disparity may partially be due to the relatively higher aerobic fitness of the participants ( $VO_{2peak}$  values:  $55$  ml/kg/min and  $72$  ml/kg FFM/min) in this study than in the previous study. In conclusion, the findings of this study suggest that there may be no direct link between ventilation efficiency and salivary mitochondrial DNA copy number in aerobically fit adolescent males and females.

**Impact and application to the field:** If a method of assessing fitness levels could be established using saliva, based on biomarkers of the mitochondrial function system, it could be a useful indicator for checking the physical condition of adolescent athletes.

We have no conflict of interest of relevance to the submission of this abstract.

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(P100020)

### Effects of long-term training on whole body DNA oxidation in adolescent female volleyball athletes

K. Tanaka, N. Yasuda

Okayama Healthcare Professional University, Japan

**Introduction:** Setting optimal training volume is important to prevent injuries and disorders induced by overtraining when adolescent athletes engage in sport-club activities. On this point, if non-invasive biomarkers related to oxidative stress could be used to monitor the physical condition of athletes, it is expected to provide athletes with some feedback to maintain and improve performance levels for the athletes. The aim of this study was to examine the cumulative effects of 12 months of volleyball training on whole body DNA oxidation (accounted for by urinary 8-hydroxy-2'-deoxyguanosine) in adolescent female athletes.

**Methods:** Nine eumenorrhoeic female volleyball players (as baseline values; age:  $15.2\pm 0.4$  year, height:  $159.9\pm 5.9$  cm, body weight:  $54.9\pm 6.4$  kg, BMI:  $21.4\pm 1.6$  kg/m<sup>2</sup>, body fat:  $22.1\pm 4.7\%$  [mean $\pm$ SD]) served as the participants. Each athlete performed volleyball training in the school gym, which consisted of ball handling, specialized drills, and practical game-style exercises, including physical training. The training cycle consisted of six days per week, with a total of approximately 2 to 2.5 of volleyball training per day. In order to examine the cumulative effects of whole body DNA oxidation, urine samples were collected before and after volleyball club activities on three successive days (Days 1, 3, and 5) at 0 (baseline) and 12 months (two consecutive days summer seasons), respectively, for the later analysis of 8-hydroxy-2'- deoxyguanosine (8-