

Social Support and Physical Activity in the Perioperative Period and Six Months After Colorectal Cancer Surgery.

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Research article

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Abstract

Background: According to the recommendations of the ERAS protocol, physical activity is a key behavior for pre-surgical preparation of patients. The research aimed at determining the relationship between physical activity and social support, self-efficacy, cancer symptoms in preparation for colorectal cancer resection and half a year after surgery.

Methods: The research was carried out among patients with colorectal cancer. The assessment was performed in a longitudinal study, a week before the surgery (T1) ($N=151$) and six months after the surgery (T2) ($N=105$). The data was collected through the following research tools: physical activity, social support (OSS-3), self-efficacy (GSES) and the experienced cancer symptoms (Brief IPQ).

Results: In a week before the surgery, social support facilitated in the time of physical activity ($\beta=.18$), whereas half a year after the surgery social support had a negative impact on the time of physical activity ($\beta=-.20$). The variable of symptoms is related to the negative effect of physical activity, and this is particularly evident in the six-month period after surgery (a week before the surgery: $\beta=-.16$; six months after the surgery: $\beta=-.34$).

Conclusions: It has been shown that social support, symptoms are important for shaping physical activity in the period before colorectal cancer surgery and six months after surgery. Patients with colorectal cancer living alone have had higher levels of physical activity than patients with colorectal cancer living in a partnership. In the period after colorectal cancer surgery social support may lead patients to believe that they do not need to make any physical effort because caregivers take care of their daily responsibilities.

Trial registrations: Ocalewski J, Michalska P. Social support and physical activity in the preoperative period and six months after colon cancer surgery. [Internet]. OSF; 2020. Available from: osf.io/px2zk

Background

Social support connected with health is defined as a sum of all efforts of the members of a support network centered on providing help and positive feedback in order to promote behaviors which are beneficial for health [1]. In healthcare, social support has long been regarded as a factor protecting against life stress and negative health conditions. Social support is an important factor for changing health-related behaviors among cancer patients [2]. Nevertheless, the results of previous studies have not verified the role of social support in shaping health-related behaviors among colorectal cancer patients at particular stages of treatment – before the surgery and half one year later. The treatment of colorectal cancer mainly requires a surgical excision of a part or the whole of the rectum along with the tumor and mesorectum which contains adipose tissue and the regional lymph basin with a margin of healthy tissues [3].

Patients awaiting surgery are expected to cut down on smoking tobacco and alcohol intake, as well as introduce regular physical activity (PA) adjusted to their abilities in order to improve their physical efficiency [4]. Studies prove that such behavior contributes to lowering the amount of postsurgical complications and increases the pace of returning to full activity following the surgery [5]. According to the recommendations of the Enhanced Recovery After Surgery (ERAS) protocol the key factor for pre- and postsurgical care is motivating patients to self-activity in order to facilitate convalescence. Introducing systematic PA in the form of 30-minute walks or cycling every day over a 4-week period prior to the surgery increases the preoperative physiological reserves of the patient and decreases the risk of acquiring postsurgical complications [6]. The studies showed a relationship between the symptoms of cancer and physical activity. For instance Beckman et al. showed that physical activity reduces the symptoms of cancer [7].

Studies on the relationship between PA and received social support among oncological patients provide unambiguous conclusions. In 2009, Stephenson et al., demonstrated that there is no relationship between PA and perceived social support among colorectal cancer patients [8]. On the other hand, Lee et al. (2018) pointed out that family support is significant for undertaking PA [9]. The ambiguity of the previous reports and contemporary recommendations concerning the introduction of pre-surgery PA prompts carrying out further scientific studies in this area. Seeking the predictors of health behaviors, scientists should also consider the sense of self-efficacy. This factor is regarded as the best predictor of behavioral change and its influence on making health-related decisions has been documented in numerous studies [10]. Cognitive psychology sees the sense of self-efficacy as the strength of conviction that a person is able to fulfil particular activities or achieve their intended aims.

The present study aimed to determine the relationship between PA and social support, self-efficacy, disease symptoms in the course of disease with two different time intervals: preparation for colorectal cancer resection and six months after the surgery. The main hypothesis is: social support increases PA in the preoperative period and six months after surgery. Self-efficacy and cancer symptoms are predictors of this relationship.

Methods

The participants of the study were qualified from patients sent to the Clinical Department of Surgical Oncology at the Oncology Centre for colorectal cancer resection (laparoscopic hemicolectomy, lower anterior resection of the rectum, abdominoperineal resection of the rectum). They were treated for one the following types of cancer: colorectal (C18), rectosigmoid junction (C19), rectum (C20), anal canal (C21). The exclusion criteria concerned patients who revealed previous cancer diagnosis, decline of cognitive functions, a risk of undernourishment based on the $BMI < 18.5 \text{ kg/m}^2$ in the period before the CRC surgery.

The assessment was performed in a longitudinal study, a week before the surgery (T1) and six months after the surgery (T2). One month before the first assessment during a visit to the anesthesiologist, patients were given a leaflet designed on the basis of the recommendations of the ERAS protocol, which

suggested undertaking moderate, at least 30-minute PA (a walk, Nordic walking, cycling). The assumption of a six-month interval between the measurements was based on the results of clinical observations indicating that it is the period when supplementary chemotherapy is completed and a relative improvement in the patients' physical functioning occurs. Each patient was handed an information leaflet based on the ERAS protocol one month before the first measurement. At T1, patients were asked to determine their health-related behaviors during the last month before the surgery. At T2, patients were asked about any increase in health-related behaviors in the last month before the study. The obtained results were analyzed through both descriptive statistics and analyses for statistical inferencing (Statistica 13).

The project received a positive opinion of the Independent Ethics Committee (the name of the institute, decision and number are concealed to ensure the authors' anonymity). The project was carried out as part of a grant financed by the National Centre of Science (the no. and title hidden to make sure the authors remain unidentified).

The first assessment before the surgery involved 151 participants ($M_{age}=64.89$, $SD_{age}=10.14$) while the second assessment was carried out six months after the surgery – 105 ($M_{age}=64.39$, $SD_{age}=10.51$). The majority of the participants were men (about 65%). The most popular type of surgery was lower anterior resection of the rectum (44%) whereas the other surgeries included sigmoid tumor resection or Transanal Endoscopic Microsurgery. Preoperative (neoadjuvant) treatment in the form of chemotherapy, radiotherapy or chemo-radiotherapy was applied in 40% of the patients. Adjuvant therapy was applied in 45% of the patients (T2). The sociodemographic variables and percentage of people in particular sample groups before the surgery ($N=151$) and six months later ($N=105$) are shown in table 1. In the T1 and T2 similar percentage shares were obtained for the variables of gender, place of residence, marital status, education, type of cancer, therapy and surgery and extent of spread of cancer. Dropout analyses were performed for social support and PA. For example social support in T1 ($M=10.21$, $SD=2.77$) among people who have not participated in T2 was not a significant difference ($p=.362$) with all participants of T1. It allowed us to compare the results in T1 and T2. There was a statistically significant difference ($p=.046$) between PA in T1 ($M=388.61$, $SD=308.28$) and PA in T2 ($M=319.43$, $SD=206.71$). It means that patients show lower PA six month after surgery than before tumor resection.

Table 1

Population and percentage of people in particular sample groups before the surgery (N = 151) and half a year after (N = 105)

	T1		T2	
	Before the surgery		Six months later	
	Number	%	Number	%
Gender				
Men	100	66.23	71	67.62
Women	51	33.77	34	32.38
Place of residence				
city	101	66.89	65	61.90
country	50	33.11	40	38.10
Marital status				
Single	7	4.64	5	4.76
Married	115	76.16	82	78.10
Widowed	24	15.89	16	15.24
Divorced	5	3.31	2	1.90
Education				
Primary	22	14.57	12	11.44
Vocational	52	34.44	37	35.24
Secondary	54	35.76	37	35.24
Higher	23	15.23	19	18.10
Type of cancer				
colorectal (C18)	51	33.77	37	35.24
rectosigmoid junction (C19)	17	11.26	13	12.38
rectum (C20) and anal canal (C21)	73	48.34	48	45.71
Colon or Rectum of uncertain or unknown behavior	10	6.62	7	6.67
Neoadjuvant therapy				
Not applied	90	59.60	66	62.86
Chemotherapy	2	1.32	2	1.90
Radiotherapy	21	13.91	15	14.29

Chemo-radiotherapy	38	25.17	22	20.95
Adjuvant therapy				
Not applied	86	56.95	55	56.19
Chemotherapy	56	37.09	42	40.95
Radiotherapy	1	.01	0	.00
Chemo-radiotherapy	8	5.30	3	2.86
Type of surgery				
laparoscopic hemicolectomy	32	21.19	23	21.90
lower anterior resection of rectum, abdominoperineal resection of rectum	67	44.37	48	45.71
another surgery or postponed	26	17.22	17	16.19
The extent of spread of cancer				
0	9	5.96	5	4.76
I	30	19.87	21	20.00
II	42	27.81	33	31.43
III	67	44.37	44	41.90
IV	3	1.99	2	1.90
	M	SD	M	SD
Physical activity	388.61	308.28	319.43	206.71
Social support	10.62	2.63	10.71	2.81
Self-efficacy	31.50	5.49	32.19	4.78
Key: <i>T1</i> – the value before colorectal cancer resection; <i>T2</i> – the value half a year after the surgery				
Source: own study results				

Physical activity

The patients' PA was operationalized on the basis of the time of everyday activities (walking, cycling, housework requiring PA, gardening and other physical activities). A respondent determined the weekly amount of time devoted to particular types of activity assuming that a single event lasts 30 minutes. This way a PA indicator was obtained. The reliability of the PA scale was *Cronbach* $\alpha=.66$.

Social support

Social support is understood as a perceived resource which an individual refers to encountering personal problems or seeking particular instrumental help (advice, money). The researchers applied *The Oslo Social Support Scale-3-items (OSS-3)*, by Dalgard, 1996 [11] recommended by WHO [12]. OSS-3 has been used in numerous studies which confirmed its predictiveness with regards to psychical and physical functioning of healthy and ill people. The reliability of the tool obtained in our own study was satisfactory (*Cronbach α* =.60).

Self-efficacy

The Generalized Self-Efficacy Scale (GSES) [13] measures the strength of the general conviction of an individual about their effectiveness in coping with difficult situations and obstacles. It is designed for measuring healthy and ill adults. The sense of self-efficacy determines the intentions and activities in various areas of health-related behavior. The reliability of the tool obtained in our own study was satisfactory (*Cronbach α* =.89).

The experienced symptoms of cancer

Symptoms – a cognitive component which indicates the degree of the experienced symptoms (ranging from “lack of symptoms” to “numerous severe symptoms”). This position was operationalized on the basis of *The Illness Perception Questionnaire* developed by Broadbent, Petrie, Main and Weinmann (2006) (*Brief IPQ*) [14]. The tool is designed to appraise these representations and, additionally, factors which may cause the illness. Reliability measured by test-retest =.75 after six weeks. The questionnaire was constructed from a semantic scale which consists of bipolar descriptions e.g. “does not influence at all” – “influences completely.”

Results

Analysis revealed a statistically significant change in the time of PA six months after surgery ($M=319.43$; $SD=206.71$) compare to a week before the surgery ($M=388.61$; $SD=308.28$), ($p=.046$). Building the models of multivariate regression, the researchers singled out the following variables which are significant for explaining the PA in T1: age, self-efficacy, symptoms and social support. The T1 Model explained 13% of the variance changeability of PA [$F(4,1143)=6.60$; $p<.001$], [(social support ($\beta=.18$; $p<.05$), self-efficacy ($\beta=.16$; $p<.05$) and symptoms ($\beta=-.16$; $p<.05$)]. The symptoms variable explained only 2% of the PA variance. Similar analyses were carried out for the time of PA in T2, putting the same data into multivariate regression but adequate for T2. The significant predictors were: symptoms ($\beta=-.34$; $p=.002$) and social support the standardized regression coefficient of which was negative ($\beta=-0,20$; $p<.05$). This model accounted for 18% of the variance changeability of PA T2 [$F(4,92)=6,24$; $p<.001$]. (*Table 2*). Medical

variables: the type of surgery, applied stoma, and adjuvant treatment were not significant predictors of the PA.

Table 2

The results of the multivariate regression analysis for the time of physical activity during T1 and T2

Variables	T1; $R^2 = .16$; $R^2 \text{ Adjusted} = .33$					T2; $R^2 = .21$; $R^2 \text{ Adjusted} = .18$				
	$F(4,14) = 6.61$; $p < .001$					$F(4,92) = 6.24$; $p < .001$				
	β	$SE \beta$	t	p	R^2	β	$SE \beta$	t	p	R^2
Absolute term			1.99	.049				3.89	<.001	
Age	-.24	.08	-3.13	.002	.05	-.19	.09	-1.98	.048	.05
Self-efficacy	.16	.08	2.10	.037	.05	.03	.11	.31	.757	n.s.
Symptoms	-.16	.08	-2.02	.046		-.34	.11	-3.15	.002	.13
					.03					
Social support	.18	.08	2.32	.021	.02	-.20	.10	-2.05	.042	.03

Key: T1 – the value a week before colorectal cancer resection; T2 – the value six months after the surgery; R^2 – the coefficient of determination; $Adjusted R^2$ – the corrected coefficient of determination; β – a standardized regression coefficient for T1 or T2; $SE \beta$ – the standard error for the standardized beta; Source: own elaboration.

The identity variable explained the highest amount of PA variance ($R^2=13\%$). The authors also indicated an interaction between the time of measurement and groups: people living alone / people living in partnership with regards to PA [$F(1,103)=4.10$; $p=.045$; $\eta^2=.04$] (Fig1.).

Fig1. The interaction of the marital status variable (T1, T2) and time of physical activity.

In the period before the surgery (T1) patients who were single and lived alone reported a lower time of PA ($M=379.17$; $SD=336.30$) than people living in partnership ($M=391.57$; $SD=300.48$). A reverse relationship was observed half a year after the surgery. The PA of people who lived alone ($M=370.43$; $SD=234.20$) was higher than among respondents living in partnership ($M=305.12$; $SD=197.53$) (Fig1.). Additionally, it has been shown that there wasn't a statistical difference in social support between people living alone and people living in partnership (T1, T2).

Discussion

Recommendations in the ERAS protocol advise to undertake deliberate activities such as walking or cycling for at least 30 minutes a day before the surgery. Before the surgery it was reported that 58.28% of patients followed these recommendations, while six months after the surgery this statistic was 47.62%. A

small percentage of active patients, limitations of PA after diagnosis and during the course of treatment are a common problem confirmed by other researchers [15,16].

It is generally assumed that social support has a positive impact on shaping health behaviors [9,17,18], psychological health [19,20]. Similarly, this study showed that social support facilitates the PA before the surgery. Nevertheless, six months after the surgery, an important role of social support for this type of health behavior was observed: the higher the perceived social support, the lower PA. It may be explained by the phenomenon which we may call "the role of a patient" [21]. Basically, following cancer surgery, people who receive more social support could more often be relieved of most of their daily duties by close relatives, which would result in decreasing their PA. We have shown that the significance of social support for PA changes depending on the period of measurement. Therefore, a systemic approach to health-related behaviors is needed that aims to improve self-managing behavior [16]. It may be claimed that social support should include a specified type of health-related behavior (e.g. social support for undertaking PA, social support for cutting down on alcohol intake) and the period over which the study is carried out (before the surgery, after the surgery).

In the period before the diagnosis and before the surgery, those patients who lived alone showed a lower time of PA than patients lived in partnership. This tendency corresponds to the findings of Hawkins et al., (2010), who proved that the fact of becoming widowed, divorced or separated contributes to decreasing the time of PA. However, a reversed relationship was seen half a year after the surgery – PA of people who lived alone was higher than people in partnership. It may be explained by the fact that people who live alone are forced to undertake more PA in everyday life than people who are assisted by a partner. This dependence confirms the discussed relationship between social support and the increase in PA [22].

The success of cancer treatment depends on external factors (e.g. the selection of an appropriate method of treatment, selection and care of medical staff) and on the patient (e.g. health behaviors, social support). Although the patient's role in self-determination and self-management in illness is crucial, there are various factors that determine the extent to which patients are aware of this. Entering the "role of a patient" involves in some way the need to modify one's own identity, internalizing in oneself those aspects of life that were previously unknown. Illness is a situation that affects not only the patient, but often requires a reformulation of the life of the entire family system. The role of social support in disease discussed in this article is complex, so it is worth looking at theories that can explain the obtained relationships.

According to Seligman's learned helplessness theory (1974), an organism that has come to terms with its inability to control the situation will react in three ways: motivational deficit, cognitive deficit and emotional deficit. The motivational deficit appears secondary to the belief that there is no control over the situation, and its effect is to refrain from attempting to change. Cognitive deficit is synonymous with the belief that nothing can be done to prevent unpleasant situations. The consequence of such thinking is developing a passive or indifferent attitude in the patient, which may lead to an attempt to take over some of the duties by the closest relatives to help relieve the patient of their daily duties [23]. As

mentioned earlier, people who are facing the disease on their own would be more active. Presumably, people without social support in a crisis situation may want to seek such support. Such an inference would explain the time of PA, because leaving home, among others for a walk, a bike ride or a trip to the store, may give the patient a greater chance of meeting someone with whom they might share their concerns. People who are provided with support in their immediate surroundings would not see the need to acquire new contacts, benefitting from a safe and familiar social environment. On the other hand, a patient's family members and relatives might enter "the role of the protector" to make them feel appreciated, important and responsible for the patient's life and health . A similar situation applies to medical staff, who might feel the need to fulfill their professional duties.

We have confirmed the positive role of self-efficacy for PA in the period before the surgery. It confirms with the studies by Morey and associates (2015) [24] and Dennis and associates (2013) [25]. It has been shown that self-efficacy had not related with PA six months after surgery. The experienced cancer symptoms proved to be of key importance for changing this behavior six months after the surgery. The patients' appraisal of their symptoms as nagging did not favor undertaking PA (symptoms explain the 13% variability in PA). It is noteworthy that such medical variables as the type of surgery, using stoma, and adjuvant treatment were not significant predictors of PA.

The study results could contribute to the development of education programs for medical staff who work with patients as well as for patients and their families. It seems important to educate them about the necessity patients' own activity in disease. In the lights of these studies it is reasonable to monitor health behaviors not only in the hospital, but also outside the medical facility.

Conclusions

1. It has been shown that social support and cancer symptoms are important for shaping PA in the period before colorectal cancer surgery and six months after surgery.
2. Patients with colorectal cancer living alone have had higher levels of PA than patients with colorectal cancer living in a partnership.
3. In the period after colorectal cancer surgery social support may lead patients to believe that they do not need to make any physical effort because caregivers take care of their daily responsibilities. This situation will not be conducive to proper time of PA, necessary for the course of postoperative recovery.
4. Six month after colorectal cancer surgery the variable concerning the patient's somatic state – symptoms – has been shown as the largest part of the variance in PA. Therefore, postoperative quality of medical care is important to eliminate pain symptoms.

Limitations And Practical Implementation

The present paper relied on the patients' self-reported assessment of PA, and therefore, subjective representations of health behaviors was obtained. In replicating the study, it would be worthwhile to apply

objective methods e.g. the use of an accelerometer [26]. Study were conducted in only one institution and other variables such as mood, pain and quality of life were not controlled. In this study, social support was understood as instrumental support and interest in the patient's situation. It is advisable that in future research the support should be operationalized as an aid in shaping PA.

Despite these limitations, the results of our study may have practical implications. The most significant – in the authors' opinion – is to inform deliberations on the influence of social support on the time of PA among colorectal cancer patients with empirically documented input. The results may contribute to designing education programs for medical staff members who remain in direct contact with patients and may have direct influence on their health-related behaviors, as well as for the patients themselves and their families.

Abbreviations

PA – physical activity, T1 – assessment a week before the surgery, T2 – assessment six months after the surgery, ERAS – Enhance Recovery After Surgery

Declarations

Ethics approval and consent to participate:

The project received a positive opinion from the Bioethics Committee of Collegium Medicum L. Rydygiera in Bydgoszcz, Nicolaus Copernicus University in Toruń (decision No.

KB 345/2017 of 25.04.2017.

Consent for publication:

All patients signed the following declaration: "I consent to the processing of my personal data regarding the implementation of the research topic, except for the publication of personal data. Only authorized persons will have access to medical data for research purposes. I give my voluntary consent to participate in this study and I am aware of the fact that I can withdraw my consent to participate in the further part of the study at any time, without giving a reason and without any consequences."

Availability of data and materials:

The details include age, sex, place of residence, marital status, type of cancer and type of surgery. The authors only obtained permission to publish general results. There is a probability of identifying people on the basis of detailed data because the research was conducted in one institution.

Competing interests:

Not applicable

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Authors' contributions:

JO, PM, PI have made substantial contributions to the conception; JO design of the work; PM, JO conducted research; JO conducted the analysis and interpretation of data; JO, PI substantively revised it and prepared conclusions.

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References

1. Gallant MP. The influence of social support on chronic illness self-management: A review and directions for research. *Health Education Behavior*. 2003;30:170–95. <https://doi.org/10.1177/1090198102251030>.
2. Law E, Levesque JV, Lambert S, Girgis A. The “sphere of care”: A qualitative study of colorectal cancer patient and caregiver experiences of support within the cancer treatment setting. *PLoS ONE*. 2018;13(12), <https://doi.org/10.1371/journal.pone.0209436>.
3. Krouse RS. Gastrointestinal Cancer. In: Holland JC, Breitbart W, Jacobsen P, Lederberg M, Loscalzo M, McCorkle R, editors. *Psycho-Oncology*. New York: Oxford University Press; 2010. pp. 140–3.
4. Lindstrom D, Sadr O, Wladis A, Tønnesen H, Linder S, Nåsell H, et al. Effects of a perioperative smoking cessation intervention on postoperative complications: a randomized trial. *Ann Surg*. 2008;248:739–45. doi:10.1097/SLA.0b013e3181889d0d.
5. Carli F, Charlebois P, Stein B, Feldman L, Zavorsky G, Kim DJ, et al. Randomized clinical trial of prehabilitation in colorectal surgery. *Br J Surg*. 2010;97:1187–97. <https://doi.org/10.1002/bjs.7102>.
6. Barberan-Garcia A, Ubre M, Roca J, Lacy AM, Burgos F, Risco R, et al. Personalised prehabilitation in high-risk patients undergoing elective major abdominal surgery: a randomized blinded controlled trial. *Ann Surg*. 2018;267(1):50–6. doi:10.1097/SLA.0000000000002293.

7. Backman M, Wengström Y, Johansson B, et al. A randomized pilot study with daily walking during adjuvant chemotherapy for patients with breast and colorectal cancer. *Acta oncologica*. 2014;53(4):510–20. doi:10.3109/0284186X.2013.873820.
8. Stephenson LE, Bebb DG, Reimer RA, Culos-Reed SN. Physical activity and diet behaviour in colorectal cancer patients receiving chemotherapy: Associations with quality of life. *BMC Gastroenterology*. 2009;9:60. <https://doi.org/10.1186/1471-230X-9-60>.
9. Lee MK, Park SY, Choi G-S. Association of support from family and friends with self-leadership for making long-term lifestyle changes in patients with colorectal cancer. *European Journal Of Cancer Care*. 2018;27(3):e12846–6. <https://doi.org/10.1111/ecc.12846>.
10. Schwarzer R, Luszczynska A, Ziegelmann JP, Scholz U, Lippke S. Social-cognitive predictors of physical exercise adherence: Three longitudinal studies in rehabilitation. *Health psychology*. 2008;27:54–63. [https://doi.org/10.1037/0278-6133.27.1\(Suppl.\).S54](https://doi.org/10.1037/0278-6133.27.1(Suppl.).S54).
11. Dalgard OS. Community health profile as tool for psychiatric prevention. In: DR. Trent & CA. Reed, editors. *Promotion of mental health*. Avebury, 1996.
12. Melzer H. Development of a common instrument for mental health. In: A. Nosikov & C. Gudex, editors. *EUROHIS: Developing Common Instruments for Health Surveys*. IOS Press, 2003. p. 35–60.
13. Schwarzer R, Jerusalem M. Self-efficacy as a resource factor in stress appraisal processes. In: R. Schwarzer, editors. *Self-efficacy: Thought control of action*. Hemisphere, 1992. p. 217–242.
14. Broadbent E, Petrie KJ, Main J, Weinman J. The brief illness perception questionnaire. *J Psychosom Res*. 2006;60(6):631–7. <https://doi.org/10.1016/j.jpsychores.2005.10.020>.
15. Possmark S, Berglind D, Sellberg F, Ghaderi A, Persson M. To be or not to be active - a matter of attitudes and social support? Women's perceptions of physical activity five years after Roux-en-Y Gastric Bypass surgery. *International Journal of Qualitative Studies on Health Well-Being*. 2019;14(1):1612704. <https://doi.org/10.1080/17482631.2019.1612704>.
16. Hawkins NA, Smith T, Zhao., Rodriguez J, Berkowitz Z, Stein KD. Health-related behavior change after cancer: Results of the American cancer society's studies of cancer survivors (SCS). *Journal Of Cancer Survivorship: Research Practice*. 2010;4(1):20–32. <https://doi.org/10.1007/s11764-009-0104-3>.
17. Fujisawa D, Umezawa S, Basaki-Tange A, Fujimori M, Miyashita M. Smoking status, service use and associated factors among Japanese cancer survivors—a web-based survey. *Support Care Cancer Off J Multinatl Assoc Support Care Cancer*. 2014;22(12):3125–34. doi:10.1007/s00520-014-2284-2.
18. McDonough MH, Beselt LJ, Daun JT, Shank J, Culos-Reed SN, Kronlund LJ, et al. The role of social support in physical activity for cancer survivors: A systematic review. *Psycho-Oncology*. 2019;28(10):1945–58. <https://doi.org/10.1002/pon.5171>.
19. Faleschini S, Millar L, Rivas-Shiman SL, Skouteris H, Hivert MF, Oken E. Women's perceived social support: associations with postpartum weight retention, health behaviors and depressive symptoms. *BMC Women's Health*. 2019;19(1):143. <https://doi.org/10.1186/s12905-019-0839-6>.

20. Wong M, Looney E, Michaels J, Palesh O, Koopman C. A preliminary study of peritraumatic dissociation, social support, and coping in relation to posttraumatic stress symptoms for a parent's cancer. *Psycho-Oncology*. 2006;15(12):1093–8. <https://doi.org/10.1002/pon.1041>.
21. Parsons T. *Action Theory and the Human Condition*. NY: Free Press; 1978.
22. Chen YC, Chang LC, Liu CY, Ho YF, Weng SC, Tsai TI. The Roles of Social Support and Health Literacy in Self-Management Among Patients With Chronic Kidney Disease. *Journal of Nursing Scholarship: An Official Publication of Sigma Theta Tau International Honor Society of Nursing*. 2018;50(3):265–75. <https://doi.org/10.1111/jnu.12377>.
23. Seligman ME. Depression and learned helplessness. In: RJ. Friedman & MM. Katz, editors. *The psychology of depression: Contemporary theory and research*. John Wiley & Sons. 1974.
24. Morey MC, Blair CK, Sloane R, Cohen HJ, Snyder DC, Demark-Wahnefried W. Group trajectory analysis helps to identify older cancer survivors who benefit from distance-based lifestyle interventions. *Cancer*. 2015;121(24):4433–40. <https://doi.org/10.1002/cncr.29684>.
25. Dennis DL, Waring JL, Payeur N, Cosby C, Daudt HML. Making lifestyle changes after colorectal cancer: Insights for program development. *Current Oncology*. 2013;20(6):493–511. <https://doi.org/10.3747/co.20.1514>.
26. Integration of physiological and accelerometer data to improve physical activity assessment
10.1249/01.mss.0000185650.68232.3f
Strath SJ, Brage S, Ekelund U. Integration of physiological and accelerometer data to improve physical activity assessment. *Med Sci Sports Exerc*. 2005;37(11):563–71.
[doi:10.1249/01.mss.0000185650.68232.3f](https://doi.org/10.1249/01.mss.0000185650.68232.3f).

Figures

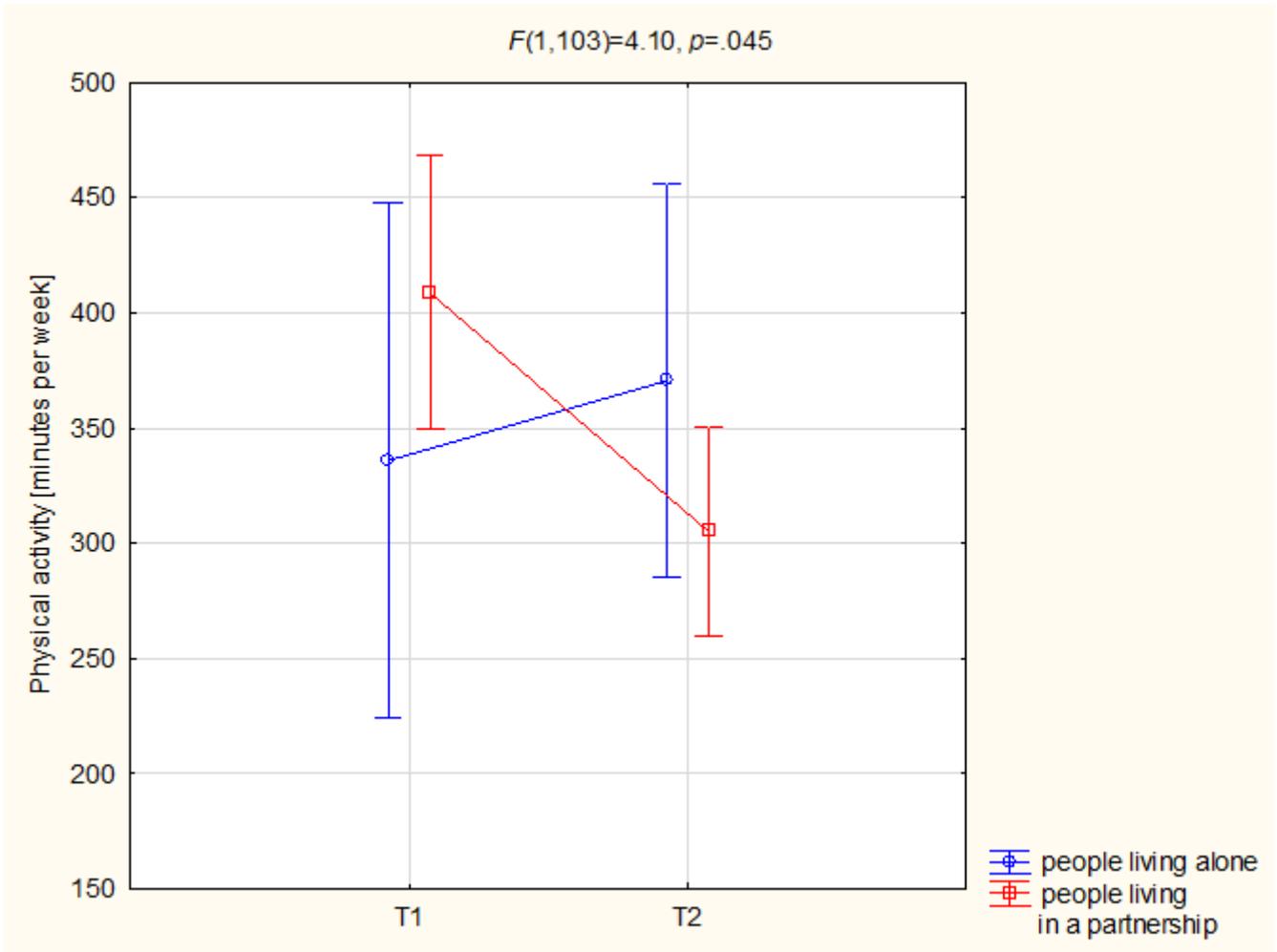


Figure 1

The interaction of the marital status variable (T1, T2) and time of physical activity.