

# Abstracts of Theses Approved for the PhD/ MSc at the School of Health Sciences, Universiti Sains Malaysia, Kubang Kerian, Kelantan, Malaysia

## ELUCIDATING THE ROLE OF BAICALEIN-ENRICHED FRACTION TO MODULATE ISCHAEMIC STROKE RECOVERY IN RAT MODEL

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**Introduction:** Ischaemic stroke is presently the top two leading causes of mortality and long-term adult disability worldwide. Up to date, recombinant tissue plasminogen activator (rtPA) is the one and only approved drug for ischaemic stroke therapy. The situation is even worse when this standard therapy has very narrow therapeutic window (~3 h–4.5 h) and detrimental side effects if administered beyond the golden hour. Therefore, natural medicinal plants-based therapy with low side effect and high bioavailability has emerged as a promising alternative for ischaemic stroke.

**Objectives:** This study assessed the therapeutic potential of baicalein-enriched fraction (BEF), a neuroprotective constituent extracted from the leaves of medicinal plant known as *Oroxylum indicum*.

**Methods:** Prior to any in vivo study using natural botanical extracts or fractions, it is crucial to validate their safety profiles and efficacy through comprehensive toxicological assessments. In this study, the preclinical acute and subacute neurotoxicology assessment of BEF was evaluated based on the Guidelines 420 and 424 set in Organisation for Economic Co-operation and Development (OECD). Taking all results together, it was clear that the BEF was safe to be consumed orally and had potential to be developed as an oral drug for ischaemic stroke treatment. Thus, 50 mg/kg BEF was orally administered to Sprague Dawley (SD) rats ( $n = 5$ ) for 4 days before the induction of ischaemic stroke using endothelin 1 (ET-1). In addition, this study also evaluated the potential of BEF as preconditioning agent to confer protection to neural stem cells (NSCs) against ischaemic conditions before transplantation into ischaemic stroke rat models for treatment.

**Results:** It was found that the half lethal dose ( $LD_{50}$ ) of BEF was more than 2,000 mg/kg, with no treatment-related toxicity behaviour or neurotoxicity impairments, no alteration in haematological, biochemical and histopathological assessments in both acute and subacute neurotoxicity study. It was found the consumption of BEF pre-ischaemic stroke induction could significantly confer protection to the brain tissue against the ischaemic injury, shown by the significantly improved neurological deficits, lower brain infarct volume and lower histological score of neuronal degradation in BEF-treated group, compared to the

non-treated group. The results revealed that the experimental rats treated with NSCs preconditioned with BEF at 3.125 µg/mL for 48 h not only showed significantly decreased brain infarct volume, neuronal degradation and inflammatory cells infiltration, they also showed significantly increased blood vessel density and improved neurological behavioural function as fast as just 24 h after the treatment, compared to rats treated with non-preconditioned NSCs and non-treated control group. Furthermore, the expression for angiogenic (ANGPT1), anti-oxidant (SOD2), anti-inflammation (IL-1Rn) and neuroprotective (JAKMIP1, STAT6, NGF, NFKB) genes also significantly increased in the rat treated with BEF-preconditioned NSCs.

**Conclusion:** In conclusion, BEF is a potential drug with neuroprotective and preconditioning effects that could be applied to enhance clinical treatments of ischaemic stroke in future.

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## THE EFFECTS OF COMBINING AEROBIC AND HEAVY RESISTANCE TRAINING ON BODY COMPOSITION, MUSCLE HYPERTROPHY AND EXERCISE SATISFACTION IN PHYSICALLY ACTIVE ADULTS

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**Introduction:** The relationship between muscle hypertrophy and metabolic rate has long been a topic of interest in exercise science. Studies have shown that increases in muscle mass leads to a higher resting metabolic rate, highlighting the energy demands associated with muscle maintenance and activity. While resistance training is commonly associated with muscle growth, the impact of combining aerobic endurance training with heavy resistance exercises on muscle hypertrophy remains a subject of debate.

**Objectives:** This study investigated the effects of combined aerobic and heavy resistance training on body composition, muscle hypertrophy, and exercise satisfaction in physically active adults in comparison to heavy resistance (hypertrophy-aimed) training alone.

**Methods:** A total of 22 healthy, physically active male adults between the ages of 18 years old and 35 years old who did not practise muscle hypertrophy training before completed the programme. They were randomly assigned to two groups: the resistance training group and the combined group (resistance training and aerobic training). Resistance training consisted of a three-day muscle group split (2–3 exercises per muscle group, 8 sets per muscle group, 6–12 RM), while aerobic training consisted of a three-times-per-week aerobic interval training programme. Both groups were exposed to 8 weeks of training interventions, one group to resistance training alone and another to a combined training of resistance training plus aerobic training, at the end of which variables of body composition, muscle hypertrophy, and exercise satisfaction were statistically analysed using SPSS 27.0 software.

**Results:** Variables selected for this study as markers of body composition responded differently to the different interventions and time; however, some trends were not statistically significant. Overall, it is impossible to state unequivocally that one training modality was superior to another in the body composition cluster; however, both interventions showed improvement with time. Exercise satisfaction has improved from the pre-test to the post-test within the groups. From pre- to post-testing, both intervention groups improved exercise satisfaction (both at  $P < 0.05$ ). There was, however, no difference between the groups (resistance training versus combined training before the intervention and after the training;  $P > 0.05$ ).

**Conclusion:** In conclusion, this study showed some insights into the impact of different training modalities on body composition, muscle hypertrophy, and exercise satisfaction among physically active adults.

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## EXAMINE THE EFFECTS OF BRAIN-BREAKS EXERCISE VIDEO PROGRAMME ON FUNDAMENTAL MOTOR SKILLS PERFORMANCE AMONG THE PRIMARY SCHOOL STUDENTS IN KAPIT, SARAWAK

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**Introduction:** Proficiency in fundamental motor skills (FMS) among children is important for children to engage in physical activity (PA) and live an active lifestyle which will bring positive implications to their physical, cognitive, and social development. However, there is evidence that indicates low proficiency in FMS among children.

**Objectives:** This study aimed to identify the Sarawakian children's FMS test scores and the percentiles of total FMS score (based on CAMSA) and examine the effects of the Brain-Breaks exercise video programme on the FMS performance among primary school students in Kapit, Sarawak.

**Methods:** The study involved two interrelated studies and was divided into 2 phases: i) cross-sectional study, ii) interventional study. Data for both study phases were collected using the Canadian Agility and Movement Skill Assessment (CAMSA) instrument. Phase 1 of the study aimed to identify the Sarawakian children's FMS test scores based on gender and to identify the percentiles of total FMS score among Sarawakian children. Data were analysed using the descriptive statistics (mean, standard deviation, percentiles, crosstabs). A total of 385 students were randomly selected from four invited primary schools from three divisions in Sarawak (Kuching, Kota Samarahan, Kapit). Males scored higher than females in all variables; completion time (males,  $28.65 \pm 6.29$ ; females,  $28.09 \pm 5.15$ ), time score (males,  $3.04 \pm 2.20$ ; females,  $2.93 \pm 1.82$ ), skill score (males,  $8.39 \pm 2.51$ ; females,  $7.84 \pm 2.62$ ), total CAMSA score (males,  $11.42 \pm 3.91$ ; females,  $10.77 \pm 3.62$ ), and interpretation (males,  $1.09 \pm .30$ ; females,  $1.06 \pm .23$ ). In addition, the the Sarawakian children's total FMS score percentiles were lower as compared to the Canadian children. Phase 2 aimed to examine the effects of Brain-Breaks exercise video programme in FMS performance among the primary school students in Kapit, Sarawak. A total of 104 students from two invited primary schools in Kapit, Sarawak participated in the study. Following the pre-test, the schools were randomly assigned to an intervention group ( $n = 53$ ) and a control group ( $n = 51$ ). The intervention group received two-30 min Brain-Breaks sessions per week for 7 weeks and the control group continued with their regular Physical Education (PE) class for 7 weeks. A post-test was conducted following the 7-week intervention. Mixed factorial analysis of variance (ANOVA) was used to examine the effects of Brain-Breaks on the study variables.

**Results:** A mixed ANOVA showed significant changes (time effect) on skill score,  $F(1,102) = 73.85$ ,  $P\text{-value} < 0.001$ ; total CAMSA score,  $F(1, 102) = 52.94$ ,  $P\text{-value} < 0.001$ ; and interpretation,  $F(1, 102) = 15.57$ ,  $P\text{-value} < 0.001$ . There were also significant differences between groups on skill score,  $F(1, 102) = 35.21$ ,  $P\text{-value} < 0.001$ ; and total CAMSA score,  $F(1, 102) = 5.81$ ,  $P\text{-value} = 0.018$ . A significant interaction effect was found for skill score,  $F(1, 102) = 17.07$ ,  $P\text{-value} < 0.001$ .

**Conclusion:** In conclusion, the skill score and total CAMSA score among primary school students significantly improved following the Brain-Breaks intervention. Behavioural change intervention programmes and strategies are essential in the acquiring of fundamental motor skills among the primary school students which are central to sports participation and physical activities.

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## THE FUNDAMENTAL UNDERSTANDING OF THE IMPACT USING BRAIN-BREAKS ON SARAWAKIAN INDIGENOUS CHILDREN BASED ON PHYSICAL ACTIVITY, NUTRITION AND HYGIENE: A UNITED NATION SDG PROJECT - #3 GOOD HEALTH AND WELL BEING

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**Introduction:** Physical activity plays a vital role in our daily lives. Regular physical activity is recommended for all people in their reproductive years since it is associated with reduced risk of morbidity, maintaining a healthy weight and the promotion of preconception health. Despite the importance of physical activity, there is a need to increase physical activity among the Malaysian adolescent communities, especially towards indigenous children, whereby they have limited access to healthy lifestyles, good nutrition and hygiene.

**Objectives:** This study aimed to investigate the effects of using Brain-Breaks on physical activity behaviour, health-related fitness, food intake, and personal hygiene among the indigenous primary school children in Sarawak, Malaysia.

**Methods:** The participants were 70 indigenous primary school children (38 males and 32 females) aged 10 years old–12 years old from two rural schools in Sarawak, Malaysia. The health-related fitness test was conducted to evaluate the students' flexibility, muscular strength, muscular endurance, body composition and cardiovascular endurance. The nutritional status of an individual was calculated using three days' food record, involving two-week days and one weekend. The hygiene of an individual was recorded using personal hygiene record. Descriptive statistics and mixed factorial ANOVA were used to analyse the data.

**Results:** The mixed factorial ANOVA for health-related fitness revealed significant changes for group effect on vertical jump,  $F(1, 68) = 7.26$ ,  $P$ -value ( $\eta^2$ ) = 0.009 (0.096), push up,  $F(1, 68) = 89.06$ ,  $P$ -value ( $\eta^2$ ) < 0.001 (0.567) and beep test,  $F(1, 68) = 4.53$ ,  $P$ -value ( $\eta^2$ ) = 0.037 (0.062). Whereas, the mixed factorial ANOVA for food intake revealed significant changes for group effect on weekday two calories intake,  $F(1, 68) = 19.94$ ,  $P$ -value ( $\eta^2$ ) < 0.001 (0.227) and weekday three calories intake,  $F(1, 68) = 89.93$ ,  $P$ -value ( $\eta^2$ ) < 0.001 (0.569). Lastly, the mixed factorial ANOVA for personal hygiene revealed significant changes for group effect on brush hair,  $F(1, 68) = 4.43$ ,  $P$ -value ( $\eta^2$ ) = 0.039 (0.061), make bed,  $F(1, 68) = 21.00$ ,  $P$ -value ( $\eta^2$ ) < 0.001 (0.236), put on pajamas,  $F(1, 68) = 12.91$ ,  $P$ -value ( $\eta^2$ ) = 0.001 (.160), and cut nails,  $F(1, 68) = 78.34$ ,  $P$ -value ( $\eta^2$ ) < 0.001 (0.535).

**Conclusion:** The study recommends school-based Brain-Breaks activity need to be vary, adapt and diversify

according to the culture, values and norms in order to improve the health, nutrition and well-being of the indigenous children in the long run.

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## EFFECTS OF BRAIN-BREAKS ON PHYSICAL ACTIVITY, ACADEMIC SELF-EFFICACY, EMOTION REGULATION, SLEEP AND RESILIENCE AMONG CHINESE UNIVERSITY STUDENTS

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**Introduction:** Encouraging physical activity is vital for university students' well-being. Brain-Breaks, an online video programme designed for classrooms, has shown positive effects on primary school students but is rarely used among university students.

**Objectives:** This study sought to explore the connections among physical activity, academic self-efficacy, emotion regulation, sleep, and resilience in Chinese university students from Jiangsu Province. It also aimed to assess the impact of the Brain-Breaks physical activity program on these variables among students at Jiangsu Vocational University of Medicine in Yancheng city.

**Methods:** The study consisted of two phases: a cross-sectional study (Phase 1) and a cluster-randomised trial (Phase 2). In Phase 1, 1534 participants completed questionnaires, split randomly into two groups: 737 for confirmatory factor analysis (CFA) and 797 for Structural Equation Modelling (SEM). Phase 2 involved 103 Chinese university students in the mixed analysis of variance (ANOVA). Chinese versions of the Brunel Lifestyle Physical Activity Questionnaire (BLPAQ-C), Academic Self-efficacy Scale (ASES-C), Emotion Regulation Questionnaire-8 (ERQ-8-C), Jenkins Sleep Scale (JSS-C), and Five-by-Five Resilience Scale (5×5RS-C) were used to measure physical activity, academic self-efficacy, emotion regulation, sleep and psychological resilience among university students. After the validity and reliability of the questionnaires and the relationship between the variables were determined, Phase 2 was performed to explore the effects of the intervention on the measured variables. Participants, divided by classes,

underwent an 8-week intervention, with the experimental group engaging in Brain-Breaks physical activity five times a week for 5 min–10 min per session. Both groups completed the questionnaire before and after the intervention. The collected data were analysed with SPSS 26.0 for descriptive statistics and mixed ANOVA, Mplus 8.3 for CFA and SEM.

**Results:** In phase 1, most participants were females (70.40%). After removing items with low factor loadings and/or adding correlated residuals within the same factor, all models exhibited good fit, reaching acceptable fit indices. The questionnaires of Chinese version were determined, and the final structural model fitted the data of the questionnaire well. The SEM produced a significant inter-relationship between the variables, with nine specific hypotheses supported by the final model. In Phase 2, the majority of participants also comprised females (71.84%). There was a significant main effect of time for planned physical activity ( $P < 0.001$ ); the main effect of time was significant for suppression ( $P = 0.020$ ); the interaction effect was significant ( $P < 0.001$ ) in the ASES-C, further simple effect analysis revealed a significant isolated effect of group in the post-test ( $P = 0.031$ ); in the 5×5RS-C, there were significant interaction effects (Optimism:  $P = 0.001$ , Social Support:  $P = 0.009$ ). Simple effect results showed significant isolated effects of time on Optimism in the experimental group ( $P = 0.004$ ).

**Conclusion:** In conclusion, university students' physical activity related to academic self-efficacy, emotion regulation, resilience, and sleep. These connections guided the intervention for better mental and physical health. While Brain-Breaks' impact lacked significant differences in several measures, it positively impacted academic performance. Thus, advocating its use in university settings is recommended.

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## THE EFFECT OF BRAIN-BREAKS ON PARTICIPATION MOTIVES, ATTITUDES, COGNITIVE FUNCTION AND PHYSICAL ACTIVITY BEHAVIOUR AMONG TRAINEE TEACHERS IN KUCHING, SARAWAK

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**Introduction:** Brain-Breaks are short mental physical breaks incorporated periodically and can help to stimulate one's health and motivation.

**Objectives:** The purposes of the study are to: i) examine the effect of Brain-Breaks on participation motives, attitudes and cognitive functions among the Sarawak's

trainee teachers (Study 1). In addition, this study also aims to: ii) examine the effect of Brain-Breaks on physical activity behaviours among the Sarawak's trainee teachers (Study 2).

**Methods:** During study 1, the Brain-Breaks were conducted twice a day, and five times a week for a duration of 12 weeks. The participants comprised of 48 trainee teachers (24 males and 24 females) aged 18 years old and 19 years old randomly divided into intervention ( $n = 24$ ) and control group ( $n = 24$ ). The Physical Activity and Leisure Motivation Scale (PALMS), Attitude towards Physical Activity Scale (APAS), MUSE headband and the BC-541 Tanita Inner Scan Body Composition Monitor were utilised. Independent  $t$ -test and mixed factorial ANOVA were used to analyse the data. During Study 2, a total of 12 trainee teachers were recruited from both Institute of Teacher Campuses. They were randomly assigned into two groups (gender matched) which were the control group ( $n = 6$ ) and intervention group ( $n = 6$ ). The Mi Band 4 was used to access the participants' physical activity through Brain-Breaks. Descriptive analysis, qualitative method of enquiry and interview were conducted at the end of the study.

**Results:** For study 1, mixed factorial ANOVA for APAS variables revealed significant time effect for self-efficacy,  $F(1, 46) = 7.20$ ,  $P$ -value ( $\eta^2$ ) = 0.010 (0.135). The mixed factorial ANOVA for PALMS variables revealed significant time effect for; competition/ego,  $F(1, 46) = 10.82$ ,  $P$ -value ( $\eta^2$ ) = 0.002 (0.019); other's expectations,  $F(1, 46) = 11.05$ ,  $P$ -value ( $\eta^2$ ) = 0.002 (0.024) and enjoyment,  $F(1, 46) = 6.64$ ,  $P$ -value ( $\eta^2$ ) = 0.013 (0.130). In addition, enjoyment,  $F(1, 46) = 6.64$ ,  $P$ -value ( $\eta^2$ ) = 0.013 (0.130) was also significant for group effect. Mixed factorial ANOVA for anthropometric body composition variables showed significant time effect for body fat percentage,  $F(1, 46) = 5.46$ ,  $P$ -value ( $\eta^2$ ) = 0.024 (0.106); together with significant interaction effect for muscle mass,  $F(1, 46) = 5.80$ ,  $P$ -value ( $\eta^2$ ) = 0.020 (0.112); bone mass  $F(1, 46) = 6.66$ ,  $P$ -value ( $\eta^2$ ) = 0.013 (0.127) and basal metabolic rate  $F(1, 46) = 7.15$ ,  $P$ -value ( $\eta^2$ ) = 0.010 (0.135). For Study 2, participants had also showed positive responses for the three-open ended questions. The positive phrases revealed by the participants showed that Brain-Breaks increased their level of motivation and focus as well as improved their learning progress.

**Conclusion:** The results revealed that Brain-Breaks were successful in improving the motivation and attitudes towards physical activity; increased real time physical activity behaviour. Thus, Brain-Breaks should be recommended to be used throughout the higher education campuses in Malaysia.

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## THE EFFECTS OF BRAIN-BREAKS EXERCISE VIDEOS ON SOCIAL-ECOLOGICAL RISKS USING A TRANSTHEORETICAL MODEL AMONG OVERWEIGHT AND OBESE CHILDREN IN CHINA

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**Introduction:** Childhood obesity has become a significant public health concern globally with multiple contributing factors. To gain a more comprehensive understanding of this issue, this study utilised a combination of the Social-ecological Model and the Transtheoretical Model (TTM) to analyse the social-ecological risk factors among overweight and obese children in China. The Brain-Breaks exercise video, specifically designed for classroom settings, was introduced as an intervention tool to enhance children's physical activity.

**Objectives:** This study aimed to examine the inter-relationship between TTM constructs, social-ecological factors, and physical activity (PA) in different body mass index (BMI) groups and the effect of Brain-Breaks exercise videos on the study variables among obese and overweight children in Shangrao City, Jiangxi Province, China.

**Methods:** This study was conducted in two phases: a cross-sectional study for Phase 1 and a randomised controlled trial for Phase 2. Cluster random sampling was used to select participants for Phase 1, resulting in the recruitment of 1573 children and adolescents between the ages of 9 years old and 15 years old. From this group, 100 participants were selected to participate in Phase 2. In Phase 1, eligible participants received a questionnaire package to complete in class and structural equation modeling was used to examine relationships between study variables. Phase 2 evaluated the effectiveness of Brain-Breaks exercise videos, with participants randomised into intervention and control groups for 4 weeks. Only the intervention group received a daily 10-min video exercise. Data analysis was performed by SPSS 26.0 and Mplus 8, and the mixed factorial analysis of variance (ANOVA) was used to examine the intervention effects on both groups.

**Results:** In phase 1, most participants were boys (56.8%) with a mean age of 12 years old (SD = 1.68). The final structural model fits the data well [comparative fit index (CFI) = 0.920, Tucker Lewis index (TLI) = 0.916, Standardised Root Mean Square Residual (SRMR) = 0.049, Root Mean Square Error of Approximation (RMSEA) (90% CI) = 0.039 (0.038, 0.040)]. It also generates significant inter-relationships between TTM constructs, social-ecological factors, and the amount of PA. Participants in Phase 2 had a mean age of 13.4 (SD = 2.53) and a mean BMI of 22.8 (SD = 2.22). The intervention group had significantly higher mean scores than the control group on three psychological constructs, including perceived benefits, self-efficacy, and stage of change ( $P = 0.006$ ,  $= 0.001$ ,  $< 0.001$ , respectively), while the control group had higher scores on perceived barriers ( $P < 0.001$ ). The intervention group also had significantly more PA ( $P = 0.003$ ).

**Conclusion:** The study concludes that social support is critical for behaviour change in overweight and obese children, and Brain-Breaks exercise videos have practical benefits for Chinese overweight and obese children, altering behaviour and motivation towards increased PA.

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## THE USAGE OF BLOOD FLOW RESTRICTION AS TRAINING INTERVENTION IN PHYSICALLY ACTIVE ADULTS AND AS REHABILITATION MODALITY IN KNEE OSTEOARTHRITIS PATIENTS

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**Introduction:** High-intensity interval training (HIIT) can be divided into two periods: exercise and interval period. It is unclear whether there are differences in physiological and biomechanical effects when blood flow restriction (BFR) is used for an exercise intervention in different phases of HIIT. Previous BFR studies on patients with musculoskeletal injuries/problems were focused on pain and physiological outcomes. The biomechanical effects of resistance exercise with and without BFR on patients with knee osteoarthritis (OA) are unknown.

**Objectives:** This study evaluated the long term effect of HIIT with BFR on healthy male adults and the immediate effect of BFR resistance training on patients with knee OA.

**Methods:** Initially, 32 healthy male adults were randomised into one of the following conditions: HIIT without BFR (Control Group,  $n = 11$ ), HIIT with BFR during exercise phase (Experimental Group,  $n = 10$ ), HIIT with BFR during interval phase (Interval Group,  $n = 11$ ). Then, exercise intervention twice a week for 12 weeks was performed. Maximum oxygen uptake ( $VO_{2max}$ ), cycling economy, isometric knee strength, Wingate test and single leg landing biomechanical test were performed in the first, sixth and twelfth weeks. Next, 15 knee OA patients completed two exercise sessions: elastic band resistance exercise (control group) or elastic band resistance exercise with BFR (experimental group). Heart rate, rating of perceived exertion, visual analogue scale, blood pressure and biomechanical indexes during Sit-to-Stand (STS) and gait were evaluated before and after exercise.

**Results:** Firstly, 12 weeks of HIIT with BFR improved aerobic and anaerobic capacity in healthy male adults. Secondly, HIIT with BFR had no effects on biomechanical variables during single leg landing among healthy male adults. In addition, the application of BFR in the interval phase of HIIT improved cycling economy and fatigue index

than when applying BFR during the exercise phase. For the OA patients, the ratings of perceived exertion (RPE) were higher after elastic band exercise with BFR. Elastic-band exercise with BFR increased the internal and lateral peak pressure of the heel during gait. Notably, the elastic band exercise with BFR reduced the gait symmetry in the early stance of gait.

**Conclusion:** Applying BFR during the interval period of HIIT can improve anaerobic capacity and cycling economy better than BFR during the exercise phase, and elastic band exercise combined with BFR is safe in patients with unilateral OA.

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## MECHANICS, FUNCTION, PAIN AND EFFECTS OF EXERCISE INTERVENTION AMONG NURSES WITH LOW BACK PAIN IN HOSPITAL UNIVERSITI SAINS MALAYSIA

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**Introduction:** Low back pain (LBP) is classified as a leading disabling musculoskeletal disorder that affects all range of the population globally and nursing is a high-risk group profession associated with LBP. However, previous studies on LBP among nurses did not quantify the mechanics during nurses-related tasks across subtypes which hinders the understanding of how these tasks cause LBP. Besides that, previous studies on exercise therapy in individuals with chronic non-specific LBP (CNLBP) were focused on pain score, muscle power and function but none on the long-term effects of exercise on full body mechanics among female nurses with CNLBP. The significance of this study compared with previous studies was the comparison of full body mechanics among female nurses with CNLBP.

**Objectives:** This research comprised of two studies that aim: i) to compare the full body mechanics between healthy nurses and those with CNLBP and ii) to evaluate the effects of exercise intervention on CNLBP among female nurses.

**Methods:** In Study 1, 26 female nurses were recruited (Healthy Group,  $n = 13$  and CNLBP Group,  $n = 13$ ) and their full body mechanics, functional disability outcomes and pain score were compared. For Study 2, 54 female nurses were randomised into three groups (Control Group,  $n = 18$ , Lumbar Stabilisation Exercise (LSE) Group,  $n = 18$  and Lumbar Muscles Strengthening Exercise (LMSE) Group,  $n = 18$ ). LSE and LMSE groups exercised for two sessions in a week for 8 weeks whereas, control group was given a diary to record their daily activities and 24 h diet recall. Participants completed four assessments which were pre- (before), middle- (during 4th week), post- (after 8 weeks) intervention and 1 month follow-up measurements. Three dimensional (3D) full body kinematics and kinetics of walking and CNT, trunk muscle strength (extensor), sit-and-reach, functional disability, pain intensity and trunk flexor endurance were tested.

**Results:** Based on the results, CNLBP participants employed greater lumbar flexion during walking ( $P < 0.05$ ), greater lumbar flexion ( $P = 0.01$ ) and decreased vertical ground reaction force (VGRF) ( $P = 0.01$ ) during carry and transfer (CNT) compared to healthy participants. This motion caused the upper body to move towards the load and decreased the VGRF, hence, indirectly applied narrow base transfer technique. Furthermore, increase in lumbar flexion during walking among CNLBP participants was common as this pattern was manifested as the compensatory mechanism to avoid pain caused by increasing of trunk stiffness. One month follow up showed LMSE had slightly increased in lumbar flexion ( $P < 0.05$ ), centre of pressure (COP) ( $P = 0.01$ ) and ankle abduction ( $P = 0.04$ ) during walking, lumbar flexion ( $P < 0.05$ ), VGRF ( $P = 0.02$ ) and knee flexion ( $P = 0.04$ ) during CNT than post-intervention.

**Conclusion:** We concluded that LMSE is more effective in long-term effects than LSE in reducing LBP among nurses.

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