Acta Kinesiologica 18 (2024) Issue.2
DOI. 10.51371/issn.1840-2976.2024.18.2.10

Original Investigation

The impact of a single "Body technique vitality protocol" treatment on vitality restoration: a randomized trial in urban women

Ana-Marija Jagodić-Rukavina[a,b], Mirna Andrijašević[b], Benjamin Banai[c], Andrea Skelin[d], Dinka Pavičić Baldani[e], Lovro Štefan[f*], Držislav Kalafatić[g]

[a]PBS centar izvrsnosti, 10 000 Zagreb, Croatia
[b]Faculty of Kinesiology, University of Zagreb, Croatia
[c]Banai analitika, Osijek, Croatia
[d]Genos d.o.o, 10 000 Zagreb, Croatia
[e]KBC-Zagreb, Department of Human Reproduction, 10 000 Zagreb, Croatia
[f]Faculty of Sports Studies, Masaryk University, 625 00 Brno, Czech Republic
[g]Clinical hospital center Zagreb, 10 000 Zagreb, Croatia

Purpose: The main purpose of the study was to investigate the efficiency and factorial validity of a newly developed vitality questionnaire (AMRJ) in women.
Methods: In this randomized trial over six weeks, 161 women were randomly included. Each category of age represents one period of life as follows: 17.5 years (adolescence), 30 years (menstruation and sexual activity), 45 years (perimenopause) and 60 years (menopause). Opposed to subjective vitality status questionnaire (SVS), the AMRJ was designed to understand one's personal perception of posture, body tissue, breathing, self-perception of health, pain and quality of life.
Results: For the AMJR, the two-factor solution explained 64% of variance among items, and all items loaded highly with their underlying factors (all $\lambda > .55$). A large effect size (d= - .89) was observed for 17.5-year-olds, and a medium effect size (d= - .50) was observed for 60-year-olds. Furthermore, current vitality ratings from the AMJR questionnaire were significantly larger as well after the intervention, but the interpretation of the significant interaction terms goes in another direction. In AMJR, the effects of the intervention increased with the participant's age. The intervention effect had a medium effect size for 17.5-year-olds (d= .67), and a large effect size (d= - .92) for 60-year-olds.
Conclusions: The AMJR questionnaire brings a new perspective on self-measured vitality and is published for the first time with the affiliated presentation of validity. It shows current and potential vitality associated with the physical domain. Potential point as a concrete individual fact brings objective goals and important motivational stimulus for vitality improvements.

Keywords: vitality; factor analysis; energy; women; correlation analysis.

Introduction

Measurement of subjective perceptions of mental and physical energy nominated as Vitality in the form of the visual analogue scales (VAS) has been established by Wood et al.[1] Since then, the concept of 'Vitality' has been investigated mainly within the fields of psychology, psychosociology, economics, public health and so far with the most standardized approach on the global level in the field of gerontology.[2,3] Within measurements scales applied as a tool to assess' human self-perception on well-being and happiness developed during the last three decades' Subjective Vitality Scale (SVS) has been found to be the most reliable and most commonly applied.[2,4] In the form of a questionnaire for self-evaluation in the context of a single factor analysis, SVS consists of seven statements rated on a seven-point Likert scale, ranging from 1= "not at all" to 7=" very true".[2] The SVS consists of the following statements; 1. I fell alive and vital, 2. I don't feel very energetic, 3. Sometimes I am so alive I just want to burst, 4. I have energy and spirit, 5. I look forward to each new day, 6. I nearly always feel awake and alert, 7. I feel energized; which have been translated and modified, and their number has been adjusted to different nationalities, regarding different languages needs.[2] The concept of subjective vitality refers to the state of feeling alive and alert–to having energy available to the self. The SVS was validated and used as a measure of psychological well-being.[5] Subjective state of vitality, as an indicator of the amount of energy available to oneself, is negatively correlated with physical pain and positively correlated with the amount of support in the current situation.[6] Lifestyles focused predominantly on extrinsic goals are less suitable for meeting needs and therefore generate less vitality.[2] Despite the fact that anciently known Eastern traditions of physical exercise practices, such as yoga and tai chi, established worldwide as fundamentals in health-related 'Vitality' gaining, the 'Vitality concept' surprisingly hasn't been jet broadly investigated within the field of kinesiology/kinesiotherapy.[2] A growing number of studies conducted so far imply that individual levels of vitality can be restored by mindful activities that satisfy basic individual needs for connection, competence, and autonomy of being fully functional and psychologically well.[7] The SVS questionnaire,

while reliable and widely used, mainly captures a subjective sense of vitality through self-evaluation of psychological well-being. However, it doesn't fully account broader scope for the physical and holistic aspects of vitality, such as posture, body tissue, breathing, and overall health perception. Broader scope enables a more detailed analysis of vitality, considering both physical and psychological factors.

Body Technique (BT) as a comprehensive, personally-oriented working out program, focused on optimizing the psycho-physical health of an individual. BT consists of more than 3000 different exercises directed at the simultaneous enhancement of body stability and mobility within all three planes of movement.[8] It significantly impacts conscious actions of an individual's posture, movements strength, breathing engagements, and muscle-fascia-tendon relaxations on the enhanced microcirculatory outflow of blood and lymph.[8] In the form of moderate intensity performance, as an optimal exercise effect in anxiety and stress-related disorders, BT exercise protocols are created to meet all WHO proposed components of healthy fitness.[9] BT approaches recreation, rehabilitation, and sports with a simultaneous focus on connecting an individual's body to its own emotions, mind, and perception of personal energy capacity load-vitality.[8] BT exercises have been shown to influence women's endocrine glandular balance and enhance activation of all fascia and subcutaneous, intermuscular, pelvic, abdominal, and thoracic connective tissue, which acts, as an electrical conductor leading to "blocked energy" release and outflow. In order to measure the impact of BT on individual vitality capacity, the Body technique vitality protocol (BTVP) has been made, targeting both genders of all age categories (Table 1). It consists of seven functional exercises influencing; (i) posture, (ii) stability, (iii) mobility, (iv) release of tension accumulated within muscular and connective tissues, (vi) controlled deep and fluid breathing as well as (vii) self-taping and (viii) self-brushing of the skin.

The Body Technique Vitality Protocol (BTVP) has a holistic impact, emphasizing conscious engagement with posture, stability, breathing, and tension release in the body. This approach significantly enhances microcirculatory blood and lymph flow. The moderate intensity of the exercises is particularly beneficial for integrating physical exercise with emotional, mental, and personal energy perceptions, fostering a comprehensive approach to health and vitality. The protocol specifically benefits the endocrine system by activating fascia and subcutaneous, intermuscular, pelvic, abdominal, and thoracic connective tissues, thereby facilitating the release of "blocked energy. These elements highlight the comprehensive nature of BTVP and its significant advantages over standard exercise programs.

To objectively analyse the efficacy of BTVP on acute vitality gain Ana-Marija Jagodić Rukavina Current and Potential Vitality questionnaire (AMRJ) is developed. The AMRJ arise on a holistic basis by combining kinesiology and psychological features of self-determination theory (SDT) in order to gain a precise understanding of one's personal perception of posture, body tissue, breathing, self-perception of health, pain and quality of life.[8]

AMRJ is designed to get subjective state of vitality, as a sign of the quantity of energy accessible to oneself, what is negatively connected with physical discomfort and positively correlated with the degree of support in the current circumstance, as well as in the anticipated future projection. The AMRJ also specifically examines the unique vitality changes women experience across different hormonal life stages, offering a more detailed and precise tool for vitality measurement compared to the SVS.

To get reliable and measurable data on how BTVP acutely influences vitality, AMJR and SVS tests are simultaneously used and scored according to Likert scale from 1 up to 7 points per statement/question. Scores are statistically compared to define a precise range of vitality measurements by AMJR. Because women go through several hormonal changes throughout their lives (puberty, reproductive age-pregnancy, perimenopause, and menopause), the primary goal of this study is to look into possible differences in vitality perception after a single BTVP intervention within the listed hormonally defined categories. These particular exercises were selected for their comprehensive approach to enhancing overall vitality, which directly aligns with the study's objectives of investigating the efficiency and factorial validity of the newly-developed vitality questionnaire (AMRJ) in women. The exercises target multiple aspects of physical and psychological well-being, including posture, stability, mobility, tension release, controlled breathing, and self-care techniques like self-taping and self-brushing of the skin. By addressing these diverse elements, the exercises are designed to impact various factors that contribute to an individual's subjective sense of vitality. This holistic approach ensures that the AMRJ questionnaire can effectively measure a broad spectrum of vitality-related factors, providing a robust tool for assessing how these exercises influence women's vitality across different life stages. Thus, the selection of these exercises supports the study's aim of validating the AMRJ by ensuring it comprehensively captures changes in vitality resulting from targeted physical interventions.

Materials and methods

Participants

A total of 161 females living an urban lifestyle from different continental and coastal cities of Croatia participated in the current study. The study was conducted over a 40 days period engaging volunteers of different ages; from high school, throughout college, working adults, and senior female citizens living within the family or at nursing homes.

Study Design

The research was conducted in high school in Velika Gorica, the School of Medicine, nursing homes in Karlovac and Zagreb, a public open workshop in Zagreb, a gym in Zagreb, and conference participants from Šibenik, Rijeka, Split, and Zagreb. Ethical review board approval was acquired prior to the start of the investigation.

Under the supervision of BT instructors, all participants conducted seven BTVP exercises in the following order: 1. "The Energy Squat", 2. "Heart Opening", 3. "Excavator with a Long Neck", 4. "A Pebble on the Head", 5. "Bringing the Earth and the Universe Together", 6. "The Cheat Sheet", 7. "The Pump" (Table 1). The Body Instructor demonstrated and supplied clear directions during the workout for more exact execution of the exercises so that all participants would reach their full goal. The time required to perform all seven exercises in six or seven sets each, ranged from 15 to 20 minutes, depending on the candidate's abilities. The respondents' vitality levels were assessed before and after the workouts using the SVS, a seven-statement questionnaire, and the AMJR, a 14-statement questionnaire and scored according Likert scale (1-strongly disagree; 2-disagree; 3-somewhat disagree; 4-neither agree nor disagree; 5-somewhat agree; 6-agree; 7-strongly agree).

The AMJR measures both mental and physical vitality in seven categories. The participants were asked to rate their current and prospective vitality within seven categories as follows: (i) self-perception of posture and spinal cord strength and mobility;

Table 1. Instructions and content of AMJR questionnaire items, together with descriptive statistics

Item no	Instructions and item content	M	SD
	Instruction: Spine and posture category: Think about your posture and how your spine supports your body's weight. Do you find yourself hunched over with your head forward with shrugged or stiff shoulders? Is your lumbar region out of balance? In which relation do you find your head, shoulders, chest, and pelvis?		
1	How would you generally rate your "current self" in the spine and posture category?	3.938	1.359
2	How would you like your "potential self" to appear and to feel (according to your capabilities) as far as the spine and posture category is concerned?	6.373	0.835
	Instruction: Belly category: Become aware of your belly area according to what you see in the mirror, but also how it feels to you. Do you have excess skin or belly fat? Do you feel it is strong and functional enough?		
3	How would you generally rate your "current self" in the belly category?	3.72	1.55
4	How would you like your "potential self" to feel (according to your capabilities) as far as the belly category is concerned?	6.28	.838
	Instruction: Body pain and disturbance category: Analyze your body pain and disturbances that you have. How would you describe "being and living" in your body? How often do you suffer from pain or any disturbances that make it difficult to function day or night?		
5	How would you generally rate your "current self" in the category of body pain and disturbance?	4.484	1.401
6	How would you like your "potential self" to feel (according to your capabilities) in the category of body pain and disturbance?	6.497	.792
	Instruction: Health problems category: Pay attention to the health problems that you have had or still have. Do you have health issues that are intense and are there any new symptoms? How would you describe the state of your hormones, organs, immunity, psyche and libido?		
7	How would you generally rate your "current self" in the category of health problems?	4.422	1.386
8	How would you like your "potential self" to feel (according to your capabilities) in the category of health problems?	6.509	.708
	Instruction: Outer appearance and physical state category: Think about your physical appearance and how you feel about it. When you look at yourself in the mirror without clothes, do you feel confident and satisfied? Do you monitor your physical needs and take good care of yourself regularly?		
9	How would you generally rate your "current self" in the category of visual appearance and physical state?	4.217	1.386
10	How would you like your "potential self" to feel (according to your capabilities) in the category of visual appearance and physical state?	6.416	.841
	Instruction: Breathing category: How familiar are you with your breath? Are you aware of your breathing quality? Do you notice at rest that your breath is short and shallow or is it the opposite, light and deep? Do you experience shortness of breath during activities?		
11	How would you generally rate your "current self" in the category of breathing?	4.584	1.39
12	How would you like your "potential self" to feel (according to your capabilities) in the category of breathing?	6.522	.751
	Instruction: Lifestyle category: Think about your lifestyle, habits, and general activities in your everyday life. How do you perceive your life so far? Do you live in accordance with your needs regarding food, work, relationships, intimacy, and physical activities? How much has your physical, emotional, mental, and spiritual experience been enriched so far?		
13	How would you generally rate your "current self" in the category of lifestyle?	4.429	1.187
14	How would you like your "potential self" to feel (according to your capabilities) in the category of lifestyle?	6.578	.695

M- Mean; SD- Standard deviation

(ii) self-perception of the „belly strength" assessing the core-strength (abdominal, lower back muscle and the muscles around the pelvis); (iii) self-perception of overall bodily discomfort; (iv) self-perception of present level of pain and discomfort in the body; (v) self-perception of any health concerns you've had or are having; (vi) self-perception of physical attractiveness and beauty; (vii) breathing quality perception and comprehension. The AMJR also questions age, physical activity habits, and a lifestyle that includes daily electronic device exposure.

Statistical tests

All analyses were conducted in R v.4.0.3.,[10] using packages lme4 lmerTest,[11] and emmeans.[12] To assess the construct validity of novel vitality measure in its first application, we explored its underlying structure by applying exploratory factor analysis (EFA). Factorability of items intercorrelation matrix was examined using Kaiser-Meyer-Olkin measure of sampling adequacy (KMO, the higher the better, appropriate above .60), and Bartlett's sphericity test (test chi square value should be < .05). The number of factors to retain was chosen based on the results of the parallel analysis,[13] after drawing 10.000 random samples, and comparing eigenvalues obtained on actual data to 95th percentile of eigenvalues calculated on simulated data. The analysis was performed using the principal axis factoring method, and extracted factors were rotated using oblimin rotation. A minimum factor loading size that was considered appropriate was .32.[14] The effect of exercise intervention was tested via linear mixed-effects models, in which the intervention and age were treated as fixed effects and random effects were estimated at the participant level since the administration of vitality measures constituted repeated measures. The overall score of SVS and the current and potential vitality of AMJR were used as dependent variables. We tested the main fixed effects of the intervention and age on ratings of vitality, as well as their interaction to examine if the effects of interventions remain similar across different life stages. Statistical significance of fixed effects was assessed with two approaches: first, 10,000 parametric bootstrap samples were drawn to assess 95% confidence intervals of regression parameters, and second, p-values were obtained via the Satterthwaite degrees of freedom method using R package lmerTest. If these two methods of obtaining statistical significance indicated different conclusions, we interpreted effects according to parametric bootstrap results. Significant interactions were followed by post-hoc analysis which was conducted using emmeans R package. Since participants' age was used as a continuous covariate, we estimated marginal means of vitality ratings for four different ages according to expected different hormonal life stages: 17.5 years (adolescence), 30 years (menstruation and sexual activity), 45 years (perimenopause) and 60 years (menopause). Model-based vitality mean ratings were estimated for pre- and post-intervention conditions and differences between them were examined using Kenward-Rogers method. The impact of intervention across different life stages was interpreted using Cohen's d effect size, following the convention of .2 being small, .5 medium, and .8 large effect size. Next, to further examine the impact of an exercise intervention (BTVP) on different aspects of physical and psychological vitality, we examined differences in current vitality individual item ratings pre- and post-intervention using paired samples *t*-test.

Results

Sixty-two (29%) of the 161 individuals were less than 20 years old (adolescents), 53 (25%) were 20-40 years old (reproductive age), 37 (17%) were 40-50 years old (perimenopause), and 63 (29%) were older than 50 years old (menopause). The youngest participant was 15 years old, the oldest was 82 years old, and the average age of the participants was 42.61 (SD = 20.44) years. Table 1 shows the content and descriptive statistics at the individual item level.

Prior to testing the impact of BTPV on perceived vitality, an EFA was carried out to explore the structure of AMJR questionnaire items. Both KMO (.735), and Bartlett's sphericity test ($\chi^2(91)$ = 2240.226, P< .001) indicated the adequacy of correlation matrix (presented in the Table 2) for factorization. Furthermore, the parallel analysis indicated that two factors should be retained. The two-factor solution explained 64% of variance among items, and all items loaded highly with their underlying factors (all $\lambda > .55$). There we no cross-loadings, meaning that all items loaded highly only with one factor. After oblimin rotation, first factor accounted for 38%, and second for 25.6% of variance, and two factors were in low and positive correlation (r = .248), and factor loadings are presented in the Table 2. Items that loaded highly on the first extracted factor were ones that asked participants to rate their potential condition, therefore this factor was labelled Potential vitality. Items that loaded highly on the second factor were the ones that asked participants to rate their current condition, and that factor was labelled Current vitality. Furthermore, we calculated Cronbach's alpha coefficients of internal consistency that indicated high reliability of both current (α = .882) and potential (α = .895) vitality scales. We further calculated overall scores on both scales and tested their difference with paired samples t-test. It was shown that the score of potential vitality (M = 45.17, SD = 4.54) is significantly higher (t(160) = 25.81, P< .001, Cohen's d = 2.03) compared to current vitality (M = 29.80, SD = 7.12). Furthermore, current vitality was in moderate and positive relation with SVS (r(159) = .653, P< .001), while potential vitality was not significantly related to SVS (r(159) = - .052, P= .513). Therefore, we interpret the current vitality as people's assessment of their current condition, whereas potential vitality is pointing to where they strive to be.

The results of linear mixed-effects model analyses that were used to explore the effects of exercise intervention and participants' age on subjective, current, and potential vitality are shown. First, intervention enhanced subjective (B = 3.07, 95% CI [2.243, 3.892], β = .41, P< .001) and current vitality (B = 3.54, 95% CI [2.942, 4.142], β = .48, P< .001), but not potential vitality (B = .12, 95% CI [-.318, .555], β = .03, P= .069). Furthermore, age was positively related to subjective vitality (B = .10, 95% CI [.046, .148], β = .27, P= .001), not related to current vitality (B = .01, 95% CI [- .044, .060], β = .02, P= .775), and negatively related to potential vitality (B = .10, 95% CI [- .131, - .070], β = - .44, P< .001). Finally, interaction terms of intervention and age were significant in predicting subjective (B = -.04, 95% CI [-.082, -.001], β = - .12, P= .104) and current vitality (B = .04, 95% CI [.011, .071], β = .12, P= .038), but not in predicting potential vitality (B = .02, 95% CI [- .007, .037], β = .07, P= .288).

Interpretation of statistically significant intervention and age interaction terms was conducted by estimating model-based marginal means. We estimated pre- and post-intervention marginal means of subjective, current, and potential vitality ratings at different ages. Ages 17.5, 30, 45, and 60 were chosen to represent different hormonal statuses across life, namely: adolescence, reproductive age, perimenopause, and menopause. Results showed that subjective vitality ratings increased significantly after the intervention across all ages, but that the effect of intervention decreases as females get

Table 2. Pearson correlation coefficients between AMJR questionnaire items, and factor loadings from exploratory factor analysis solution

	Pearson correlation coefficients													Factor loadings	
Item	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**Factor 1**	**Factor 2**
1	—														.771
2	.219**	—												.749	
3	.354***	.1	—												.559
4	.092	.52***	.421***	—										.767	
5	.567***	.112	.405***	.139	—										.792
6	.070	.531***	.068	.647***	.215**	—								.890	
7	.578***	.101	.372***	.129	.695***	.144	—								.840
8	.072	.565***	.056	.538***	.191*	.772***	.225**	—						.884	
9	.505***	.156*	.546***	.227**	.531***	.129	.538***	.173*	—						.720
10	.045	.632***	.147	.632***	.104	.655***	.084	.723***	.244**	—				.940	
11	.486***	.167*	.305***	.181*	.425***	.178*	.527***	.172*	.352***	.138	—				.586
12	.044	.545***	.046	.621***	.097	.760***	.135	.743***	.143	.723***	.323***	—		.935	
13	.451***	.059	.368***	.155*	.400***	.078	.535***	.081	.513***	.140	.393***	.084	—		.656
14	- .001	.553***	.087	.590***	.077	.657***	.050	.643***	.115	.763***	.121	.701***	.168*	.903	

*- *P*< .05; **- *P*< .01; ***- *P*< .001; note: Factor loadings lower than .32 are not presented.

older. For example, a large effect size (d = - .89) was observed for 17.5-year-olds, and a medium effect size (d = - .50) was observed for 60-year-olds. Furthermore, current vitality ratings from the AMJR questionnaire were significantly larger as well after the intervention, but the interpretation of the significant interaction terms goes in another direction. In the case of current vitality ratings, the effects of the intervention increase with the participant's age. The intervention effect had a medium effect size for 17.5-year-olds (d = .67), and a large effect size (d = - .92) for 60-year-olds.

Lastly, findings of direct effects of BTPV intervention on perceived vitality, and its' interaction with participants' age are summed in the Figure 1, where panel A represents results for subjective, and panel B represents results for current vitality. Dashed line, that shows vitality ratings indicate the increase in perceived vitality after the intervention. Furthermore, significant interaction between the intervention and age is visible in the difference between solid line (ratings pre-intervention) and dashed line (ratings post-intervention). In the case of subjective vitality, it is shown that this difference decreases with participants age indicating smaller effects of intervention, while this difference increases with participants' age in case of current vitality indicating greater effects among elder. Furthermore, we followed significant and positive effects of BTVP intervention on current vitality with a series of paired-samples t-test that examined changes in individual items to assess which aspects of physical and mental vitality are impacted by the intervention. These results are presented in form of dumbbell plot, at Figure 1 (panel C), where triangular point represent ratings pre-intervention, and circular points represents ratings post-intervention. It has been shown that ratings on all items were significantly higher in post-intervention measurement. The intervention had the largest impact on the ratings of spine and posture (d = .69), followed by health problems (d = .50), belly (d = .48), body pain and disturbance (d = .42), visual appearance and physical state (d = .40), lifestyle (d = .37) and breathing (d = .35).

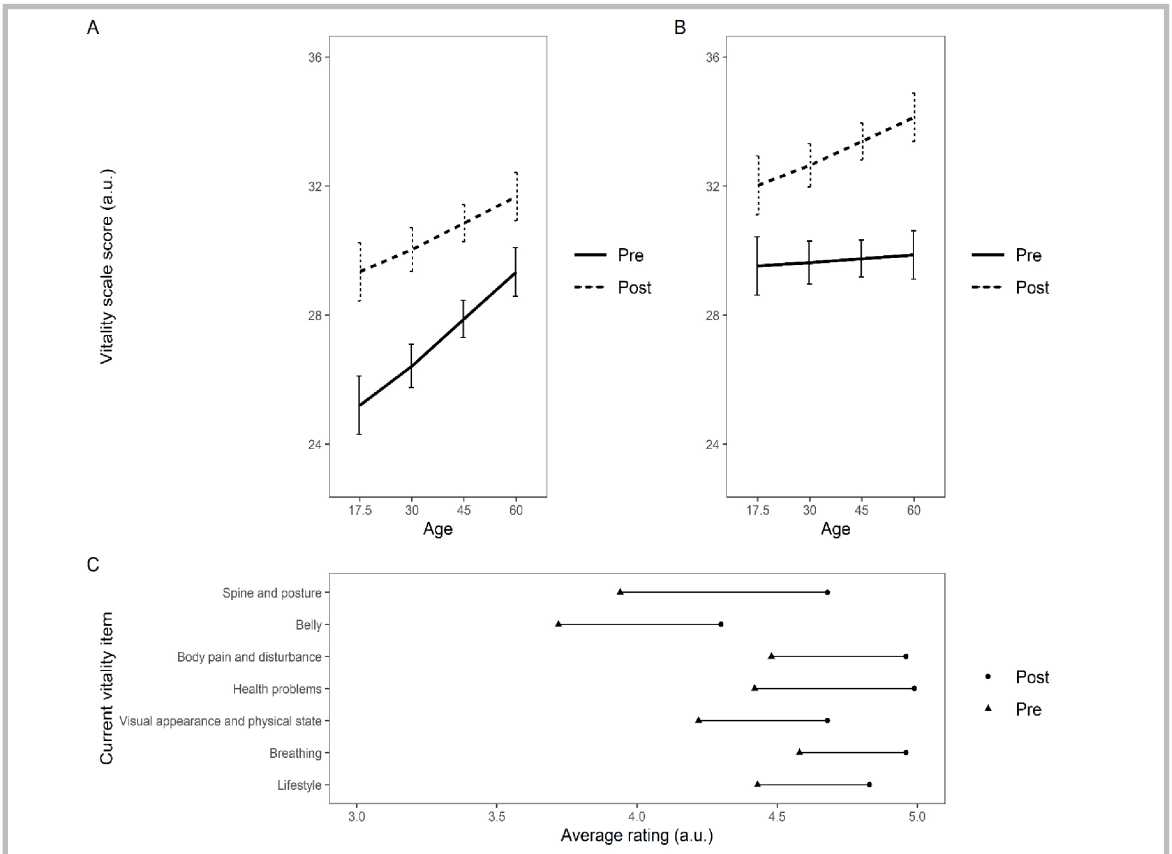

Figure 1. Estimated marginal means of subjective (A) and current (B) vitality ratings pre- and post-intervention, relative to participants' age; and dumbbell plot of average pre- and post- intervention ratings on current vitality items (C)

Discussion

The vitality level is most often measured using the Medical Outcomes Study Short Form-36 vitality scale, which consists of four dimensions, and SVS as a unidimensional measure. Fatigue or low vitality may be indicative of underlying psychiatric or medical illness and seen as an early indicator of frailty, caused by an increased vulnerability in multiple biological and physiological systems.[15] There is also evidence that stress, exhaustion, and depression are associated with telomere length in leucocytes and glycan profiles in serum[16], suggesting that life stress may be linked to macromolecular changes, and contribute to an acceleration of the rate of biological aging.[17-20] However, very little is known about the biological correlates to vitality, particularly self-perception of physical appearance caused by an increased vulnerability in physiological systems. The results of Maynard et al. suggest that subjective vitality in healthy men is linked to BMI (but not glucose/lipid levels), physical performance, and DNA breaks, and thus suggest that these measures could serve as biomarker warning signals for imminent frailty or fatiguing illnesses.[21] Considering underlying physiological and cellular parameters that impact subjective vitality, we present a measurement tool, the AMJR questionnaire, that can evaluate through mental and physical self-perception of

vitality, current, but also potential state as an objective point of recovery and lifting vitality.

Therefore, in this study, we used two questionnaires for vitality. SVS, as a unidimensional measure of vitality state, and a novel AMJR scale. AMJR scale brings a new perspective on self-measured vitality and is published for the first time with the affiliated presentation of validity. It shows current and potential vitality associated with the physical domain. Potential point as a concrete individual fact brings objective goals and important motivational stimulus for vitality improvements. However, it should be noted here that the independent validation of the questionnaire was not conducted, and that the construct validity of the instrument should be evaluated using confirmatory procedures in the future. In the present study, we examined the effects of physical exercise, namely BTVP, on ratings of vitality for females of different ages. Vitality was measured via SVS which assesses the subjective feeling of being full of energy and alive and AMJR which assesses mental and physical aspects of vitality as current and potential vitality. It has been shown that ratings of subjective and current vitality were significantly increased after the exercise intervention, while there were no changes in ratings of potential vitality. Participants' age was positively related to subjective, negatively related to potential, and not related to current vitality ratings. The effects of the intervention on vitality ratings were not stable across different age groups. It has been shown that intervention effects remain positive but decrease among older participants in terms of subjective vitality, while the effects of intervention increase with participants' age in terms of current vitality. We showed that BTVP exercise positively impacts subjective and current vitality ratings, meaning that participants felt more energetic and alive afterward. This finding is in line with study results that support the impact of exercise on perceived vitality,[22-24] highlighting the overall importance of exercise in healthy mental functioning. Furthermore, it has been demonstrated through the BTVP that even a short set of exercises that include alternating phases of relaxation, contraction, and stretching can improve perceived vitality in the short term. This effect was demonstrated on two scales that assess the feeling of vitality at the time of assessment, while it was not demonstrated on the potential vitality scale. Potential vitality is aimed at assessing a person's view of what might be their highest or ideal vitality level in the long run, and it might be the case that changes on this scale could be visible after long-term and continuous exercise intervention. It has also been shown that age moderated the impact of the BTVP exercises on subjective and current vitality differently. In the case of subjective vitality, the effects of intervention were significant across different ages but they decreased with participants' age, while the effects of the intervention increased with participant's age when assessed with current vitality. The reason for these different trends might be in the set of items that were used in two different measures. The main difference between these two measures is that subjective vitality is assessed with items only directed towards psychological, while current vitality is assessed with items describing psychological and physical aspects of vitality. It might be that BTVP has a greater impact on physical aspects of vitality and that that effect was more pronounced among elderly participants, thus resulting in greater effect sizes in older women. BTVP is a physical impact of seven exercises that can be exerted at anytime and anywhere due to its simple but integrated way of proper breathing, posture, taping, and brushing during movement. We could argue that their effects on the better circulatory supply of deep tissue with nutrients and oxygen are a sensible effect, especially for those who had lost their deep tissue functionality due to hormonal changes, degenerative processes, a sedentary lifestyle, and lower self-esteem regarding bodily functions. The older population, due to related health status, is more prone to feel these acute differences in current vitality connected to the physical aspects. Furthermore, many studies revealed that acute exercise intervention programs, lasting 4–32 weeks, intensified feelings like energy, vigorous, pleasant mood, pleasant affect, and joy.[25] As potential vitality did not improve after the BTVP intervention in our research in all age groups, we can assume that the everyday routine of BTVP in a minimum of 4 weeks could meet a person's potential vitality and help overall long-term vitality state. Studies on the feel-good effects of daily life physical activity have not systematically identified the specific type of pleasant feelings that physical activity elicited.[26-30] Therefore, we suggest BTVP as a daily moderate, non-invasive, simple, and encouraging short-term physical activity to ensure pleasant feelings and health-related boost for all age groups. Body technique enables balanced activity for women of all ages, especially in periods of hormonal imbalance, since it integrates proper breathing, and posture and increases functional movement patterns, which affects a better supply of deep tissues with nutrients, hormonal balance, vitality, and emotional stability. Increased or decreased secretion of hormones is reflected in a person's mental and physical condition as well as self-assessment of that condition. It has been known for a long time that a connection exists between different hormone secretion and the psychophysical state. A high level of cortisol is manifested through increased fatigue, tension, and the accumulation of fat around the abdomen, while a low level is manifested through exhaustion. High levels of oestrogen cause increased sensitivity of the breasts, while low levels of oestrogen cause a drop in mood and libido, dryness of the vagina, less flexibility of the joints, and less concentration and liveliness. Low thyroid hormone levels are associated with weight gain and slower digestion. When looking into pre- and post-intervention results on individual current vitality items, it can be seen that the pre-intervention ratings are the lowest for the item that is related to the feeling of vitality in the "belly", or in other words in the abdominal area. This can be related to elevated cortisol that accumulates excess fat around the abdomen, but also to low thyroid hormone levels. The post-intervention ratings in the variable "belly" were statistically higher, even though the BTVP exercises did not stimulate specific strengthening of the abdominal muscles. Self-perception of the specific body region and its connection with better circulation invigorated through the BTVP exercises can be changed in the short-term intervention leading to overall better vitality of the body. Therefore, it could be helpful for various medical needs. Furthermore, the intervention had the largest impact on the "spine and posture" ratings. We hypothesize that this result implies deeper connections with the central axis of our body- our spine and from this intrinsic sensation the overall feeling of vitality.

The integrity and individual approach are more and more present in conventional medicine, and there are more and more studies that confirm the influence of different alternative methods in different health conditions. Hormonal imbalance can lead to an imbalance of the entire organism, which is the basis for the emergence of mental and physical illness. The review paper by Ennour-Idrissi et al.[31] emphasizes the importance of physical activity in women to stimulate the balance of sex hormones. Awareness and care of the individual body through the regular practice of functional movement patterns, optimal posture, and deep breathing is effective active care of health and vitality. It is important that women respect the complexity of the hormonal

changes they experience throughout their lives and that they learn to maintain their vitality in the long term. Physical activity should be adapted to health and hormonal status to ensure hormonal balance and consequently long-term vitality.[8] From this study, it is evident that BTVP is a balanced physical intervention for different age groups because it affects a positive change in the psychological and physical perception of oneself already after seven exercises, which is shown by a significant difference between the initial and final measurements. When the emotional state improves, our brain begins to perceive information and events differently and when neurotransmitters such as serotonin, dopamine, endorphins, oxytocin, and anandamide flood our brain, we feel satisfied, safe, connected to our own body, blissful and peaceful.

This study has a few limitations. First, a holistic approach to vitality may somewhat be difficult to measure and is highly associated to one's perception of health status, energy capacity and overall quality of life. However, our newly developed questionnaire combines body posture, body tissue, breathing, and overall health perception into a one major component of vitality. With appropriate reliability and validity properties, the new questionnaire may be used in settings of women suffering from urinary incontinence, as it is sensitive to training changes over a period of time. Second, a relatively small sample size may have caused a lack of statistical power and generalizability to other populations. Finally, physiological parameters to establish health status and its relations to vitality status are not taken from the participants, which could have strengthened the psychometric properties of the questionnaire.

Practical applications

The short-term physical activity of seven BTVP exercises increases the perceived subjective and current vitality of women of different ages. The effects of BTVP on vitality increased with age by means of both mental and physical aspects of vitality (AMJR), while the effects of BTVP decreased with age when only the mental aspect of vitality (SVS) was assessed. This indicates that AMJR has the ability to detect different vitality effects and can be used in psychological, biomedical and kinesitherapy research, on its own or in addition to a standard SVS measure. AMJR shows that BTVP had no effect on potential vitality. Given that vitality declines with age, the importance of using BTVP is greater and more significant for maintaining vitality in middle-aged and older women. Furthermore, our research aims to assess the biological age and vitality of women of all age groups, with a particular focus on those undergoing perimenopause and menopause, analyzing the total IgG N glycome using the patented GlycanAge test.[32-34] The chronology of reproductive and hormonal changes during perimenopause has been linked to biological aging. Given that the Body technique impacts the activation and functionality of deep muscles, along with improving vital indicators such as breathing and energy flow while balancing hormones, we anticipate that it will lead to a reduction in pro-inflammatory N-glycans and an increase in proportion of anti-inflammatory N-glycans of immunoglobulin G. Consequently, this may reveal a lower biological age among participants following the implementation of the BTVP exercise program compared to compared to the period before its initiation.

Conclusions

In conclusion, BT is an example of a balanced exercise activity for women in all periods of life with an emphasis on the period of a woman's life naturally predisposed to hormonal imbalance. It significantly raises the perception of physical and physical aspects of vitality, as identified in the results of the two questionnaires for self-assessment (AMJR and SVS) before and after BTVP intervention. In further research, it is necessary to investigate additional types of exercises that, in terms of intensity and duration, could have a positive impact on the woman's body at any age as a safe intervention that could have a positive impact on the hormonal status and high self-estimated vitality without too intensive impact on the organism.

Acknowledgments

The authors gratefully thank all the participants for their cooperation during the study.

Ethical Committee approval

Ethical review board approval was acquired prior to the start of the investigation; No. 33/2033 Kinesiology Faculty University of Zagreb.

Topic

Sport Science

Conflicts of interest

The authors have no conflicts of interest to declare.

Funding

No funding was received for this investigation.

Author-s contribution

Conceptualization, A.-M. JR.; methodology, A.-M. JR; software, L.Š.; validation, L.Š.; formal analysis, A.-M. JR; investigation, A.-M. JR ;resources, A.-M. JR; data curation, A.-M. JR; writing—original draft preparation, A.-M. JR., M.A., B.B., A.S., D.P.B. and D.K.; writing—review and editing, A.-M. JR., M.A., B.B., A.S., D.P.B. and D.K.; visualization, A.-M. JR.; supervision, A.-M. JR.; project administration, A.-M. JR. All authors have read and agreed to the published version of the manuscript.

References

1. Wood C, Magnello ME, Jewell T. Measuring vitality. *J R Soc Med*. 1990;83(8):486-489.
2. Lavrusheva O. The concept of vitality. Review of the vitality-related research domain. *New Ideas Psychol*. 2020;56:17.
3. Bautmans I, Knoop V, Amuthavalli Thiyagarajan J, et al. WHO working definition of vitality capacity for healthy longevity monitoring. *Lancet Healthy Longev*. 2022;3(11):789-796. doi:10.1016/S2666-7568(22)00200-8
4. Ryan RM, Frederick C. On energy, personality, and health: subjective vitality as a dynamic reflection of well-being. *J Pers*. 1997;65(3):529-565. doi:10.1111/j.1467-6494.1997.tb00326.x
5. Castillo I, Tomás I, Balaguer I. The Spanish-Version of the Subjective Vitality Scale: Psychometric Properties and Evidence of Validity. *Span J Psychol*. 2017;20:26.

6. Núñez-Cortés R, Espin A, Calatayud J, et al. Can Vitality and Mental Health Influence Upper Extremity Pain? A Prospective Cohort Study of 1185 Female Hospital Nurses. *Eur J Investig Health Psychol Educ*. 2023;13(10):2192-2201.
7. Nix GA. Ryan RM, Manly JB, Deci EL. Revitalization through self-regulation: The effects of autonomous and controlled motivation on happiness and vitality. *J Exp Soc Psychol.* 1999;35(3):266–284. https://doi.org/10.1006/jesp.1999.1382
8. Jagodić-Rukavina A. *Body tehnika: naučite slušati svoje tijelo*. Zagreb: PBS centar sportske izvrsnosti, 2019.
9. Herring MP, Puetz TW, O'Connor PJ, Dishman RK. Effect of exercise training on depressive symptoms among patients with a chronic illness: a systematic review and meta-analysis of randomized controlled trials. *Arch Intern Med*. 2012;172(2):101-111. doi:10.1001/archinternmed.2011.696
10. R Core Team. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria, 2022. URL: https://www.R-project.org/.
11. Kuznetsova A, Brockhoff PB, Christensen RHB. lmerTest package: tests in linear mixed effects models. *J Stat Soft.* 2017;82(13).
12. Lenth R. _emmeans: Estimated Marginal Means, aka Least-Squares Means_. R package version 1.5.4, 2021. <https://CRAN.R-project.org/package=emmeans>.
13. Horn JL. A rationale and test for the number of factors in factor analysis. *Psychometrika*. 1965;30:179-185. doi:10.1007/BF02289447
14. Tabachnick BG, Fidell LS. *Using multivariate statistics*. Boston, MA: Pearson, 2012.
15. Avlund K. Fatigue in older adults: an early indicator of the aging process?. *Aging Clin Exp Res*. 2010;22(2):100-115. doi:10.1007/BF03324782
16. Moreno-Villanueva M, Morath J, Vanhooren V, Elbert T, Kolassa S, Libert C, Bürkle A, Kolassa IT. N-glycosylation profiling of plasma provides evidence for accelerated physiological aging in post-traumatic stress disorder. *Transl Psychiatry*. 2013;3(10):320. doi: 10.1038/tp.2013.93.
17. Lin J, Epel E. Stress and telomere shortening: Insights from cellular mechanisms. *Ageing Res Rev*. 2022;73:101507. doi:10.1016/j.arr.2021.101507
18. Kananen L, Surakka I, Pirkola S, Suvisaari J, Lönnqvist J, Peltonen L, Ripatti S, Hovatta I. Childhood adversities are associated with shorter telomere length at adult age both in individuals with an anxiety disorder and controls. *PLoS One*. 2010;5(5):10826. doi: 10.1371/journal.pone.0010826.
19. Wolkowitz OM, Mellon SH, Epel ES, Lin J, Dhabhar FS, Su Y, Reus VI, Rosser R, Burke HM, Kupferman E, Compagnone M, Nelson JC, Blackburn EH. Leukocyte telomere length in major depression: correlations with chronicity, inflammation and oxidative stress--preliminary findings. *PLoS One*. 2011;6(3):17837. doi: 10.1371/journal.pone.0017837.
20. Ahola K, Sirén I, Kivimäki M, Ripatti S, Aromaa A, Lönnqvist J, Hovatta I. Work-related exhaustion and telomere length: a population-based study. *PLoS One*. 2012;7(7):40186. doi: 10.1371/journal.pone.0040186.
21. Maynard S, Keijzers G, Hansen AM, Osler M, Molbo D, Bendix L, Møller P, Loft S, Moreno-Villanueva M, Bürkle A, Hvitby CP, Schurman SH, Stevnsner T, Rasmussen LJ, Avlund K, Bohr VA. Associations of subjective vitality with DNA damage, cardiovascular risk factors and physical performance. *Acta Physiol (Oxf)*. 2015;213(1):156-70. doi: 10.1111/apha.12296.
22. Prakash RS, Voss MW, Erickson KI, Kramer AF. Physical activity and cognitive vitality. *Annu Rev Psychol*. 2015;66:769-797. doi:10.1146/annurev-psych-010814-015249
23. Solberg PA, Hopkins WG, Ommundsen Y, Halvari H. Effects of three training types on vitality among older adults: A self-determination theory perspective. *Psychol Sport Exerc*. 2012;13:407–417.
24. Rodrigues F, Faustino T, Santos A, Teixeira E, Cid L, Monteiro D. How does exercising make you feel? The associations between positive and negative affect, life satisfaction, self-esteem, and vitality. *Int J Sport Exerc Psychol*. 2021;20(3):813-827.
25. Basso JC, Suzuki WA. The Effects of Acute Exercise on Mood, Cognition, Neurophysiology, and Neurochemical Pathways: A Review. *Brain Plast*. 2017;2(2):127-152.
26. Giacobbi PR, Hausenblas HA, Frye N. A naturalistic assessment of the relationship between personality, daily life events, leisure-time exercise, and mood. *Psychol Sport Exerc*. 2005;6(1):67-81.
27. Hausenblas HA, Gauvin L, Symons Downs D, Duley AR. Effects of abstinence from habitual involvement in regular exercise on feeling states: an ecological momentary assessment study. *Br J Health Psychol*. 2008;13(Pt 2):237-255.
28. Mata J, Thompson RJ, Jaeggi SM, Buschkuehl M, Jonides J, Gotlib IH. Walk on the bright side: physical activity and affect in major depressive disorder. *J Abnorm Psychol*. 2012;121(2):297-308.
29. Watson D. Intraindividual and interindividual analyses of positive and negative affect: their relation to health complaints, perceived stress, and daily activities. *J Pers Soc Psychol*. 1988;54(6):1020-1030.
30. Steptoe A, Kimbell J, Basford P. Exercise and the experience and appraisal of daily stressors: a naturalistic study. *J Behav Med*. 1998;21(4):363-374.
31. Ennour-Idrissi K, Maunsell E, Diorio C. Effect of physical activity on sex hormones in women: a systematic review and meta-analysis of randomized controlled trials. *Breast Cancer Res*. 2015;17(1):139.
32. Mijakovac A, Frkatović A, Hanić M, Ivok J, Martinić Kavur M, Pučić-Baković M, Spector T, Zoldoš V, Mangino M, Lauc G. Heritability of the glycan clock of biological age. *Front Cell Dev Biol*. 2022;10:982609. doi: 10.3389/fcell.2022.982609.
33. Jurić J, Kohrt WM, Kifer D, Gavin KM, Pezer M, Nigrovic PA, Lauc G. Effects of estradiol on biological age measured using the glycan age index. *Aging (Albany NY)*. 2020;12(19):19756-19765. doi: 10.18632/aging.104060.
34. Gudelj I, Lauc G, Pezer M. Immunoglobulin G glycosylation in aging and diseases. *Cell Immunol*. 2018;333:65-79.

Corresponding information:
Received: 25.04.2024.
Accepted: 18.06.2024.
Correspondence to: Lovro Štefan
University: Faculty of Sports Studies,
625 00 Brno, Czech Republic
E-mail: lovro.stefan1510@gmail.com