Colorectal cancer risk and the influence of recreational physical activity

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Abstract

Aim: Physical activity is a main component of energy balance and it is of great importance for the overall health prosperity. There is convincing evidence for the relationship between physical activity and some certain type of carcinomas. Colorectal cancer (CRC) is one of the most important neoplasms in association with physical activity. Our aim was to examine the relationship between recreational physical activity and the risk of developing CRC.
Methods: We investigated 540 people, divided into two groups: 270 patients with CRC and 270 healthy controls. A questionnaire, including information about recreational physical activity, was completed from each participant. CRC was diagnosed by fibro-colonoscopy with biopsies. Because of the conflicting data about the risk of colon cancer and rectal cancer, we considered the association of recreational physical activity and colorectal cancer risk in men and women, generally and by sub-site in particular. We selected the last five years of life, as a period of impact. Collected data was statistically processed.
Results: There was a relationship between some of the examined types of physical activity and CRC risk, and that performing none of the indicated activities in the questionnaire increased the risk of this carcinoma.
Conclusion: Considering the positive role of physical activity in the overall health prosperity, and for the prevention of CRC in particular, we recommend employment of this healthy lifestyle characteristic in the general population.

Keywords: colorectal cancer, physical activity, recreational, risk factors.

Introduction

Physical activity is one of the main components of energy balance. It is known that regular physical exercises improve health through: controlling the weight, maintaining healthy musculoskeletal system, decreasing the risk of developing arterial hypertension, diabetes mellitus, cardiovascular diseases and the risk of premature death (1). It is established that physical activity may affect the risk of developing carcinoma. There is evidence for the relationship between exercising and the risk of developing prostate, lung, and endometrial cancer. There are convincing data, that suitable physical activity may decrease colorectal (CRC) risk (2).

CRC is one of the commonest neoplasms worldwide and the second reason for carcinoma-associated death. As a reason for its rise, along with the hereditary factors, important roles have lifestyle factors too. Establishing such modifiable factors is of great importance, because it gives an opportunity for effective prevention of this frequent and severe disease (3).

Physical activity is usually divided into occupational and recreational exercises. Some authors consider that its health effects differ according to whether it is aerobic or anaerobic. Important determinants of physical activity are frequency, duration and intensity. Some studies connect its helpful effects with the occurrence of certain types of carcinoma.

It is difficult to evaluate the exact quantity of physical activity and we can only make a rough assessment of its beneficial effect. Most authors established that if physical activity is more intensive, frequent and prolonged, it will optimize the protective effect (4). Given that the general population has sedentary lifestyle, it is very important to identify the minimal quantity of physical activity that is useful for the prevention of CRC. We chose to examine the recreational physical activity because it depends only in personal assessment and allows planning of the leisure time.

There are different perceptions about the role of physical activity in rectal carcinogenesis in the literature. Some authors accept and another reject it. In our study, individuals with CRC were divided into three groups according to localization of the carcinoma and rectal localization was detached as an independent group, so we could be more precise in the evaluation of the influence of the examined factors. We accepted as a null hypothesis that recreational physical activity has no importance for the prevention of CRC.

Methods

The study was conducted in Medical Institute – Ministry of Interior Sofia, Bulgaria. Patients and controls were enrolled within three years, between 2010 and 2013. Each participant signed an informed consent.

There were 540 persons participating in the research study. Their age was between 22 and 86 years. Three hundred and eight (57%) participants were men and 232 (43%) were women. Median age was 62.69±11.32 years.

Participants were divided into two groups, and the distribution by sex and age was quite uniform in these two groups.

The first group included 270 cases with CRC. They were diagnosed at the Clinic of Gastroenterology, Medical Institute – Ministry of Interior. This group was divided into three subgroups by sub-site of carcinoma: patients with cancer of proximal colon, distal colon and rectum. As a proximal type we accepted the carcinoma localized in the colon ascendens and the proximal half of colon transversum. As a distal type we accepted carcinoma localized in the distal half of colon transversum and colon descendens. Total fibrocolonoscopy was accomplished to every patient to localize and prove the cancer, with video-colonoscope Olympus CLE Exera II 145. Biopsies (4-6) were taken from every pathological lesion. Histological materials were processed with hematoxylin-eosin, as a standard.

The second group included 270 healthy controls – individuals without previous or present colorectal carcinoma, without clinical and laboratory data

pointing at such diagnose. In this group we ranged people that came for medical check or for medical certificate, just like patients from Ophthalmology Clinic and Clinic of Otorhinolaryngology.

The studied types of recreational physical activity included walking equally at least 30 minutes/daily, climbing stairs at least three floors/daily, cycling for at least 30-60 minutes biweekly, swimming for at least 30-60 minutes biweekly, garden work for at least 60 minutes biweekly, tourism once or twice per month. As duration of impact of the factor we accepted the last five years. Information about the intensity was not obtained. Data was collected through a specially designed questionnaire, including closed (structured) questions and with the help of trained interviewers.

Data was processed with the statistical program IBM SPSS Statistics 22.0. The level of statistical significance for rejection of the null hypothesis was set at ≤ 0.05.

The following statistical methods were used: descriptive analysis consisted of the frequency distributions of considered signs, divided by subgroups; furthermore, measures of central tendency and dispersion were calculated; conversely, binary logistic regression was used to assess the association of CRC with physical activity.

Results

Walking equally at least 30 minutes daily during last five years was a significant protective factor for CRC (OR=0.212, 95%CI=0.142-0.316, P<0.001) (Table 1). The impact was statistically significant for both genders, and for all of the localizations. The protective influence was highest (85%) for rectal localization in men. The impact was the lowest (71%) for distal colon in men.

Table 1. Results from logistic regression analysis for the factor walking equally at least 30 minutes daily during the last five years

Factor	Group	Localization	Comparison	OR*	95%CI**		P
					Lower bound	Upper bound	
Walking at least 30 minutes daily	All	All	Yes/No	0.212	0.142	0.316	<0.001
	Men	All	Yes/No	0.197	0.113	0.345	<0.001
	Women	All	Yes/No	0.224	0.125	0.399	<0.001
	All	Proximal colon	Yes/No	0.205	0.118	0.358	<0.001
	All	Distal colon	Yes/No	0.270	0.161	0.454	<0.001
	All	Rectum	Yes/No	0.174	0.105	0.289	<0.001
	Men	Proximal colon	Yes/No	0.183	0.085	0.394	<0.001
		Distal colon	Yes/No	0.289	0.139	0.604	0.001
		Rectum	Yes/No	0.153	0.077	0.302	<0.001
	Women	Proximal colon	Yes/No	0.232	0.103	0.521	<0.001
		Distal colon	Yes/No	0.249	0.118	0.526	<0.001
		Rectum	Yes/No	0.193	0.089	0.417	<0.001

Climbing stairs at least three floors during the past five years was also a significant protective factor for CRC (OR=0.387, 95%CI=0.271-0.553, P<0.001). This protective effect was statistically significant for both genders and for all the localizations, except for the rectal localization in men. The protective effect was the highest (83%) for proximal colon in women, and the lowest (50%) in men (Table 2).

Table 2. Results from logistic regression analysis for the factor climbing stairs at least three floors daily during the last five years

Factor	Group	Localization	Comparison	OR*	95% CI**		P
					Lower bound	Upper bound	
Climbing stairs	All	All	Yes/No	0.387	0.271	0.553	<0.001
	Men	All	Yes/No	0.505	0.317	0.806	0.004
	Women	All	Yes/No	0.271	0.156	0.471	<0.001
	All	Proximal colon	Yes/No	0.285	0.158	0.514	<0.001
	All	Distal colon	Yes/No	0.412	0.249	0.681	0.001
	All	Rectum	Yes/No	0.450	0.278	0.729	0.001
	Men	Proximal colon	Yes/No	0.418	0.195	0.893	0.024
		Distal colon	Yes/No	0.475	0.240	0.937	0.032
		Rectum	Yes/No	0.598	0.323	1.107	0.102
	Women	Proximal colon	Yes/No	0.168	0.065	0.437	<0.001
		Distal colon	Yes/No	0.340	0.161	0.718	0.005
		Rectum	Yes/No	0.298	0.136	0.652	0.002

Cycling at least two times weekly for about 30-60 minutes was a protective factor for CRC (OR=0.538, 95%CI=0.244-1.189, P=0.126). It was statistically significant for men, and displayed a decreasing risk of 65% (Table 3).

Table 3. Results from logistic regression analysis for the factor cycling at least 30-60 minutes biweekly during the last five years

Factor	Group	Localization	Comparison	OR	95% CI		P
					Lower bound	Upper bound	
Cycling	All	All	Yes/No	0.538	0.244	1.189	0.126
	Men	All	Yes/No	0.352	0.134	0.926	0.034
	Women	All	Yes/No	2.018	0.362	11.236	0.423

Garden working at least 60 minutes two times weekly, during the last five years was a significant protective factor for CRC (OR=0.659, 95%CI=0.470-0.926, P=0.016). The protective effect was statistically significant in men, and for proximal colon and rectal localization in women. The highest protective effect (60%) was evident for proximal colon in men and the lowest (34%) for the whole excerpt (Table 4).

Swimming for at least 30-60 minutes twice weekly, during the last five years was not a significant factor for developing CRC. Overall: OR=0.535, 95%CI=0.195-1.468, P=0.225; for men: OR=0.433, 95%CI=0.130-1.436, P=0.171; for women: OR=0.991, 95%CI=0.137-7.158, P=0.993. The OR value under one, in all groups, indicates protective influence. The obtained data was not sufficient to sort the results by localization of carcinoma.

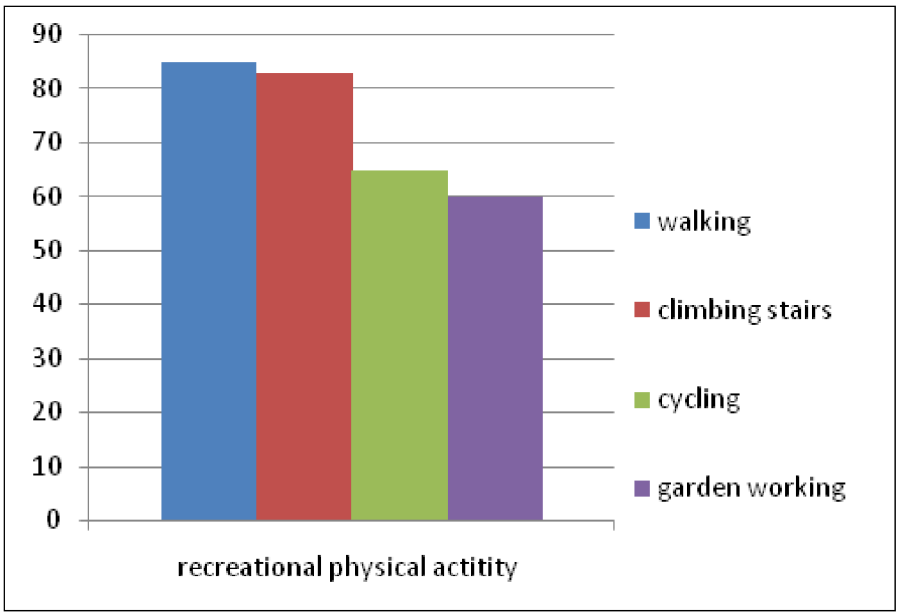
Tourism at least one or two times monthly, during the last five years was not a significant factor for developing CRC (overall: OR=0.880, 95%CI=0.535-1.446, P=0.613).

Performing none of the aforementioned activities during the last five years was a risk factor for developing CRC and was statistically significant in the overall study

Table 4. Results from logistic regression analysis for the factor garden work at least 60 minutes, biweekly during the last five years

Factor	Group	Localization	Comparison	OR	95% CI		P
					Lower bound	Upper bound	
Garden work	All	All	Yes/No	0.659	0.470	0.926	0.016
	Men	All	Yes/No	0.599	0.382	0.942	0.026
	Women	All	Yes/No	0.746	0.445	1.251	0.267
	All	Proximal colon	Yes/No	0.541	0.322	0.911	0.021
	All	Distal colon	Yes/No	0.884	0.552	1.415	0.608
	All	Rectum	Yes/No	0.578	0.364	0.918	0.020
	Men	Proximal colon	Yes/No	0.359	0.175	0.738	0.005
		Distal colon	Yes/No	0.779	0.412	1.472	0.442
		Rectum	Yes/No	0.670	0.369	1.216	0.188
	Women	Proximal colon	Yes/No	0.889	0.413	1.911	0.763
		Distal colon	Yes/No	1.048	0.520	2.110	0.896
		Rectum	Yes/No	0.429	0.199	0.924	0.031

Figure 1. Protective influence of some types of recreational physical activities (in percentages)



sample (OR=2.796, 95%CI=1.719-4.549, P<0.001), but not for the distal colon in men (OR=2.148, 95%CI=0.725-6.362, P=0.168), or the proximal colon in women (OR=1.960, 95%CI=0.787-4.883, P=0.148). The highest risk (4.4 folds) was for the rectum in men (OR=4.363, 95%CI= 1.756-10.845, P=0.002), whereas the lowest risk (2.3 folds) was for the distal colon (OR= 2.280, 95%CI=1.200-4.330, P=0.012).

Discussion

As a result of the study, we confirm that physical activity is an important factor in prevention of CRC occurrence. We established the minimal level for some types of activity which are needed for protection. This is very important given the inactivity of the general populations, which is a global health problem. Our results are slightly varying according to gender.

Physical activity has protective effect for the rectal localization, too. The highest level of protection is provided by walking at least 30 minutes daily regardless of the gender or the sub-site (Figure 1).

Many researchers are studying the association between CRC and recreational physical activity. They also consider the following types of activities: walking, cycling, climbing stairs, garden working, tourism and treadmill running, different kind of sports. As opposed to our study, they pay attention to the quantity of the energy expended, measured by MET hours per week or kilojoules per day (3,5). Some of the studies did not find differences in the protective effect of various types of activity, and supposed that only the intensity matters (6,7). Another study finds variations according to gender and sub-site. For example, walking has the highest protective impact in both genders and in all sub-sites. Other studies did not find an association between recreational walking and risk of developing CRC in men and women (8). They did not find a relationship between cycling, different kind of sports and garden working in women, but established the importance of garden working and employment in sport at least two hours per week for the distal colon cancer in men. They detected no connection between cycling and the risk of developing CRC in men (8).

In regard to swimming twice weekly at least 30-60 minutes we did not find statistically significant association with CRC risk. In the literature, the role of chlorine-containing preparations used for disinfection of the swimming-pool water is considered as a potential carcinogen. Some studies found relationship between the risk of developing carcinomas and chloric substance in the water of the swimming pools (9,10). Additional research about this issue is needed to provide more convincing conclusions.

Although the results are partly inconsistent, most authors conclude that physical activity decrease the risk of developing CRC. Evidence shows that people who are more physically active can decrease their risk of developing CRC from 10% to 25% (4,11,12). Some studies state a higher percentage of the protective impact (from 30% to 40%) compared to those with sedentary lifestyle, irrespective of body mass index and with the greatest risk reduction in most physically active participants (4,11,13,14). Exercises decrease the risk of developing adenomas – the main precursors of the carcinoma (15).

Intensity, duration and frequency of physical activity are important. Some research reports that protective influence is supreme among most physically active people, although optimal levels and duration of activity are yet difficult to define, due to differences in studies and terminology, making comparisons difficult (16,17). Moreover, the assessment of intensity to mild, average and vigorous is subjective (18). Some authors determine 30-60 minutes on average to vigorous physical activity daily, as needed for the prevention of CRC (1,14). Other authors connect the meaning of intensity with gender, and claim that vigorous intensity has protective effect in men but not in women (2,20).

In summary, the intensity of physical activity has influence on health outcomes, and different categories of intensity have independent impact on risk reduction (5,21-24). Moreover, some studies have established a threshold of intensity over which the effect can be unfavorable (25).

There are some unclear aspects about the specific effect of duration of physical activity, whether sedentary lifestyle has an independent influence beyond obesity, the dose of physical activity that is needed for prevention in different age-groups, and the like (19).

Another aspect of association between CRC risk and physical activity is the localization of carcinoma. Two questions are discussed in the literature. The first is if physical activity has the same importance for the rectal and for the colon cancer. The second question is if there is a difference in its meaning for the proximal and distal colon cancers (5). The results of most studies are consistent in regard to the benefit of the physical activity for the colon cancer, (6,20,33), but it is not so plain if the effect is protective for the

rectal cancer (4,12,26-28). We found that walking has a protective effect in all sub-sites (proximal, distal colon and rectum), climbing stairs also, excluding rectal localization in men, garden working is also protective for proximal colon and rectum, but not for distal colon, whereas for cycling there is not enough information to make a firm conclusion.

Identification of a different relationship between physical activity and CRC risk by sub-site, may lead to a better understanding of the etiology of disease. If physical activity is strongly associated with the risk of distal colon cancer, this may require more prevalent screening for CRC (29), as adenomas- the known precursors of carcinoma are more likely to be removed during the flexible sigmoidoscopy and colonoscopy, when they are localized in the distal colon versus proximal (30,31). Even more colonoscopy shows a relationship with greater advanced neoplasms risk reduction in distal versus proximal colon (32).

There are different explanations of the causal connection between physical activity and proximal and distal colon cancer. It is supposed that physical activity may increase more the gut motility in the proximal colon than in the distal colon (34-36). On the other hand, increasing the gastrointestinal transit time and decreasing the constipation, physical activity should have greater influence on risk of distal cancer, because the distal colon has greater store function versus proximal colon. It is considered that the impact of the physical activity on the metabolic hormones and growth factor's levels influence more on the proximal colon cancer risk than distal colon cancer risk (35). Even more, the association between physical activity and obesity reduction on one hand and vitamin D levels on the other is supposed as a reason for greater cancer risk reduction in distal colon versus proximal colon (33).

Generally, physical activity affects colorectal carcinogenesis through the following mechanisms: increasing gut motility (decreasing the contact time between carcinogens and colonic mucosa); improving the immune function; reducing the obesity and levels of insulin and insulin like growth factor-1; improving the cleansing systems for free radicals; affecting the prostaglandin levels, some hormones and growth factors, COX 2, high sensitive C-reactive protein, interleukin-6, tumor necrotic factor-alfa receptor 2, adiponectin, retinol-binding protein, interleukin-1 receptor antagonist, C-peptid), which are connected with inflammation and affect the growth of the tumor (1,2,4,37-40). Through decreasing the inflammation of the colon, slower cell multiplication is achieved and thus there is a smaller chance for mistakes during cell replication, which may lead to cancer. Taken together, evidences provide strong support to the fact that the lack of physical activity is casually related with CRC risk (1,2,4).

Except as a mean of primary prophylaxis, physical activity decreases the risk of relapse and improves the prognosis of CRC. It may decrease the development of comorbidities and improve the physical wellbeing and quality of life. The positive effect of physical activity, as a primary, secondary and tertiary prophylaxis, prompts many public organizations to recommend people to be more physical active. It has to be a part of the rehabilitation in survivors. More studies are needed though to establish in what levels it is possible (27,41).

Our findings should be interpreted with caution as cases and controls were uniform only by gender and age. Furthermore, we did not consider the intensity of physical activity, the body mass index, the nutritional habits, smoking, alcohol consumption and occupational physical activity. All these factors may impact the role of physical activity in CRC prevention.

Conclusion

Establishing the minimal levels of physical activity which are preventive for CRC and are recommendatory is the main contribution of our study. This is very useful because of the frequency of this neoplasm among the population and the large percentage of cases determined by physical inactivity. Although physical activity has an independent effect on the

CRC risk, our efforts should be pointed to the more vulnerable population groups, namely people with high levels of obesity and overweight, cancer survivors, people with low socioeconomic level, and the like.

Future studies about physical activity and CRC risk may be focused on other aspects of the relationship, and how obesity, dietary habits and ethnicity may interact in this relationship.

Conflicts of interest: None declared.

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