University of Szczecin
Faculty of Physical Culture
and Health Promotion

1/2019

Central European Journal of Sport Sciences and Medicine

EDITORIAL OFFICE
University of Szczecin
Faculty of Physical Culture and Health Promotion
Al. Piastów 40B, building 6, 71-065 Szczecin, Poland

SECRETARIAT
Joanna Szwak
e-mail: joanna.szwak@usz.edu.pl

FUNDING BODY
Faculty of Physical Culture and Health Promotion
University of Szczecin, Poland

TEXT DESIGN AND TECHNICAL EDITORIAL | Iwona Mazurkiewicz-Jamrozik

COVER DESIGN | Agnieszka Nawrocka

Print edition is the original published version of the journal
Indexed in: AGRO, Index Copernicus, Google Scholar, PSJD, SafetyLit, Pol-Index

The names of the reviewers are available on the journal's website: www.wnus.edu.pl/cejssm

ISSN 2300-9705

PUBLISHER | Wydawnictwo Naukowe Uniwersytetu Szczecińskiego

Central European Journal of Sport Sciences and Medicine

a quarterly journal

University of Szczecin
Faculty of Physical Culture
and Health Promotion

Vol. 25, No. 1/2019

Contents

INTERVENTION EFFECT OF SUPPORTIVE GROUP THERAPY AND PHYSICAL EXERCISE ON THE QUALITY OF LIFE OF CANCER PATIENTS

Dimitra Papastergiou,[1, A, B, D] Dimitrios Kokaridas,[2, A, D] Konstantinos Bonotis,[1, A, D] Nikolaos Digelidis,[2, A, D] Asterios Patsiaouras[2, C, D]

[1] Faculty of Medicine, School of Health Science, University of Thessaly, Greece
[2] Department of Physical Education & Sport Science, University of Thessaly, Greece
[A] Study Design; [B] Data Collection; [C] Statistical Analysis; [D] Manuscript Preparation

Address for correspondence:
D. Papastergiou
Aisxylou 1, 41336 Larisa, Greece
E-mail: d_papastergiou@yahoo.gr

Abstract Psychological distress is a multidimensional concern affecting patients' ability to cope with cancer, its physical symptoms, and treatments.

This study examined the effect of an exercise program and a group psychotherapy program on the quality of life of Greek cancer patients.

The sample consisted of 39 cancer patients (10 males and 29 females), assigned randomly in three groups of 13 patients each group, that is, a control, an exercise and a psychotherapy group. The duration of the training program for the individuals of the exercise group was 10 weeks at a frequency of two sessions per week, 60 minutes each session. The patients of the psychotherapy group received a 10 weeks' supportive-expressive group therapy, at a frequency of one time per week, of 90 minutes each meeting. The quality of life SF-36 questionnaire was administered to examine the short-term effect of both programs prior and after intervention on quality of life. Control group individuals did not participate in any program and they just filled in the SF-36 questionnaire prior and after intervention.

Improvement in "vitality" ($p = 0.006$) and mental health subscale ($p = 0.011$) was statistically significant between pre and post measures in the supportive therapy group. All other domains exhibit no significant changes. In the exercise group, physical functioning, role functioning and emotional role values were also improved but not to the point to generate statistically significant results. The findings of the present study support the positive impact of psychotherapy intervention on vitality and mental health component of patients with cancer, followed in less extent by the beneficial effect of the exercise program.

Key words quality of life, cancer survivors, exercise, group psychotherapy

Introduction

Cancer is a chronic disease threatening the life and physical integrity of the patient that extends over time and raises issues of psychological significance for the individual. As such, cancer diagnosis is a psycho-traumatic event, while treatment and progression of the disease compose a complex and extremely stressful experience for the

patient that alleviates over time and affects both in short- and long- term the overall functionality level of sufferers (Trudel-Fitzgerald et al., 2017).

Emerged clinical phenomena that characterize the development of post-traumatic syndrome include constant disease engaging, intrusive thoughts of death and refusal or avoidance of anything that recalls the disease including available therapeutic options. Furthermore, relapses of the disease may be even more traumatic than its initial attack and consequent arising anxiety psychologically disrupts patient's quality of life (Stanton, Bower, 2015).

Quality of life is a subjective and multidimensional concept and health-related quality of life concerns the subjective assessment of disease incidence and its treatment at the physical, psychological and social level of functionality and well-being. Therapeutic interventions that are often ambulatory and adjuvant therapies such as chemotherapy and radiotherapy, affect patients at a physical, psychological, social and mental level, resulting in anxiety, depression and quality of life reduction (Naughton, Weaver, 2014).

Psychological distress is a multidimensional concern affecting patients' ability to cope with cancer, its physical symptoms and treatment consequences (Gundelach, Henry, 2016) and if untreated, may lead to lowered quality of life, reduced coping and compatibility with the disease and even suicide (Klaassen et al., 2017). Appropriate interaction with cancer patients is necessary for dealing with side effects of cancer therapy and improving their quality of life (QoL) (Badger et al., 2013).

Psychological interventions exert beneficial effects on patients' mood and further on their quality of life. Yeh et al in their systematic review reported that these interventions had a positive effect that improved psychological distress and several QoL domains (Yeh, Chung, Hsu, Hsu, 2014) and supported a potential bio-behavioral pathway relevant to cancer survivorship (Wenzel et al., 2015). Furthermore, exercise interventions are associated with reduced depression, pain and sense of fatigue, leading cancer survivors to the development of stress coping mechanisms, vitality enhancement and quality of life improvements even for patients who receive chemotherapy (Craft, Vaniterson, Helenowski, Rademaker, Courneya, 2012; Gerritsen, Vincent, 2015).

Nevertheless, psychological outcomes in research efforts including both psychological and exercise interventions in their design are yet to be drawn. This study examined the effect of a supportive group therapy program and an exercise program on the quality of life of Greek cancer patients.

Methods

This study and its randomized control trial protocol and procedures were reviewed and approved by the DPESS University of Thessaly bioethics committee.

Sample

The sample consisted of 39 patients (10 males and 29 females, with mean age of 57.8 ±15.98 and 58.3 ±9.05 respectively) with cancer, any type (19 with breast cancer, 7 with colorectal cancer, 3 with ovarian cancer and 6 with other types of respiratory, hematological and other malignancies), regardless of previous kind of treatment (surgery alone, and/or adjunct therapy – radiation/chemotherapy) as diagnosed by their oncologist. All patients were registered members of the Larissa cancer patients association, they volunteered to participate in the study and they were all able to keep on normal activity with minor symptoms of the disease according to the Karnofsky performance scale (Azevedo, Viamonte, Castro, 2013).

Pre-intervention phase included a meeting prior initiation of the program with information provided by the researcher regarding benefits, content and safety of exercise and group psychotherapy intervention procedures. Thus, all patients were aware of any possible risks associated with their participation and they agreed to sign the consent form of participation in the study, to complete the SF-12 instrument prior and after intervention and to have their information used for research purposes. Next, the sample was assigned randomly into three groups (a control group, an exercise group and a psychotherapy group, of 13 patients each one).

Procedure

Psychotherapy (SEGT) group

Supportive-expressive group therapy (SEGT) is a non-structured intensive form of group psychotherapy that provides several psychosocial advantages, applied mainly to women with metastatic breast cancer and other cancer conditions too. SEGT orientation is existential and cognitive, encouraging communication, emotional expression, sharing of mutual beneficial ideas, development of coping strategies and network support of cancer patients so as to address their arising concerns caused by the disease (Butler et al., 2009).

Studies suggest that SEGT implementation affects positively indicators such as physical symptoms, depression and anxiety, mental discomfort, emotional suppression, quality of life, and survival rate of patients, although few contradictory results has also been reported in research studies (Azevedo et al., 2013; Butler et al., 2009). Engaging in SEGT provides bonding opportunities among patients and creates a setting for self-disclosure that reduces fear and confusion, thus, SEGT has a special feature designed for application to cancer patients (Butler et al., 2009; Hill, Amir, Muers, Connolly, Round, 2003).

In this study, a 10 weeks' supportive-expressive group therapy (SEGT) was applied to patients of the psychotherapy group at a frequency of one session (meeting) per week of 90 minutes each session, with the researcher and a specialized psychologist present. In each meeting, SEGT intervention was designed to use emotions as a marker for what may be important to focus so as to encourage communication and deal with isolation feelings, changes in self and body image, reordering of life priorities and fear concerns of dying and death. No drop outs occurred during sessions.

Exercise group

Individuals of the exercise group received a 10 weeks training program, at a frequency of two (2) training sessions each week, of 60 minutes per session. Since this sample of patients had heterogeneous types of the disease and there are no precise guidelines for exercise prescription for each different type of cancer (Azevedo et al., 2013), this study followed general exercise recommendations that include duration of 20 to 60 minutes per session at a moderate exercise intensity recommended for cancer patients, described as the physical effort that makes participants breathe somewhat harder than normal but does not interfere with conversation (Clark et al., 2007). Furthermore, the Borg Scale (Borg, 1982) was used a subjective mean of exercise intensity, with 12 and 14 (from "fairly light" to "somewhat hard") specified as the desired perceived exertion in each session. Training frequency was 2 times per week that is better tolerated for de-conditioned populations (Schmitz et al., 2010) as compared to training frequency of 3–5 sessions per week suggested for healthy participants.

Each session included a 5-minute warm-up period of flexibility and respiratory exercises followed by 10 minutes of walking, 35 minutes of balance, co-ordination and aerobic activities and a 10 minutes cool-down

period of breathing and relaxation. The exercise intervention was supervised and group-based with modifications as needed according to individualized needs and performance, leading all participants to successfully complete the exercise program. A swimming session was also included following patients' request. Finally, a medical clearance was provided by their physician prior the start of the program to ascertain that no general contraindications to exercise participation were present (Moreno-Smith, Lutgendorf, Sood, 2010).

Control Group

Control group individuals did not participate in any exercise or supportive therapy program or and they just filled in the SF 36 questionnaire prior and after intervention.

Instruments

The Greek version (Pappa, Kontodimopoulos, Niakas, 2005) of the SF-36 Health Survey (Ware, Sherbourne, 1992) was used to assess health-related quality of life. Good psychometric properties of the SF-36 were previously documented in cancer patients (Bunevicius, 2017; Treanor, Donnelly, 2015) and in cancer survivors (Reulen et al., 2006). The SF-36 examines individual perceptions regarding quality of life in relation to eight different items of functioning that is, physical functioning, bodily pain, role limitations due to physical problems and general health that are summarized into a physical component score, and social functioning, energy/vitality, role limitations due to emotional problems and mental health that constitute a mental component score. Scores range from 0 (worse) to 100 (best) possible range with higher scores indicating a better health related quality of life.

Statistical Analysis

The Statistical Package of Social Sciences (SPSS 22.0) was used for statistical analysis. Normality of sample distribution was examined using Shapiro-Wilk analysis (Ghasemi, Zahediasl, 2012). Since sample distribution was normal, parametric tests (paired sample t test, ANOVA) were applied to examine differences between groups in pre and post measures. No missing data or data transformations were noted. Statistical significance was set at $p = 0.05$.

Results

A normal test distribution was noted using Shapiro-Wilk analysis (Reulen et al., 2006), since no significant results were observed for all variables and criterion value was high. An increase of vitality score was statistically significant ($p = 0.006$) in post measures for the psychotherapy (SEGT) group while mental health component was also improved at a statistically significant level ($p = 0.011$). In the exercise group, post intervention values in physical functioning, role functioning and emotional role were improved but not to the extent to produce statistically significant results.

No such differences were noted in control group either (Table1).

Table 1. Pre and post-intervention SF-36 scores

Variables	Group (pre-post-test)	Mean ± SD	p
1	2	3	4
Physical Functioning	SEGT (pre)	63.64 ±27.26	0.397
	SEGT (post)	58.18 ±23.69	
	Exercise (pre)	75.42 ±17.90	0.736
	Exercise (post)	77.08 ±18.02	
	Control (pre)	61.36 ±27.39	0.541
	Control (post)	59.09 ±30.32	
Role Functioning	SEGT (pre)	65.38 ±36.14	0.721
	SEGT (post)	61.54 ±39.02	
	Exercise (pre)	68.75 ±44.11	0.909
	Exercise (post)	70.96 ±35.01	
	Control (pre)	38.46 ±41.60	1,000
	Control (post)	38.46 ±45.20	
Role Emotional	SEGT (pre)	78.79 ±37.34	0.258
	SEGT (post)	60.61 ±41.68	
	Exercise (pre)	63.89 ±45.97	0.748
	Exercise (post)	69.44 ±41.34	
	Control (pre)	58.33 ±40.51	0.137
	Control (post)	44.44 ±35.77	
Vitality	SEGT (pre)	59.23 ±21.20	0.006
	SEGT (post)	77.31 ±9.92	
	Exercise (pre)	65.83 ±15.93	0.940
	Exercise (post)	65.42 ±17.77	
	Control (pre)	61.67 ±26.31	0.570
	Control (post)	63.33 ±27.33	
Mental Health	SEGT (pre)	65.09 ±27.37	0.011
	SEGT (post)	89.64 ±9.42	
	Exercise (pre)	70.55 ±21.04	0.251
	Exercise (post)	59.27 ±28.39	
	Control (pre)	74.33 ±26.50	0.891
	Control (post)	74.00 ±25.67	
General Health	SEGT (pre)	63.46 ±17.49	0.531
	SEGT (post)	59.62 ±23.05	
	Exercise (pre)	71.11 ±18.33	0.938
	Exercise (post)	71.67 ±13.92	
	Control (pre)	57.73 ±26.21	0.821
	Control (post)	58.18 ±25.72	
Bodily Pain	SEGT (pre)	70.00 ±23.10	0.229
	SEGT (post)	60.91 ±28.09	
	Exercise (pre)	80.23 ±20.26	0.641
	Exercise (post)	76.82 ±18.68	
	Control (pre)	67.71 ±32.64	0.406
	Control (post)	69.38 ±32.14	

1	2	3	4
Social Functioning	SEGT (pre)	76.04 ±21.62	0.339
	SEGT (post)	66.67 ±26.83	
	Exercise (pre)	72.92 ±27.09	0.845
	Exercise (post)	75.00 ±26.11	
	Control (pre)	70.83 ±33.43	0.615
	Control (post)	72.92 ±30.07	
Physical Health Subscale	SEGT (pre)	264.06 ±88.16	0.239
	SEGT (post)	236.56 ±98.71	
	Exercise (pre)	302.19 ±81.71	0.906
	Exercise (post)	298.94 ±36.53	
	Control (pre)	222.22 ±128.53	0.171
	Control (post)	228.89 ±128.04	
Mental Health Subscale	SEGT (pre)	271.91 ±101.32	0.400
	SEGT (post)	243.85 ±92.32	
	Exercise (pre)	278.65 ±93.17	0.685
	Exercise (post)	265.03 ±102.40	
	Control (pre)	247.43 ±120.91	0.543
	Control (post)	237.20 ±106.84	

Discussion

In this study, findings support the positive effect of SEGT implementation on vitality and mental health of cancer patients, referring to less sense of fatigue and improved energy levels, less anxiety and depression symptoms and recovery of emotional control, leading to an improved psychological wellbeing and quality of life perception. As for exercise, scores in all SF-36 domains did not change substantially compared to SEGT application, although individuals of the experiment group improved their post scores in relation to less limitations experienced due to physical or mental health difficulties caused by the disease. Nevertheless, pre-post differences were not statistically significant.

Comparisons with previous intervention studies for cancer patients including exercise in their design are challenging due to differences in their methodological design. J.K. Gerittsen and A.J. Vincent (2015) in their systematic review and meta-analysis of randomized control trials (RCTs) concerning exercise and quality of life of cancer patients, showed that only 6 out of 16 of these researches had a duration of less or equal to 10 weeks that is comparable to ours, with 3 of them producing statistically significant results. Two of these studies included mixed cancer patients population like our study, receiving, however, either a high-intensity cardiovascular and heavy resistance training combined with relaxation and body awareness training of 9 hours weekly for 6 weeks (Andersen et al., 2013) or a combined walking and strength training program for five days per week for six weeks (Samuel et al., 2012) compared to the medium intensity exercise program twice per week of our study. Of the three aforementioned studies, only S.R. Samuel et al. (2012) used the SF-36 questionnaire along with 3 other studies out of the 16 RCTs included in the systematic review of J.K. Gerittsen and A.J. Vincent (2015).

Overall, most studies reported a significant improvement in terms of fatigue. Nevertheless, although exercise especially when supervised exerts beneficial effects on fatigue and depression with improvements in the relevant quality of life fields among cancer survivors (Gerritsen, Vincent, 2015), beyond these areas, exercise contribution

to total quality of life improvement needs further investigation in short-term interventions (Monga et al., 2007; Hejazi, Bahrami, Keshvari, Alavi, 2017). The most recent meta-analysis of L.M. Buffart et al. (2017) concluded that exercise effects on QOL were significant, but small in general. According to L.M. Buffart et al. (2017) exercise, especially when supervised, improves quality of life and physical function of cancer patients with different clinical or demographic characteristics during and following treatment, thus, there is consistent evidence to support exercise implementation as part of cancer care. Nevertheless, issues such as patient's motivation to participate, the duration of the program and the subjective evaluation of quality of life (Korstjens et al., 2008) require further investigation. In our sample of participants with different cancer types, all patients were in the after treatment period where only intense aerobic exercise such as cycling or rowing for at least 12 months in certain cancer groups has been reported to have a significant effect (Gerritsen, Vincent, 2015).

On the other hand, psychological interventions are less time consuming and demand minimal physical effort from cancer patients. In this regard, patients of any age could attend intervention sessions and some early results might be obvious within a couple of weeks. Even a 3-week communicational program consisting of distributing educational booklets, practices, and phone follow-ups may have positive impact on psychological distress (Hejazi et al., 2017). The randomized clinical trial of L. Wenzel et al. (2015) in 204 survivors of cervical cancer examining the effect of psychosocial telephone counseling on QOL domains and its association with biomarkers confirmed mood and quality of life benefits related to positive bio-indicator changes, supporting in this way a potential bio-behavioral pathway relevant to cancer survivorship.

A. Torre-Luque et al.,(2016) in their meta-analysis noted that psychological treatments promote greater QoL for survivors, with a noteworthy effect on reducing somatic anxiety, sleep problems or other symptomatology as a consequence of medical treatments, although these benefits tend to reduce in patients under active treatment. As patients recover from cancer they have to adapt to different daily conditions than before. In this transition phase, the physical and psychological consequences could be efficiently managed within the context of psychological support. Nevertheless, psychological interventions effect size is rather small regarding improvement of QOL and reduction in depressive symptomatology, thus, strategies towards these goals should be included in future psychological treatments (Knobf, Thompson, Fennie, Erdos, 2014).

Unique survivor characteristics should always be considered when recommending different interventions that might improve psychological QOL (Badger et al., 2013), such as the exercise and SEGT interventions used in our study, to further recommend appropriate care for cancer patients. Variables related to the individual's pre-morbid psychological characteristics and the manner in which this individual copes with the cancer are more related to QOL scores than to cancer-related variables such as treatment types and cancer severity (Brunault et al., 2016). Future studies should consider optimizing such interventions, by taking into account patients' unique needs.

Overall, this study underlines the effect of a SEGT program on improving mental health and vitality of cancer patients leading to an improved quality of life perception. The small sample size, the mixed population of cancer patients and the relatively short duration of intervention all constitute limitations. In this context, it seems that for the cancer patients of our study sharing their experience with others through a SEGT approach was more effective to improve their QOL perceptions compared to individual efforts to cope with the disease through physical effort. Exercise seemed to have a small but not significant effect in post mental health scores but only psychotherapy enhanced QOL domains of cancer patients. Future researches with larger samples and longer periods of intervention

in selected patients (e.g. specific age groups, non-mixed population) are needed to further verify QOL gains derived from exercise and/or SEGT strategies.

Implications for Practice

The results of this study support the importance of supportive-expressive group therapy (SEGT) as an effective intervention tool that improve vitality and mental health of cancer patients leading to an enhanced quality of life perception. Furthermore, it provides in detail the design of psychotherapy and exercise procedures that could be applied in everyday nursing practice or adopted by future studies. Finally, it recommends that exercise should not be overlooked as a potential mean to improve psychological wellbeing of cancer patients, creating the need for future everyday practices and research efforts to combine psychotherapy and exercise interventions so as to maximize psychological benefits.

References

Andersen, C., Rørth, M., Ejlertsen, B., Stage, M., Møller, T., Midtgaard, J., Quist, M., Bloomquist, K., Adamsen, L. (2013). The effects of a six-week supervised multimodal exercise intervention during chemotherapy on cancer-related fatigue. *Eur J Oncol Nurs*, *17*, 331–339.

Azevedo, M.J., Viamonte, S., Castro, A. (2013). Exercise prescription in oncology patients: General principles. *Rehabilitación*, *47*, 170–178.

Badger, T.A., Segrin, C., Figueredo, A.J., Harrington, J., Sheppard, K., Passalacqua, S., Pasvogel, A., Bishop, M. (2013). Who benefits from a psychosocial counselling versus educational intervention to improve psychological quality of life in prostate cancer survivors? *Psychol Health*, *28*, 336–354.

Borg, G.A. (1982). Psychophysical bases of perceived exertion. *Med Sci Sports Exerc, 14*, 377–381.

Brunault, P., Champagne, A.L., Huguet, G., Suzanne, I., Senon, J.L., Body, G., Camus, V. (2016). Major depressive disorder, personality disorders, and coping strategies are independent risk factors for lower quality of life in non-metastatic breast cancer patients. *Psycho-Oncology*, *25* (5), 513–520.

Buffart, L.M., Kalter, J., Sweegers, M.G., Courneya, K.S., Newton, R.U., Aaronson, N.K., Jacobsen, P.B., May, A.M., Galvão, D.A., Chinapaw, M.J., Brug, J. (2017). Effects and moderators of exercise on quality of life and physical function in patients with cancer: An individual patient data meta-analysis of 34 RCTs. *Cancer Treat Rev*, *52*, 91–104.

Bunevicius, A. (2017). Reliability and validity of the SF-36 Health Survey Questionnaire in patients with brain tumors: a cross-sectional study. *Health and quality of life outcomes*, *15*, 92.

Butler, L.D., Koopman, C., Neri, E., Giese-Davis, J., Palesh, O., Thorne-Yocam, K.A., Dimiceli, S., Chen, X.H., Fobair, P., Kraemer, H.C., Spiegel, D. (2009). Effects of supportive-expressive group therapy on pain in women with metastatic breast cancer. *Health Psychology*, *28*, 579.

Clark, M.M., Vickers, K.S., Hathaway, J.C., Smith, M., Looker, S.A., Petersen, L.R., Pinto, B.M., Rummans, T.A., Loprinzi, C.L. (2007). Physical activity in patients with advanced-stage cancer actively receiving chemotherapy. *Journal of Supportive Oncology*, 5, 487–493.

Craft, L.L., Vaniterson, E.H., Helenowski, I.B., Rademaker, A.W., Courneya, K.S. (2012). Exercise effects on depressive symptoms in cancer survivors: a systematic review and meta-analysis. *Cancer Epidemiology and Prevention Biomarkers Prev*, *21*, 3–19.

Gerritsen, J.K., Vincent, A.J. (2015). Exercise improves quality of life in patients with cancer: a systematic review and meta-analysis of randomized controlled trials. *British Journal of Sports Medicine*, *50*, 796–803.

Ghasemi, A., Zahediasl, S. (2012). Normality tests for statistical analysis: a guide for non-statisticians. *International Journal of Endocrinology and Metabolism*, *10*, 486–489.

Gundelach, A., Henry, B. (2016). Cancer-Related Psychological Distress: A Concept Analysis. *Clinical Journal of Oncology Nursing*, *20*, 630–634.

Hejazi, F., Bahrami, M., Keshvari, M., Alavi, M. (2017). The Effect of a Communicational Program on Psychological Distress in the Elderly Suffering from Cancer. *Iran J Nurs Midwifery Res*, *22*, 201–207.

Hill, K.M., Amir, Z., Muers, M.F., Connolly, C.K., Round, C.E. (2003). Do newly diagnosed lung cancer patients feel their concerns are being met? *European Journal of Cancer Care, 12*, 35–45.

Klaassen, Z., Arora, K., Wilson, S.N., King, S.A., Madi, R., Neal, D.E. Jr, Kurdyak, P., Kulkarni, G.S., Lewis, R.W., Terris, M.K. (2017). Decreasing suicide risk among patients with prostate cancer: Implications for depression, erectile dysfunction, and suicidal ideation screening. *Urol Oncol*, S1078–1439, 30470–30472.

Knobf, M.T., Thompson, A.S., Fennie, K., Erdos, D. (2014). The effect of a community-based exercise intervention on symptoms and quality of life. *Cancer Nurs*, *37*, E43–50.

Korstjens, I., May, A.M., van Weert, E., Mesters, I., Tan, F., Ros, W.J., Hoekstra-Weebers, J.E., van der Schans, C.P., van den Borne, B. (2008). Quality of life after self-management cancer rehabilitation: a randomized controlled trial comparing physical and cognitive-behavioral training versus physical training. *Psychosom Med*, *70*, 422–429.

Monga, U., Garber, S.L., Thornby, J., Vallbona, C., Kerrigan, A.J., Monga, T.N., Zimmermann, K.P. (2007). Exercise prevents fatigue and improves quality of life in prostate cancer patients undergoing radiotherapy. *Arch Phys Med Rehabil*, *88*, 1416–1422.

Moreno-Smith, M., Lutgendorf, S.K., Sood, A.K. (2010). Impact of stress on cancer metastasis. *Future Oncology*, *6*, 1863–1881.

Naughton, M.J., Weaver, K.E. (2014). Physical and mental health among cancer survivors: considerations for long-term care and quality of life. *N C Med J*, *75*, 283–286.

Pappa, E., Kontodimopoulos, N., Niakas, D. (2005). Validating and norming of the Greek SF-36 Health Survey. *Qual Life Res*, *14*, 1433–1438.

Reulen, R.C., Zeegers, M.P., Jenkinson, C., Lancashire, E.R., Winter, D.L., Jenney, M.E., Hawkins, M.M. (2006). The use of the SF-36 questionnaire in adult survivors of childhood cancer: evaluation of data quality, score reliability, and scaling assumptions. *Health Qual Life Outcomes*, *4*, 77.

Samuel, S.R., Arun, M.G., Babu, A.S., Vidyasagar, M.S. (2012). Effect of exercise training on functional capacity & quality of life in head & neck cancer patients receiving chemoradiotherapy. *Indian J Med Res*, *137*, 515–520.

Schmitz, K.H., Courneya, K.S., Matthews, C., Demark-Wahnefried, W., Galvão, D.A., Pinto, B.M., Irwin, M.L., Wolin, K.Y., Segal, R.J., Lucia, A., Schneider, C.M., von Gruenigen, V.E., Schwartz, A.L. (2010). American College of Sports Medicine roundtable on exercise guidelines for cancer survivors. *Med. Sci. Sports Exerc*, *42*, 1409–1426.

Stanton, A.L., Bower, J.E. (2015). Psychological Adjustment in Breast Cancer Survivors. *Adv Exp Med Biol*, *862*, 231–242.

Torre-Luque, A., Gambara, H., López, E., Cruzado, J.A. (2016). Psychological treatments to improve quality of life in cancer contexts: A meta-analysis. *International Journal of Clinical and Health Psychology, 16*, 211–219.

Treanor, C., Donnelly, M. (2015). A methodological review of the Short Form Health Survey 36 (SF-36) and its derivatives among breast cancer survivors. *Qual Life Res*, *24*, 339–362.

Trudel-Fitzgerald, C., Tworoger, S.S., Poole, E.M., Zhang, X., Giovannucci, E.L., Meyerhardt, J.A., Kubzansky, L.D. (2017). *Psychological Symptoms and Subsequent Healthy Lifestyle after a Colorectal Cancer Diagnosis.* Health Psychol.

Ware, J.E., Sherbourne, C.D. (1992). The MOS 36-item short-form health survey (SF-36): I. conceptual framework and item selection. *Medical Care*, *30*, 473–483.

Yeh, M.L., Chung, Y.C., Hsu, M.Y., Hsu, C.C. (2014). Quantifying psychological distress among cancer patients in interventions and scales: a systematic review. *Curr Pain Headache Rep*, *18*, 399.

Wenzel, L., Osann, K., Hsieh, S., Tucker, J.A., Monk, B.J., Nelson, E.L. (2015). Psychosocial telephone counseling for survivors of cervical cancer: results of a randomized biobehavioral trial. *J Clin Oncol*, *33*, 1171–1179.

Cite this article as: Papastergiou, D., Kokaridas, D., Bonotis, K., Digelidis, N., Patsiaouras, A. (2019). Intervention Effect of Supportive Group Therapy and Physical Exercise on the Quality of Life of Cancer Patients. *Central European Journal of Sport Sciences and Medicine*, *1* (25), 5–13. DOI: 10.18276/cej.2019.1-01.

PREVALENCE OF DEPRESSIVE SYMPTOMS AMONG YOUNG ADULTS IN SZCZECIN

Marta Stępień-Słodkowska,[1, A, B, D] Hanna Kostkiewicz,[1, A, B, D] Katarzyna Kotarska,[1, C, D, E] Bożena Kawicka[2, B, D]

[1] Faculty of Physical Culture and Health Promotion, University of Szczecin, Poland
[2] The Clinic of Somatopsychology and Psychotherapy for Children and Adults, Szczecin, Poland
[A] Study Design; [B] Data Collection; [C] Statistical Analysis; [D] Manuscript Preparation; [E] Funds Collection

Address for correspondence:
Marta Stępień-Słodkowska
Faculty of Physical Culture and Health Promotion, University of Szczecin
Al. Piastów 40 b, bl. 6, 71-065 Szczecin, Poland
E-mail: marta.stepien-slodkowska@usz.edu.pl

Abstract Depressive disorders have become one of the greatest health problems of the modern society, with about 350 million people suffering from depression around the world (WHO). The aim of this study was to determine the prevalence of symptoms of depressed mood and symptoms indicating the possibility of depression or its progression among young people living in the city of Szczecin, Poland. Data from 150 students (107 women and 43 men) from one of the local universities constituted the material for this anonymous study which was based on the Beck Depression Inventory – 21 questions assessing the severity of depressive symptoms. Our results showed that 78% of women and 89% of men did not show symptoms of depression (Figure 1). The incidence of mild depressive episodes was revealed in 15% of women and 7% of men, moderate episodes in 3% of women and 2% of men, and severe depression in 4% of women and 2% of men.

Key words depression, mood reduction, Beck Depression Inventory, students

Introduction

The term 'depression' is often used colloquially to describe any feeling of depressed mood and dejection (Pużyński, 2009). In psychiatry it relates to mood and emotion disorders which last longer than the transient feeling of dejection (Kużel, Krajewska-Kułak, Śmigielska-Kuzia, 2015). The disorder impairs the proper functioning and quality of life in every aspect of health, whether physical, social, mental or sexual. It leads to the disturbance of basic biological and cognitive functions, and consequently changes human behavior. The etiology of depression is not well understood, but it is evident that it is caused by many coexisting factors (Kużel et al., 2015; Han, Pae, 2015). These include genetic factors, serotonin metabolism disorders, drug and psychoactive substance abuse, as well as stressful situations or failures and the anxiety or stress reactions they entail. Increasingly, mood disorders and depression are being associated with other civilization diseases, such as cardiovascular diseases or obesity (Ufnal,

Wolynczyk-Gmaj, 2011; Kerling et al., 2015). Therefore, the treatment of depression should be conducted in an interdisciplinary manner by psychiatrists and other medical and paramedical specialists, depending on the individual needs of each patient. The ICD-10 classification of somatic symptoms used in the diagnosis of depressive states includes waking in the morning several hours before the usual time, marked psychomotor retardation, agitation, loss of appetite, weight loss, and loss of libido (Święcicki, 2002).

Depressive disorders have become one of the greatest health problems in society, with depressive symptoms present in human populations all over the world (Grygorczuk, 2008; Hallstrom, McClure, 2007). According to the World Health Organisation (WHO), depression affects about 350 million people worldwide (Smith, 2014). In Poland, the percentage of people affected by depression is estimated at 2%. According to a report by the World Health Organization, by 2020 depression may become the second largest health threat after cardiovascular diseases.

There are many social campaigns in Poland aimed at raising public awareness of the causes and symptoms of depression and the institutions which offer adequate help. The 23rd of February is a National Depression Day. The Ithaca Foundation runs a website "Depression is an illness. You may cure it!" and the campaign "Live, don't die", which draws particular attention to the problem of suicide as the most serious consequence of untreated depression. The "Forum Against Depression" has also been operating in Poland since 2007. Its aim is to spread knowledge and make the public aware of the significance of depression as a health problem, that it is not just a temporary condition but a serious disease that should be treated (https://forumprzeciwdepresji.pl, access 17.09.2018).

Objective of the study

The aim of the study was to determine the prevalence of depressed mood and symptoms indicating the possibility of depression or its development among young people.

Material and test methods

Data from 150 students (107 women and 43 men) from one of the universities in Szczecin constituted the material for the study. The age of the respondents ranged from 18 to 27 years (M = 21.61). The data from the respondents were obtained by means of a questionnaire (Babbie, 2009). The anonymous study was a Beck Depression Inventory consisting of 21 questions assessing the severity of depressive symptoms in patients (Beck, Ward, Mendelson, Mock, Erbaugh, 1961). The sum of points indicates the severity of depression. Eleven (11) points or less denotes minimal depression, 12 to 26 points are mild depression, 27 to 49 points moderate depression, and 50 points or more indicate severe depressive episodes.

Test results

Table 1 shows the severity of depressive symptoms in the studied population.

Table 1. Characteristics of depressive symptoms of the subjects

Question	Options for responses	Number of subjects
1	2	3
1.	I do not feel sad (0)	103
	I feel sad (1)	39
	I am sad all the time and I can't snap out of it (2)	6
	I am so sad and unhappy that I can't stand it (3)	2

1	2	3
2.	I am not particularly discouraged about the future (0)	59
	I feel discouraged about the future (1)	80
	I feel I have nothing to look forward to (2)	9
	I feel the future is hopeless and that things cannot improve (3)	2
3.	I do not feel like a failure (0)	115
	I feel I have failed more than the average person (1)	27
	As I look back on my life, all I can see is a lot of failures (2)	8
	I feel I am a complete failure as a person (3)	0
4.	I get as much satisfaction out of things as I used to (0)	121
	I don't enjoy things the way I used to (1)	21
	I don't get real satisfaction out of anything anymore (2)	8
	I am dissatisfied or bored with everything (3)	0
5.	I don't feel particularly guilty (0)	98
	I feel guilty a good part of the time (1)	46
	I feel quite guilty most of the time (2)	2
	I feel guilty all of the time (3)	4
6.	I don't feel I am being punished (0)	133
	I feel I may be punished (1)	14
	I expect to be punished (2)	2
	I feel I am being punished (3)	1
7.	I don't feel disappointed in myself (0)	120
	I am disappointed in myself (1)	25
	I am disgusted with myself (2)	5
	I hate myself (3)	0
8.	I don't feel I am any worse than anybody else (0)	122
	I am critical of myself for my weaknesses or mistakes (1)	24
	I blame myself all the time for my faults (2)	4
	I blame myself for everything bad that happens (3)	0
9.	I don't have any thoughts of killing myself (0)	141
	I have thoughts of killing myself, but I would not carry them out (1)	7
	I would like to kill myself (2)	1
	I would kill myself if I had the chance (3)	1
10.	I don't cry any more than usual (0)	125
	I cry more now than I used to (1)	18
	I cry all the time now (2)	3
	I used to be able to cry, but now I can't cry even though I want to (3)	4
11.	I am no more irritated by things than I ever was (0)	93
	I am slightly more irritated now than usual (1)	43
	I am quite annoyed or irritated a good deal of the time (2)	11
	I feel irritated all the time (3)	3
12.	I have not lost interest in other people (0)	100
	I am less interested in other people than I used to be (1)	35
	I have lost most of my interest in other people (2)	13
	I have lost all of my interest in other people (3)	0
13.	I make decisions about as well as I ever could (0)	89
	I put off making decisions more than I used to (1)	45
	I have greater difficulty in making decisions more than I used to (2)	12
	I can't make decisions at all anymore (3)	4
14.	I don't think that I look any worse than I used to (0)	128
	I am worried that I am looking old or unattractive (1)	8
	I feel that there are permanent changes in my appearance that make me look unattractive (2)	12
	I believe that I look ugly (3)	2

1	2	3
15.	I can work about as well as before (0)	124
	It takes an extra effort to get started at doing something (1)	19
	I have to push myself very hard to do anything (2)	6
	I can't do any work at all (3)	1
16.	I can sleep as well as usual (0)	103
	I don't sleep as well as I used to (1)	39
	I wake up 1–2 hours earlier than usual and find it hard to get back to sleep (2)	7
	I wake up several hours earlier than I used to and cannot get back to sleep (3)	1
17.	I don't get more tired than usual (0)	103
	I get tired more easily than I used to (1)	42
	I get tired from doing almost anything (2)	2
	I am too tired to do anything (3)	3
18.	My appetite is no worse than usual (0)	127
	My appetite is not as good as it used to be (1)	16
	My appetite is much worse now (2)	3
	I have no appetite at all anymore (3)	4
19.	I haven't lost much weight, if any, lately (0)	115
	I have lost more than five pounds (1)	22
	I have lost more than ten pounds (2)	7
	I have lost more than fifteen pounds (3)	6
20.	I am no more worried about my health than usual (0)	122
	I am worried about physical problems like aches, pains, upset stomach, or constipation (1)	14
	I am very worried about physical problems and it's hard to think of much else (2)	9
	I am so worried about my physical problems that I cannot think of anything else (3)	5
21.	I have not noticed any recent change in my interest in sex (0)	135
	I am less interested in sex than I used to be (1)	10
	I have almost no interest in sex (2)	0
	I have lost interest in sex completely (3)	5

Our results showed that 78% of women and 89% of men did not show depressive symptoms (Figure 1). The incidence of mild depressive episodes was revealed in 15% of women and 7% of men, moderate episodes in 3% of women and 2% of men, and severe depression in 4% of women and 2% of men.

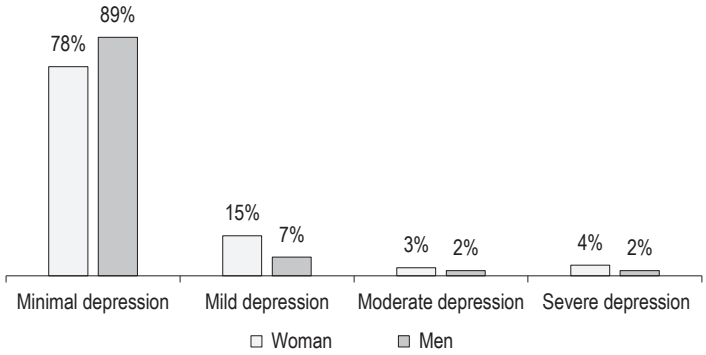


Figure 1. Intensification of depressive symptoms among the studied students depending on gender

Discussion

The start of university studies is an important stage in the life of every young person, and often means changing the social and family environment, different place of residence and, above all, beginning an independent life. Such a large amount of stressful stimuli and pressure combined with a high level of independence may often cause an adjustment disorder which significantly hinders adaptation to the new conditions and normal functioning of young people (Radochoński, 2001).

A drop in mood is usually associated with sadness, weeping, and dejection. However, young people express their depressed mood through anger and aggression. Such behavior discourages contact and thus makes it more difficult to provide assistance. There are also instances of aggressive behaviors towards other people, propensity to conflicts, impulsive expression of emotions or other violent behaviors. It is usually a consequence of constant tension, irritation and irritability. Those who are around people suffering from depression are often surprised by the fact that the person reacts violently or excessively to calm statements or remarks. Therefore, it should be remembered that in young people a lowered mood is associated with elevated irritability. A young person with depression will often enter into numerous conflicts, quarrels or discussions with teachers and parents. Unpleasant situations are constantly re-lived and repeated in the mind, which even more affects their mood. An additional problem is often that their family and friends do not notice the symptoms or ignore them, which means that young people do not receive proper help.

One of the groups at high risk of developing depression are university students (Jaworska, Morawska, Morga, Szczepańska-Gieracha, 2014; Białkowska, Mroczkowska, Zomkowska, Rakowska, 2014). Students because of the symptoms of the disease do not fully develop their development potential (Mojs et al., 2015). The research conducted by K. Marek et al. (2005) on a group of 206 students of the Medical University of Gdańsk showed that this population was characterized by a relatively high level of anxiety, and their intensity was much higher in the first year of studies than in the following years. Anxiety symptoms were often accompanied by a sense of loneliness and excessive burden. The research also found that young people most often applied strategies requiring social contact to solve the problem, but a large percentage of respondents negated the need for psychiatric treatment of mood disorders or depression.

Any change in life can cause stress. It usually takes several months to adapt to a change. Students are especially at risk of depression in two periods: at the beginning and at the end of their studies. The two main symptoms include reduced mood and a loss of interest in any life activity. Some depressive symptoms are associated just with the reduced sense of well-being, while not losing interest in their studies. Students are still learning, and they blame the stresses of their daily life for their depressed mood. They do not abandon their studies, but also do not decide to receive treatment, which may lead to a further reduction in their mood or full-blown depression, which turns to a chronic state. On the other hand, some students who suffer from depression are inclined to abandon their studies, which aggravates the symptoms even further.

Numerous studies indicate that a high proportion of university students have adjustment problems. According to a study by the National College of Health Assessment, one third of students at one point “felt so depressed that they were unable to function”. In addition, mental health problems are more common among university students than among the general population. As a result of the research conducted in Olsztyn, one in eight students was found to be at risk of mood disorders (Marek et al., 2005). It showed some gender-related differences in terms of sleep

problems, frequent awakening or excessive sleepiness, fatigue or lack of energy, eating disorders. In addition, women were the most vulnerable group in term of risk of depression.

Although depression studies in a group of university students are important from the point of view of public health, their results cannot be generalized for the whole population (Vredenburg, Flett, Krames, 1993). T. Pietras et al. (2012) believe that education is important for shaping young people's attitudes and views. Educational institutions are places where immature young people are intensively socialized, and where they can shape their views and characteristic attitudes on their own. This period of schooling at each stage can be both pleasant and traumatic, often resulting in psychosocial disorders.

Our research did not confirm mood disorders and symptoms of depression in the majority of the surveyed university student in Szczecin. However, we did find symptoms of mild depression in 15% of women and 7% of men. More worryingly, moderate depression was observed in 3% of women and 2% of men, and severe depression symptoms were found in 4% of women and 2% of men. Moreover, it was noted that women were more at risk of a mood reduction and depressive episodes. A review of available research results shows that gender is an important predictor of mood disorders. Women experience higher levels of depression than men as a result of, inter alia, a gender-specific perception of stressful situations (Rosal et al., 1997). Accordingly, women of all ages are more likely to meet the diagnostic criteria of anxiety disorders and eating disorders (Lewinsohn, Hops, Roberts, Seeley, Andrews, 1993). Higher exposure of women to stress was also observed in a study by M. Dahlin, N. Joneborg, B. Runeson (2005) where the incidence of depressive symptoms among students was about 13%, and also significantly higher in women than in men. The highest number of mood disorders was observed among students in earlier years, where most of them experienced the highest level of pressure associated with studying.

To sum up, it should be noted that studies on the prevalence of depression in groups of students are important from the point of view of public health, although the results do not allow making generalizations regarding the entire population. This is due to the relative scarcity of scientific reports on mood disorders and depression among young people. So far, research papers have been characterized by a high randomness in terms of the selection of methods and a diverse number of groups, thus making it impossible to make generalized conclusions regarding the research subject matter. Therefore, it is advisable to conduct extended psychological research, and diagnose the causes of depressive episodes in young adults. We should not forget, either, how important health education is in preventing depression and other civilization diseases. Young people leaving their primary families should be equipped with the resources that enable them to function properly in society, cope with difficult situations and maintain their ability to cope with a changing environmental and living conditions. The emphasis on the importance of the family in this respect should be supported by appropriate educational measures in every educational institution and at every level.

References

Babbie, E. (2009). *Podstawy badań społecznych*. Warszawa: Wydawnictwo Naukowe PWN.

Beck, A.T., Ward, C.H., Mendelson, M., Mock, J., Erbaugh, J. (1961). An inventory for measuring depression. *Archives of General Psychiatry*, *4*, 53–63.

Białkowska, J., Mroczkowska, D., Zomkowska, E., Rakowska, A. (2014). Ocena zdrowia psychicznego studentów na podstawie Skróconego Kwestionariusza Zdrowia Pacjenta. *Hygeia Public Health*, *49* (2), 365–369.

Dahlin, M., Joneborg, N., Runeson, B. (2005). Stress and depression among medical students: a cross-sectional study. *Med Educ*, *39*, 594–604.

Gregorczuk, A. (2008). Związek zaburzeń depresyjnych nawracających z płcią psychologiczną i sposobami radzenia sobie w sytuacjach stresowych. *Psychiatria*, *25* (1), 13–22.

Hallstrom, C., McClure, N. (2007). *Depresja. Odpowiedzi na pytania*. Wrocław: Elsevier Urban & Partner.

Han, C., Pae, C. (2015). Pain and depression: a neurobiological perspective of their relationship. *Korean Neuropsychiatric Association.* DOI: 10.4306/pi.2015.12.1.1.

https://forumprzeciwdepresji.pl (17.09.2018).

Jaworska, L., Morawska, N., Morga, P., Szczepańska-Gieracha, J. (2014). Analiza częstości występowania objawów depresyjnych wśród studentów Wydziału Fizjoterapii Akademii Wychowania Fizycznego we Wrocławiu w kontekście planów zawodowych. *Fizjoterapia*, *22* (3), 10–22. DOI: 10.1515/physio-2014-0007.

Kerling, A., Tegtbur, U., Gützlaff, E., Kück, M., Borchert, L., Ates, Z., von Bohlen, A., Frieling, H., Hüper, K., Hartung, D., Schweiger, U., Kahl, K.G. (2015). Effects of adjunctive exercise on physiological and psychological parameters in depression: a randomized pilot trial. *Journal of affective disorders*, *177*, 1–6.

Kużel, A., Krajewska-Kułak, E., Śmigielska-Kuzia, J. (2015). Percepcja depresji w wybranych grupach społecznych. *Medycyna Ogólna i Nauki o Zdrowiu*, *21* (3), 295–302.

Lewinsohn, P.M., Hops, H., Roberts, R.E., Seeley, J.R., Andrews, J.A. (1993). Adolescent psychopathology: I. Prevalence and incidence of depression and other DSM-III – Disorders in high school students. *J Abnormal Psychol*, *102* (1), 133–144.

Marek, K., Białoń, P., Wichowicz, H., Melloch, H., Nitka-Siemińska, A. (2005). Przesiewowa ocena rozpowszechnienia objawów depresyjnych i lękowych wśród studentów Akademii Medycznej w Gdańsku. *Psychiatria*, *2* (4), 217–224.

Mojs, E., Bartkowska, W., Kaczmarek, Ł.D., Ziarko, M., Bujacz, A., Warchoł-Biedermann, K. (2015). Właściwości psychometryczne polskiej wersji skróconej Skali Depresji Kutchera dla Młodzieży (Kutcher Adolescent Depression Scale) – pomiar depresji w grupie studentów. *Psychiatria Polska*, *49* (1),135-144.

Pietras, T., Witusik, A., Panek, M., Zielińska-Wyderkiewicz, E., Kuna, P., Górski, P. (2012).Nasienie depresyjności u studentów kierunku pedagogika. *Pol Merk Lek*, 32 (189), 163–166.

Pużyński, S. (2009). *Depresje i zaburzenia efektywne*. Warszawa: Wydawnictwo Lekarskie PZWL.

Radochoński, M. (2001). *Podstawy psychopatologii dla pedagogów.* Rzeszów: Wydawnictwo Uniwersytetu Rzeszowskiego.

Rosal, M.C, Ockene, I.S, Ockene, J.K, Barrett, S.V, Ma, Y., Hebert, J.R. (1997). A Longitudinal study of students' depression at one medical school. *Acad Med*, *72* (6), 542–546.

Smith, K. (2014). Menthal health: a world of depression. *Nature*, *13* (515), 181–190. DOI: 10.1038/515180a.

Święcicki, Ł. (2002). *Depresja – definicja, klasyfikacja, przyczyny*. Warszawa: Via Medica.

Ufnal, M., Wolynczyk-Gmaj, D. (2011). Mózg i cytokiny – wspólne podłoże depresji, otyłości i chorób układu krążenia? *Postępy Higieny i Medycyny Doświadczalnej*, *65*, 228–235.

Vredenburg, K., Flett, G.L., Krames, L. (1993). Analogue versus clinical depression: a critical reappraisal. *Psychol Bull*, *113* (2), 327–344.

Cite this article as: Stępień-Słodkowska, M., Kostkiewicz, H., Kotarska, K., Kawicka, B. (2019). Prevalence of Depressive Symptoms among Young Adults in Szczecin. *Central European Journal of Sport Sciences and Medicine*, *1* (25), 15–21. DOI: 10.18276/cej.2019.1-02.

EFFECTS OF MULTIPATH AND CONVENTIONAL NMES ON MAXIMUM COMFORTABLE STIMULUS AND TORQUE PRODUCTION

Cody B. Bremner,[1, A, B, C, D, E] William R. Holcomb[2, A, B, D]

[1] Department of Kinesiology & Outdoor Recreation,Southern Utah University, USA
[2] College of Health Professions, Mercer University, USA
[A] Study Design; [B] Data Collection; [C] Statistical Analysis; [D] Manuscript Preparation; [E] Funds Collection

Address for correspondence:
Cody B. Bremner, PhD, LAT, ATC
351 W. University Blvd., PEB 209
Cedar City, UT 84720, USA
E-mail: codybremner@suu.edu

Abstract A novel multipath NMES (m-NMES) device has shown improved outcomes relative to conventional NMES (c-NMES) during recent basic and training studies. However, the mechanisms by which m-NMES outperformed c-NMES remain unclear. This study aimed to better understand these mechanisms by comparing the effects of m-NMES and c-NMES on maximum comfortable stimulus intensity and the subsequent NMES-induced torque, as these variables ultimately impact NMES training intensity; which is considered to be the primary determinant of NMES effectiveness.

We measured maximum comfortable stimulus intensity and the subsequent NMES-induced torque while participants performed NMES-induced contractions under two conditions (m-NMES and c-NMES).

Maximum comfortable stimulus intensity was significantly greater under the m-NMES condition, but the subsequent NMES--induced torque was not significantly different across conditions.

m-NMES does not appear to influence the outcomes in a clinically meaningful manner, since it performed similarly to c-NMES with respect to peak NMES-induced torque.

Key words multipath, NMES, quadriceps

Introduction

Neuromuscular electrical stimulation (NMES) treatments are common in orthopedic clinical settings as they can be used for a variety of purposes (Gondin, Cozzone, Bendahan, 2011; Holcomb, 1997; Lake, 1992). Despite this versatility, NMES is most often used for the specific goal of enhancing muscular strength. The effectiveness of NMES for this purpose is believed to be primarily determined by NMES training intensity (Maffiuletti, 2010; Maffiuletti, Minetto, Farina, Bottinelli, 2011), which is often defined as the ratio of NMES-induced torque to torque produced during a maximum voluntary isometric contraction (expressed as % MVIC) (Gondin et al., 2011). Accordingly, clinicians are encouraged to maximize NMES training intensities to the degree possible (Maffiuletti,

2010), but the ability to achieve and maintain appropriate NMES training intensities is limited by a variety of factors; which include: patient discomfort (Gobbo, Maffiuletti, Orizio, Minetto, 2014; Gondin et al., 2011; Maffiuletti, 2010), muscle fatigue (Doucet, Lam, Griffin, 2012; Laufer, Elboim, 2008; Maffiuletti, 2010; Maffiuletti, Vivodtzev, Minetto, Place, 2014) and spatially limited motor unit recruitment (Gobbo et al., 2014; Maffiuletti, 2010; Maffiuletti et al., 2014).

The Kneehab® XP (Theragen LLC, Leesburg, VA) is an electrical stimulator that has received substantial attention in the literature (Asakawa, Jung, Koh, 2014; Bremner Holcomb, In-press; Bruce-Brand et al., 2012; Coote, Hughes, Rainsford, Minogue, Donnelly, 2015; Feil, Newell, Minogue, Paessler, 2011; Maffiuletti et al., 2014; Morf, Wellauer, Casartelli, Maffiuletti, 2015; Paessler, 2012; Walls, McHugh, O'Gorman, Moyna, O'Byrne, 2010), because it implements a novel strategy designed to address the aforementioned primary factors limiting NMES training intensity (Neurotech®, 2012a; Paessler, 2012; Walls et al., 2010). The stimulator uses multipath™ technology, which distributes the electrical current between four large electrodes integrated within a neoprene thigh garment via two separate channels while also altering pulse durations (Maffiuletti et al., 2014; Morf et al., 2015; Paessler, 2012; Walls et al., 2010); thus it is referred to as multipath NMES (m-NMES). In contrast, conventional NMES (c-NMES) stimulators distribute the electrical current in each channel via a single fixed path between a pair of electrodes. It has been suggested that m-NMES is advantageous because it provides an asynchronous stimulus and improves spatial distribution through dynamically changing the pathways by which current is distributed and by dynamically altering the pulse duration (Feil et al., 2011; Gobbo et al., 2014). For example, greater spatial distribution of the NMES stimulus may results in greater torque production, as improved spatial distribution may maximize the number of motor units recruited by the stimulus (Maffiuletti et al., 2014).

To date, a single randomized controlled trial comparing the use of m-NMES and c-NMES on clinical outcomes has been completed, with S. Feil et al. (2011) observing greater improvements following ACL reconstruction while using the m-NMES device. However, the authors acknowledged that the mechanism(s) responsible for their observations remain unclear. Subsequent basic studies have attempted to identify the possible mechanism(s) by which m-NMES outperformed c-NMES, with mixed results. Two studies comparing m-NMES and c-NMES observed improved fatigue and discomfort related outcomes while using m-NMES (Maffiuletti et al., 2014; Morf et al., 2015), but substantially different electrode configurations were used across conditions; thus the authors' ability to attribute their observations to the novel multipath current distribution method was limited. Consequently, a similar basic study was performed in our laboratory while using similar electrode configurations because this approach allowed us to better examine the influence of the novel multipath current distribution method on these outcomes (Bremner, Holcomb, in-press). Using this approach, we did not observe any clinically relevant differences across the two conditions.

We standardized the NMES stimulus intensity across conditions during our previous study to limit baseline differences, which is necessary when comparing fatigue and discomfort related outcomes. However, this methodology did not allow us to examine differences in maximum comfortable stimulus intensity and the subsequent NMES--induced torque; which are also important outcomes when comparing NMES treatment conditions because they impact NMES training intensity (Bremner, Holcomb, Brown, 2015; Dantas, Vieira, Siqueira, Salvini, Durigan, 2015; Holcomb, Golestani, Hill, 2000). To the best of our knowledge, the influence of m-NMES on maximum comfortable stimulus intensity and the subsequent NMES-induced torque while using similar electrode configurations has yet to be examined. Each of these outcome measures are clinically relevant and warrant further investigation, as they ultimately impact the NMES training intensity. Therefore, the purpose of this study is to compare the effects

of m-NMES and c-NMES on the clinically relevant maximum comfortable stimulus intensity and subsequent NMES--induced torque outcomes. We hypothesize that the maximum comfortable stimulus intensity and subsequent NMES-induced torque will be greater while using m-NMES.

Methods

Design

We performed a single-blind counterbalanced crossover study with 1 independent variable (NMES condition at 2 levels: m-NMES and c-NMES) and 2 dependent variables (maximum comfortable stimulus intensity and NMES-induced torque). We assigned participants to one of two permutations designed to counterbalance the session order in which the c-NMES and m-NMES treatment conditions were performed.

Participants

We performed an *a priori* power analysis using G*Power software (version 3.1.9.2) to determine a target sample size (Faul, Erdfelder, Lang, Buchner, 2007). We determined a target sample size of 17 participants in order to maintain adequate power ($1 - \beta = 0.80$) and detect a medium to large effect size ($d = 0.650$) while using a dependent *t*-test (Cohen, 1988). We selected medium to large effect sizes for the power analysis because we believe that any statistically significant differences with corresponding effect sizes smaller than this threshold would lack clinical relevance for the outcomes included in our study.

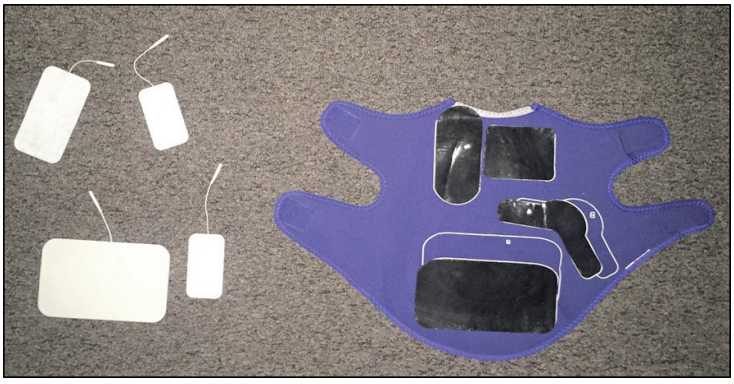
A convenience sample of 21 participants (age = 23.9 ±5.1 years, height = 175.1 ±7.4 cm, mass = 78.1 ±11.7 kg, BMI = 25.3 ±2.6 kg/m^2) from the university and community completed two study sessions. As has been done previously (Gorgey, Dudley, 2008), participants in our current study had prior NMES experience due to their participation in an earlier study (Bremner Holcomb, In-press). We elected to use participants from a previous study because an individual's tolerance to NMES is likely to improve over the first few exposures to NMES treatments (Alon, Smith, 2005).

Participants were required to be healthy, recreationally active, males, between the ages of 18–35. Participants also had to have a body mass index (BMI) ≤30 kg/m^2 to be included, as NMES tolerance and motor thresholds have been shown to differ between individuals with a BMI above and below 30 kg/m^2 (Maffiuletti, Morelli, et al., 2011). To be included in our current study participants had to tolerate a NMES training intensity of at least 30% MVIC during a previous study. This study was approved by the University's institutional review board and participants provided written informed consent. To facilitate participant recruitment, we incentivized participants via a lottery for a chance to win one of four $ 50 gift cards.

Instrumentation

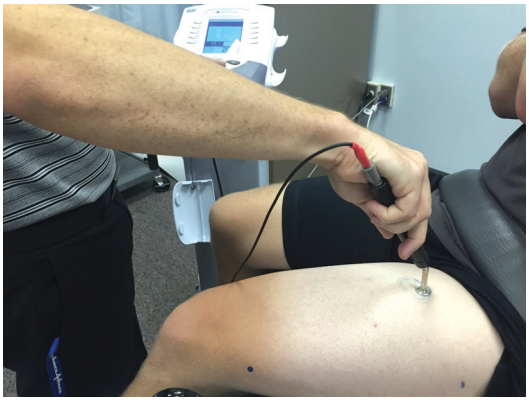
We used a Quickset 4 Biodex dynamometer (Biodex Medical Systems Inc., Shirley, New York) to measure and record isometric knee extension torque following procedures used previously (Bremner, Holcomb, In-press). We applied the c-NMES treatment using the same Sonicator® Plus 940 stimulator (Mettler Electronics® Corp., Anaheim, CA). To maintain consistency across the two NMES conditions, we set the c-NMES parameters as similar as possible to the parameters used with the Kneehab® XP program 6 (Table 1). We used four self-adherent electrodes to deliver the c-NMES current (two – 5 cm × 9 cm [Metron™, Bolingbrook, IL], one – 10.79 cm × 17.78 cm

[TENS Products, Grand Lake, CO], one – 7 cm × 14 cm electrode (SME INC., Wilmington, NC; Figure 1). To guide the placement of the c-NMES electrodes, we manually identified four motor points that would allow us to place the c-NMES electrodes in a similar fashion to the m-NMES electrode configuration (proximal and distal vastus lateralis, proximal rectus femoris and distal vastus medialis) using a pencil electrode (Mettler Electronics XK2, Active Forever, Scottsdale, AZ; Figure 2) (Gobbo et al., 2014).



Note: c-NMES electrodes are on the left side of the photo and m-NMES electrodes are integrated into the neoprene garment on the right side of the photo.

Figure 1. Electrode Configuration Comparison



Note: the photo illustrates the pencil electrode method for manually identifying motor points.

Figure 2. Motor Point Identification

We applied the m-NMES treatment using the same Kneehab® XP stimulator (Theragen LLC, Leesburg, VA), however we assigned each participant a separate Kneehab® XP garment with integrated electrodes. We integrated the m-NMES electrodes into the neoprene garment and subsequently placed the garment on the dominant thigh

according to the manufacturer's recommendations (Figure 3) (Neurotech®, 2012b). We set the stimulator parameters to program 6 during all m-NMES treatments (Table 1).

Table 1. Parameters of Neuromuscular Electrical Stimulation Conditions

Parameter	m-NMES	c-NMES
Current distribution	Multipath	Single path within two independent channels
Waveform	Biphasic Square	Biphasic Square
Frequency	70 Hz	70 Hz
Pulse duration	400/100 µsec	400 µsec
Ramp	1 second up : 0.5 seconds down	1 second up : 0 seconds down*
On time/off time	10 s/50 s	10 s/50 s
Stimulus intensity	Maximum comfortable	Maximum comfortable
Number of electrodes	4	4
Total area of electrodes	427 cm^2	360 cm^{2*}

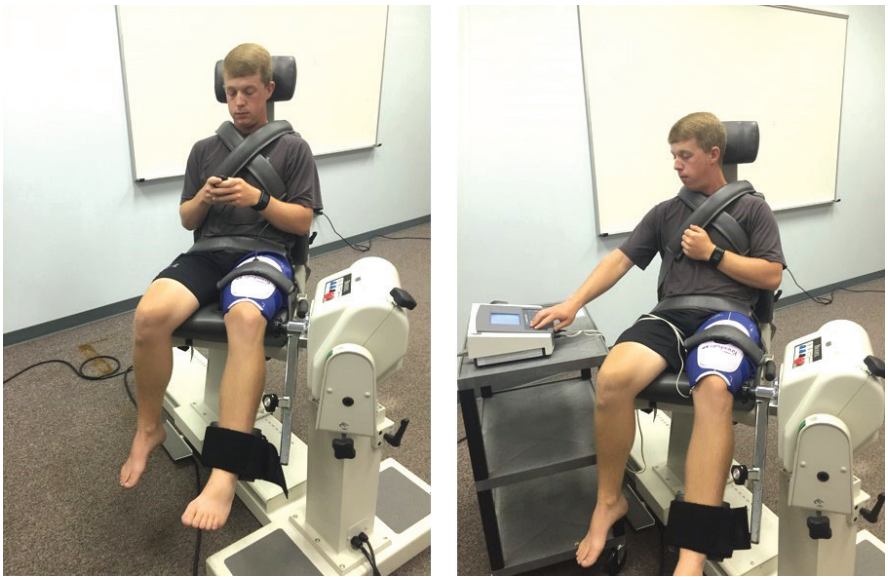
* It was not possible to select a ramp-down of 0.5 seconds with this particular c-NMES device while also maintaining a similar ramp-up and hold time to the m-NMES device, thus a ramp-down was not included. A slightly smaller total area of electrodes was used during the c-NMES condition.

Procedures

Participants reported at the same time of day (±2 hours) on two occasions and each session lasted approximately 1 hour. Each participant's dominant leg, which was defined as the leg with which they would use to kick a soccer ball, served as the leg of interest throughout the study (20 right, 1 left). We also instructed participants to report well hydrated and to refrain from strenuous activities for 12 hours prior to reporting.

Each session began with the participants completing a standardized warm-up following procedures used previously (Bremner, Holcomb, in-press). Participants rested for 8 minutes following the warm-up, during which we identified the motor points using the pencil electrode method and cleaned the leg of interest with an alcohol free wipe. Although motor point identification was not necessary for the m-NMES condition because the electrodes were integrated within the garment, we still identified motor points during both sessions in an effort to blind participants to treatment condition.

To continue the warm-up, participants performed maximum voluntary isometric contractions (MVICs) of the quadriceps for 6 seconds in duration and then rested for 5 minutes prior to performing the NMES procedures, during which we placed the Kneehab® XP garment with integrated electrodes or the c-NMES electrodes over the participant's shaved dominant thigh. We also placed an empty Kneehab® XP garment over the c-NMES electrodes in an effort to blind participants to treatment condition (Figure 3) (Morf et al., 2015). As has been done previously to limit fatigue (Bremner et al., 2015), participants performed a single NMES-induced contraction during each session (c-NMES or m-NMES) while using a self-selected maximum comfortable stimulus intensity; which is defined as the highest intensity that does not cause pain (Holcomb, Rubley, Girouard, 2007).The maximum comfortable stimulus intensity was determined following procedures used previously (Figure 3) (Bremner, Holcomb, in-press).



Note: the photo on the left illustrates the participant self-selecting a maximum comfortable stimulus intensity with the m-NMES device. The photo on the right illustrates the participant self-selecting a maximum comfortable stimulus intensity with the c-NMES device.

Figure 3. NMES Treatments

Outcome Measures

Maximum Comfortable Stimulus Intensity. We manually recorded the maximum comfortable stimulus intensity selected by each participant (expressed in milliamps [mA]). The m-NMES device does not express the stimulus intensity in mA units, thus a conversion table provided by the manufacturer was used to convert the observed m-NMES stimulus intensities into the appropriate units.

Normalized NMES-induced Torque. The isokinetic dynamometer measured and recorded the NMES--induced peak torque under each condition. In an effort to reduce inter-participant variability, we normalized the NMES-induced peak torque values to each participant's body mass, which converts the unit of measure to Newton-meters per kilogram (Nm/kg) and has been done previously (Bremner et al., 2015; Holcomb et al., 2000).

Statistical Analysis

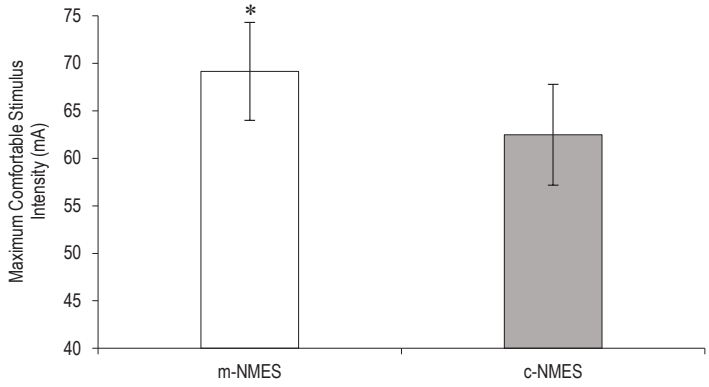
We used the Statistical Package for Social Sciences (SPSS) version 23.0 (IBM Corporation, Armonk, NY) to analyze the data. We performed a separate dependent *t*-test to analyze each outcome measure. To examine the magnitude of the differences, we calculated Cohen's *d* effect sizes (Cohen, 1988). We calculated Cohen's *d* effect sizes corresponding to within groups comparisons using the equation suggested by Cumming (2012) which uses the average standard deviation of the paired data as the standardizer (d_{sav}). Since *d* statistics are believed to overestimate the population effect size, Cumming recommended that an unbiased Cohen's *d* (d_{unb}) also be provided. Accordingly, we calculated d_{unb} values using the equation provided by Cumming.

Results

Prior to analyzing the data, we assessed the tenability of the applicable statistical assumptions, and the data were considered to be normally distributed without any outliers.

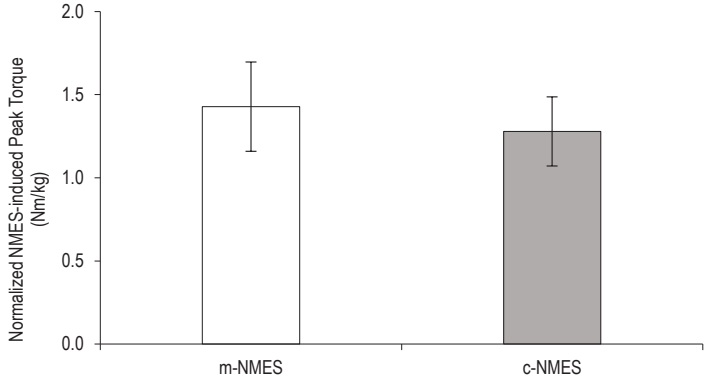
Maximum Comfortable Stimulus Intensity

The maximum comfortable stimulus intensity (mA) was significantly higher during the m-NMES condition (t_{20} = 2.817; P = 0.006; d = 0.581; 95% CI for effect size: –0.133, 1.018; d_{unb} = 0.559; Figure 4).



Note: * Significantly greater maximum comfortable stimulus intensity (*P* = 0.006). Error bars indicate 95% confidence intervals calculated using a critical *t*-value as has been recommended (Cumming, 2012).

Figure 4. Maximum Comfortable Stimulus Intensity



Note: error bars indicate 95% confidence intervals and were calculated using a critical *t*-value as has been recommended (Cumming, 2012).

Figure 5. Initial Normalized NMES-induced Peak Torque

Normalized NMES-induced Torque

The normalized NMES-induced torque (Nm/kg) was not significantly different across conditions (t_{20} = 1.397; P = 0.089; d = 0.282; 95% CI for effect size: -0.125, 0.683; d_{unb} = 0.272; Figure 5).

Discussion

While using similar electrode configurations, the findings of our study indicate that the maximum comfortable stimulus intensity was significantly higher under the m-NMES condition. However, the higher stimulus intensity did not result in significantly greater NMES-induced torque production during the subsequent NMES-induced contraction. Due to the positive linear relationship between stimulus intensity and NMES-induced torque (Adams, Harris, Woodard, Dudley, 1993; Gorgey, Mahoney, Kendall, Dudley, 2006; Maffiuletti, 2010), the primary clinical objective of using higher stimulus intensities is to enhance the NMES training intensity by increasing NMES-induced torque production. Therefore, the greater maximum comfortable stimulus intensity that we observed during the m-NMES condition does not appear to be clinically meaningful.

Despite our efforts to standardize the electrode configurations, the m-NMES electrodes covered an area of 427 cm^2 while the c-NMES electrodes covered a surface area of roughly 360 cm^2 (Morf et al., 2015). Since the current was spread over a greater area during the m-NMES condition, the current density (mA/cm^2) was subsequently lower during this condition while using the same amount of current (Hooker, 2003). We observed similar values when normalizing the mean stimulus intensities by total electrode area for each condition (m-NMES = 0.16 mA/cm^2, c-NMES = 0.17 mA/cm^2). Therefore, the difference in electrode sizes is a possible explanation as to why we did not observe significantly greater NMES-induced torque during the m-NMES condition. Although a small difference in the area covered by c-NMES and m-NMES remained during our study (Figure 1), the c-NMES electrode configurations used during previous studies consisted of three electrodes covering only 100 cm^2 (Maffiuletti et al., 2014; Morf et al., 2015).

The maximum comfortable stimulus intensities we observed under the m-NMES and c-NMES conditions were 69.1 ±11.3 mA and 62.5 ±11.6 mA, respectively (Figure 4). During a similar study Maffiuletti et al. (2014) reported values of 92 ±25 mA and 53 ±25 mA during their m-NMES and c-NMES conditions. Despite the fact that both of these studies observed significantly greater stimulus intensities under the m-NMES condition, the mean stimulus intensity we observed during m-NMES is much smaller. Two likely explanations for this difference are that Maffiuletti et al. used a maximum tolerable stimulus intensity and a modified m-NMES device that allowed a maximum current output of 200 mA. We elected to use a lower threshold maximum comfortable stimulus intensity because it has been suggested to be more clinically relevant (Holcomb et al., 2007). In addition, Maffiuletti et al. acknowledged that their use of a modified research version of the m-NMES device was a limitation of their study, as it is not available to clinicians, so we elected to use the clinically available m-NMES device with a maximum output of only 79.2 mA.

During the m-NMES and c-NMES conditions we observed normalized NMES-induced torque values of 1.4 ±0.6 Nm/kg and 1.3 ±0.5 Nm/kg, respectively (Figure 5). It is difficult for us to directly compare these values to similar studies comparing m-NMES and c-NMES because normalized torque values were not reported (Maffiuletti et al., 2014; Morf et al., 2015). To facilitate the comparison of our results to these previous studies, we converted the normalized NMES-induced torque values to NMES training intensities using the values recorded during the warm-up MVICs. The subsequent training intensities were 47.9 ±17.1% MVIC and 43.6 ±13.8% MVIC for m-NMES and c-NMES,

respectively. Interestingly, our observed values are near the upper margin of the proposed therapeutic window of 25–50% MVIC (Alon, Smith, 2005). This observation suggests that both devices are capable of producing the torque required for effective NMES treatments, which may be of interest to clinicians as the m-NMES device is portable.

Although the previous studies comparing torque output across m-NMES and c-NMES conditions used a higher threshold maximum tolerable stimulus intensity (Maffiuletti et al., 2014; Morf et al., 2015), the NMES training intensities we observed are comparable to values reported during these studies; which ranged from roughly 35–45% MVIC. Despite using a lower threshold maximum comfortable stimulus intensity, we believe that the comparable NMES training intensities observed during our study are due to the participants' previous NMES experience, as this likely allowed participants to better acclimate to the NMES stimulus prior to participation in our current study (Alon, Smith, 2005). In contrast, one of the other studies comparing m-NMES and c-NMES did not incorporate familiarization sessions and the other included a single familiarization session (Maffiuletti et al., 2014; Morf et al., 2015).

Although we observed a significantly greater maximum comfortable stimulus intensity under the m-NMES condition, we did not observe a significant difference with respect to the NMES-induced torque across the two conditions. This observation is contrary to the results of previous studies (Maffiuletti et al., 2014; Morf et al., 2015), and methodological differences between our study and the previous studies warrant further discussion. Maffiuletti et al. and Morf et al. hypothesized that a possible mechanism for the significantly greater NMES-induced torque they observed during m-NMES was the novel multipath current distribution method. Maffiuletti et al. suggested that relative to the fixed single path current distribution method of c-NMES, a larger number of motor units may have been recruited during the m-NMES condition due to its greater spatial distribution of the stimulus. However, the m-NMES and c-NMES conditions during these studies differed in two systematic ways, which were the current distribution method and electrode configuration. Morf et al. indicated that as a result of these two systematic differences, it is unclear whether the greater NMES-induced torque they observed was primarily attributable to the multipath current distribution method, larger electrodes or a combination of these factors. Consequently, we standardized the electrode configuration across conditions to the extent possible during our study, as we believe this approach allowed us to better isolate the influence of current distribution method on NMES-induced torque. Since we did not observe significantly greater NMES-induced torque under the m-NMES condition, our results do not support the hypothesis of Maffiuletti et al. and Morf et al. that the multipath current distribution method is a possible mechanism by which m-NMES resulted in greater NMES-induced torque during their studies.

Limitations

Eight participants reached the output capacity of the m-NMES device prior to achieving their maximum comfortable threshold during our study. This likely prevented these participants from reaching their true maximum comfortable stimulus intensity during the m-NMES condition, and this may have subsequently reduced the magnitude of our observed effect. Although incorporating the clinically available device during our study may be viewed as a limitation, we feel that it ultimately enhances the clinical applicability of our findings; as the device used in previous studies is a modified version allowing 200mA, but is not available to clinicians.

The extent to which our results are generalizable is unclear, due to our use of healthy participants and exclusion of females. The menstrual cycle has been shown to influence self-reported discomfort levels (Teepker, Peters, Vedder, Schepelmann, Lautenbacher, 2010), thus due to our study design requiring repeated measurements over time we felt it was necessary to exclude females. In addition, during exploratory NMES studies, similar in nature to our study, it is

common practice to use healthy participants (Alon, Smith, 2005; Dantas et al., 2015; Gorgey, Dudley, 2008; Holcomb et al., 2007; Holcomb, Rubley, Miller, Girouard, 2006; Holcomb, Rubley, Randolph, 2011; Maffiuletti et al., 2014).

Conclusions

The results of our study do not indicate that the novel multipath current distribution method improves the outcomes included in our study in a clinically meaningful manner. Contrary to our results, similar previous studies have observed improved outcomes when comparing m-NMES and c-NMES (Maffiuletti et al., 2014; Morf et al., 2015). We believe it is likely that contributing factors for their improved outcomes were differences in electrode configuration and their use of a modified version of the device not available to clinicians; rather than the novel current distribution method.

Acknowledgments

We thank Dr. Trenton E. Gould, Dr. Scott G. Piland and Dr. Gary V. Krebs for their assistance throughout this study. In addition, we thank Theragen LLC for providing the materials used in this study to perform the multipath neuromuscular electrical stimulation (m-NMES) condition.

References

Adams, G.R., Harris, R.T., Woodard, D., Dudley, G.A. (1993). Mapping of electrical muscle stimulation using MRI. *Journal of applied physiology, 74* (2), 532–537.

Alon, G., Smith, G.V. (2005). Tolerance and conditioning to neuro-muscular electrical stimulation within and between sessions and gender. *J Sports Sci Med*, *4* (4), 395–405.

Asakawa, Y., Jung, J., Koh, S. (2014). Neuromuscular electrical stimulation improves strength, pain and weight distribution on patients with knee instability post surgery. *Physical Therapy Rehabilitation Science*, *3* (2), 112–118. DOI: 10.14474/ptrs.2014.3.2.112.

Bremner, C.B., Holcomb, W.R. (in-press). A Comparison of Multipath and Conventional Neuromuscular Electrical Stimulation. *Athletic Training & Sports Health Care*.

Bremner, C.B., Holcomb, W.R., Brown, C.D. (2015). Knee Joint Angle Influences Neuromuscular Electrical Stimulation-Induced Torque. *Athletic Training & Sports Health Care*, *7* (4), 165–172. DOI: 10.3928/19425864-20150707-07.

Bruce-Brand, R.A., Walls, R.J., Ong, J.C., Emerson, B.S., O'Byrne, J.M., Moyna, N.M. (2012). Effects of home-based resistance training and neuromuscular electrical stimulation in knee osteoarthritis: a randomized controlled trial. *BMC musculoskeletal disorders*, *13* (118), 1–10.

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences* (2nd ed.). Hillsdale, N.J.: Lawrence Erlbaum Associates.

Coote, S., Hughes, L., Rainsford, G., Minogue, C., Donnelly, A. (2015). Pilot randomized trial of progressive resistance exercise augmented by neuromuscular electrical stimulation for people with multiple sclerosis who use walking aids. *Arch Phys Med Rehabil*, *96* (2), 197–204. DOI: 10.1016/j.apmr.2014.09.021.

Cumming, G. (2012). *Understanding the New Statistics: Effect Sizes, Confidence Intervals, and Meta-analysis*. New York, NY: Routledge.

Dantas, L.O., Vieira, A., Siqueira, A.L., Jr., Salvini, T.F., Durigan, J.L. (2015). Comparison between the effects of 4 different electrical stimulation current waveforms on isometric knee extension torque and perceived discomfort in healthy women. *Muscle Nerve*, *51* (1), 76–82. DOI: 10.1002/mus.24280.

Doucet, B.M., Lam, A., Griffin, L. (2012). Neuromuscular Electrical Stimulation for Skeletal Muscle Funciton. *Yale Journal of Biology and Medicine*, *85* (2), 201–215.

Faul, F., Erdfelder, E., Lang, A.G., Buchner, A. (2007). G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav Res Methods*, *39* (2), 175–191.

Feil, S., Newell, J., Minogue, C., Paessler, H.H. (2011). The effectiveness of supplementing a standard rehabilitation program with superimposed neuromuscular electrical stimulation after anterior cruciate ligament reconstruction: a prospective, randomized, single-blind study. *Am J Sports Med*, *39* (6), 1238–1247. DOI: 10.1177/0363546510396180.

Gobbo, M., Maffiuletti, N.A., Orizio, C., Minetto, M.A. (2014). Muscle motor point identification is essential for optimizing neuromuscular electrical stimulation use. *Journal of Neuroengineering and Rehabilitation*, *11* (17), 1–6. DOI: 10.1186/1743-0003-11-17.

Gondin, J., Cozzone, P.J., Bendahan, D. (2011). Is high-frequency neuromuscular electrical stimulation a suitable tool for muscle performance improvement in both healthy humans and athletes? *Eur J Appl Physiol*, *111* (10), 2473–2487. DOI: 10.1007/s00421-011-2101-2.

Gorgey, A.S., Dudley, G.A. (2008). The role of pulse duration and stimulation duration in maximizing the normalized torque during neuromuscular electrical stimulation. *J Orthop Sports Phys Ther*, *38* (8), 508–516. DOI: 10.2519/jospt.2008.2734.

Gorgey, A.S., Mahoney, E., Kendall, T., Dudley, G.A. (2006). Effects of neuromuscular electrical stimulation parameters on specific tension. *Eur J Appl Physiol*, *97* (6), 737–744. DOI: 10.1007/s00421-006-0232-7.

Holcomb, W.R. (1997). A practical guide to electrical therapy. *Journal of Sport Rehabilitation*, *6* (3), 272–282.

Holcomb, W.R., Golestani, S., Hill, S. (2000). A comparison of knee-extension torque production with biphasic versus russian current. *Journal of Sport Rehabilitation*, *9*, 229–239.

Holcomb, W.R., Rubley, M.D., Girouard, T.J. (2007). Effect of the Simultaneous Application of NMES and HVPC on Knee Extension Torque. *Journal of Sport Rehabilitation*, *16*, 307–318.

Holcomb, W.R., Rubley, M.D., Miller, M.G., Girouard, T.J. (2006). The effect of rest intervals on knee-extension torque production with neuromuscular electrical stimulation. *Journal of Sport Rehabilitation*, *15* (2), 116–124.

Holcomb, W.R., Rubley, M.D., Randolph, S.M. (2011). Increasing Neuromuscular Electrical Stimulation Amplitude to Reduce the Decline in Knee Extension Torque. *Athletic Training & Sports Health Care*, *3* (2), 63–68.

Hooker, D.N. (2003). Electrical Stimulating Currents. In: W.E. Prentice (ed.), *Therapeutic Modalities for Sports Medicine and Athletic Training* (5th ed., pp. 191–239). New York, NY: McGraw-Hill.

Lake, D.A. (1992). Neuromuscular electrical stimulation: an overview and its application in the treatment of sports injuries. *Sports medicine*, *13* (5), 320–336.

Laufer, Y., Elboim, M. (2008). Effect of burst frequency and duration of kilohertz-frequency alternating currents and of low-frequency pulsed currents on strength of contraciton, muscle fatigue, and percieved discomfort. *Physical Therapy*, *88* (10), 1167–1176.

Maffiuletti, N.A. (2010). Physiological and methodological considerations for the use of neuromuscular electrical stimulation. *Eur J Appl Physiol*, *110*(2), 223-234. doi: 10.1007/s00421-010-1502-y

Maffiuletti, N.A., Minetto, M.A., Farina, D., Bottinelli, R. (2011). Electrical stimulation for neuromuscular testing and training: state-of-the art and unresolved issues. *Eur J Appl Physiol*, *111* (10), 2391–2397. DOI: 10.1007/s00421-011-2133-7.

Maffiuletti, N.A., Morelli, A., Martin, A., Duclay, J., Billot, M., Jubeau, M., ..., Sartorio, A. (2011). Effect of gender and obesity on electrical current thresholds. *Muscle & Nerve*, *44* (2), 202–207.

Maffiuletti, N.A., Vivodtzev, I., Minetto, M.A., Place, N. (2014). A new paradigm of neuromuscular electrical stimulation for the quadriceps femoris muscle. *Eur J Appl Physiol*, *114* (6), 1197–1205. DOI: 10.1007/s00421-014-2849-2.

Morf, C., Wellauer, V., Casartelli, N.C., Maffiuletti, N.A. (2015). Acute effects of multipath electrical stimulation in patients with total knee arthroplasty. *Arch Phys Med Rehabil*, *96* (3), 498–504. DOI: 10.1016/j.apmr.2014.10.011.

Neurotech® (2012a). *Kneehab® XP Quadriceps Therapy System*. Hoboken, NJ: Bio-medical research Ltd.

Neurotech® (2012b). *Quick start guide for clinicians*. Hoboken, NJ: Biomedical Research Ltd.

Paessler, H.H. (2012). Emerging Techniques in Orthopedics: Advances in Neuromuscular Electrical Stimulation. *American Journal of Orthopedics*, *41* (5 Suppl.), 1–8.

Teepker, M., Peters, M., Vedder, H., Schepelmann, K., Lautenbacher, S. (2010). Menstrual variation in experimental pain: correlation with gonadal hormones. *Neuropsychobiology*, *61* (3), 131–140.

Walls, R.J., McHugh, G., O'Gorman, D.J., Moyna, N.M., O'Byrne, J.M. (2010). Effects of preoperative neuromuscular electrical stimulation on quadriceps strength and functional recovery in total knee arthroplasty. A pilot study. *BMC Musculoskelet Disord*, *11* (119), 1–9. DOI: 10.1186/1471-2474-11-119.

Cite this article as: Bremner, C.B., Holcomb, W.R. (2019). Effects of Multipath and Conventional NMES on Maximum Comfortable Stimulus and Torque Production. *Central European Journal of Sport Sciences and Medicine*, *1* (25), 23–33. DOI: 10.18276/cej.2019.1-03.

THE USE OF SUPPLEMENTATION AMONG PEOPLE PRACTICING POWERLIFTING AND ITS CONNECTIONS WITH THEIR SELF – ESTEEM AND BODY VALUE

Andrzej Knapik,[1, A, C, D] Weronika Gallert-Kopyto,[2, C, D] Krzysztof Jendrysik,[3, A, B] Piotr Ziemianek,[3, A, B] Mikołaj Horodecki,[3, A, B] Andrzej Myśliwiec[4, A, D]

[1] School of Health Sciences in Katowice, Medical University of Silesia in Katowice, Department of Adapted Physical Activity and Sport, Poland
[2] School of Health Sciences in Katowice, Medical University of Silesia in Katowice, Department of Kinesiology, Chair of Physiotherapy, Poland
[3] School of Health Sciences in Katowice, Medical University of Silesia in Katowice, Scientific Students' Society at the Department of Adapted Physical Activity and Sport, Katowice, Poland
[4] Department of Kinesiotherapy and Special Methods in Physiotherapy, The Jerzy Kukuczka Academy of Physical Education, Katowice, Poland
[A] Study Design; [B] Data Collection; [C] Statistical Analysis; [D] Manuscript Preparation; [E] Funds Collection

Address for correspondence:
Andrzej Knapik
Medical University of Silesia in Katowice, Department of Adapted Physical Activity and Sport
Medyków 8, 40-751 Katowice, Poland
E-mail: aknapik@o2.pl

Abstract Supplementation is one of the forms of powerlifting training support. It may have an influence on physical parameters of the contenders and may also have an impact on perception of the body and self – esteem. The aim of the study was to assess relationships between age, BMI, data concerning training, supplementation, self – assurance and body value among the contenders practising powerlifting.

51 people who regularly practise powerlifting: 11 women aged 23.5 ±3.6 and 40 men aged 23.9 ±8.5 have been examined using self – esteem (SES) and body – esteem (BES) questionnaires. Data concerning age, BMI, training variables and supplementation have been also gathered.

Supplementation is used by 91% of women and 85% of men. Men use more types of supplements than women ($p < 0.05$). Among women SES does not correlate with any other variables. Among men SES negatively correlates with the number of used supplements, as well as with all of the BES domains.

Using supplementation among people who train powerlifting is rather common. Among women, SES in not related in any way with training or supplementation. Among men, lower self – esteem (SES) is significantly counterbalanced with BES.

Key words powerlifting, supplementation, body self – assessment

Introduction

Modern competitive sport puts extreme demands to meet physical and mental requirements (Czaja, Lebiedzińska, Marszall, Szefer, 2011), roperly selected training, regeneration after exertion, balanced diet as well as supplementation are the key determinants to achieve expected results in sports. Furthermore, it also determinates maintaining good health. This leads to the search for possible "reserves" in all aspects related to the functional

capabilities of the organism. This also applies to nutritional supplementation. Its purpose is to meet the energy needs and other nutrients that are consumed during high workloads (Kaczka, Tomaszewski, 2012). Completing the diet with supplements applies to a wide range of sports. It is crucial among sport disciplines, which are based on specialized strength training (Seidler, Sobczak, 2012; Cortese, 2014; Helms, Arago, Fitschen, 2014).

Taking up strength sports is inextricably linked with significant changes in people's physique, in particular – modelling figure. Silhouette modelling is one of the main motives why non – professionals decide to take up weight training without the desire of participating in any type of sport competitions (Kowal, Derkacz, Chmiel-Perzyńska, Mazur, 2010). It is also the one of the vital motives for practice among professional weight training contenders (Knapik, Horodecki, Jendrysik, Ziemianek, Rottermund, 2015).

Powerlifting is a typical strength sport, which includes three disciplines: squat with a barbell, bench press and deadlift. Powerlifters are characterized by powerful silhouette, gained through training and proper diet. Moreover, they practice intense weight training which requires properly formulated nutritional plan, which is almost always assisted by supplementation. This results in motor effects and morphological changes. Training and diet may be also associated with some psychological aspects, in particular concerning self – esteem and the value of the contenders' own body. The issue of assessing one's own body in the context of weight training has been already analysed from the perspective of occurring disorders (Pope, Katz, 1994; Mayville, Williamson, White, Netemeyer, Drab, 2002; Kropiwnicki, Rabe- Jabłońska, 2005; Hale, Diehl, Weaver, Briggs, 2013).

There are no empirical studies among powerlifters concerning supplementation from the non – pathological perspective. The research results presented in this study are the answer to the above mentioned issues (Choi, Pope, Olivardia, 2002; Rakfalska, Schier, 2008).

Material and Methods

Participants

The group of 51 contenders taking up powerlifting: 11 women (W) and 40 men (M) from the Upper Silesia (Southern Poland) has been examined. The research was anonymous and voluntary.

Study participants met selection criteria, which were based on powerlifting practice (regular training and taking part in competitions).

Methods

The research was divided into sections. Used questionnaires included following components:

- morphological data: gender, age, height (cm), body weight (kg) and BMI (calculated on the basis of height and body weight),
- data related to training: training period (years), the average number of workouts per week, training duration (scale interval: 1: <30 minutes; 2: 30–60 minutes; 3: 60–90 minutes; 4: >90 minutes),
- questions related to diet supplementation (type, time and regularity of using supplements),
- BES scale – Body Esteem Scale: to examine the value of one's own body,
- SES scale – Self Esteem Scale: to examine one's self – esteem.

BES scale (Body Esteem Scale) consists of 35 questions related to self – assessment of appearance and body functions. Answers of the responder are expressed in points from 1 to 5, where 1 represents definite negative

feelings and 5 stands for definite positive feelings. Results are expressed in three categories for women and for men. However, two categories are different for women and for men. Common category (calculated differently for each gender) is Physical Condition: PC. Different categories are: Sexual Attractiveness: SA and Weight Concern: WC for women and Physical Attractiveness: PA and Upper Body Strength: UBS for men. The value of each category is the average of point answers to questions included in particular category (Franzoi, Shields, 1984; Franzoi, 1994).

The SES scale is a tool used for general self – report of self – esteem (Rosenberg, 1965). It includes ten statements. The task of the responder is to define to what extent they agree with statements in the questionnaire. There are four possibilities: "I definitely agree", "I agree", "I don't agree", "I definitely don't agree". Each response is scored. The total sum of points indicates the degree of overall self – esteem: the higher the score, the better self – esteem is. The total amount of the responses points in the SES scale was used for statistical calculations (Blascovich, Tomaka, 1991).

Statistical analysis included descriptive statistics in the form of following calculations: mean values, ±95% CI, median, minimum values, maximum values and standard deviations. The reliability of the applied questionnaires (BES and SES) has been assessed by the Cronbach's alpha coefficients – AC calculations.

Further analysis has been conducted by using non – parametric statistics. Differences between variables in groups have been calculated using the U Mann-Whitney test (UMW), while relationships between variables have been calculated using Spearman rank correlations. Statistical significance was assumed at $p < 0.05$.

The study has been approved by the Bioethics Committee of the Medical University of Silesia in Katowice, Resolution No. KNW/0022/KB1/42/I/11.

Results

Descriptive statistics for analysed variables are presented in Table 1.

Table 1. Descriptive statistics for analysed variables and comparisons according to gender

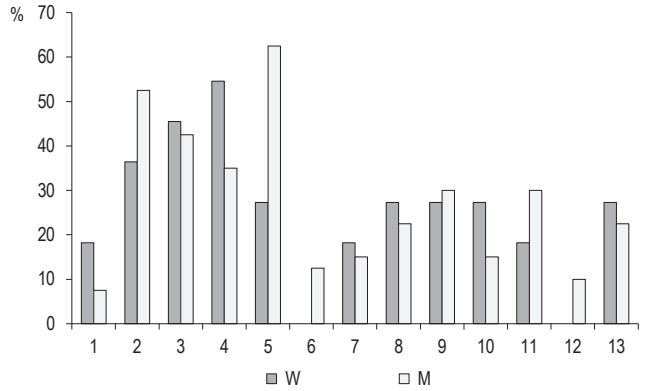
Variable	Gender	x(SD)	95%CI	Min-max	Me	UM-W Test	
						U	P*
1	2	3	4	5	6	7	8
Age (years)	W	23.55 (3.59)	21.13–25.96	18–30	23	184.0	0.5623
	M	23.95 (8.49)	21.16–26.74	16–36	22		
BMI	W	22.82 (3.39)	20.54–25.11	18.34–28.27	21.72	72.0	<0.0010
	M	28.14 (4.40)	26.71–29.49	18.94–42.59	27.40		
Training period (years)	W	4.00 (3.32)	1.69–6.31	1.0–10.0	3.5	131.0	0.1668
	M	5.04 (3.97)	3.80–7.74	1.0–17.0	4.0		
Number of workouts per week	W	2.45 (0.52)	2.10–2.81	2–3	2	194.0	0.5563
	M	2.60 (0.59)	2.41–2.79	2–4	3		
Training time (h)	W	3.18 (0.75)	2.68–3.69	2–4	3.0	152.5	0.1233
	M	3.62 (0.63)	3.36–3.79	2–4	4		
The number of supplements used regularly	W	2.81 (2.48)	1.15–4.49	0–7	4	94.5	<0.0100
	M	6.03 (3.25)	4.99–7.06	0–13	6		
The number of supplementation applied irregularly	W	2.18 (1.94)	0.88–3.49	0–7	2	210.0	0.8302
	M	2.63 (2.54)	1.81–3.44	0–8	2		
Total number of dietary supplements used	W	5.00 (2.97)	3.01–6.99	0–10	5	90.5	<0.0100
	M	8.65 (3.58)	7.51–9.79	0–13	10		

1	2	3	4	5	6	7	8
Average time of using supplementation (months)	W	23.45 (23.11)	7.93–38.98	3–72	12	192.5	0.0589
	M	30.23 (36.39)	17.73–42.73	1–180	12		
SES	W	18.00 (3.16)	15.88–20.12	13–23	18	149.5	
	M	19.88 (4.11)	18.56–21.19	10–28	20		
BES: SA	W	4.04 (0.49)	3.69–4.39	3.31–4.84	4.00		
BES: WC	W	3.69 (0.78)	3.14–4.24	2.30–4.60	4.00		
BES: PC	W	4.06 (0.66)	3.63–4.48	3.00–4.78	4.28		
	M	3.73 (0.79)	3.47–4.00	1.00–4.93	3.80		
BES: PA	M	3.60 (0.81)	3.34–3.87	1.00–4.82	3.45		
BES: UBS	M	3.80 (0.83)	3.53–4.08	1.00–4.78	3.89		

* Results with corrections for continuity.

Analysis of the reliability of used questionnaires revealed their sufficient internal cohesion. Cronbach's α for SES was 0.739. Cronbach's scale α for BES – SA was: 0.796; for BES – WC was: 0.891; for BES – PC was: 0.856 {W}, AC: 0.877 {M}; for BES – PA was: 0.918; and for BES – UBS was: 0.896.

Most of the respondents use supplements, it refers to 10 women (90.9%) and 34 men (85.0%). Applied types of supplements are presented in Figure 1.



Description: 1 – herbal supplements; 2 – amino – acids and their various forms; 3 – vitamins; 4 – minerals; 5 – creatine and its forms; 6 – testosterone boosters, antiestrogens; 7 – fat burners; 8 – others, e.g.: HMB, omega – 3 fatty acids, MCT, joints regenerators; 9 – carbohydrate nutrients; 10 – carbohydrate – protein nutrients; 11 – protein nutrients; 12 – food replacements, e.g. bars; 13 – isotonic drinks, hypertonics, energy drinks.

Figure 1. Types of used supplementation considering gender

Considering the fact that only one woman declared no supplementation, it was impossible to compare SES and BES – due to supplementation. Among men, after adopting the criteria of using supplements or not as an independent variable, comparison between SES and BES {UMW test} showed no statistically significant differences SES: $p = 0.9853$; BES – PA: $p = 0.0922$, UBS: $p = 0.3800$, PC: $p = 0.0922$.

Subsequent steps of the analysis concerned relationships between training data, used supplementation, SES and BES. Correlation results related to gender are presented in Table 2.

Table 2. Correlations between data related to training, supplementation, SES and BES according togender

Variable	Gender	Supplementation			
		average time of using supplementation	the number of supplements used regulary	the number of supplements used irregulary	the total number of used supplements
Training period	W	0.294	0.201	0.019	0.071
	M	0.128	0.060	–0.192	–0.184
Number of training per week	W	0.030	0.384	–0.059	0.145
	M	0.120	0.024	–0.051	0.007
Duration of training unit	W	0.211	0.010	–0.196	0.047
	M	–0.282	0.106	0.320*	0.325*
SES	W	–0.463	0.329	–0.479	0.129
	M	0.162	–0.176	–0.320*	–0.321*
BES: SA	W	0.606	–0.424	0.368	–0.089
BES: WC	W	0.529	0.429	0.559	0.685*
BES: PC	W	0.354	0.127	0.368	0.300
	M	0.051	0.166	0.227	0.275
BES: PA	M	–0.065	0.240	0.207	0.333*
BES: UBS	M	0.056	0.220	0.211	0.295

* Significant correlation.

The results of calculated correlations between BES and SES seem to be interesting. These results did not reveal any dependence among women. Among men, all of three domains showed statistically significant differences: PC – SES: r = –0.503; PA – SES: r = –0.564; UBS – SES: r = –0.366.

Discussion

Widely pursued marketing and its consequences in the form of socio – cultural changes, cause dynamic development of the industry of dietary supplements, which are often mistakenly referred to as "over – the – counter drugs" (Czaja et al., 2011). Supplements are used by various social groups, among people in different age. Motives of applying them are diversified but mostly related to health aspects. A peculiar group of supplements users are athletes. Among people who practice sports heavily, there is a strong belief that customarily used diet is not able to provide an adequate supply of nutrients. This may be the reason why supplementation has become almost the sole requirement for achieving success in sports (Seidler, Sobczak, 2012; Dymkowska-Malesa, Walczak, 2011; Lacerda, Gomes, Hortegal, Cabra, Veloso, 2015). This motive seems to find its confirmation in presented data rates and qualitative results of this study (Figure 1).

The prevalence of the use of supplements among athletes entails certain risks, which concern qualitative and quantitative aspects of their application. Mistakes resulting from insufficient knowledge in the usage of supplementation are usually made by athletes who practice endurance sports and weight training (Janiszewska, Przybyłowicz, Szyszko, 2012; Pilis, Michalski, 2014; Alsaeed, Alabkal, 2015). Poorly balanced diet, excessive

amounts of supplements, especially concerning substances rich in amino acids – these are the conclusions which have been emphasized by the researchers mentioned above. Diet mistakes have been also highlighted in the research of K. Janiszewska et al. (2012). Effectiveness of supplements available on the market has been extensively analyzed (Nissen, Sharp, 2003), as well as their quality, which has been also evaluated (Petroczi, Taylor, Naughton, 2011).

Research results presented in this study indicate that the predominant supplement used by men was creatine, whereas women preferred minerals (Figure 1). This seems to indicate a certain level of knowledge about supplements and gender as a variable differentiating the purpose of supplementation. It may be confirmed by gender differences in the type of used supplements, in the number of used supplements (Table 1) and in the fact that women do not use supplements 6 and 12 (Figure 1).

Self – esteem is considered as a primary element of welfare (Rosenberg, 1965). Majority of researchers (McAuley et al., 2005; Griffin, Kirby, 2007), despite the complexity of the problem (Hubbs, Doyle, Bowden, Doyle, 2012; Ziemianek, Jendrysik, Horodecki, Knapik, 2015), consider physical activity as beneficial for self – esteem. Analysis of average values and median of SES of the respondents (Table 1) may lead to conclusion that mutual relations between activities and SES are generally favourable. However, analysis of the results of the span (min–max) suggest caution in interpreting this view in terms of dogma. This gap is larger among men than among women.

Negative correlation of SES with the number of used supplements among men who use supplements may be also interesting, taking into account that there are no differences in SES – due to the use of supplementation. However, these relationships require further study in a larger group of people. The argument for the confirmation of the validity of such research could be for example a tendency to use anabolic steroids.

Furthermore, according to the authors, negative correlations between SES domains and BES among men (Table 2) are also important aspects of this study. The average values and median of BES are at adequate level – according to the adopted scale. Nevertheless, the gap in these results is quite large (Table 1). The lack of differences between people applying and not applying supplementation indicates that this variable has no effect on the level of BES. Yet, the statistical significance of BES and SES domains correlations amid men also proves interrelations.

Cross – sectional nature of this study does not allow the interpretation of these relationships in terms of a process. However, the lack of correlation between BES, SES and training variables appears to be consistent with the results presented by A. Hubbs et al. (2012). Moreover, it is also suggested that this problem should be considered in the aspects of training motives, as well as its effectiveness in terms of achieving success in sports.

Conclusions

Cross – sectional nature of the study and the number of respondents unfortunately represent limitations of this study and require caution in drawing conclusions. Nevertheless, on the basis of these results some conclusions may be formulated.

The first one supports the view of the universality of supplementation among people professionally engaged in powerlifting.

The latter indicates a certain level of knowledge concerning expected results of supplements application – different for each gender.

Furthermore, gender is not a variable differentiating SES, whereas the relationship of SES and BES are disparate. Among women, there is no dependence, while among men dependences are negative and require further research.

References

Alsaeed, I., Alabkal, J. (2015). Usage and perceptions of anabolic-androgenic steroids among male fitness centre attendees in Kuwait – a cross – sectional study. *Substance Abuse Treatment, Prevention, and Policy*, *10*, 33.

Blascovich, J., Tomaka, J. (1991). Measures of self-esteem. In: J.P. Robinson, P.R. Shaver, L.S. Wrightsman (eds.), *Measures of personality and social psychological attitudes. Volume 1: Measures of social psychological attitudes* (pp. 115–160). New York: Academic Press.

Choi, P.Y., Pope, H.G. Jr., Olivardia, R. (2002). Muscle dysmorphia: a new syndrome in weightlifters. *Br J Sports Med*., *36* (5), 375–376.

Cortese, A. (2014). Muscle as Fashion: Messages from the Bodybuilding Subculture. *AMA Journal of Ethics*, *7* (16), 565–569.

Czaja, J., Lebiedzińska, A., Marszall, M., Szefer, P. (2011). Evaluation for magnesium and vitamin B6 supplementation among Polish elite athletes. *Annals of the National Institute of Hygiene*, *62* (4), 413–418.

Dymkowska-Malesa, M., Walczak, Z. (2011). Supplementation in Sport. *Nowiny Lekarskie*, *80* (3), 199–204.

Franzoi, S.L. (1994). Further evidence of the reliability and validity of the body esteem scale. *Journal of Clinical Psychology*, *50*, 237–239.

Franzoi, S.L., Shields, S.A. (1984). The Body – Esteem Scale: Multidimensional structure and sex differences in a college population. *Journal of Personality Assessment*, *48*, 173–178.

Griffin, M., Kirby, S. (2007). The Effect of Gender in Improving Body Image and Self Esteem. Atletic Insight. *The Online Journal of Sport psychology*, *9* (3), 83–92. Retrieved from: http://www.athleticinsight.com/Vol9Iss3/GenderandPositiveChange.htm (15.01.2015).

Hale, B.D., Diehl, D., Weaver, K., Briggs M. (2013). Exercise dependence and muscle dysmorphia in novice and experienced female bodybuilders. *Journal of Behavioral Addictions*, *2* (4), 244–248.

Helms, E.R., Arago, A.A., Fitschen, P.J. (2014). Evidence – based recommendations for natural bodybuilding contest preparation: nutrition and supplementation. *Journal of the International Society of Sports Nutrition*, *11*, 20.

Hubbs, A., Doyle, E.I., Bowden, R.G., Doyle, R.D. (2012). Relationships among self – esteem, stress, and physical activity in college students. *Psychol Rep*., *110* (2), 469–474.

Janiszewska, K., Przybyłowicz, K., Szyszko, M. (2012). Analysis of consumption of dietary fiber and fats by football and handball players and selected anthropometric parameters. *Polish J Sport Med*, *28* (1), 59–65.

Kaczka, P., Tomaszewski, W. (2012). Effective supplementation in modern professional sport. *Polish J Sport Med*, *28* (1), 1–14.

Knapik, A., Horodecki, M., Jendrysik, K., Ziemianek, P., Rottermund, J. (2015). Motives and sense of one's body among people regularly exercising at the gym. In: E. Pribisova, P. Beno, M. Sramka (eds), *Nove trendy v sucasnom zdravotnictve. Osetrovatelstvo, verejne zdravotnictvo, ekonomika z zdravotnictvo* (pp. 180–190. Presov: Ustav socialnych vied a zdravotnictva bl. P.P Gojdica.

Kowal, A., Derkacz, M., Chmiel-Perzyńska, I., Mazur, A. (2010). What does motivate the young men to attend gym? *Family Medicine & Primary Care Review*, *12* (3), 689–693.

Kropiwnicki, P., Rabe-Jabłońska, J. (2005). Muscle dysmorphia – a variant of dysmorphophobia? Studies on the body image disorders in men. *Psychiatr Psychol Klin*, *5* (1), 44–51.

Lacerda, F., Gomes, W., Hortegal, W., Cabra, N., Veloso, H. (2015). Factors associated with dietary supplement use by people who exercise at gyms. *Rev Saúde Pública*, *49*, 63.

Mayville, S.B., Williamson, D.A., White, M.A., Netemeyer, R.G., Drab, D.L. (2002). Development of the Muscle Appearance Satisfaction Scale: a self – report measure for the assessment of muscle dysmorphia symptoms. *Assessment*, *9* (4), 351–360.

McAuley, E., Elavsky, S., Motl, R.W., Konopack, J.F., Hu. L., Marquez, D.X. (2005). Physical Activity, Self-Efficacy, and Self-Esteem: Longitudinal Relationships in Older Adults. *J Gerontol B Psychol Sci Soc Sci*, *60* (5), 268–275.

Nissen, S.L., Sharp, R.L. (2003). Effect of dietary supplements on lean mass and strength gains with resistance exercise: a meta-analysis. *J Appl Physiol*, *94*, 651–659.

Petroczi, A., Taylor, G., Naughton, D.P. (2011). Mission impossible? Regulatory and enforcement issues to ensure safety of dietary supplements. *Food Chem. Toxycol*., *49*, 393–402.

Pilis, K., Michalski, C. (2014). A nutritional evaluation of dietary behaviour in various professional sports. *Annals of the National Institute of Hygiene*, *65* (3), 227–234.

Pope, H.G. Jr., Katz, D.L. (1994). Psychiatric and medical effects of anabolic-androgenic steroids use. A controlled study of 160 athletes. *Arch. Gen. Psychiatry*, *51*, 375–382.

Rakfalska, A., Schier, K. (2008). Body perception by men intensely training force sports. Muscle dysmorphia cases. *Psychiatr Psychol Klin*, *8* (2), 93–103.

Rosenberg, M. (1965). *Society and the adolescent self-image*. Princeton, NJ: Princeton University Press.

Seidler, T., Sobczak, A. (2012). Diet supplements in nutrition of Sport Mastery School students. *Annals of the National Institute of Hygiene*, *63* (2) 193–198.

Ziemianek, P., Jendrysik, K., Horodecki, M., Knapik, A. (2015). Self – esteem and the value of body in people who exercise regularly at the gym – the results of pilot studies. *Quality in Sport*, *3* (3) 61–69.

Cite this article as: Knapik, A., Gallert-Kopyto, W., Jendrysik, K., Ziemianek, P., Horodecki, M., Myśliwiec, A. (2019). The Use of Supplementation Among People Practicing Powerlifting and its Connections with their Self – esteem and Body Value. *Central European Journal of Sport Sciences and Medicine*, *1* (25), 35–42. DOI: 10.18276/cej.2019.1-04.

CHARACTERISTICS OF RE-GRIPPING TECHNIQUES PRECEDING SCORED THROWS IN INTERNATIONAL-LEVEL JUDO COMPETITION

Kiyoshi Ito,[1, A, B, C, D] Nobuyoshi Hirose,[2, D, E] Naoya Maekawa[3, C]

[1] Faculty of Economics, Fuji University, Iwate, Japan
[2] Graduate School of Health and Sports Science, Juntendo University, Chiba, Japan
[3] Faculty of Physical Education, International Budo University, Chiba, Japan
[A] Study Design; [B] Data Collection; [C] Statistical Analysis; [D] Manuscript Preparation; [E] Funds Collection

Address for correspondence:
Kiyoshi Ito
Faculty of Economics, Fuji University
450-3, Shimoneko, Hanamaki, Iwate
025-0025 Japan
E-mail: kiyoshi@fuji-u.ac.jp

Abstract Significant changes in *kumite* tactics were verified after the 2013 International Judo Federation rule revision, which mandated that competitors initiate sparring immediately at match outset. The research contained in this paper focused on the re-gripping techniques which were affected by this rule revision, relating to the gripping targets, the use of cross gripping techniques, body rotation when executing throws, and the attacking patterns. In total, 372 men's contests from the Judo Grand Slam Paris 2016 were analyzed using All Japan Judo Federation Science and Research Department SMART Edge system. Throws resulting in scores were identified and the preceding *kumite* tactics were analyzed. Re-gripping techniques resulted in significantly higher score rates than the no re-gripping techniques when competitors grabbed the place of the competition number, and the place(s) other than the collar and sleeve with at least one hand except the place of the competition number. Re-gripping the opponent and targeting the place of the competition number might facilitate scoring. Using the re-gripping techniques could make a variety of gripping targets effective to score. We emphasize the importance of classifying *kumite* techniques into two major patterns: re-gripping and no re-gripping techniques when coaching competitors for *kumite* tactics.

Key words combat sports, throwing techniques, tactical preparation, technical effectiveness, gripping targets

Introduction

Judo's official rules have been revised by the International Judo Federation (IJF) several times in the last decade; specifically in 2009, 2010, 2013, 2014 and 2017 (International Judo Federation, 2013, 2014, 2018). According to the IJF, these changes are aimed at making judo more dynamic, entertaining and pursuant of judo's traditional goal of achieving *ippon* (Yamaguchi, 2008; Boguszewski et al., 2014). The pursuit of a more dynamic sport through new regulations forced competitors to alter their *kumite* tactics if they hoped to score. *Kumite* is

a standing technique performed by grabbing the opponent's jacket or body part(s) with one or both hands before initiating an attack (Ito, Hirose, Nakamura, Maekawa, Tamura, 2014).

N. Hirose, M. Suganami, M. Nakamura, and S. Takahashi (2000) reported the average attacking frequency per one minute of competition in standing position was 1.86 times for the men's 60 kg category and 1.71 times for the women's 48 kg category in the 1997 World Judo Championship. These results suggest the remainder of the time was, to some extent, used in different activities relating to *kumite*, such as competitors considering how to grab their opponent and attempting to gain an advantage over their opponent once *kumite* had commenced. N. Maekawa et al. (2013; 2014) created a rating scale enabling coaches and managers to determine skill level through methods other than performance in competitions. They did this by querying top level Japanese university judo coaches on factors used in selection for participation in competitions. Two of the twelve factors identified as selection criteria were the assertiveness of the athlete in applying *kumite* and proper *kumite* while practicing. H. Kajmovic, I. Rado, A. Mekic, B. Crnogorac, and E. Colakhodzic (2014) developed a method of categorizing *kumite* tactics that assists in determining its effect on competition outcomes. They created three broad *kumite* technique classifications: same grip configuration (right and right grip, left and left grip), opposite grip configuration (right vs left grip) and sleeve ends configuration (sleeve grips). Men were found to use the same grip configuration style significantly more than other configurations, while women used the opposite grip configuration significantly more, as seen in matches from the 2008 European Cadets Judo Championship. *Kumite* is an essential component of throw initiation. Therefore, it's logical that contestants would alter their *kumite* strategies to comply with the rule revisions, as opposed to discontinuing their use of *kumite* altogether. G.F. Pedrosa et al. (2015) reported on a sparring activity done by two people, with one of them attempting to grab the other one, who is aggressively attempting to break their grip. This activity is, in effect, focused on bettering the competitors' *kumite* abilities. They found that this exercise was effective in training for international competitions. R.L. Kons, J.A. Dias, and D. Detanico (2017) reported the athletes with higher isometric endurance grip strength perform a higher number of attacks and show higher effectiveness in competition.

M. Tamura et al. (2012) reported following the 2009 IJF rule revision, a significant increase in the number of times that competitors grabbed the collar and sleeves when attacking their opponent; however the result did not relate gripping targets to scored throw. We reported that *kumite* performed before a scored throw showed a significant increase in attack efficacy when a competitor gripped their opponent three times prior throwing them after the 2013 rule revision, implying that reestablishing a grip on the opponent was more effective than attempting to throw the opponent after only one or two grasps (Ito et al., 2014). In addition to this, we clarified scoring rates significantly increased when competitors re-gripped their opponents in *aiyotsu*: both competitors standing with closed stance, *kenkayotsu*: both competitors standing with open stance and the total of both stances after the 2013 rule revision (Ito, Hirose, Maekawa, Tamura, Nakamura, 2015).

Given these examples of research performed on different aspects relating to *kumite*, the authors feel that research focused solely on *kumite* tactics should be performed to make throwing techniques more effective and judo more attractive as a whole. The authors of this paper take the position that a competitor's *kumite* skills are vital to their success in judo, as it is the primary method in setting up a throw. However, in order to enhance the effectiveness of the technique, no prior research has been conducted to investigate the relationship between the number of gripping attempts and the cross grip techniques preceding the scored throws. In addition, there is no previous study on the relationship between the number of gripping attempts and the scored throw involved body

rotation. The aim of present study was to identify the characteristics of *kumite* re- gripping techniques preceding the scored throws relating to gripping targets, the use of cross gripping techniques, throws that require body rotation, and the attacking patterns. This analysis was based on a comparison of score ratios between re-gripping and no re-gripping techniques preceding scored throws in international-level competitive matches. The results of this research clarified the effectiveness of throwing techniques through linking the use of selected re-gripping techniques to other *kumite* maneuvers. This research was conducted with the intention of improving coaching quality for international judo competitors. It is the authors' intention that this research support a more dynamic judo style that the IJF is seeking, specifically in regards to throwing technique effectiveness.

Yuko is not a point designation under current competition rules (International Judo Federation, 2018); however, this research was carried out on competitions under previous rules (International Judo Federation, 2014), so it was considered in our analyses. Because *yuko* is included in *waza-ari*, a point-yielding maneuver under current competition rules, the analyses results regarding *yuko* usage are valid under the current rules and *yuko* should still be considered worthwhile. Thus, those results containing data concerning *yuko* should be considered valid.

Material and Methods

Analysis data and analysts

In total, 372 men's contests from the Judo Grand Slam Paris 2016 were analyzed using All Japan Judo Federation Science and Research Department SMART Edge system. Three analysts took part in this research. One analyst is "7th *dan*" (sex: male; age: 66; practice frequency: 4 times a week), and the other two analysts are "6th *dan*" (sex: male; age: 53; practice frequency: 5 times a week/sex: male; age: 55; practice frequency: 6 times a week). *Dan* is a ranking system indicating comprehensive skill level. In judo, there are examinations for the ranks from the first-*dan* to the tenth *dan*, with the tenth *dan* being the highest (Ito et al., 2015). Each analyst has at least 30 years of experience in judo practice and is qualified as a judo instructor with an A-rating, the highest level in Japan, as specified by the All Japan Judo Federation. Each instructor is currently active in judo instruction.

Procedures

Videos of 329 scored throws (*yuko*, *waza-ari*, *ippon*) and the preceding *kumite* were identified in the data and analyzed. All data were coded using both the revision of tactical analysis sheet for throwing techniques developed by N. Hirose et al. (2000) and the *kumite* parts table developed by H. Wakayama et al. (2003) using MS Excel software.

We analyzed the following items to be examined.

- Score rates of gripping targets preceding scored throws according to re-gripping behavior.
- Score rates of the scored throws that involve cross gripping techniques according to re-gripping behavior.
- Score rates of the scored throws that require body rotation according to re-gripping behavior.
- Score rates by the attacking patterns of the scored throws according to re-gripping behavior.

Kumite preceding a scored throw was analyzed to see if re-gripping was attempted, and if so, how many of these attempts were made. This was done according to the method documented by K. Ito et al. (2015). *Kumite* preceding a scored throw was considered to include a re-gripping attempt if the competitor released their opponent with either hand and grabbed their opponent again with the same hand without a break in sparring. Thus, *kumite*

that included more than two instances of a competitor grabbing their opponent in a continuous sequence was categorized as a re-gripping. *Kumite* in which grasping occurred less than three times in a continuous motion was considered to be *kumite* with no re-gripping.

Grabbing an opponent by using the opposite side of a judo jacket or a body part, usually stretching an arm diagonally, was categorized as cross gripping techniques. Executing their techniques with their body rotating, facing their back to the opponents chest and belly, and throwing the opponents to the front direction of the opponents, was categorized as techniques with body rotation; for example, the techniques of s*eoi-nage, tai-otoshi,* and, *harai-goshi* were included (Sogabe et al., 2008; Adam, Tyszkowski, Smaruj, 2011; Adam, Laskowski, Smaruj, 2012; Daigo, 2005).

Attacking patterns were classified into three categories as direct single, combination, and counter attacks following the previous research (Ito et al., 2012).

All data relating to competitors' use of the *kumite* techniques were confirmed unanimously by all three analysts as part of the validation process.

Statistical analysis

Chi-square tests were used to determine differences in the ratio of scored throws between the re-gripping and no re-gripping techniques with regards to the variables selected for the study. The statistical significance level was set at $p < 0.05$ for all analyses. Statistical Package for Social Science (SPSS) for Windows 21.0 was used to compute the statistics.

Results

Table 1 contains the classification of the gripping targets, Table 2 contains the gripping targets preceding the scored throws confirmed from the present study and Table 3 contains the scored throws that involved body rotation confirmed from the present study.

Table 1. Classification of gripping targets

Gripping Categories	Gripping targets
Collar and Sleeve	Collar, Sleeve, Collar & Sleeve, Collar & Collar, Sleeve & Sleeve
Competition Number	Number, Number & Number, Number & Collar, Number & Sleeve, Number & Others
Other Areas	Collar or Sleeve and the place othe than Collar, Sleeve and Number, Place(s) other than Collar, Sleeve, and Number

Table 2. Gripping targets preceding scored throws confirmed from the present research

Gripping categories	Gripping targets
Collar and Sleeve	Collar, Sleeve, Collar & Sleeve, Collar & Collar, Sleeve & Sleeve
Competition Number	Number, Number & Number, Number & Sleeve, Number & Collar, Number & Armpit, Number & Upper Arm
Other Areas	Collar & Shoulder, Collar & Neck, Collar & Wrist, Collar & Upper Arm, Collar & Skirt, Collar & Side, Collar & Finger,Collar & Armpit, Sleeve & Soulder,Sleeve & Neck,Sleeve & Waist, Sleeve & Upper Arm, Sleeve & Wrist, Sleeve & Side, Sleeve & Finger, Sleeve & Armpit, Belt & Collar,Belt & Neck, Belt & Upper Arm, Belt & Side, Belt & Armpit, Belt & Sleeve, Armpit & Side, Armpit & Soulder, Armpit & Neck, Armpit & Armpit, Armpit & Finger, Upper Arm & Upper Arm, Upper Arm & Side

Table 3. Techniques that require body rotation confirmed from the present research

Throwing technique classification	Techniques with body rotation		
Te-waza (hand-technique)	*seoi-nage*	*seoi-otoshi*	*ippon-seoi-nage*
	tai-otoshi		
Ashi-waza (leg-technique)	*uchi-mata*		
Koshi-waza (hip-technique)	*turi-goshi*	*harai-goshi*	*koshi-guruma*
	o-goshi	*sode-turikomi-goshi*	
Sutemi-waza (sacrifice-technique)	*uchimata- makikomi*	*harai-makikomi*	*soto-makikomi*

As Table 4 contains, the results indicate that the no re-gripping techniques prior to throwing resulted in a significantly higher score rate than the re-gripping when competitors grabbed their opponents in the place(s) of collar(s) and sleeve(s) (no re-gripping: 69.9%, re-gripping: 32.5%; $\chi^2 = 45.642$; df = 2; p = 0.000). Re-gripping techniques resulted in significantly higher score rates than the no re-gripping techniques when competitors grabbed the place of the competition number (re-gripping: 41.5%, no re-gripping: 15.0%; $\chi^2 = 45.642$; df = 2; p = 0.000; Table 4) and the place(s) other than the collar and sleeve with at least one hand except the place of the competition number (re-gripping: 26.0%, no re-gripping: 15.0%; $\chi^2 = 45.642$; df = 2; p = 0.000; Table 4).

Table 4. Score rates of gripping targets preceding scored throws according to re-gripping behavior

	N (%)			χ^2	df	P
	collar & sleeve	competition number	other areas			
Re-gripping	40 (32.5)	51 (41.5)†	32 (26.0)†	45.642*	2	0.000
No re-gripping	144 (69.9)†	31 (15.0)	31 (15.0)			

n = 329; * – p <.05; † – Significantly higher.

Re-gripping techniques resulted in higher score rate than the no re-gripping when competitors used cross gripping techniques; however, it was not significant (re-gripping: 24.4%, no re-gripping: 19.9%; $\chi^2 = 0.916$; df = 1; p = 0.338; Table 5). In addition to the result, regardless of using either re-gripping or no re-gripping techniques, the score rates of no cross gripping techniques were higher than that of cross gripping (re-gripping: 75.6%, no re-gripping: 80.1% ;Table 5).

Table 5. Score rates of scored throws that involve cross gripping techniques according to re-gripping behavior

	N (%)		χ^2	df	P
	cross grippping	no cross gripping			
Re-gripping	30 (24.4)	93 (75.6)	0.916	1	0.338
No re-gripping	41 (19.9)	165 (80.1)			

n = 329.

Re-gripping techniques resulted in higher score rate than the no re-gripping when competitors used techniques without body rotation; however, it was not significant (re-gripping: 61.8%, no re-gripping: 51.9%; $\chi^2 = 3.025$; df = 1; p = 0.082; Table 6).

Table 6. Score rates of the scored throws that require body rotation according to re-gripping behavior

	N (%)		χ^2	df	P
	body rotation	no body rotation			
Re-gripping	47 (38.2)	76 (61.8)	3.025	1	0.082
No re-gripping	99 (48.1)	107 (51.9)			

n = 329.

Re-gripping techniques resulted in higher score rate than the no re-gripping when competitors used direct single techniques; however, it was not significant (re-gripping: 74.8%, no re-gripping: 71.4%; $\chi^2 = 0.550$; df = 2; p = 0.760; Table 7). In addition to the result, regardless of using either re-gripping or no re-gripping techniques, the score rates of direct single techniques were higher than those of combine and counter attacks(re-gripping: 74.8%, no re-gripping: 71.4%; Table 7).

Table 7. Score rates by attacking patterns of scored throws according to re-gripping behavior

	N (%)			χ^2	df	P
	direct single	combain	counter attack			
Re-gripping	92 (74.8)	9 (7.3)	22 (17.9)	0.550	2	0.760
No re-gripping	147 (71.4)	19 (9.2)	40 (19.4)			

n = 329.

Discussion

Grabbing the collar and sleeve is considered traditional, standard and the most effective *Kumite* style in Japan (Matsumoto, 1985). This theory seemed to be still alive in international-level competition even today. Probably, the competitors may have chosen grabbing the collar and sleeve as the most effective places following the traditional style of *kumite*, and immediately initiated their techniques without any hesitation. And if competitors felt inadequate to execute an ideal throw when grabbing the collar and sleeve, they could try to re-grip the place of the competition number in order to close the distance between them. In addition to grabbing the competition number, re-gripping techniques were able to increase the other gripping targets that could contribute to broadening competitors mind for bettering throwing techniques.

The hypothesis of our research team on the purpose of using re-gripping techniques was using cross gripping techniques to create unexpected *kumite* tactics; therefore, the score rates of re-gripping techniques could become significantly higher when competitors used cross gripping techniques. However the score rate of re-gripping techniques was higher than no re-gripping, but it was not significant. Besides that, the score rates of both re-gripping and no re-gripping techniques were very high when competitors did not use cross gripping techniques. According to the IJF referee rules of 2014–2016 (International Judo Federation, 2014), cross gripping should be followed by an immediate attack; if not so, competitors will be penalized with *shido* or a minor violation. Therefore, competitors didn't intentionally and aggressively use cross gripping techniques to avoid being penalized. They may have used cross gripping techniques in contingent occasions only.

We hypothesized that when re-griping, the score rate of techniques without body rotation would be significantly higher than no re-gripping techniques. Because, re-gripping techniques may require grabbing the places other than

the collar and sleeve, so using re-gripping could result in closing competitors distance when grabbing. In this case, it would be difficult for competitors to make body rotation due to the close distance between them and naturally competitors may choose the techniques without body rotation. However, this research data indicated that though the score rate of re-griping techniques was higher than no re-gripping when competitors used techniques without body rotation, however it was not significant. We assume that even being in the close distance to opponents, according to the opponent movements, competitors could have used sacrifice techniques with their bodies rotating forcibly; the techniques could be *yoko-sutemi-waza*: *harai-makikomi, uchimata-makikomi* and *soto-makikomi* (Daigo, 2005).

Score rates of attacking patterns were almost the same as the results of previous research we performed in 2015 (Ito et al., 2015). The lowest score rate of the three attacking patterns was combined attacking, while, the highest rate of the three was the direct single attacking technique. We think that the quality of techniques could be an important factor to score in international-level competitions. We thought re-gripping opponents means successfully grabbing better place(s) to execute their ideal techniques than the first grabbing; therefore, competitors wouldn't need to combine their techniques and to use counter techniques. Therefore, the score rate of re-gripping techniques would be significantly higher than no re-gripping when competitors used direct single attacking. However the score rate of re-gripping technique was not significantly higher when competitors used direct single attacking. We assume no re-gripping techniques was effective to score when both competitors' skill level was totally different, especially in the first round matches, because of unnecessary for superior competitors to re-grip opponents.

Limitations of the study include the inability to compare across the rounds due to the lack of applicable samples. Future studies should include an increased research sample size to accommodate for this limitation. Furthermore, similar research accounting for weight categories and difference between men and women is advisable.

Conclusions

Based on this study's findings, when using re-gripping techniques, targeting the place of the competition number and the place (s) other than the collar and sleeve with at least one hand except the place of the competition number for grabbing might facilitate scoring. That is to say, using the re-gripping techniques could make a variety of effective gripping targets.

On the other hand, we found out that the use of re-gripping techniques did not affect the score rates of the use of cross gripping techniques, techniques with body rotation, and attacking patterns.

If the complicated movements of judo in international-competition further develop in the future, re-gripping techniques could be more needed and become effective. We emphasize the importance of introducing two major gripping patterns: re-gripping and no re-gripping techniques, into coaching manuals and should research on the characteristics of the two gripping techniques to facilitate scoring and make judo more dynamic in the international-level competitions.

Acknowledgement

We appreciate the support of the information and strategy department in Japan Judo Federation strengthening committee for lending us the research materials.

Reference

Adam, M., Laskowski, R., Smaruj, M. (2012). Directions and Way of Executing Judo Throws during Judo Contests as a Control Criterion of an Individual's Training Versatility. *Baltic Journal of Health and Physical Activity*, *4* (4), 238–249.

Adam, M., Tyszkowski, S., Smaruj, M. (2011). The Contest Effectiveness of the Men's National Judo Team of Japan and Character of Their Technical-Tactical Preparation during the World Judo Championships 2010. *Baltic Journal of Health and Physical Activity*, *3* (1), 65–74.

Boguszewski, D., Adamczyk, J.G., Boguszewska, K., Siewierski, M., Blach, W., Bialoszewski, D. (2014).The Attractiveness of Judo Contests as Sports Entertainment. *Arch Budo Sci Martial Art Extreme Sport*, *10*, 31–38.

Daigo, T. (2005). *Kodokan Judo Throwing Techniques*. Tokyo–New York–London: Kodansha International Publishers.

Hirose, N., Suganami, M., Nakamura, M., Takahashi, S. (2000). The Analysis of Judo Competition in Tactics of Throw Techniques-Comparisons between Men and Women Competitors. *J Health and Sports Sci. Juntendo University*, *4*, 76–87.

International Judo Federation (2013). IJF Refereeing New rules for the period from 1.01.2013 to 31.12.2013. Retrieved from: http://www.ipon.org.

International Judo Federation (2014). IJF Refereeing New rules for the period from 1.01.2014 to 31.12.2016. Retrieved from: http://www.ipon.org.

International Judo Federation (2018). Detailed Explanation of the IJF Judo Refereeing Rules Effective from January 2018 (Version 9 March 2018). Retrieved from: https://www.ijf.org/ijf/documents/6.

Ito, K., Hirose, N., Maekawa, N., Tamura, M., Nakamura, M. (2015). Alterations in Kumite Techniques and the Effects on Score Rates Following the 2013 International Judo Federation Rule Revision. *Arch Budo*, *11*, 87–92.

Ito, K., Hirose, N., Nakamura, M., Maekawa, N., Tamura, M. (2014). Judo Kumi-te Pattern and Technique Effectiveness Shifts After the 2013 International Judo Federation Rule Revision. *Arch Budo*,*10*, 1–9.

Ito, K., Hirose, N., Nakamura, M., Maekawa, N., Tamura, M., Hirotsu, N. (2012). The Transformation of Technical-Tactical Behaviors for Hand Techniques Used in Attacking Below the Belt After the 2010 International Judo Federation Rule Revision. *Arch Budo*, *1*, 1–6.

Kajmovic, H., Rado, I., Mekic, A., Crnogorac, B., Colakhodzic, E. (2014). Differences in Gripping Configurations During the Execution of Throwing Techniques Between Male and Female Cadets at the European Judo Championship. *Arch Budo*, *10*, 141–146.

Kons, R.L., Dias, J.A., Detanico, D. (2017). Can physical tests predict the technical-tactical performance during official judo competitions? *Arch Budo Sci Martial Art Extreme Sport*, *13*, 143–151.

Maekawa, N., Hirose, N., Ito, K., Ishil, K., Koshino, T., Yazaki, R., Tamura, M. (2013). The Method of Expert Evaluation of Specific Abilities to Practice Judo – A Proposition of Japanese Top Level University Judo Coaches. *Arch Budo*, *9* (4), 219–224.

Maekawa, N., Ito, K., Ishi, K., Koshino, T., Yazaki, R., Tamura, M., Hirose, N. (2014). A Study of Validation of Competitive Abilities Scale of Judo Competitors by Using AHP. *Jpn Acad Budo*, *47* (1), 1–8.

Matsumoto, Y. (1985). *Judo Coaching*. Tokyo: Taishukan Press.

Pedrosa, G.F., Soares, Y.M., Goncalves, R., Couto, B.P., Silva, R.A.D., Szmuchrowski, L.A. (2015). Elabolation and evaluation of judo training means. *Arch Budo*, *11*, 7–16.

Sogabe, A., Sasaki, T., Sakamoto, M., Ishikawa, Y., Hirokawa, M., Kubota, H., Yamasaki, S. (2008). Analysis of patterns of response to *kuzushi* in eight direction based on plantar pressure and reaction movement. *Arch Budo*, *4*, 70–77.

Tamura, M., Hirose, N., Nakamura, M., Saitoh, H., Yamauchi, N., Tanaka, C., …, Suganami, M. (2012). Changes in Judo *Kumi-te* Tactics According to revisions of the IJF competition rules. *Jpn Acad Budo*, *45* (2), 143–149.

Wakayama, H., Murayama, H., Hayashi, H., Watanabe, M., Nakajima, H., Oku, C., Yamamoto, Y. (2003). Competitive Analysis on Winners of the Men's Category in the 2001 World Judo Championship in Germany. *B Assoc Sci Stud on Judo in Kodoukan*, *8*, 12–26.

Yamaguchi, K. (2008). *JUDO*. Kodokan Press.

Cite this article as: Ito, K., Hirose, N., Maekawa, N. (2019). Characteristics of Re-gripping Techniques Preceding Scored Throws in International-level Judo Competition. *Central European Journal of Sport Sciences and Medicine*, *1* (25), 43–50. DOI: 10.18276/cej.2019.1-05.

NUTRITIONAL PRINCIPLES OF ADOLESCENT SWIMMERS

Kamil Ferens,[1, A, B, D] Anna Przeliorz-Pyszczek[2, A, D]

[1] Student Science Club at Dietetics Department, Wrocław Medical University, Poland
[2] Department of Dietetics, Wrocław Medical University, Poland
[A] Study Design; [B] Data Collection; [C] Statistical Analysis; [D] Manuscript Preparation; [E] Funds Collection

Address for correspondence:
Anna Przeliorz-Pyszczek
Wrocław Medical University, Department of Dietetics
Parkowa 34, 51-616 Wrocław, Poland
E:mail: anna.przeliorz-pyszczek@umed.wroc.pl

Abstract Adolescence is a period between age 10 and 19. Intensive changes associated with the development of the organism influence the nutritional needs during this period. Young swimmers' training is characterized by large volume, so their diet can play an important role in their results and future career. The energy intake of a developing athlete should be determined individually based on gender, anthropometric measurement, character, and number of workouts per day. The frequent presence of drowsiness and fatigue during training may indicate insufficient dietary energy supply. Dehydration exceeding 2% of body weight should be prevented. Isotonic drinks should only be consumed during training longer than 75 minutes. Young swimmers should consume adequate amounts of carbohydrates to restore glycogen reserves before another training unit. Carbohydrates with a high glycemic index of 1–1.2 g/kg b.w./h should be delivered during the post-training period. Immediately following training, a meal containing a complete protein should be consumed to accelerate post-exercise recovery. The total protein supply should be at least 1.2 g/kg b.w./h. The minimum intake of fat in the diet of a young swimmer should be 2 g/kg lean b.w. It is recommended to limit products containing large amounts of saturated fatty acids.

Key words adolescent, swimming, nutrition, exercise, sports

Introduction

Adolescence is a period between age 10 and 19. This period is characterized by intense changes, both physiological and psychological. It is also a time of rapid body growth, with up to 45% increase in bone mass (WHO, 2005). Due to the increased intensity of growth processes in the body, nutritional needs are greater than in childhood or infancy (WHO, 2005; Charzewska, Wajszczyk, 2008; Jegier, Nazar, Dziak, 2013). The most intense growth occurs in girls aged 12 and in boys aged 14 (Jegier et al., 2013).

Adolescents with moderate physical activity should consume five meals a day and deliver from 2,100 to 2,500 kilocalories (for girls) or 2,400 to 3,400 kcal (for boys) (Jarosz, 2012). There are no unequivocal recommendations for the energy value of the athlete's diet at adolescence. Because of the metabolic processes and the lack of coordination of exercise, this group of the population spends more energy during physical activity

compared to adults (Jegier et al., 2013; Zając et al., 2014; Bean, 2014). Intensification of growth processes makes it difficult to clearly identify the needs of the young organism (Charzewska et al., 2008; Bean, 2014).

While creating a diet plan for young athletes, the need for energy and nutritional components directly related to sports discipline needs to be taken into account (Zając et al., 2014).

Swimming is a discipline practiced from a very young age (Shaw, Boyd, Burke, Koivisto, 2014). Young swimmers preparing to take part in competitions perform large and exhaustive workouts. In swimming, we distinguish 4 basic styles (butterfly, backstroke, breaststroke, freestyle) and medley (combining butterfly style, backstroke style, breaststroke style and crawl). Athletes competing at various distances from 25 m to 1,500 m (male style) or 800 m (any female style). Short distance competitions (25 m, 50 m, 100 m) are considered as speed-strength. In turn, long distance competitions (800 m, 1,500 m) are recognized as endurance (Shaw et al., 2014).

Swimming workout is aimed at physically preparing the athlete to achieve better results in sports competitions (Vanheest, Rodgers, Mahoney, De Souza, 2014). Proper nutrition plays a key role in improving athletic performance, the course of the training process and can be crucial for the future career of young athletes (Hassapidou, Valasiadou, Tzioumakis, Vrantza, 2002; Bean, 2014).

Dominguez et al. (2017) published a review in which they set the nutritional recommendations for adult swimmers. For young athletes, the recommendations may be different due to physical and mental processes of growth and development

The purpose of this review is to create nutritional recommendations for adolescent swimmers to increase performance and improve athletic performance.

Material and Methods

Articles were found with search in databases PubMed and ScienceDirect. The search terms included: adolescent, swimming, nutrition, hydration, carbohydrate, glycogen, fat, protein.

Inclusion criteria were the following: clinical trial, population were swimmers between 10–19 years old.

Quality of young swimmers' diet

Analysis of the results of the study led by M.N. Hassapidou et al. (2002) showed that the diets of young swimmers were not sufficient to maximize athletic performance. Adolescent swimmers' diet provided the right amount of calories, however, the insufficient supply of vitamins B1, B2, calcium, iron and zinc was revealed (Hassapidou et al., 2002). A.C. Collins et al. (2012) found that young swimmers consumed too little fruit, vegetables, cereal and dairy products. In another study the diet of most swimmers was characterized by an insufficient supply of energy and carbohydrates in relation to the body needs (da Costa, Schtscherbyna, Soares, Ribeiro, 2013).

A.V. de Mello et al. (2015) stated in his study that the BMI score cannot be used as the sole parameter for assessing body composition of adolescent swimmers. Among the measured participants, the BMI index indicated the risk of being overweight, but the percentage of body fat was normal. There was an insufficient supply of vitamin B9, iodine and dietary calcium (de Mello et al., 2015). Table 1 provides a summary of the study data in which swimmers diets were assessed.

Analysis of the results of the study by J.L. Vanheest et al. (2014) showed that an optimal hormonal and metabolic environment should be maintained to maximize athletic performance, which can be ensured through appropriate dietary energy intake. There was a statistically significant decrease in the average swimming speed

by 9.8% in the swimmers' group with reduced serum level of sex hormones (estradiol and progesterone). In the group of athletes, where sex hormones level was adequate, a statistically significant increase in average swimming speed was observed by 8.2%. The study involved swimmers aged 15–17 years. Female swimmers characterized by decreased secretion of sex hormones provided statistically significantly less energy by their diet compared to those with proper sex hormone secretion. All participants of the study trained every day for about 2 hours. Energy expenditure associated with the training was 900–1,225 kcal per day during the twelve-week training period.

Table 1. Trainings, energy intake and percentage of macronutrient in the diet of young swimmers

Study	Number of participants	Average age of study participants	Energy supply	Carbohydrates supply*	Protein supply*	Fat supply*	Training
Kabasakalis et al.	F 16 M 16	10–11 years	n.d.	<50%	>15%	25–30%	3 times per week; 75–90 minutes; 2,687 m/training
J.L. Vanheest et al.	F 10 M 0	15–17 years	2,481–2,530 kcal	57–59%	15.0%	26–28%	Trainings in pool – 13.5 h/wk; Endurance training on land – 1.6 h/wk
H.L. Petersen et al.	F 24 M 0	18–21 years	2,405 kcal	62%	13.0%	24.0%	Training on land: 1.5 h (3 times per week); Training in pool 6 d/wk (9 two-hour trainings, 6,400–10,000 m/training)
D.D. Ramos et al.	F 0 M 6	12–18 years	3,335 kcal	59%	14.6%	26.4%	n.d.
A.V. Mello et al.	F 7 M 8	16–18 years	50.1 kcal/kg b.w. 54.2 kcal/kg b.w.	49%	27%	24%	Training in pool: 5 h; 6 d/wk
T.A. Trappe et al.	F 5 M 0	19.7 years	5,497 kcal	68.5%	11.5%	20.3%	16.8–18.2 km/d
M.N. Hassapidou et al.	F 15 M 20	15–18 years	2,318 kcal 2,720 kcal	47% 44%	1.1–1.5 g/kg b.w. 0.8–2.5 g/kg b.w.	40.6% 42.5%	Total training: 2.5 h/d
A.C. Collins et al.	F 61 M 30	13.7 years	44 kcal/kg b.w. 50 kcal/kg b.w.	52.0%	14.0%	36.0%	Training in pool: 8.6 h/wk
N.F. da Costa et al.	F 77 M 0	11–19 years	52–62.1 kcal/kg b.w.	4.5–6.5 g/kg b.w.	1.7–2.0 g/kg b.w.	26.9–30.6 g/kg b.w.	n.d.
J.R. Berning et al.	F 21 M 22	14–18 years	3,572.6 kcal 5,221.6 kcal	7.35 g/kg b.w. 7.71 g/kg b.w.	1.84 g/kg b.w. 2.14 g/kg b.w.	41.4% 42.8%	n.d.
A.E. Soares et al.	F 30 M 37	15–26 years	56 kcal/kg b.w.** 67 kcal/kg b.w.**	46% 48.6%	2.5 g/kg b.w.** 2.6 g/kg b.w.**	35% 34.5%	10 intense workouts a week for 3–4 h each

n.d. – no data; F – female; M – male.
* Values expressed in% of energy supplied with the diet or per kg b.w.
** In the group of participants aged 15–17.

Energy requirements for young swimmers

The Sports Dietitians Australia (SDA) (Desbrow et al., 2014) states that there is no equation with which it would be possible to properly determine the energy needs of adolescent athletes. The energy spent by the body

of an adolescent athlete on growth and physical development means the difference between energy intake and energy spent with sports activity. Growth and development indicators should be regularly reviewed to determine if the athlete's energy intake is adequate (Desbrow et al., 2014).

Children compared to adults spend more energy during the same exercise due to lack of coordination between agonistic and antagonistic muscles. Improving in a given exercise reduces the energy cost. Among those who exercise irregularly daily energy requirements for boys between 11 and 18 years of age are between 2,250 and 2,755 kcal per day, and for girls from the same age group from 1,845 to 2,110 kcal. For a young athlete who trains daily, it can be assumed that the physical activity level (PAL) indicator is equal to 1.6 for moderate training, 1.8 for moderate and intense training, and 2.0 for intensive training sessions every day. As a result of insufficient energy supply, young athletes may experience a frequent feeling of drowsiness and weakness during training. Among children, oxygenic metabolism prevails, and the main source of energy used during activity is fat. Energy costs of swimming can range from 4.3 MET (Metabolic Equivalent) to 13.6 MET while swimming at an average speed of 2-4 km/h respectively (Barbosa et al., 2006). A young athlete can burn up to 700 kcal/h of swimming (Bean, 2014).

One study found that daily energy need of adolescents girls swimming on average 4.3 km per day was 2,300 kcal. For heavier workouts, it can be up to 3,000 kcal per day (Ousley-Pahnke, Black, Gretebeck, 2001). In a study conducted by T.A. Trappe, A. Gastaldelli, A.C. Jozsi, R.R. Wolfe (1996), it was observed that on training days the total metabolism of female swimmers aged 19.7 was approximately 5497 kcal. Athletes swam every day on average 18.2 km of freestyle or 16.8 km of medley style (Trappe et al., 1996). Other data (Berning, Troup, VanHandel, Daniels, Daniels, 1991) indicate that in the group of swimmers aged 14–18, during the 10,000 m distance boys burned 2,166.7 kcal and girls 1,825.4 kcal on average. In addition, female swimmers were characterized with statistically significantly higher body use of oxygen while swimming compared to the male group. (Berning et al., 1991). In the study led by D.L. Costill et al. (1988) participants swimming 8,970 m a day needed 4,667 kcal to cover the total daily energy demand.

There is not enough information from studies to clearly describe nutrition needs of young swimmers. Growth and development indicators should be regularly controlled not to allow insufficient energy delivery.

Hydration status

Proper hydration is essential to achieve peak performance and to prevent overheating of the organism (Higham, Naughton, Burt, Shi, 2009). Adequate fluid supply during physical activity may facilitate exercise and delay the onset of fatigue. The volume of lost fluid depends on the type, intensity, duration of exercise, temperature, humidity, sex, body surface and individual characteristics of human metabolism (Bean, 2014). Within one hour of exercising, adults may lose 2–4 l of fluid (Bean, 2014, Górski, 2008) and adolescents 350–700 ml (Bean, 2014). In the group of swimmers aged 16–18 years average amount of 2.3 l water of fluid loss per day was observed (de Mello et al., 2015).

Sports Dietitians Australia (SDA) (Desbrow et al., 2014) points out that young athletes should strive to maintain a proper level of hydration throughout the day by supplying fluids such as water and milk. Athletes in adolescence should be educated about proper hydration, especially when fluid supply during exercise is limited or where the environment promotes dehydration. Monitoring body mass changes before and after exercise is necessary to determine the degree of dehydration. Dehydration equal to or greater than 2% body weight (b.w.) should be avoided (Desbrow et al., 2014).

Isotonic drinks during training are recommended only if the activity lasts longer than 75 minutes (Desbrow et al., 2014). For a drink to be classified as isotonic it should deliver 80–350 kcal/1,000 ml and sodium 460–1,150 mg/1,000 ml. The osmolality of the isotonic drink ranges from 270 to 330 mOsm/kg (European Comission, 2001).

Dehydration may increase the subjective feeling of exercise intensity and cause the excessive increase in heart rate. Other signs of dehydration in young athletes may occur, such as muscle cramps, headache, nausea, faster fatigue, loss of strength and reduced concentration (Bean, 2014). In the group of students aged 8–17, no statistically significant association of hydration with cognitive functions such as visual attention, visual memory, short-term memory, visuomotor skills was observed (Trinies, Chard, Mateo, Freeman, 2016).

In the study led by V. Trinies et al. (2016), 42% of students aged 8–17 were diagnosed dehydrated in the morning and this state increased during the day. Ensuring unlimited access to drinking water was significantly correlated with decreased dehydration during the day (Trinies et al., 2016). During swimming there occurs an increased heat loss due to continuous contact with water. In the group of swimmers aged 13–18 years, 85% observed dehydration not exceeding 2% b.w. The authors stated that the subjective assessment of dehydration based on the urine color is an inaccurate method, in contrast to the measurement of urinary specific gravity. In the group of male adolescent swimmers, there was a greater loss of fluid along with the sweat, compared to the group of adolescent female swimmers, suggesting that when performing the same training load, the higher the muscle mass is, the more metabolic heat is produced (Higham et al., 2009).

Study results analysis led by J.D. Adams et. al. (2016) deliver similar findings. More than 71% of participants of the study began the training unit being insufficiently hydrated. After two hours of training, during which participants were given drinks ad libitum, there were no statistically significant differences in body weight and subjective feeling of thirst. The author suggested that after the swim training, urine markers of dehydration may not reflect the hydration of adolescent athletes (Adams et al., 2016).

G.L. Briars et al. (2017) analyzed the relationship between hydration status during swimming training with improved performance and existing specific differences in response between individual athletes. For 12 weeks, swimmers, performed an additional task 10 × 100 m, after training unit on Friday. During this training, they drank water, sports drink or did not take liquids at all. During exercise, the center velocity was measured between 25 m and 75 m. The results of the data analysis showed that the fluid intake during swimming is not positively correlated with the average speed of swimming. Four of the nineteen participants swam significantly faster during training, when drinking a sports drink. One person swam significantly faster during training as drinking water. During the study, respondents did not exceed more than 2% of body weight dehydration. The authors suggested that there is another factor besides hydration affecting the swimming performance (Briars et al., 2017).

Other data (Arnaoutis et al., 2015) indicated that 89.8% of adolescent athletes representing different disciplines were dehydrated at the beginning of the training. The urinary specific gravity significantly decreased only in the group of adolescent swimmers. The authors suggested that this could have been caused by submergence of the body in the water (Arnaoutis et al., 2015). Adolescent swimmers should drink enough fluids to prevent dehydration of more than 2% of body weight.

Carbohydrates

Carbohydrates and fats are the main energy substrates for cells. The organism is able to store them and use in case of starvation (Górski, 2008). Increased physical effort enlarge utilization of glucose and free fatty acids from the blood in the cells (Zając et al., 2014; Górski, 2008).

Sports Dieticians Australia (SDA) (Desbrow et al., 2014) points out that recommendations for the supply of carbohydrates for adult athletes may be suitable for the athletes during the period of adolescence. The carbohydrates intake should depend on the type of discipline, exercise duration, and its intensity. Young athletes within 4 hours after training should provide carbohydrates in the amount of 1–1.2 g/kg b.w./h. The daily intake of carbohydrates with the diet for athletes with low-intensity training sessions should vary between 3–5 g/kg b.w. For those who perform moderate intensity training the amount of 5-7 g/kg b.w. of carbohydrates is recommended. Among young athletes training 4–5 h per day, performing endurance training, the supply of carbohydrates should be at the level of 8–12 g/kg b.w. During exercise that lasts less than 75 minutes it is not recommended to supply carbohydrates, but during a training period between 75 minutes to 2.5 hours, the recommended carbohydrate intake is 30–60 g/h (Desbrow et al., 2014).

D.L. Costill et al. (1988) examined the physiological and psychological changes associated with a sudden increase in exercise volume in a group of swimmers aged on average 19.1 years, training intensively for the 6 months preceding the study. During the training period, which was characterized by increased intensity of the training, the daily energy demand of the studied swimmers was on average 4,667 kcal, the energy needs related to swimming training (on average 8,970 m per day) were 2,293 kcal. Those subjects who were classified as chronically fatigued (not fulfilling the criteria for overtraining status) provided statistically significantly less energy (48.2 vs. 62.8 kcal/kg/d) and carbohydrates (5.3 vs. 8.2 g/kg/d) compared to the other participants of the study. There was a statistically significant decrease in muscle glycogen concentration at day 11 compared to day 0 of the study (110.2 vs 130.5 mmol/kg). Among athletes from the group classified as chronically fatigued, there was a statistically significant decrease in muscle glycogen resources compared to other participants of the study. A 10-day training period with increased training volume did not affect significantly the speed or endurance parameters in the swimmers' group. The authors concluded that lower tolerance of training loads in the group of athletes classified as chronically tired could have been caused by the low muscle glycogen resources status. The authors concluded that the depletion of muscle glycogen resources was due to swimming training and that intensive swimming training was correlated with a decrease in blood lactate concentration. Participants of the study with increased training volume had a problem maintaining proper energy and carbohydrates supply (Costill et al., 1988).

Research conducted by H. Soultanakis, T. Platanou (2008) revealed that during swimming training unit changes in blood glucose concentrations occur. During training with swimmers providing 8 g/kg b.w./d carbohydrates with diet, it was observed that blood glucose level at 60th minute of training was statistically significantly lower compared to pre-workout levels. Among those athletes who delivered 5 g of carbohydrates/kg b.w./d, a comparable decrease in blood glucose was observed 20 minutes after the start of exercise. The value of serum glucose level during training and at the end of it was significantly higher in the group providing 8 g of carbohydrates/kg b.w./d. No case of hypoglycemia occurred among participating athletes during training. The authors concluded that a faster decrease in glucose levels in one group may be caused by a lower glycogen resources in the liver at the beginning of the training. According to the authors, the athletes providing more carbohydrates with the diet could present higher glycogen reserves, which could be responsible for its supercompensation in the liver and muscles.

The authors stated that carbohydrate intake should be determined individually based on intensity and duration of exercise (Soultanakis, Planatou, 2008).

Analysis of results of T. Reilly, V. Woodbridge (1999) showed that changing the amount of carbohydrates in the diet may affect the athletic performance of adolescent swimmers. Increasing energy from carbohydrates was associated with an ergogenic effect on the performance of teenage athletes during swimming training at distances of 100–400 yards at submaximal and maximum speeds. The change in carbohydrate intake was associated with a statistically significant effect on the mean speed when the blood lactate concentration was equal 4 mmol. Among participants of the study who had a reduced carbohydrate supply diet (39.4% vs. 53.6% energy) for 3 days, a statistically significant increase in mean swimming velocity from 0.67 to 0.7 m/s for blood lactate equal 4 mmol concentration was observed. According to the author, the results of the study allow us to question the effectiveness of measuring lactate concentration in blood as a tool for determining the intensity of swimming training for swimmers during adolescence. The study confirmed the ergolytic effect of reduced carbohydrate intake in combination with maintaining a regular workout. Changes in diet carbohydrate supply had a statistically significant effect on the amount of lactate produced while swimming at maximum and submaximal speeds. The author stated that diet and blood lactate concentrations should be continuously monitored (Reilly, Woodbridge, 1999).

In another study conducted by L. Afshari, S. Mohammadi, S. Shakerian, R. Amani (2014) it was shown that in the group of swimmers aged 12–17 the consumption of 200 ml 6% sucrose solution 5–15 min before the 200 m sprint significantly increased the time of swimming compared to the 200 ml group drinking 6% glucose solution or placebo drink which contained aspartame. The authors concluded that the availability of glucose in the blood may affect the exercise capacity of swimmers during adolescence (Afshari et al., 2014).

Other data indicate that insufficient carbohydrate intake in the group of adolescent swimmers may contribute to upper respiratory tract symptoms, such as nasal congestion, sneezing, bronchitis, sinusitis, or rhinitis (Ramos, Toriani, Silva, Dalquano, 2010). Adolescent swimmers, who train few times a day should deliver 8–12 g/kg b.w. carbohydrates daily. Carbohydrate-rich products should be eaten between the training sessions to maintain proper glycogen restoration.

Protein

The role of proper protein intake among adolescent swimmers is immense. During performing an exercise 1–5% of energy is derived from proteins, depending on its intensity. During prolonged exercise of moderate intensity, there is a small increase in alanine concentration and a decrease in glutamine and BCAA levels, which is caused by the increased use of alanine in the process of gluconeogenesis and its reduced de novo production in the muscles. During short-term exercise, characterized by submaximal and maximal intensity, the increase of free alanine and glutamine in the muscles and in the blood occurs. Exercise increases the oxidation of leucine and other branched chain amino acids in the body (Górski, 2008).

Sports Dieticians Australia (SDA) (Desbrow et al., 2014) indicates that in order to determine the protein needs of adolescent athletes, recommendations for adults can be used because the research data to determine protein requirements for the adolescent athletes is insufficient. Protein-rich products should be evenly distributed through the day so that protein supply is steady. A meal rich in proteins should be consumed immediately after workout. The daily amount of protein adequate to cover the growth and development needs, and the maintenance of lean body mass for boys aged 12–13 and 14–18 years is 0.94 and 0.99 g/kg b.w., respectively, whereas in girls at

the same age, 0.87 and 0.77 g/kg b.w. These recommendations may also be suitable to physically active teens. However, they will not be adequate for high-performance athletes during adolescence (Desbrow et al., 2014). Other recommendations suggest that young athletes should deliver 1.1–1.2 g protein/kg b.w. with diet. Growing athletes should know their individual protein requirements and be able to deliver the right amount of protein with conventional products (Bean, 2014). The use of supplements is not necessary for adolescent athletes, but they are acceptable in this age group if they are used to improve the comfort of preparing meals and the quality of food eaten (Bean, 2014; Desbrow et al., 2014).

In S. Krause, M. Langrock, M. Weiss (2002), a statistically significant negative correlation between training volume and BCAA plasma concentration was observed. The authors concluded that the race for 100 meters freestyle did not lead to depletion of glycogen stores, so there was no protein utilization. The authors also found that the body has worse adaptation to exercise after a break in training sessions, which may be characterized by higher levels of ammonia in the blood (Krause et al., 2002).

The research needed to create nutritional recommendations for adolescent swimmers protein intake is insufficient. In order to cover protein needs essential for growth and development processes and physical activity, young athletes should supply at least 1.1–1.2 g/kg b.w. protein a day.

Fat

Apart from carbohydrates, the second most important energy substrate used by working muscles are fats, more specifically, free fatty acids, triacylglycerols in the plasma, triacylglycerols found in muscles and ketones (Górski, 2008).

Sports Dieticians Australia (SDA) (Desbrow et al., 2014) indicates that fat intake among adolescent athletes should be consistent with national guidelines (Desbrow et al., 2014). According to the Nutrition Standards for the Polish population, the percent of fat in the diet of people aged 10–18 should be 20 to 35% of total energy intake (Jarosz, 2012). Young people should consume vegetable oils and fish to provide unsaturated fatty acids. People in adolescence should limit their intake of foods rich in saturated fatty acids. It is also important to draw attention to the high energy density of fat, which, when over-consumed, can promote the formation of adipose tissue (Desbrow et al., 2014). Other recommendations (Bean, 2014) suggest that the proportion of fats in a young person's diet should not be greater than 35% (Bean, 2014).

According to recommendations made on the basis of studies involving athletes of strength sports, which include swimming, athletes who train more than 2 hours a day should provide 2 g of fat per kilogram of non-fat mass daily. This amount is essential for the regeneration of muscle triglycerides stores, utilized during exercise. The supply of fat at this level also aims to assimilate fat-soluble vitamins supplied with the diet, to provide substrates for hormone synthesis and to build cell membranes. It is believed that higher fat intake in strength sports athletes could impair muscle glycogen recovery and muscle tissue regeneration. However, there are no recommendations whether the same dietary fat recommendations also apply to young swimmers (Boesch, Décombaz, Slotboom, Kreis, 1999; Décombaz et al., 2000; Decombaz et al., 2001).

A study by P.M. Andrade, B.G. Ribeiro, M.T. Bozza, L.F. Costa Rosa (2007) showed that fish oil supplementation results in an increase in alpha-linolenic acid (ALA), eicosapentaenoic acid (EPA) docosahexaenoic acid (DHA) and a decrease in the concentration of arachidonic acid in the blood. Study participants supplemented 2.5 g of fish oil (including 950 mg EPA and 500 mg DHA) a day for a 6 week period. High availability of n-3 acids in cell membranes

was associated with reduced production of strong lipid mediators of inflammation caused by intensive training. In order to support the immune system during intensive training, a diet rich in n-3 acids is recommended. The study was conducted with swimmers aged 20–35 years old (Andrade et al., 2007).

On the basis of available data, it can be recommended for the young athletes to provide 2 g/kg/l.b.m. of fat with diet daily, in order to keep the proper amount of muscle triglycerydes in the body. Further studies on supplementation of fatty acids in the group of high-performance swimmers in adolescence are needed.

Conclusions

In order for a young swimmers to develop properly and improve their athletic performance, they should take care of proper fluids, energy, and macronutrients supply.

Young swimmers should drink fluids regularly during the day, to prevent dehydration of more than 2% b.w., which could impair exercise capacity during training or competitions. An isotonic drink is recommended if the training unit lasts more than 75 minutes.

Determining the energy needs of a growing swimmer should be set individually. Appetite level and anthropometric measurements can be used to determine energetic requirements.

Carbohydrates are the main energy substrate for swimmers during adolescence. The proper supply of this macronutrient will help to keep muscular glycogen stores at a proper level. Swimmers who do more than one workout per day should consume products with a high glycemic index after each training unit, in the amount of 1–1.2 g/kg/b.w./h, which is supposed to accelerate glycogen resynthesis.

Proteins participate in many processes in the body and are essential for the proper development and regeneration of the body's immune system. Young swimmers should consume 1–1.2 g/kg/b.w. of protein daily.

Fat is also an energy substrate that can be used by the body during swimming training. Adolescents should consume at least 2 g/kg/l.b.m. a day. It is important to reduce the intake of products containing a large amount of saturated fatty acids and to provide a proper intake of omega-3 acids with diet.

The demand for young swimmers for micro- and macroelements is higher compared to adult athletes. In conclusion, there is not enough research to unequivocally establish nutritional recommendations for this age group of athletes performing swimming training.

The main test groups for athletes are cyclists and runners. Less research is done including swimmers, especially those during the period of adolescence.

References

Adams, J.D., Kavouras, S.A., Robillard, J.I., Bardis, C.N. Johnson, E.C., Ganio, M.S., McDermott, B.P., White, M.A. (2016). Fluid Balance of Adolescent Swimmers During Training. *J Strength Cond Res*, *30* (3), 621–625. DOI: 10.1519/JSC.0000000000001132.

Afshari, L., Mohammadi, S., Shakerian, S., Amani, R. (2014). The Effect of Oral Carbohydrate Solutions on the Performance of Swimmers. *Ann. Appl. Sport Sci*, *2* (3), 13–22. DOI: 10.18869/acadpub.aassjournal.2.3.13.

Andrade, P.M., Ribeiro, B.G., Bozza, M.T., Costa Rosa, L.F., Tavares do Carmo, M.G. (2007). Effects of the fish-oil supplementation on the immune and inflammatory responses in elite swimmers. *Prostaglandins Leukot Essent Fatty Acids.*, *77* (3–4), 139–145. DOI: 10.1016/j.plefa.2007.08.010.

Arnaoutis, G., Kavouras, S.A., Angelopoulou, A., Skoulariki, C., Bismpikou, S., Mourtakos, S., Sidossis, L.S. (2015). Fluid Balance During Training in Elite Young Athletes of Different Sports. *J Strength Cond Res*, *29* (12), 3447–3452. DOI: 10.1519/JSC.0000000000000400.

Barbosa, T.M., Fernandes, R., Keskinen, K.L., Colaco, P., Cardoso, C., Silva, J., Vilas-Boas, J.P. (2006). Evaluation of the Energy Expenditure in Competitive Swimming Strokes. *Int J Sports Med*, *27* (11), 894–899. DOI: 10.1055/s-2006-923776.

Bean, A. (2014). *Żywienie w sporcie. Kompletny przewodnik*. Poznań: ZYSKA I S-KA Wydawnictwo.

Berning, J.R., Troup, J.P., VanHandel, P.J., Daniels, J., Daniels, N. (1991). The nutritional habits of young adolescent swimmers. *Int J Sport Nutr, 1* (3), 240–248.

Boesch, C., Décombaz, J., Slotboom, J., Kreis, R. (1999). Observation of intramyocellular lipids by means of 1H magnetic resonance spectroscopy. *Proc. Nutr. Soc*., *58* (4), 841–850.

Briars, G.L., Gordon, G.S., Lawrence, A., Turner, A., Perry, S., Pillbrow, D., Walston, F.E., Molyneux, P. (2017). Swim drink study: a randomised controlled trial of during-exercise rehydration and swimming performance. *BMJ Paediatr Open*, *1* (1), e000075. DOI: 10.1136/bmjpo-2017-000075.

Charzewska, J., Wajszczyk, B. (2008). Co powinna zawierać prawidłowa, zbilansowana dieta? Rola urozmaiconej diety. In: M. Jarosz (ed.), *Zasady prawidłowego żywienia dzieci i młodzieży oraz wskazówki dotyczące zdrowego stylu życia* (pp. 28–43). Warszawa: Instytut Żywności I Żywienia.

Collins, A.C., Ward, K.D., Mirza, B., Slawson, D.L. , McClanahan, B.S., Vukadinovich, C. (2012). Comparison of nutritional intake in US adolescent swimmers and non-athletes. *Health (Irvine Calif)*, *4* (10), 873–880. DOI: 10.4236/health.2012.410133.

Costill, D.L., Flynn, M.G., Kirwan, J.P., Houmard, J.A., Mitchell, J.B., Thomas, R., Park, S.H. (1988). Effects of repeated days of intensified training on muscle glycogen and swimming performance. *Med Sci Sports Exerc*, *20* (3), 249–254.

da Costa, N.F., Schtscherbyna, A., Soares, E.A., Ribeiro, B.G. (2013). Disordered eating among adolescent female swimmers: dietary, biochemical, and body composition factors. *Nutrition*, *29* (1), 172–177. DOI: 10.1016/j.nut.2012.06.007.

de Mello, A.V., Villarim, W.L.F., Machado, A.D., Olivon, E.V., da Cruz, D.L., Nogueira, L.R., Nacif, M. (2015). Avaliacao da composicao corporal e do consumo alimentar de nadadores adolescents. *Rev Bras Med Esporte*, *21* (5), 381–385. DOI: 10.1590/1517-869220152105117781.

Décombaz, J., Fleith, M., Hoppeler, H., Kreis, R., Boesch, C. (2000). Effect of diet on the replenishment of intramyocellular lipids after exercise. *Eur. J. Nutr.*, *39* (6), 244–247.

Décombaz, J., Schmitt, B., Ith, M., Decarli, B., Diem, P., Kreis, R., Hoppeler, H., Boesch, C. (2001). Postexercise fat intake repletes intramyocellular lipids but no faster in trained than in sedentary subjects. *Am. J. Physiol. Regul. Integr. Comp. Physiol*., *281* (3), R760–R769. DOI: 10.1152/ajpregu.2001.281.3.R760.

Desbrow, B., McCormack, J., Burke, L.M., Cox, G.R., Fallon, K., Hislop, M., Logan, R., Marino, N., Sawyer, S.M., Shaw, G., Vidgen, H., Leveritt, M. (2014). Sports Dietitians Australia position statement: sports nutrition for the adolescent athlete. *Int J Sport Nutr Exerc Metab*, *24* (5), 570–584. DOI: 10.1123/ijsnem.2014-0031.

Dominguez, R., Jesús-Sánchez-Oliver, A., Cuenca, E., Jodra, P., Fernandes da Silva, S.F., Ordóñez, C.M. (2017). Nutritional needs in the professional practice of swimming: a review. *J Exerc Nutrition Biochem*, *21* (4): 1–10. DOI: 10.20463/jenb.2017.0030.

Scientific Committee on Food, European Commission (2001). Report of the Scientific Committee on Food on composition and specification of food intended to meet the expenditure of intense muscular effort, especially for sportsmen. Brüssel: European Commission.

Górski, J. (2008). *Fizjologiczne podstawy wysiłku fizycznego*. Warszawa: Wydawnictwo Lekarskie PZWL.

Hassapidou, M.N., Valasiadou, V., Tzioumakis, L., Vrantza, P. (2002). Nutrient intake and anthropometric characteristics of adolescent Greek swimmers. *Nutrition & Dietetics*, *59*, 38–42.

Higham, D.G., Naughton, G.A., Burt, L.A., Shi, X. (2009). Comparison of fluid balance between competitive swimmers and less active adolescents. *Int J Sport Nutr Exerc Metab*, *19* (3), 259–274.

Jarosz, M. (2012). *Normy żywienia dla populacji polskiej – nowelizacja*. Warszawa: Instytut Żywności i Żywienia.

Jegier, A., Nazar, K., Dziak, A. (2013). *Medycyna sportowa*. Łódź–Warszawa: PZWL.

Kabasakalis, A., Kalitsis, K., Nikolaidis, M.G., Tsalis, G, Kouretas, D., Loupos, D., Mougios, V. (2009). Redox, iron, and nutritional status of children during swimming training. *J Sci Med Sport*, *12* (6), 691–624. DOI: 10.1016/j.jsams.2008.05.005.

Krause, S., Langrock, M., Weiss, M. (2002). Influence of seasonal variations in training loads on selected amino acids and parameters of the psychoimmunological network in a swimming team. *Int J Sports Med*, *23* (5), 380–387. DOI: 10.1055/s-2002-33147.

Ousley-Pahnke, L., Black, D.R., Gretebeck, R.J. (2001). Dietary intake and energy expenditure of female collegiate swimmers during decreased training prior to competition. *J Am Diet Assoc*, *101* (3), 351–354. DOI: 10.1016/S0002-8223(01)00091-8.

Petersen, H.L., Peterson, C.T., Reddy, M.B., Hanson, K.B., Swain, J.H., Sharp, R.L., Alekel, D.L. (2006). Body composition, dietary intake, and iron status of female collegiate swimmers and divers. *Int J Sport Nutr Exerc Metab*, *16* (3), 281–295.

Ramos, D.D., Toriani, S., Silva, S., Dalquano, E.C. (2010). Avaliacao nutricional e sintomas metabolicos de nadadores de competicao. *Revista Brasileira de Nutrição Esportiva. São Paulo*, *21* (4), 217–224.

Reilly, T., Woodbridge, V. (1999). Effects of moderate dietary manipulations on swim performance and bron blood lactate-swimming velocity curves. *Int J Sports Med*, *20* (2), 93–97. DOI: 10.1055/s-2007-971099.

Shaw, G., Boyd, K.T., Burke, L.M., Koivisto, A. (2014). Nutrition for swimming. *Int J Sport Nutr Exerc Metab*, *24* (4), 360–72. DOI: 10.1123/ijsnem.2014-0015.

Soares, E.A., Ishii, M., Burini, R.C. (1994). Estudo antropométrico e dietético de nadadores competitivos de áreas metropolitanas da região sudeste do Brasil. *Rev Saude Publica*, *28* (1), 9–19.

Soultanakis, H., Platanou, T. (2008). Effect of dietary carbohydrate content on blood glucose levels of swimmers during training. *J Sports Med Phys Fitness*, *48* (3), 335–340.

Trappe, T.A., Gastaldelli, A., Jozsi, A.C., Troup, J.P., Wolfe, R.R. (1996). Energy expenditure during high volume swimming training by the doubly labeled water (2H218O) method. *Br J Sports Med*, *7*, 112–118.

Trinies, V., Chard, A.N., Mateo, T., Freeman, M.C. (2016). Effects of Water Provision and Hydration on Cognitive Function among Primary-School Pupils in Zambia: A Randomized Trial. *PLoS One*, *11* (3),1–14. DOI: 10.1371/journal.pone.0150071.

Vanheest, J.L., Rodgers, C.D., Mahoney, C.E., De Souza, M.J. (2014). Ovarian suppression impairs sport performance in junior elite female swimmers. *Med Sci Sports Exerc*, *46* (1), 156–166. DOI: 10.1249/MSS.0b013e3182a32b72.

Wawrzyniak, S., Rokita, A., Ściślak, M. (2013). Zainteresowanie aktywnością ruchową uczniów wybranych liceów ogólnokształcących we Wrocławiu. *Rozprawy Naukowe Akademii Wychowania Fizycznego we Wrocławiu*, *43*, 29–38.

World Health Organisation (2005). *Nutrition in adolescence – Issues and Challenges for the Health sector.* World Health Organisation.

Zając, A., Zydek, G., Michalczyk, M., Poprzęcki, S., Czuba, M., Gołaś, A., Boruta-Gojny, B. (2014). Żywienie i suplementacja w sporcie, rekreacji i stanach chorobowych. Katowice: Wydawnictwo Akademii Wychowania Fizycznego im. Jerzego Kukuczki w Katowicach.

Cite this article as: Ferens, K., Przeliorz-Pyszczek, A. (2019). Nutritional Principles of Adolescent Swimmers. *Central European Journal of Sport Sciences and Medicine*, *1* (25), 51–61. DOI: 10.18276/cej.2019.1-06.

EMOTIONAL STATE IN RELATION TO PHYSICAL ACTIVITY AMONG OLDER PEOPLE

Agnieszka Błaszczak,[1, A, B, C, D] Ewa Dołowy,[1, B] Siemowit Muszyński[2, C, D]

[1] Department Tourism and Recreation, University of Life Sciences in Lublin, Lublin, Poland
[2] Department of Physics, University of Life Sciences in Lublin, Lublin, Poland
[A] Study Design; [B] Data Collection; [C] Statistical Analysis; [D] Manuscript Preparation; [E] Funds Collection

Address for correspondence:
Siemowit Muszyński
University of Life Sciences in Lublin
Akademicka 13, 20-950 Lublin, Poland
E-mail: siemowit.muszynski@up.lublin.pl

Abstract Old age is a stage in human life associated with alteration of physical, mental and social functioning. The aim of this study was to investigate the associations between regular physical activity (PA) and purpose of life, intensity of depressive moods, sense of coherence (SoC) and the level of anxiety in older adults. Forty six individuals physically active (A) and 49 physically inactive (NA) without mental or physical disability were included in the study. The purpose of life was assessed by Purpose of Life Scale (PIL), intensity of depressive moods by Beck Depression Inventory (BDI), SoC by Antonovsky's questionnaire and level of anxiety by State-Trait Anxiety Inventory (STAI). An NA individuals had lover BDI-feelings level compared with A group ($p < 0.05$). The NA group also showed a significantly lower scores in anxiety-feature domain of the STAI ($p < 0.05$). Our results suggest that improved self-perceived quality of life is significantly associated to PA among older adults and regular PA may be effective for improving depression and anxiety symptoms in older adults. A better understanding of the relationship between the PA and depressive moods and level of anxiety is important to develop recommendations regarding modifications in life-style.

Key words physical activity, sense of coherence, anxiety, aging

Introduction

Old age is a stage in human life associated with numerous changes in physical, mental and social functioning. The intensity of these changes is largely determined by previous phases of life. As a result of it, the efficiency of all systems decreases, especially cardio-respiratory, secretory, genitourinary and nervous system; organism immunity also decreases (Zych, Kaleta-Witusiak, 2010). Moreover, the capacity of various senses deteriorates, including vision and hearing receptors which are extremely important for independent functioning (Kielar-Turska, 2007).

The "threshold of old age" is considered to be the age of 60 years (Steuden, 2012), but due to considerable diversification of the older population in terms of health, physical ability, mental condition and life and social situation, it is further divided into two sub-periods: early old age, usually associated with a fairly good psychophysical

efficiency and late old age characterized by a significant decline in physical ability and mental condition, which lower the quality of life and functional independence. The age of 75 years is the boundary between these sub-periods (Kawula, 2003). In the consecutive age ranges, the efficiency of adaptive mechanisms decreases, the resistance of the body to harmful bacterial and viral factors and mental stress is reduced, which can lead to chronic diseases in consequence. Physical efficiency and fitness decreases, muscle sarcopenia intensifies and muscle strength and mass drops, which adversely affects the functional status of elderly people (Steuden, 2012). The cognitive functions deteriorate: including especially memory, attention, orientation and logical thinking, hindering professional activity as well as social and day to day functioning (Steuden, 2012). Deterioration of intellectual functioning is often observed. It is associated with disturbances of short-term memory system, deterioration of concentration, increase of response time (Kielar-Turska, 2007).

Changes also refer to mental and social functioning (Janiszewska-Rain, 2005). Resistance to stressful events becomes lower. A serious problem among mental disorders affecting elderly people is posed by depressive moods, which affect 15 to 25% of people over 65 years of age (Parnowski, 2005). Neuroses are also no less important, including existential neuroses affecting from 14 to 21% of elderly people, resulting from the lack of meaning of life. These disorders are very often the reason for the loss of enjoyment of life, social isolation, withdrawal from all activities which leads to a further increase in health problems, decrease in the quality of life, and even death.

As many years of research indicate, the key to obtain high psychophysical condition of an individual, allowing for the so-called successful aging, can be in regular physical activity, allowing for effective adaptation and satisfying, independent life. Numerous studies have documented the importance of regular exercise in vascular diseases of the brain (Drygas, 2006), hypertension (Sobieszczańska, Kalka, Pilecki, Adamus, 2009), osteoporosis (Jessup, Home, Vishen, Wheeler, 2003), diabetes, states of pain or in the prevention of cancer (Drygas, 2006). It was proved that moderate physical effort improves the efficiency of the immune system, preventing respiratory infections (Kostka, 2001). Regular exercise also contributes to raising respiratory, hemodynamic parameters associated with the improvement of the time of heart rate and blood pressure restitution and fitness parameters, as regards agility, stamina, strength and speed (Trzeciak, Zawadzki, 1997). When undertaken at any age it inhibits motor regression and leads to increased efficiency and physical fitness, which is extremely important in preventing from falling over (MacAuley, 2000).Physical exercise is important in the prevention and treatment of obesity which can cause numerous health problems among elderly people.

These reports confirm that physical activity is an important factor in determining the widely-understood human health, and therefore in recent years, the scope of recommendations for physical exercise among elderly people has been expanded (Sęk, 2001). Regular physical activity of moderate intensity strengthens the physical and mental condition of seniors, becoming not only an important element in the prevention and treatment of many diseases, but also plays an important role in building the psycho-physical potential which increases immunity resources that help to cope with difficult situations, helping to reduce the level of anxiety, depressive moods or negative moods, recognized as indicators of mental health (Sęk, 2001).

The key role in achieving, protecting and restoring health is attributed to a sense of coherence, which, according to A. Antonovsky is the main determining factor of how people perceive different kinds of stressors and how they deal with them (Sęk, 2001). People who are characterized by a high sense of coherence enjoy a better psycho-physical condition and are more willing to undertake activity, accept the difficulties encountered more easily, experience greater satisfaction with life and rate its quality higher (Kocięcka, Andruszkiewicz, Wrońska, 2010).

A strong sense of coherence positively correlates with adopting healthy behaviour types by a person, such as healthy diet, physical activity and preventive behaviour (Heszen, Sęk, 2002).

Numerous studies indicate that the sense of life meaningfulness plays an important role in maintaining physical and mental health (Takkienen, Suutama, Ruoppila, 2001). It reduces the risk of Alzheimer's disease and mild cognitive impairments, the maintenance of functional status and mobility of elderly people and in addition it is also associated with the reduction of the risk of death (Wysocka-Pleczyk, Słowik, 2012). Therefore, the meaning of life is considered to be one of the main elements of psychological well-being and the most important motivational factor of an individual.

The aim of this study was to investigate the relationship between taking up physical activity by seniors and their emotional state determined by variables such as the level of depressive moods, the level of anxiety, experiencing the meaning of life, a sense of coherence, self-assessment of health condition.

It was assumed that elderly people who declare pursuing systematic physical activity will be in a better emotional state than their inactive peers. Physical exercise undertaken by them will reduce the level of anxiety and depressive moods and will strengthen the sense of life meaningfulness and the sense of coherence. Moreover, the emotional state of active seniors will positively affect the perception of their own health condition.

Material and methods

The study was conducted during the period from January to April 2014. 123 people at retirement age participated in research. Participation in the study was voluntary. In order to obtain information regarding physical activity and health condition, as well as personal data, a questionnaire designed for the purpose of this study was used. After a preliminary analysis questionnaires of people under the age of 60 were rejected. Finally, 95 people aged 60 to 88 (average age 66.94) formed the study group (Table 1). The participants were city residents, living in their own flats; most of them had higher education (54.73% – 52 people). Respondents who declared secondary education accounted for 35.78% (34 people) of the total respondents' number, only 6.31% (6 people) of the respondents declared vocational education, and 3.15% (3 people) declared basic education (Table 1).

Table 1. Characteristics of the research participants

	A group	NA group	p-value
Participants, n	46	49	
Women, n (%)	40 (87.0%)	44 (89.8%)	0.755
Age, $\bar{x}$ ± sd	66.5 ±4.7	67.4 ±5.7	0.620
Education, n (%)			0.192
Basic	0 (0.0%)	3 (6.1%)	
Vocational	2 (4.3%)	4 (8.2%)	
Average	15 (32.,6%)	19 (38.8%)	
Higher	29 (63.0%)	23 (46.9%)	
BMI, $\bar{x}$ ± sd	27.2 ±3.8	26.5 ±3.5	0.392

A – physically active; NA – physically inactive; BMI – body mass index; $\bar{x}$ – mean; sd – standard deviation.

On the basis of the replies to the survey questions, concerning the pursue of systematic physical exercises, the study participants were divided into two groups: a group of physically active (A) and inactive (NA) individuals. People

who regularly took physical exercises lasting 2–3 hours at least 2–3 times a week, were considered physically active. 46 people, including 40 women and 6 men, were qualified as a physically active group, while 49 people, including 44 women and 5 men, were qualified as a physically inactive group. Almost 87% (40 respondents) of the active group declared participation in exercises twice or more times a week, only 6 people said they did exercise once a week, while 37 people from this group exercised regularly once a week by taking part in gymnastics classes, as part of UTA. More than 30% of people from group A declared that they had exercised for over 15 years, 43.4% had done exercise for at least 4 years, and the remaining 28.2% had exercised for at least one year. The distinguished groups were homogeneous with relation to age ($p = 0.620$), gender ($p = 0.755$) and the level of education ($p = 0.192$). Also, the BMI index in both groups did not differ significantly ($p = 0.392$).

Standardised research tools, having satisfactory psychometric properties, which can also be applied to elderly people, were used in order to assess the mental state of the participants.

To assess the degree of the realisation of the meaning of life part A of Purpose in Life Scale (PIL) was used (Crumbaugh,Maholick, 1964).

To study the Sense of Coherence (SOC-29) a questionnaire by A. Antonovsky was used. The questionnaire consists of 29 questions. Test questions comprise three sub-scales corresponding to the components of the sense of coherence: comprehensibility, resourcefulness and meaningfulness. The results allow for specifying both a global sense of coherence and its individual components (Antonovsky, 1987).

Beck Depression Inventory (BDI) was used to assess the intensity of depressive moods and to distinguish healthy people from ill ones. It consists of 21 items representing the affective, cognitive, motivational, and physiological symptoms of depression (Hammen, Watkins, 2008).

To measure the level of anxiety as a "state" Spielberger's State-Trait Anxiety Inventory (STAI) was used. In this test the anxiety is understood as the current, volatile emotional state of an individual and fear as "features", so relatively constant dispositions to experience anxiety states (Spielberger, 1983).

A statistical analysis of the collected results was conducted. In case of quantitative data, the arithmetic mean ($\bar{x}$) and standard deviation (sd) were calculated, while for qualitative data – the frequency and percentage figures. The verification of distribution normality was accomplished with the use of the Shapiro-Wilk W test. In order to compare average values of the results in terms of psychological variables between the two groups, the non-parametric U Mann-Whitney test for independent samples was applied and qualitative data were compared by means of the chi-square test (χ^2), assuming the level of statistical significance $p \leq 0.05$. Statistical analysis was performed with the use of SPSS 20.0 programme.

Results

Table 2 shows the results of investigating self-assessment of health condition by the participants in both groups. The results indicate significant differences in the self-assessment of health condition of people physically active and inactive ($p = 0.006$). Over 39% of the people from group A and only 10.2% from the NA group evaluate their health as good. More than 39% of participants from group A and up to 55.1% from the NA group evaluated their health status as "average". Only one person from group A and 7 from the NA group consider their health condition as "rather bad", and one person from the NA group evaluated it as "definitely bad". An equal number of people from both groups ($n = 9$) stated that their health condition is "rather good". It is interesting that the respondents from both groups, while answering the question of whether they suffered from chronic diseases, responded similarly. Almost

35% of people from group A and over 40% from the NA group gave positive answers to this question, and the difference in responses was not statistically significant (p = 0.509). Thus, slightly fewer people from group A suffer from chronic diseases, but these respondents perceive their current health condition better.

Table 2. The characteristics of the health condition self-assessment by the participants

	A group	NA group	p-value
The self-assessment of the current health condition, n (%)			0.006
Good	18 (39.1%)	5 (10.2%)	
Rather good	9 (19.6%)	9 (18.4%)	
Average	18 (39.1%)	27 (55.1%)	
Rather bad	1 (2.2%)	7 (14.3%)	
Definitely bad	0 (0.0%)	1 (2.0%)	
Incidence of chronic diseases, n (%)	30 (65.0%)	29 (59.2%)	0.509

A – physically active; NA – physically inactive.

Comparing the intensity of the meaning of life perception of the seniors declaring systematic physical activity and those physically inactive, there were no significant differences in the result pertaining to the general purpose of life, nor in the subscales: affirmation of life, self-acceptance, awareness of goals, a sense of freedom, the attitude towards future and attitude towards death, which is presented in Table 3.

Table 3. Purpose in Life (PIL) of A and NA individuals

Variable	A group		NA group		p-value
	$\bar{x}$	sd	$\bar{x}$	sd	
PIL, the overall result	109.02	18.90	102.44	23.20	0.256
Affirmation of life	43.47	8.36	41.08	9.85	0.327
Self-acceptance	17.13	2.90	15.87	3.93	0.133
Awareness of goals	16.36	3.74	15.51	4.03	0.293
The sense of freedom	10.67	2.21	9.91	2.98	0.276
Attitude towards the future	10.63	2.62	9.69	2.85	0.101
Attitude towards death	10.73	2.15	10.36	2.80	0.801

A – physically active; NA – physically inactive; $\bar{x}$ – mean; sd – standard deviation.

Statistical analysis also showed that there was no significant difference in the level of coherence between those physically active and inactive, although, as with the meaning of life, within the group of active people there are higher average values observable, both in the general result, as well as in the particular components. These data are presented in Table 4.

Table 5 shows the results of measuring depressive moods in both examined groups. On the basis of the obtained data, significant differences between physically active and inactive persons were found only in the BDI subscale feelings (p = 0.034), which includes factors such as mood, pessimism, sense of failure, dissatisfaction, a sense of punishment, self-hatred, self-accusation, the desire of self-punishment and propensity for crying. These factors are strongly associated with the affective sphere of the individual. On other scales, i.e. in general result, interpersonal contacts and somatic symptoms, there were no statistically significant differences. It is worth noting that the average overall score in both groups indicates a slight worsening of the depressive moods of the

respondents, while in the group of inactive persons they are significantly higher (p = 0.067). On other scales, despite the lack of significant differences, one can see a clear trend towards decreasing moods of depression in the group of people taking up exercise.

Table 4. The sense of coherence (SOC) of A and NA individuals

Variable	A group		NA group		p-value
	$\bar{x}$	sd	$\bar{x}$	sd	
SOC, overall result	140.86	23.95	129.91	28.69	0.079
The sense of comprehensibility	49.17	10.14	44.81	12.24	0.128
The sense of manageability	48.89	8.40	45.20	10.43	0.077
The feeling of meaningfulness	42.80	7.86	39.89	8.97	0.094

A – physically active; NA – physically inactive; $\bar{x}$ – mean; sd – standard deviation.

Table 5. The intensification of depressive moods (BDI) in the A and NA group of individuals

Variable	A group		NA group		p-value
	$\bar{x}$	sd	$\bar{x}$	sd	
BDI, overall result	10.23	8.40	12.57	7.89	0.067
Feelings	3.45	4.66	4.40	3.98	**0.034**
Interpersonal contacts	2.06	2.22	2.83	2.25	0.074
Somatic symptoms	4.71	3.08	5.32	2.96	0.205

A – physically active; NA – physically inactive; $\bar{x}$ – mean; sd – standard deviation.

The mental health of older people is affected, to a large extent, by the level of perceived anxiety, hence there was also made a comparison between the groups of active and physically inactive people in terms of this variable. The obtained results are presented in Table 6.

Table 6. The level of anxiety in A and NA groups

Variable	A group		NA group		p-value
	$\bar{x}$	sd	$\bar{x}$	sd	
Anxiety, state	11.73	7.00	13.44	6.10	0.087
Anxiety, feature	18.10	8.78	22.24	9.88	**0.023**

A – physically active; NA – physically inactive; $\bar{x}$ – mean; sd – standard deviation.

A significant difference was found in the characteristics of anxiety (p = 0.023) between the physically active and inactive individuals and no significant difference in the case of the state of anxiety (p = 0.087). These results therefore indicate that the physically active people are characterized by a significantly lower tendency to react with fear in threat situations.

Discussion

The period of late adulthood is a time when man, in the face of numerous losses, must revise their own identity, adapt to the changes (self-image, social status, professional status, economic status, loss of loved ones) and redefine the way they function; give it value and meaning (Janiszewska-Rain, 2005). Improving the emotional state of seniors involves, among other things, a positive attitude to life, a sense of its value and meaningfulness and the lack of negative states such as anxiety or depressed mood.

In the present study it a decision was made to verify whether physical activity, undertaken regularly, can affect the emotional state of the elderly, as well as their self-evaluation of health condition.

The presented results only partially confirm the hypothesis, which assumes that exercise undertaken by seniors has a beneficial effect on the level of anxiety and depressive moods and the sense of purpose in life and coherence, because statistically significant differences between the group of physically active and inactive individuals occurred only in terms of negative moods and referred to the feature of anxiety ($p = 0.023$) and the subscale of feeling in the evaluation of depressive moods BDI ($p = 0.034$). Significant differences between the groups were not established in the sense of purpose in life, the sense of coherence, the general result of the BDI and the other subscales (interpersonal contacts, somatic symptoms), as well as in the anxiety state. It is worth highlighting the fact that the physically active people were much more appreciative than their inactive peers in perceiving their health condition ($p = 0.006$), although in terms of contracting chronic diseases they were not significantly different in statistical terms ($p = 0.509$). This is especially important in relation to older people because positive assessment of their own health contributes to a more positive balance of life and may have an impact on the psychological well-being (Izdebski, Polak, 2005).

The study found no significant differences between active and inactive seniors in terms of the meaning of life, which leads to the conclusion that doing physical exercises does not affect the well-being of the respondents in this respect. However, the analysis of the obtained data can help one to notice that in the group of physically active individuals the average values on all PIL scales are significantly higher. One can therefore conclude that in better controlled test conditions, the obtained results could have been more favourable. The confirmation of this thesis lies in the data available in the literature, demonstrating the positive effect of regular physical activity on the meaning of life in older women (Takkienen et al., 2001; Guszkowska, 2012). The obtained result could have been affected by the fact that the PIL test, applied in research, differentiates better people experiencing existential frustration than purpose in life. Thus, in the case of healthy people, differences may be too small to capture.

It was not proved either, that physical activity significantly affects the level of the sense of coherence in respondents. At the same time, experimental studies available in publications suggest that people taking regular exercise improve their emotional state; there is an increase in their sense of life meaningfulness, and the sense of coherence; lower incidence of mental health problems is observed (Guszkowska, 2012). In the case of the sense of coherence, the direction of this relation was not defined, so it is difficult to determine whether physical activity affects the growth of the sense of coherence, or whether people with a high sense of coherence often take physical exercise (Włodarczyk, Ziółkowski, Włodarczyk, 2008).

The sense of coherence takes shape up to about the age of 30 under the influence of multiple experiences of an individual related to their environment and lifestyle. It can therefore be assumed that the sense of coherence, as a persistent, generalized, emotional and cognitive perception of the world, oneself and one's own life, does not undergo major changes in later periods of life. However, it should be noted that with a high sense of coherence

comes the belief that life is meaningful, predictable and orderly, which triggers the motivation to be healthy, to function efficiently, trying to improve the quality of one's own life (Dolińska-Zygmunt, 2001).

This study had a comparative character and was based on declarations, and thus it was impossible to verify the actual level of physical activity of the active individuals, which could have been crucial for the obtained results. Additionally, in the research only the activity in the form of recreational physical exercises was considered, while in the case of elderly people every type, duration and intensity of physical activity, including those related to day-to-day activities or working in a garden, may be significant for their well-being. Thus, perhaps only a tendency of active people towards improvement in depressive moods, sense of coherence and the meaning of life was outlined. The predominance of women among the research respondents could have been significant, as it has been shown that in the case of women physical activity contributes to reducing symptoms of depression to a lesser extent than in men (Reichert, Diogo, Vieira, Dalacorte, 2011).

The results indicate that active people are characterized by a significantly lower tendency to react with fear in threat situations, and therefore should also be less prone to experiencing situational anxiety. The observed lack of significant difference in the case of the "state" of fear may stem from the fact that the questionnaire was not filled in immediately after doing exercise and, therefore, the subjects could have been exposed to various factors causing a momentary sense of fear at that time. In the research on the impact of exercise on anxiety, the time that elapses between exercise and survey may be significant (Guszkowska, 2013). Too large a gap may trigger the fading of the anxiolytic effects of exercise, which primarily reduce physical tension and bring satisfaction.

The results suggest that physical activity is more significant in reducing adverse conditions, namely in the field of anxiety and depressive moods (Guszkowska, Kozdroń, 2009). Physical activity improves moods of older women, and contributes to the weakening of the dependence of the mood on the feature of fear, bringing benefits in the emotional sphere (Guszkowska,Kozdroń, 2009). Moreover, exercise allows one to relieve emotional tension and decreases the readiness to respond with negative emotions (Guszkowska, 2005).

Also, other studies have shown that regular physical activity, can slow down the process of change in terms of cognitive functions and abilities (O'Dwyer, Burton, Pachana, Brown, 2007; Miller, Taler, Davidson, Messier, 2012), improve self-perception and social interaction (Fox, Stathi, McKenna, Davis, 2007), have positive influence on reducing the level of anxiety and depression (Teixeira, Vasconcelos-Raposo, fernandes, Brustad, 2013), improve mood (Arent, Landers, Etnier, 2000), self-esteem, one's own body image, memory, concentration, family relationships (Sheridan, Radmacher, 1992). In the review by Vagetti and co-workers, discussing the results of studies from recent years on the impact of physical activity on the quality of life of older people, it was found that over 85% of all research reports positive effects of physical exercise on the perception of the quality of life in the field of mental health. These authors did not find works dealing with the negative impact of physical activity on these domains of life (Vagetti et al., 2014).

In conclusion, this study has revealed no significant differences between physically active and inactive individuals in terms of the sense of coherence and sense of life meaningfulness – variables which are important resources for human immunity. There were, however important differences between physically active and inactive individuals in terms of the perception of their own health, depressive moods (the scale of emotionality) and anxiety feature, thus suggesting a positive effect of systematic physical activity on negative moods of seniors. These results encourage one to conduct further research in this area in experimental conditions, because physical activity can be used as a widely available prophylactic and therapeutic means, supporting other forms of treatment of the emotional

states of seniors. Unfortunately, people who in their youth did not develop the need to be active and take up physical activity in themselves, do not undertake physical activity in older age; not only as a result of deteriorating health and physical function, but also due to social stereotypes regarding elderly people and old age (Błaszczak, Dołowy, Bednarska, 2015). Hence there is ample justification for the actions aimed not only at encouraging older people to pursue physical activity, but also to create conditions for its practice, so that it could become a regular part of their lifestyle.

References

Antonovsky, A. (1987). *Unraveling the mystery of health. How people manage stress and stay well*. San Francisco: Jossey-Bass Publishers.

Arent, S., Landers, D., Etnier, J. (2000). The effects of exercise on mood in older adults: A meta-analytic review. *Journal of Aging and Physical Activity*, *8*, 407–430.

Błaszczak, A., Dołowy, E., Bednarska, B. (2015). Physical activity in the lifestyle of elderly persons. In: B. Sawicki (ed.), *Promotion of healthy lifestyle in European countries* (pp. 254–270). Lublin: University of Life Sciences.

Crumbaugh, J., Maholick, L. (1964). An experimental study in existentialism: The psychometric approach to Frankl's concept of noogenic neurosis. *Journal of Clinical Physiology*, *20*, 200–207.

Dolińska-Zygmunt, G. (2001). Orientacja salutogeniczna w problematyce zdrowotnej. Model Antonovsky'ego. In: G. Dolińska-Zygmunt (ed.), *Podstawy psychologii zdrowia* (pp. 19–33). Wrocław: Wydawnictwo Uniwersytetu Wrocławskiego.

Drygas, W. (2006). Czy „siedzący" styl życia nadal stanowi zagrożenie dla zdrowia społeczeństwa polskiego? *Medycyna Sportowa*, *2* (6), 111–116.

Fox, K., Stathi, A., McKenna, J., Davis, M. (2007). Physical activity and mental well-being in older people participating in the Better Ageing Project. *European Journal of Applied Physiology*, *100*, 591–602.

Guszkowska, M. (2005). *Aktywność ruchowa a przebieg transakcji stresowej u młodzieży.* Warszawa: Wydawnictwo AWF.

Guszkowska, M. (2012). Aktywność fizyczna a nastrój i zadowolenie z życia kobiet w wieku późnej dorosłości. In: J. Nowocień, K. Zuchora (eds.), *Aktywność fizyczna i społeczna osób trzeciego wieku* (pp. 217–227). Warszawa: Wydawnictwo AWF.

Guszkowska, M. (2013). *Aktywność fizyczna i psychika.* Toruń: Adam Marszałek Press.

Guszkowska, M., Kozdroń, A. (2009). Wpływ ćwiczeń fizycznych na stany emocjonalne kobiet w starszym wieku. *Gerontologia Polska*, *17*, 71–78.

Hammen, C., Watkins, E. (2008). *Depression* (2nd ed.). London: Physiology Press/Taylor & Francis.

Heszen, I., Sęk, H. (2002). *Psychologia zdrowia*. Warszawa: Wydawnictwo Naukowe PWN.

Izdebski, P., Polak, A. (2005). Bilans życia i poczucie koherencji osób starszych w zależności od ich sytuacji życiowej. *Gerontologia Polska*, *13*, 188–194.

Janiszewska-Rain, J. (2005 Okres późnej dorosłości. Jak rozpoznać potencjał ludzi w wieku podeszłym. In: A. I. Brzezińska (ed.), *Psychologiczne portrety człowieka* (pp. 591–622). Gdańsk: Gdańskie Wydawnictwo Pedagogiczne.

Jessup, J., Horne, C., Vishen, R., Wheeler, D. (2003). Effects of exercise on bone density, balance and self-efficacy in older women. *Biolgical Research for Nursing*, *4*, 171–180.

Kawula, S. (2003). *Pedagogika społeczna. Dokonania-aktualność-perspektywy.* Toruń: Adam Marszałek Press.

Kielar-Turska, M. (2007). Rozwój człowieka w pełnym cyklu życia. In: J. Strelau (ed.), *Psychologia* (vol. 1, pp. 285–332). Gdańsk: Gdańskie Wydawnictwo Pedagogiczne.

Kocięcka, A., Andruszkiewicz, A., Wrońska, I. (2010). Poczucie koherencji a stan zdrowia pielęgniarek czynnych zawodowo. *Problemy pielęgniarstwa*, *18*, 139–144.

Kostka, T. (2001). The role of physical activity in health promotion in older people. *Medycyna Sportowa*, *5* (suppl. 2), 149–150.

MacAuley, D. (2000). Rola aktywności ruchowej w promocji zdrowia u osób starszych. *Medycyna Sportowa*, *4*, E7–E14.

Miller, D., Taler, V., Davidson, P., Messier, C. (2012). Measuring the impact of exercise on cognitive aging: methodological issues. *Neurobiology of Aging*, *33*, e29–e43.

O'Dwyer, S., Burton, N., Pachana, N., Brown, W. (2007). Protocol for fit bodies, fine minds: a randomized controlled trial on the effect of exercise and cognitive training on cognitive functioning in older adults. *BMC Geriatrics*, *7*, 23.

Parnowski, T. (2005). *Depresje w wieku podeszłym*. Warszawa: Instytut Psychiatrii i Nerobiologii, Warszawa.

Reichert, C., Diogo, C., Vieira, J., Dalacorte, R. (2011). Physical activity and depressive symptoms in community-dwelling elders form southern Brazil. *Revista Brasileira de Psiquiatria*, *33*, 165–170.

Sęk, H. (2001). Salutogeneza i funkcjonowanie właściwości poczucia koherencji. In: H. Sęk, T. Pasikowski (eds.), *Zdrowie – Stres – Zasoby. O znaczeniu poczucia koherencji dla zdrowia* (pp. 23–42). Poznań: Wydawnictwo Humaniora.

Sheridan, C., Radmacher, S. (1992). *Health psychology: challenging the biomedical model*. New York: Wiley & Sons.

Sobieszczańska, M., Kałka, D., Pilecki, W., Adamus, J. (2009). Aktywność fizyczna w podstawowej i pierwotnej prewencji choroby sercowo-naczyniowej. *Polski Merkuriusz Lekarski*, *26*, 156–159.

Spielberger, C. (1983). *State-Trait Anxiety Inventory*. Palo Alto: Consulting Psychologists Press.

Steuden, S. (2012). *Psychologia starzenia się i starości*. Warszawa: Wydawnictwo Naukowe PWN.

Takkienen, S., Suutama, T., Ruoppila, I. (2001). More meaning by exercising? Physical activity as a predictor of a sense of meaning in life and of self-rated health and functioning in old age. *Journal of Aging and Physical Activity*, *9*, 128–141.

Teixeira, C., Vasconcelos-Raposo, J., Fernandes, H., Brustad, R. (2013). Physical activity, depression and anxiety among the elderly. *Social Indiccators Research*, *113*, 307–318.

Trzeciak, B., Zawadzki, M. (1997). Kinezyterapia a wydolność fizyczna osób starszych. *Kultura Fizyczna*, *7–8*, 21–23.

Vagetti, G., Barbosa Filho, V., Moreira, N., de Oliveira, V., Mazzardo, O., de Campos, W. (2014). Association between physical activity and quality of life in the elderly: a systematic review. *Revista Brasileira de Psiquiatria*, *36*, 76–88.

Włodarczyk, P., Ziółkowski, A., Włodarczyk, A. (2008). Wpływ składników poczucia koherencji na podejmowanie aktywności fizycznej. In: M. Krawczyński (ed.), *Psychologiczne konteksty aktywności fizycznej człowieka* (pp. 225–240). Gdańsk: Wydawnictwo Ateneum – Szkoła Wyższa w Gdańsku.

Wysocka-Pleczyk, M., Słowik, P. (2012). Poczucie sensu życia i style radzenia sobie u pacjentów z chorobą niedokrwienną serca. *Problemy Higieny i Epidemiologii*, *93*, 771–778.

Zych, A., Kaleta-Witusiak, M. (2010). Geragogika specjalna-moralnym obowiązkiem naszych czasów. In: A. Nowicka (ed.), *Wybrane problemy osób starszych* (pp. 27–41). Kraków: Oficyna Wydawnicza Impuls.

Cite this article as: Agnieszka Błaszczak, A., Dołowy, E., Muszyński, S. (2019). Emotional State in Relation to Physical Activity Among Older People. *Central European Journal of Sport Sciences and Medicine*, *1* (25), 63–72. DOI: 10.18276/cej.2019.1-07.

PRO-HEALTH BEHAVIOURS IN TIME BUDGET OF EX-CYCLISTS

Magdalena Bentkowska

Department of Theory and Methodology of Physical Education, Faculty of Physical Education and Sport, University of Physical Education in Kraków, Poland

Address for correspondence:
Magdalena Bentkowska
Jarzębinowa 19, 32-052 Radziszów, Poland
E-mail:maga.bentkowska@gmail.com

Abstract The study involved 50 ex-cyclists at age 22–66, there were 17 women and 33 men. This survey-based study was performed using two standardized tools: Health Behaviour Inventory (IZZ) and The questionnaire on daily routines (chronocard). The most of the studied group (58%) undertook pro-health behaviours at the median level, 24% presented the maximum level of health behaviours, and the smallest studied group (18%) presented the minimum level of IZZ. It showed that gender didn't influence the health behaviour of ex-cyclists ($p = 0,784$). An amount of time for different activities (work/study, activities at home, relax, entertainment, physical activity and others) is different during each weekdays. The dominance in the time budget of ex-cyclists was work (study). The most of the leisure time, the studied group spent for amusements and the less for relax and physical activity. The dominance of the studied group were in median and minimum level of health behaviours with the most escalated behaviours in positive mental attitude and lower in nutritional habits, prophylactic behaviours and healthy habits. The studied group presented very restricted pro-healthy lifestyle.

Key words pro-health behaviours, time budget, ex-athletes, cycling

Introduction

In considerations regarding health these days, the lifestyle – to which at the end of the seventies of the 20th century a decisive role in the creation of health has been granted, in line with the concept of health fields included in the Lalonde Report – is significant. In the context of health it can be defined as "an interrelated system of behaviours (habits and actions) characteristic of an individual or a social group and being significant for health" (Heszen, Sęk, 2012). Pro-health behaviours foster health, in particular rational eating habits, physical activity, effective coping with psychological stress, avoiding psychoactive substances and risky sexual contacts and making use of preventive examinations. (Heszen, Sęk, 2012; Wojtyniak, Goryński, Moskalewicz, 2012). An important element of pro-health lifestyle is a systematic, recreational physical activity, adjusted to the individual needs and exercise capacity of a person. Being physically active from the young age fosters not only taking up various forms of physical activity in adulthood, but also the quality of life at elderly age (Rejeski, Mihalko, 2001). Research has also proved that the lack of physical activity is one of the basic problems of public health, touching upon whole societies, including

adults, children and teenagers. The factors which are considered as those limiting physical activity are a result of not only a progress in urbanization and automatization but also of ways of spending free time competitive to physical activity (television, Internet) (Wojtyniak, Goryński Moskalewicz, 2012). In addition to this, research indicates that a modification of a lifestyle is possible at each stage of life and can not only influence its quality, but decrease mortality and the necessity of professional health care as well. It is important to be at peace with your inner self, satisfy your needs, and at the same time obey the rules of a healthy lifestyle (Śmigielski, Bielecki, Dryga, 2013). Every stage of development determines different purposes and needs. A competitor in the course of his/her career is driven by competition. It is important for him/her to realize his/her dream and stand on the top step of the podium. The style of life he/she leads is determined by the sport discipline practiced. One is motivated and driven by the purpose, which is success.

Ending the professional career influences the whole life of a sportsperson. The changes are often drastic and irrevocably affect the lifestyle. It is very frequent for the physical and mental health of an individual to worsen in those who have retired (Bartoszewicz, Gandziarski, Lewandowska, Szymańska, 2014). As a consequence of the above, the psychosocial balance, being a result of the adjusting processes which become more and more difficult, is upset. It is very often a problem of finding a place in the new life role. A change of customs, habits, behaviours may lead to a decrease of the life satisfaction level, a feeling of emptiness and hopelessness, which, as a result, affects mental health causing malaise and unfriendly attitude towards the surrounding reality.

A changing lifestyle also contributes to a change in activities taken up so far. The amount of free time usually increases. The priorities of a competitor change as well. Due to the change of a lifestyle, determining the amount of free time of an individual, as well as the way in which it is spent, takes on a new meaning. J. Dumazedier emphasizes that „rest is an activity different from the duties related to work, family and society. Duties which are being given up foster the feeling of relaxation, increasing knowledge as well as spontaneity" (Dumazedier, 1974). In line with this rule, a life of a human should be based on maintaining harmony between work performed, other activities and rest. Taking into consideration budget analysis, it is also important to define free time "in its pure form, which means it is a natural element of a human existence. It is a part of their 24-hour time budget and it is free of any obligatory activities" (Kolny, 2016). It means performing active and passive tasks, resulting in the experience of satisfaction and pleasure. The free time is determined here by the state of mind, the result of which mainly emotional needs are satisfied.

Till 1965 time budget measurements in Poland were carried out only on narrow socioоccupational groups (railway workers, teachers, textile workers), but only since 1965 (after the unification of measurement methods by UNESCO) more representative researches have been carried out, taking into consideration civilizational, social and cultural conditions for spending free time among various groups and social environments (Bukowiec, 1990). Taking into account the time budget it is possible to precisely determine all the behaviours and activities taken up by a human in a given time. The data also enable determining the time of duration of a given activity and the frequency of its occurrence.

Purpose of work

The purpose of this work has been the assessment of pro-health behaviours in the context of time budget of ex-cyclists.

Material and methods

Researches were carried out at the turn of 2016 and 2017 on ex-cyclists as pilot schemes. They covered a group of 50 people who finished their professional careers. Among the examined, there were 17 women (33%) and 33 men (67%) at the age of 22–66 (the average age: 34.9). It was randomly selected group. The ex-cyclists were on the different levels during their sport's career. They were winners of the championships, Tour de Pologne. They competed in the Olympic Games. Their sports career lasted 2– 25 years (the average: 11 years). The time since they have finished the sport's career 2–37 years (the average: 9.5 years). The examined have been divided into two groups. First group was an early adulthood (N = 33) (the average age: 26.6), the second group was middle adulthood and late adulthood (N = 17) (the average age: 51.0).

The diagnostic poll method was used, and the research tool were two standardized questionnaires: Inventory of Pro-health Behaviours and Questionnaire of Autoregistration of the daily activities – a chronocard.

The Inventory of Pro-health Behaviours is made up of 24 statements describing behaviours related to health. The statements can be categorized as follows: eating habits, preventive behaviours, positive attitude, health practices. The questionnaire enables obtaining the general score as well as a score in each of these categories. It also has norms in the standard ten scale, thanks to which it is possible to make a reference of the general score to the average score of the population of Poland. A high score (7–10) indicates the dominance of pro-health behaviours in the examined individual, while a low score (1–4) indicates the dominance of anti-health behaviours. Scores in the range of 5-6 indicate the existence of mixed behaviours (Juczyński, 2009).

Time budget of the examined has been described using the Questionnaire of Autoregistration of the daily activities – a chronocard. The time budget is based on a collation of a length of an activity and its consequence in a determined period of time, which is mainly a day and night or a week – the time budget includes at least three series of data: the kind of activity, the place of an activity over time and the duration of an activity (Bukowiec, 1990). Thanks to such a division, the similarities and differences among different social or demographic groups can be spotted. The examined noted down all their activities during day and night with an accuracy of 15 minutes over a period of 1 week.

The calculations have been made with the use of programmes Statistica 12 and SPSS 21. Test t and chi-square test with multiple comparisons have been used for the analyses of intergender differences (z tests for the proportion with Bonferroni correction, indicated in percentage tables with letters a and b). GLM has been used for the analyses of differences in the amount of time dedicated for various activities in the course of a week, and Pearson correlation analysis has been used for determining the relations between the variables. The materiality level adopted in statistical analyses has been determined to $\alpha = 0.05$.

Results

Pro-health behaviours have been assessed with the Inventory of Pro-health Behaviours. On the basis on the obtained data (Table 1) it has been shown that the majority of the examined (58%) displayed pro-health behaviours to the average extent, 18% presented a low level of the general index of pro-health behaviours and the minority of the examined (24%) declared a high level of such behaviours. No material differences in the existence of pro-health behaviours among men and women have been spotted ($p = 0.784$).

No material intergender differences in the level of pro-health behaviours have been discovered (Table 1).

Table 1. Level of pro-health behaviours per gender

Gender	Total		Results of the Inventory of Pro-health Behaviours					
			low		average		high	
	N	%	N	%	N	%	N	%
Women	16	32.0	2_a	12.5	10_a	62.5	4_a	25.0
Men	34	68.0	7_a	20.6	19_a	55.9	8_a	23.5
Total	50	100.0	9	18.0	29	58.0	12	24.0

$\chi 2$ (2) = 0.49; p = 0.784; a, b – z tests for proportions with Bonferroni correction (values in rows with material differences have been marked: a, b).

Among the categories included in the Inventory of Pro-health Behaviours (Table 2), the examined have obtained the highest average in the category of positive attitude (22.51), then in the category of proper eating habits (20.86) and preventive behaviours (20.10), and the lowest score in the category of everyday pro-health practices (19.25). This implies that the examined predominantly display behaviours related to, among others, mental health, i.e. avoiding strong emotions and tensions, coping with stress. They pay less attention to the proper eating habits and preventive behaviours, e.g. gathering information about factors fostering keeping up good health and preventing the development of diseases or regular medical check-ups, and the least important are for them the daily pro-health practices in the form of the proper amount of everyday sleep and rest, recreational physical activity and limiting stimulants. The gender analysis of pro-health behaviours of the examined (Table 2) indicates that there have been no material differences between men and women, although women have obtained slightly higher average scores in all the categories of the Inventory of Pro-health Behaviours.

Table 2. Categories of pro-health behaviours of the examined per gender (M ± SD)

Pro-health behaviours	Total (N = 51)		Women (N = 17)		Men (N = 34)		Difference
	M	SD	M	SD	M	SD	p
Possitive attitude	22.51	2.96	23.12	2.85	22.21	3.01	0.305
Preventive behaviours	20.10	4.04	21.18	3.56	19.56	4.21	0.180
Proper eating habits	20.86	4.32	21.53	3.68	20.53	4.62	0.441
Health practices	19.25	3.14	19.35	2.60	19.21	3.42	0.877
Inventory of Pro-health Behaviours – general index	82.73	9.36	81.18	8.10	81.50	9.81	0.189

Legend: M – mean; SD – standard deviation.

The activities from the chronocard have been classified and listed under the following groups:

I – work/study,

II – time at home (tidying-up, getting dressed, packing, preparing and eating meals, time spent with own kids, minor home repairs, washing, ironing, toilet),

III – rest (night sleep, walk, rest, day sleep, other),

IV – entertaining activities, social life, consumption of cultural goods and religious practices (watching TV, time spent using the computer/Internet, conversations with family/friends, social life/meeting friends,

reading books/press, time spent with a partner/wife/husband, discos/family gatherings/concerts/cinema, religious practices, telephone conversations, hobby),

V – participating in various forms of physical culture (cycling, running, swimming, gym, fartlek, tourist-recreational activities, watching sport events, morning and evening exercises),

VI – various activities (commuting, travelling, trips, shopping, business meetings, dealing with official matters, medical appointments, other).

Analysis were perform to compare the level of various activities during the week (Table 3) and free-time activities (Table 4) between the distinguished age groups.

Table 3. The differences in the level of various activities during the week between age groups

	df	F	p	Partial Eta-squared	Power observed (alfa = 0.05)
Age group	1	0.12	0.727	0.00	0.06
Error	48				
Day	5	0.87	0.500	0.02	0.31
Day × age group	5	0.86	0.510	0.02	0.31
Error	240				
Type of activity	6	226.55	<0.001	0.83	1.00
Type of activity × age group	6	0.77	0.595	0.02	0.30
Error	288				
Day × type of activity	30	6.98	<0.001	0.13	1.00
Day × type of activity × age group	30	0.89	0.631	0.02	0.84
Error	1,440				

Legend: df – degrees of freedom; F – value of analysis of variance; p – p-value; Partial Eta^2 – effect size.

There hasn't been observed any statistically significant relations between age group and activity level during the week. There has been observed a relation in all week's level of direct physical activities ($F_{6,288} = 226.55$; $p < 0.001$), and it has been observed that the level of variety activities is different during the week ($F_{30,1440} = 6.98$; $p < 0.001$) (Figure 1).

The activities such as: work/study, work/study at home, rest and entertainment were the most popular during the beginning of the week, especially the third day. At the end of the week these activities were on the lower level. The physical activity and various activities were at the same low level during all the week. The more detail information is included in the Appendix 1.

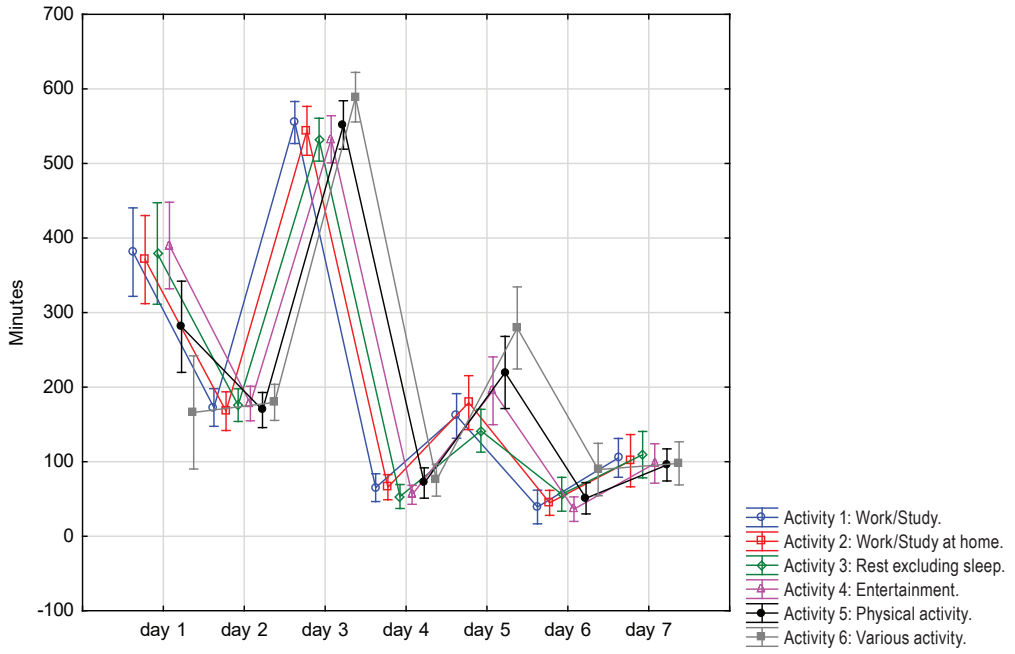


Figure 1. Variety of physical activities during the week

Table 4. The differences in the level of free-time activities between age groups

	df	F	p	Partial Eta-squared	Power observed (alfa = 0.05)
Age group	1	2.39	0.129	0.05	0.33
Error	48				
Day	5	12.10	0.000	0.20	1.00
Day × age group	5	0.63	0.677	0.01	0.23
Error	240				
Type of free-time activity	2	92.61	<0.001	0.66	1.00
Type of free-time activity*age group	2	1.95	0.148	0.04	0.39
Error	96				
Day × type of free-time activity	10	3.03	0.001	0.06	0.98
Day × type of free-time activity × age group	10	0.85	0.585	0.02	0.45
Error	480				

Legend: df – degrees of freedom; F – value of analysis of variance; p – p-value; Partial Eta^2 – effect size.

There has been no statistically significant relation between the age and the direct activities in the free time ($F_{2.96}$ = 1.95; p = 0.148). There has been a relation in the level of direct activities independently of age ($F_{2.96}$ = 92.61; p < 0.001) (Figure 2). Detailed comparisons were made with the Tukey post-hoc test (Table 5). It was also observed

that the level of various free-time activities changes during the week ($F_{10,480} = 3.03$; $p = 0.001$). Detailed results are presented in Figure 3 (the more detail information are in the Appendix 2 (NIR test)).

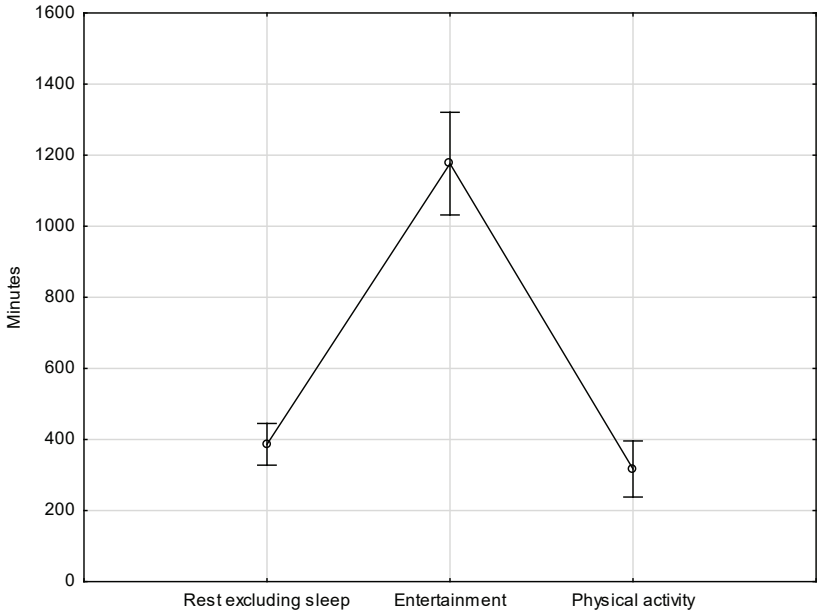


Figure 2. Amount of time spent on various free-time activities

Table 5. Tukey post-hoc test (p-value for differences between types of free-time activities)

Activity	Rest excluding sleep Mean = 380.60	Entertainment Mean = 1,136.4	Physical activity Mean = 318.70
1. Rest excluding sleep	–	<0.001	0.622
2. Entertainment			<0.001
3. Physical activity			–

The research group most of their all week's free time spent for entertainment. The least time of the all week's free time they spent for physical activity and rest excluding sleep.

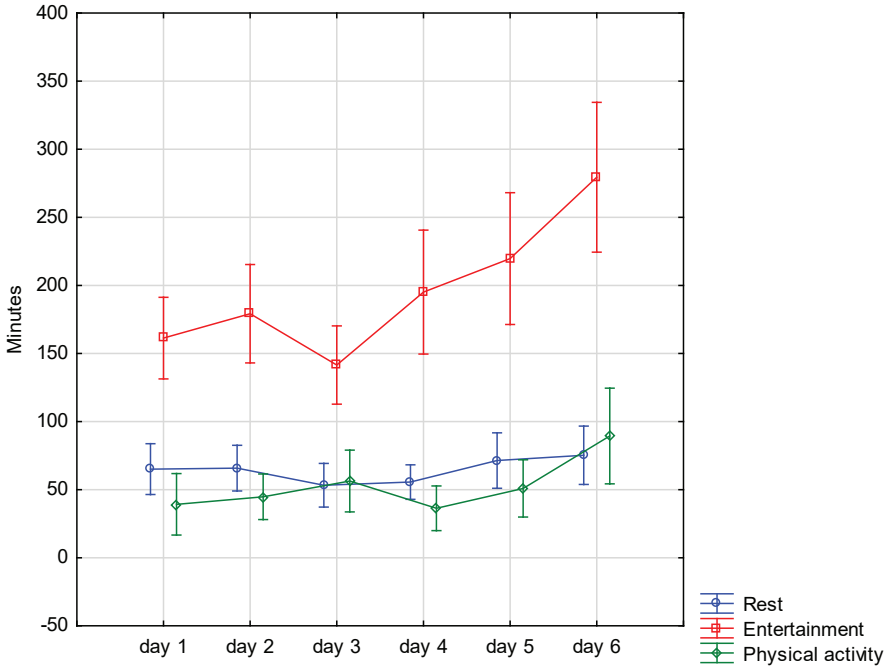


Figure 3. Amount of time spent on various free-time activities during the week

The conducted analyses have shown, that the research group spent most of their free time for entertainment, however that difference was seen especially on Friday and Saturday. It has been also seen that on Monday and Wednesday the examined spent the less of the all week's time for entertainment. The sooner the end of the week the more time for entertainment was spent. There was a decrease in the amount of time devoted to physical activity on Thursday, during the weekend the amount of time devoted to physical activity increased, especially on Saturday.

Due to the lack of statistically significant differences between the distinguished age groups, it was decided to perform a correlation analysis for all the subjects (Table 6).

Three statistically significant relations have been observed between the amount of time spent on various activities and the level of pro-health behaviours. An increase of positive attitude was accompanied by a decrease in the amount of time spent on rest (including night sleep). An increase of proper eating habits was accompanied by an increase of time spent on physical activity and an increase of preventive behaviours was accompanied by a decrease of time spent on various, other activities, e.g. commuting, shopping, dealing with official matters or medical appointments.

Table 6. The correlations between amount of time spent on various activities in the week and pro-health behaviours

		Positive attitude	Preventive behaviours	Proper eating habits	Health practices	Inventory of Prohealth Behaviours
Work/Study	r	0.051	0.050	–0.101	–0.037	–0.022
	p	0.727	0.730	0.484	0.797	0.881
Work at home	r	0.092	0.141	–0.018	0.030	0.093
	p	0.524	0.328	0.901	0.834	0.521
Rest	r	–0.312	–0.228	–0.278	0.166	–0.273
	p	0.028	0.111	0.051	0.250	0.055
Rest excluding sleep	r	–0.186	–0.182	–0.096	0.054	–0.165
	p	0.196	0.207	0.507	0.709	0.251
Entertainment	r	–0.021	–0.009	0.002	–0.155	–0.062
	p	0.887	0.952	0.988	0.281	0.671
Physical activity	r	0.053	0.067	0.296	0.059	0.204
	p	0.715	0.644	0.037	0.685	0.156
Various activities	r	–0.010	–0.320	0.067	0.002	–0.111
	p	0.943	0.023	0.646	0.987	0.442
Free time (%)	r	–0.150	–0.094	–0.022	–0.008	–0.102
	p	0.299	0.516	0.878	0.956	0.480
Free time excluding sleep	r	–0.143	–0.041	0.057	0.015	–0.032
	p	0.321	0.777	0.694	0.919	0.824
Free time excluding sleep (%)	r	–0.054	–0.037	0.098	–0.084	–0.015
	p	0.711	0.801	0.496	0.564	0.916
Free time	r	–0.055	–0.018	0.136	–0.077	0.012
	p	0.704	0.902	0.347	0.596	0.934

Legend: r – Pearson correlation index; p – p-value.

Discussion

The results of own research indicate that the most of ex-cyclists declared an average (58%) and high (24%) level of pro-health behaviours. No material differences have also been discovered in the level of pro-health behaviours of men and women (p = 0.715). Among the analysed, four categories of pro-health behaviours (Juczyński, 2009), the examined have obtained the highest scores in the category of positive attitude (positive thinking, maintaining positive relations with other people, avoiding strong emotions and tensions), lower in the category of proper eating habits (regarding the kind and regularity of the consumed products) and the category of preventive behaviours (obeying doctors' recommendations, regular checkups, avoiding colds, obtaining health information). The lowest scores have been observed in the area of health practices (proper amount of sleep, recreational physical activity, body mass control, avoiding stimulants). No material differences have been observed between men and women in the above mentioned category of pro-health behaviours.

Low, different from the characteristics of health training level of participation in physical culture and limited scale of rational eating choices has been indicated in the research of M. Gacek (2011a) carried out on a group

of 240 doctors from Lesser Poland Voivodship at the age of 35–50 (Gacek, 2011b). The research, whose purpose was to assess the pro-health behaviours of doctors, was carried out on the whole territory of Poland in 2015. In the group of 523 active medical doctors at the average age of 49.16 ±13.56, 27.34% were indicated to display predominantly anti-health behaviours. It was additionally discovered that the risk of anti-health behaviours in the analysed group was increasing by 3.2% every year since the completion of the specialisation ($p < 0.01$). The results of the research showed that women displayed a higher level of pro-health behaviours than men ($p < 0.01$) (Bąk-Sosnowska, Kołodziej, Gojdźm Skypules-Plinta 2015). Women at around the menopausal age were observed to realize the assumption of a healthy lifestyle to a limited extent in rural and municipal areas, whereas some of the prohealth behaviours, especially the level of recreational physical activity, psychoactive substances usage and methods of coping in difficult situations differ depending on the place of residence (Gacek, 2011b). Another research on 75 women aged 36–50 proved that only 28% of the questioned confirmed that in their lifestyles there are some pro-health behaviours and 49% of the questioned was unable to state what kind of lifestyle they led. It turned out that pro-health attitudes and habits are understood in two ways. Younger women understand a healthy lifestyle form the perspective of proper eating and physical activity while those at the age of 36–50 find wellbeing, lack of addictions and regular physical activity a core of a healthy lifestyle (Kwilecki, 2011). A research carried out in 2016 regarding the lifestyle and pro-health behaviours on the rural areas of Subcarpathian region among 800 farmers aged 3060 indicated that almost a half of the questioned (47%) displayed a low level of pro-health behaviours. Similarly to the case of the examined doctors, women showed a higher level of pro-health behaviours than men ($p < 0.001$) (Binkowska-Bury et al., 2016). Also, the lifestyle of teachers, the vocational group who participate directly in shaping pro-health behaviours and attitudes, significantly stands out from the pro-health model (Prażmowska, Dziubak, Morawska, Stach, 2011; Laudańska-Krzemińska, 2014). A research of Kaleta and others (Kaleta, Makowiec-Dąbrowska, Polańska, Dziankowska-Zaborszczyk, Drygas, 2009) also indicated that pro-health behaviours measured with the so called index of healthy lifestyle (not smoking, regular physical activity, proper body mass and daily fibre consumption) are not widespread. The random sample included professionally active residents of Łódź and Lublin Voivodships (N = 442). The carried out research indicated that only 3.5% men and 1.9% women lead a healthy lifestyle. A research of Reeves and Rafferty (2005) also indicates that pro-health behaviours in the American population are poorly represented as only 3% of adults meet the criteria of a healthy lifestyle (Gacek, 2011a). In the analysis of Berrigan and others (Berrigan, Dodd, Troiano, Krebs-Smith, Barbash, 2003), the healthy lifestyle recommendations, including not smoking, physical activity, fruit and vegetables consumption, limiting alcohol and fat consumption was obeyed by mere 5.9% of adults (Bäckmand, Kujala, Sarna, Kaprio, 2010).

The own research of ex-cyclists indicates that during the week most of the time the examined spent on work and the least time on rest and physical activity. The research carried out on the medical doctors (Bąk-Sosnowska et al., 2015) also confirms that in their weekly time budget work is predominant. The results of the own research also show that with an increase of the proper eating habits the amount of time spent on physical activity increased too, and with an increase of time spent on preventive behaviours there was a decrease of time spent on various, other activities, e.g. commuting, shopping, dealing with official matters or medical appointments. As regards the increase in positive attitude, there was a corresponding decrease of time spent on rest (including night sleep).

Research in which ex-sportspeople, both professional and amateur took part, carried out in Canada in 2015, presented a picture of their behaviours in the psychological context. The results indicated that the lifestyles of sportspeople in the course of their careers were at less than optimal level (MacCosham, Patry, Beswick, Gravelle, 2015). However, after finishing their career, the sportspeople changed their behaviours and perception of the world. They were able to balance physical activity with other important aspects of their lives, decreasing at the same time the risk of rejection or the feeling of resignation in the surrounding environment. Research covering the risk of diseases after finishing professional career was carried out on 20 sportspeople (17 men and 3 women) at the average age of 52.4 ±16.6 in 2015 in Italy. The questioned played different sports (sailing, football, cycling, combat sports, fencing, swimming and tennis). The results of the research showed that 10% of the examined population was facing the danger of depression, 25% led an unhealthy lifestyle and was fighting against obesity. The result of a "lack of sport" was not only a problem of an increased BMI level, but also depression or fears diminishing the quality of lives of the questioned (Stefani, Di Tante, Matan, Galanti, 2015). The next research carried out on 6 ex-sportspeople in individual sports disciplines picture life situations of sportspeople at the moment of finishing their professional careers. This research indicates that all sportspeople after finishing their sports career have displayed positive attitudes and the lifestyles they led were characterized by pro-health behaviours and frequent physical activity. While choosing a new career path, they were predominantly led by their sports experience (Rezende, Maciel, Carvalho, Cappelle, Campos, 2015). Other research also indicate that ex-sportspeople continue physically active lifestyle and lead a more pro-health lifestyle in comparison to other groups in the population and less frequently suffer from cancer (Sormunen et al., 2014).

Conclusions

The obtained results of research have enabled forming the following end conclusions:

1. In the examined group of ex-cyclists an average and high level of pro-health behaviours dominate, with the most frequent behaviours in the area of positive attitude and the least frequent (in the hierarchical order): positive attitude, proper eating habits, preventive behaviours and health practices. The examined group realizes a pro-active lifestyle to a limited extent.
2. The amount of time spent on various activities (work/study, home activities, rest, entertainment, physical activity and other activities) is different in particular days of the week. In the time budget of ex-cyclists, work and study dominate. The amount of these decreases proportionally towards the end of the week.
3. The most of their free time, the examined spent on entertainment, and the least on rest and physical activity.
4. With an increase of the level of proper eating habits there was an increase in the amount of time spent on physical activity.

Appendix 1. Planned comparisons

Day	(I) Activity	(J) Activity	The mean difference (I-J)	Standard error	Relevance **b**	95% confidence interval for the difference **b**	
						lower limit	upper limit
1	2	3	4	5	6	7	8
Day 1	work/study	work at home	208,480*	37,664	<0.001	132,751	284,210
		rest	–173,792*	37,682	<0.001	–249,557	–98,028
		rest excluding sleep	316,029*	33,307	<0.001	249,062	382,997
		entertainment	219,804*	34,918	<0.001	149,597	290,011
		physical activity	341,907*	34,935	<0.001	271,666	412,148
		various activities	275,976*	36,072	<0.001	203,449	348,503
	work at home	rest	–382,273*	16,546	<0.001	–415,541	–349,005
		rest excluding sleep	107,549*	14,458	<0.001	78,480	136,618
		entertainment	11,324	20,428	0.582	–29,749	52,396
		physical activity	133,427*	16,907	<0.001	99,433	167,420
		various activities	67,496*	18,420	0.001	30,460	104,531
	rest	rest excluding sleep	489,822*	11,677	<0.001	466,343	513,300
		entertainment	393,596*	20,624	<0.001	352,128	435,064
		physical activity	515,700*	17,813	<0.001	479,883	551,516
		various activities	449,768*	21,120	<0.001	407,303	492,233
	rest excluding sleep	entertainment	–96,225*	16,864	<0.001	–130,133	–62,318
		physical activity	25,878	14,367	0.078	–3,009	54,764
		various activities	–40,053*	17,384	0.026	–75,007	–5,100
	entertainment	physical activity	122,103*	18,691	<0.001	84,523	159,684
		various activities	56,172*	20,264	0.008	15,428	96,916
	physical activity	various activities	–65,931*	16,746	<0.001	–99,602	–32,261
Day 2	work/study	work at home	203,275*	36,924	<0.001	129,034	277,516
		rest	–172,714*	36,427	<0.001	–245,955	–99,472
		rest excluding sleep	305,250*	31,688	<0.001	241,537	368,963
		entertainment	191,863*	41,441	<0.001	108,540	275,186
		physical activity	326,266*	31,825	<0.001	262,278	390,253
		various activities	269,710*	35,134	<0.001	199,069	340,352
	work at home	rest	–375,989*	22,102	<0.001	–420,429	–331,550
		rest excluding sleep	101,974*	16,765	<0.001	68,266	135,682
		entertainment	–11,413	21,024	0.590	–53,685	30,860
		physical activity	122,990*	14,885	<0.001	93,062	152,918
		various activities	66,435*	23,831	0.008	18,520	114,349
	rest	rest excluding sleep	477,963*	12,643	<0.001	452,544	503,383
		entertainment	364,577*	23,087	<0.001	318,158	410,996
		physical activity	498,980*	18,945	<0.001	460,888	537,071
		various activities	442,424*	26,569	<0.001	389,003	495,845
	rest excluding sleep	entertainment	–113,387*	18,943	<0.001	–151,475	–75,299
		physical activity	21,016	12,501	0.099	–4,120	46,152
		various activities	–35,539	20,008	0.082	–75,768	4,689
	entertainment	physical activity	134,403*	22,087	<0.001	89,995	178,811
		various activities	77,848*	27,228	0.006	23,102	132,593
	physical activity	various activities	–56,555*	19,885	0.007	–96,537	–16,574

1	2	3	4	5	6	7	8
Day 3	work/study	work at home	203,382*	38,864	<0.001	125,242	281,523
		rest	–152,718*	40,831	<0.001	–234,815	–70,622
		rest excluding sleep	325,971*	35,891	<0.001	253,808	398,135
		entertainment	237,683*	43,145	<0.001	150,935	324,431
		physical activity	322,883*	37,121	<0.001	248,247	397,520
		various activities	269,813*	43,857	<0.001	181,633	357,993
	work at home	rest	–356,101*	18,276	<0.001	–392,848	–319,353
		rest excluding sleep	122,589*	15,295	<0.001	91,837	153,342
		entertainment	34,300	18,459	0.069	–2,814	71,415
		physical activity	119,501*	14,842	<0.001	89,659	149,343
		various activities	66,430*	18,746	0.001	28,739	104,122
	rest	rest excluding sleep	478,690*	10,756	<0.001	457,064	500,316
		entertainment	390,401*	17,550	<0.001	355,114	425,689
		physical activity	475,602*	19,366	<0.001	436,664	514,539
		various activities	422,531*	20,03	<0.001	382,258	462,805
	rest excluding sleep	entertainment	–88,289*	14,802	<0.001	–118,049	–58,528
		physical activity	–3,088	14,402	0.831	–32,045	25,869
		various activities	–56,159*	17,879	0.003	–92,106	–20,211
	entertainment	physical activity	85,201*	19,466	<0.001	46,061	124,340
		various activities	32,130	20,127	0.117	–8,338	72,598
	physical activity	various activities	–53,070*	21,486	0.017	–96,270	–9,871
Day 4	work/study	work at home	211,974*	32,203	<0.001	147,226	276,723
		rest	–142,447*	40,465	0.001	–223,806	–61,087
		rest excluding sleep	334,421*	31,531	<0.001	271,024	397,818
		entertainment	194,906*	40,348	<0.001	113,782	276,031
		physical activity	353,668*	32,277	<0.001	288,770	418,565
		various activities	292,375*	35,948	<0.001	220,097	364,653
	work at home	rest	–354,421*	19,181	<0.001	–392,986	–315,855
		rest excluding sleep	122,447*	13,470	<0.001	95,364	149,529
		entertainment	–17,068	29,584	0.567	–76,551	42,416
		physical activity	141,693*	14,795	<0.001	111,947	171,440
		various activities	80,401*	17,430	<0.001	45,356	115,446
	rest	rest excluding sleep	476,867*	14,727	<0.001	447,257	506,477
		entertainment	337,353*	26,625	<0.001	283,821	390,885
		physical activity	496,114*	16,684	<0.001	462,569	529,659
		various activities	434,822*	20,645	<0.001	393,312	476,332
	rest excluding sleep	entertainment	–139,514*	23,326	<0.001	–186,414	–92,615
		physical activity	19,247*	9,117	0.040	0,915	37,579
		various activities	–42,045*	13,913	0.004	–70,019	–14,072
	entertainment	physical activity	158,761*	24,911	<0.001	108,674	208,848
		various activities	97,469*	27,898	0.001	41,376	153,562
	physical activity	various activities	–61,292*	14,495	<0.001	–90,437	–32,148

1	2	3	4	5	6	7	8
		work at home	111,604*	35,616	0.003	39,993	183,215
		rest	–270,731*	42,735	<0.001	–356,656	–184,806
	work/study	rest excluding sleep	209,541*	34,604	<0.001	139,964	279,118
		entertainment	61,248	45,156	0.181	–29,545	152,041
		physical activity	230,031*	34,709	<0.001	160,245	299,818
		various activities	185,218*	32,727	<0.001	119,416	251,020
		rest	–382,335*	17,910	<0.001	–418,346	–346,325
		rest excluding sleep	97,937*	16,221	<0.001	65,322	130,551
	work at home	entertainment	–50,357	29,961	0.099	–110,597	9,884
		physical activity	118,427*	15,456	<0.001	87,351	149,503
Day 5		various activities	73,614*	15,174	<0.001	43,105	104,123
		rest excluding sleep	480,272*	13,806	<0.001	452,512	508,031
		entertainment	331,979*	29,057	<0.001	273,555	390,402
	rest	physical activity	500,762*	17,586	<0.001	465,404	536,120
		various activities	455,949*	20,503	<0.001	414,724	497,174
		entertainment	–148,293*	27,660	<0.001	–203,907	–92,679
	rest excluding sleep	physical activity	20,490	14,393	0.161	–8,448	49,428
		various activities	–24,323	15,537	0.124	–55,563	6,918
	entertainment	physical activity	168,783*	27,446	<0.001	113,599	223,968
		various activities	123,971*	28,780	<0.001	66,105	181,836
	physical activity	various activities	–44,813*	13,744	0.002	–72,446	–17,179
		work at home	–13,462	41,601	0.748	–97,106	70,183
		rest	–422,888*	44,816	<0.001	–512,996	–332,779
	work/study	rest excluding sleep	90,847*	40,502	0.030	9,413	172,281
		entertainment	–113,347*	54,759	0.044	–223,446	–3,247
		physical activity	76,658	46,421	0.105	–16,677	169,993
		various activities	68,360	44,291	0.129	–20,694	157,414
		rest	–409,426*	19,559	<0.001	–448,753	–370,099
		rest excluding sleep	104,308*	15,063	<0.001	74,021	134,595
	work at home	entertainment	–99,885*	33,510	0.005	–167,261	–32,509
		physical activity	90,119*	20,512	<0.001	48,877	131,362
Day 6		various activities	81,822*	19,472	<0.001	42,671	120,972
		rest excluding sleep	513,734*	13,675	<0.001	486,238	541,231
		entertainment	309,541*	31,183	<0.001	246,843	372,239
	rest	physical activity	499,545*	23,164	<0.001	452,971	546,120
		various activities	491,248*	22,654	<0.001	445,700	536,796
		entertainment	–204,193*	30,604	<0.001	–265,726	–142,661
	rest excluding sleep	physical activity	–14,189	19,901	0.479	–54,202	25,824
		various activities	–22,487	18,146	0.221	–58,971	13,998
	entertainment	physical activity	190,004*	35,180	<0.001	119,270	260,739
		various activities	181,707*	32,156	<0.001	117,053	246,361
	physical activity	various activities	–8,298	22,741	0.717	–54,022	37,427

Legend: * The mean difference is statistically significant 0.05; b The corrections for multiple comparisons.

Appendix 2. Fisher NIR test (p-value for differences between types of free-time activities)

	Day	Type of activity	{1} 62.400	{2} 152.90	{3} 46.500	{4} 62.200	{5} 176.20	{6} 48.200	{7} 55.900	{8} 133.10	{9} 53.200	{10} 55.100	{11} 189.00	{12} 40.800	{13} 72.400	{14} 211.30	{15} 47.800	{16} 72.600	{17} 273.90	{18} 82.200
{1}	day1	Rest excluding sleep	–	<0.001	0.391	0.991	<0.001	0.444	0.726	<0.001	0.620	0.694	<0.001	0.244	0.589	<0.001	0.431	0.582	<0.001	0.286
{2}	day1	Entertainment			<0.001	<0.001	0.209	<0.001	<0.001	0.286	<0.001	<0.001	0.052	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001
{3}	day1	Physical activity				0.397	<0.001	0.927	0.612	<0.001	0.718	0.643	<0.001	0.758	0.163	<0.001	0.944	0.159	<0.001	0.054
{4}	day2	Rest excluding sleep					<0.001	0.450	0.734	<0.001	0.627	0.702	<0.001	0.248	0.582	<0.001	0.437	0.575	<0.001	0.281
{5}	day2	Entertainment						<0.001	<0.001	0.020	<0.001	<0.001	0.490	<0.001	<0.001	0.059	<0.001	<0.001	<0.001	<0.001
{6}	day2	Physical activity							0.678	<0.001	0.787	0.710	<0.001	0.690	0.192	<0.001	0.983	0.188	<0.001	0.067
{7}	day3	Rest excluding sleep								<0.001	0.884	0.966	<0.001	0.415	0.373	<0.001	0.662	0.368	<0.001	0.156
{8}	day3	Entertainment									<0.001	<0.001	0.003	<0.001	0.001	<0.001	<0.001	0.001	<0.001	0.006
{9}	day3	Physical activity										0.918	<0.001	0.503	0.300	<0.001	0.771	0.295	<0.001	0.118
{10}	day4	Rest excluding sleep											<0.001	0.440	0.351	<0.001	0.694	0.345	<0.001	0.144
{11}	day4	Entertainment												<0.001	<0.001	0.229	<0.001	<0.001	<0.001	<0.001
{12}	day4	Physical activity													0.089	<0.001	0.706	0.087	<0.001	0.026
{13}	day5	Rest excluding sleep														<0.001	0.185	0.991	<0.001	0.597
{14}	day5	Entertainment															<0.001	<0.001	0.001	<0.001
{15}	day5	Physical activity																0.181	<0.001	0.064
{16}	day6	Rest excluding sleep																	<0.001	0.604
{17}	day6	Entertainment																		<0.001
{18}	day6	Physical activity																		–

References

Bartoszewicz, R., Gandziarski, K., Lewandowska, M., Szymańska, K. (2014). Zachowania prozdrowotne i poczucie koherencji osób późnej dorosłości objętych wsparciem społecznym instytucji edukacyjnej w obszarze kultury fizycznej. *Rozprawy Naukowe AWF*, *47*, 108–116.

Bąk-Sosnowska, M., Kołodziej, S., Gojdź, K., Skypulec-Plinta, V. (2015). Podmiotowe czynniki ryzyka zachowań antyzdrowotnych w grupie lekarzy medycyny. *Medycyna Środowisko Environmental Medicine*, *18* (3), 17–24.

Bäckmand, H., Kujala, U., Sarna, S., Kaprio, J. (2010). Former athletes' health-related lifestyle behaviours and self-rated health in late adulthood. *Int J Sports Med*, *31* (10), 751–758.

Berrigan, D., Dodd, K., Troiano, R.P., Krebs-Smith, S.M., Barbash, R.B. (2003). Patterns of health behaviour in US adults. *Prev. Med*, *36* (5), 615–623.

Binkowska-Bury, M., Iwanowicz-Palus, G., Kruk, W., Perenc, L., Mazur, A., Filip, R., Januszewicz, P. (2016). Pro-health behaviours – a sense of coherence as the key to a healthy lifestyle in rural areas. *Ann Agric Environ Med*, *23* (2), 345–349.

Bukowiec, M. (1990). Postulowane, założone i rzeczywiste funkcje wychowania fizycznego w przygotowaniu do uczestnictwa w kulturze fizycznej. *Wydawnictwo Monograficzne*, *39*, 135–146.

Dumazedier, J. (1974). *Leisure and the social system.* In: J.F. Murphy (ed.), *Concepts of Leisure*. Englewood Cliffs, NJ, Prentice-Hall.

Gacek, M. (2011a). Zachowania żywieniowe i aktywność fizyczna w grupie lekarzy. *Probl Hig Epidemiol*, *92* (2), 254–259.

Gacek, M. (2011b). Wybrane zachowania zdrowotne grupy kobiet w środowisku wiejskim i miejskim w świetle statusu socjoekonomicznego i stanu odżywienia. *Probl Hig Epidemiol*, *92* (2), 260–266.

Heszen, I., Sęk, H. (2012). *Psychologia zdrowia*. Warszawa: Wydawnictwo Naukowe PWN.

Juczyński, Z. (2009). *Narzędzia pomiaru w promocji zdrowia.* Warszawa: Pracownia Testów Psychologicznych PTP.

Kaleta, D., Makowiec-Dąbrowska, T., Polańska, K., Dziankowska-Zaborszczyk, E., Drygas, W. (2009). Palenie tytoniu i inne negatywne zachowania zdrowotne wśród osób czynnych zawodowo. *Medycyna Pracy*, *60* (1), 7–14.

Kolny, B. (2016). Analiza czasu wolnego w budżecie czasu Polaków. *Handel Wewnętrzny*, *2* (361), 228–240.

Kwilecki, K. (2011). *Rozważania o czasie wolnym. Wybrane zagadnienia.* Katowice: GWSH.

Laudańska-Krzemińska, I. (2014). Health behaviours and their determinants among physical education and pedagogy students as well as school teachers – a comparison study. *Acta Universitatis Carolinae Kinanthropologica*, *50* (2), 69–78.

MacCosham, B., Patry, P., Beswick, C., Gravelle, F. (2015). Leisure Lifestyle and Dropout: Exploring the Experience of Amateur Athletes in Competitive Sport. *International Journal of Sport Management, Recreation and Tourism*, *20*, 20–39.

Prażmowska, B., Dziubak, M., Morawska, S., Stach, J. (2011). Wybrane zachowania zdrowotne nauczycieli szkół średnich. *Problemy Pielęgniarstwa*, *19* (2), 210–218.

Reeves, M.J., Rafferty, A.P. (2005). Healthy lifestyle characteristics among adults in the United States. *Arch. Intern. Med*., *165* (8), 854–857.

Rejeski, W.J., Mihalko, S.L. (2001). Physical activity and quality of life in older adults. *The Journals of Gerontology. Series A: Biological Sciences & Medical Sciences, 56* (2), 23–35.

Rezende, L.H., Maciel, L.H.R., Carvalho, M., Cappelle, A., Campos, R.C. (2015). Continuando a jornada: explorando a recolocacao professional de ex-atletas de alto rendimento. *RECADM*, *14* (2).

Sormunen, J., Bäckmand, H.M., Sarna, S, Kujala, U.M., Kaprio, J, Dyba, T, Pukkala, E. (2014). Lifetime physical activity and cancer incidence- a cohort study of male former elite athletes in Finland. *J Sci Med Sport*, *17* (5), 479–484.

Stefani, L., Di Tante, V.D.T., Matan, M.Y., Galanti, G.G. (2015). Metabolic and psychological aspects as consequences of sports interruption in ex-elite athletes. *Eur J Prev Cardiol*, Abstract Book 1, 66–98.

Śmigielski, J., Bielecki, W., Dryga, W. (2013). Health and lifestyle – related determinants of survival rate in the male residents of the city of Łódź. *Int J Occup Med Environ Health*, *26* (3), 337–348.

Wojtyniak, B., Goryński, P., Moskalewicz, B. (2012). *Sytuacja zdrowotna ludności Polski i jej uwarunkowania.* Warszawa: Narodowy Instytut Zdrowia Publicznego Państwowy Zakład Higieny.

Cite this article as: Bentkowska, M. (2019). Pro-health Behaviours in Time Budget of Ex-cyclists. *Central European Journal of Sport Sciences and Medicine, 1* (25), 73–88. DOI: 10.18276/cej.2019.1-08.

ISSN 2300-9705

71-101 Szczecin, ul. Mickiewicza 66
tel. 91 444 20 06, 91 444 20 12
e-mail: wydawnictwo@univ.szczecin.pl
www.wnus.edu.pl