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# The role of physical activity in cancer patients: a narrative review

## Abstract

Physical activity plays an important role in the proper functioning of the human body and it is recommended in the prevention and treatment of many disease syndromes. The importance of physical activity in cancer patients has been highlighted in recent years. Physical activity has a positive impact on the course of the disease as well as on the condition of patients after anticancer treatment. It also reduces the risk of developing some types of cancer. Physical activity can be recommended to patients during and after cancer treatment. This narrative review presents current knowledge regarding the indications, applicability, and efficacy of physical activity in cancer patients, based on the recommendations of the American College of Sports Medicine International Multidisciplinary Roundtable on Exercise and Cancer. The paper discusses the role of physical activity in cancer patients receiving palliative care on the basis of the available systematic reviews.

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**Key words:** physical activity, cancer, anticancer treatment, quality of life, palliative care

## Introduction

It is increasingly often emphasized in modern medicine that physical activity plays an important role in cancer patients. Physical activity prevents the development of some cancers, reduces the severity of symptoms, prolongs survival and has a positive impact on the quality of life, functioning of the patient as well as other symptoms that occur after anticancer treatment [1]. Exercises can be safely performed by cancer patients during and after anticancer treatment, and they should be included in the treatment plan [1, 2]. However, the incorporation of physical activity

into clinical practice remains limited by such barriers as: the lack of knowledge regarding potential benefits of physical activity, insufficient accessibility to medical rehabilitation for cancer patients, and concerns among health care professionals, patients, and their families regarding the safety of physical activity. This article presents the current knowledge regarding physical activity in cancer patients and discusses the position of experts from the American College of Sports Medicine International Multidisciplinary Roundtable on Exercises and Cancer [1, 2]. It presents current views on physical activity in cancer patients receiving palliative care based on systematic reviews.

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## Physical activity in cancer patients

The first report concerning physical activity in cancer patients was published in the 1990s [3]. In 2010 the Expert Group of the American College of Sports Medicine published their recommendations [4]. In the last decade, experts have presented more clinical studies concerning benefits of physical activity and adequate nutrition. Also, recommendations and opinions of experts have aimed at incorporating physical activity into daily clinical practice in oncology, palliative medicine and medicine of pain [5–10]. According to the 2020 definition of the World Health Organization (WHO), physical activity is defined as every movement of the body produced by skeletal muscles that requires energy expenditure [11].

Physical activity can be classified by its type [11, 12]:

- aerobic, during which large muscles move rhythmically over an extended period of time, for example while walking, running, swimming or cycling; it is also known as endurance activity, and it improves cardiorespiratory fitness;
- anaerobic — short, intense exercises, during which oxygen demand exceeds oxygen supply, e.g. weightlifting, sprints.

On the basis of intensity, expressed in metabolic equivalents of task (*MET*), with 1 *MET* being the equivalent of energy expended by a seated person at rest, we distinguish the following types of physical activity:

- low-intensity physical activity, 1.5–3 *MET*, for example a slow walk, bath or other activities that do not cause a significant increase in the heart or respiratory rate;
- moderate-intensity physical activity, 3–6 *MET*, for example a vigorous walk, water aerobics, ballroom dancing, slow cycling;
- intense physical activity, 6 *MET* or above, for example running, heavy gardening (digging), fast cycling.

Two distinct types of physical activity have been identified [11, 12]:

- a sedentary lifestyle defined as an activity of 1.5 *MET* or less: sitting, lying, resting during work, free time, driving, watching TV; it also concerns people who are unable to stand up, for example individuals in wheelchairs;
- multi-component physical activity that consists of combining several types of exercise (aerobics, muscle strengthening, and balance training) in a single session, such as walking (aerobic activity), weight lifting (muscle strengthening), and balance training (e.g. walking backwards or sideways,

standing on one leg while doing upper body strengthening exercises) or dancing.

## The impact of physical activity on the risk of cancer

Physical activity reduces the risk of certain cancers [1, 10, 13]:

- colorectal cancer, by 26–27% among individuals whose level of physical activity was the highest compared to those who were physically inactive, regardless of body mass index (BMI);
- endometrial cancer, by 20% in patients with the highest level of physical activity;
- breast cancer, by 25%;
- kidney cancer, by 22%;
- gastric cancer (cardia), by 21%;
- bladder cancer;
- esophageal adenocarcinoma;
- lung cancer, by 22% among former smokers and by 23% among current smokers; no relationship between lung cancer and physical activity in non-smokers has been demonstrated.

It was confirmed that physical activity reduces the risk of colorectal, breast, renal, endometrial, bladder and gastric cardia cancer as well as esophageal adenocarcinoma. In the case of lung cancer, the quality of the evidence confirming the positive impact of physical activity is moderate [1, 13]. Limited scientific evidence suggests that physical activity can reduce the risk of liver, head and neck, haematopoietic, pancreatic, prostate and ovarian cancer. No relationship between physical activity and thyroid and rectal cancer has been demonstrated [1, 13].

Physical activity can increase the risk of melanoma. A high level of physical activity was associated with a 27% greater risk of melanoma than in individuals with a low level of physical activity [1]. Considering the proven impact of exposure to solar radiation on the development of melanoma, it is likely that the greater risk thereof stems from the fact that physically active people tend to spend more time outdoors. This hypothesis, however, must be confirmed by further studies [1].

The duration, type and intensity of physical activity is important in cancer prevention. Experts recommend at least 150–300 minutes of moderate physical activity, or 75–150 minutes of an equivalent vigorous aerobic activity per week, but the exact duration and intensity of physical activity needed to reduce the risk of cancer has not been established yet [1]. The best results can probably be achieved by performing physical activity in the free time and during work. Epidemic analyses concerning patients with breast and bladder

cancer revealed that there is a relationship between a lower risk of cancer and moderate to intense physical activity, and in patients with endometrial cancer — also low-intensity physical activity [1].

The age at which patients undertake physical activity is also important in cancer prevention. Long-term, sustained physical activity is associated with a lower risk of esophageal cancer [1]. Physical activity performed recently, compared to that performed earlier in life, is associated with a lower risk of renal cancer [1]. In patients with breast cancer it was observed that the reduction in the risk of cancer was the greatest (by even 17%) in the group of patients who were physically active in late adulthood, over the age of 50, while physical activity at the age of 25–50 and in patients under 25 reduced the above-mentioned risk by 11 and 10%, respectively. Physical activity performed at any age is associated with a reduced risk of breast cancer, however, the reduction may be somewhat more pronounced, when it is performed in late adulthood, compared to early or mid-adulthood. This can be explained by hormonal changes occurring in women, which may have a varying impact on the relationship between physical activity and the development of cancer [14]. Currently, there is no data from meta-analyses on bowel cancer risk, but narrative reviews suggest that there is an association between physical activity in adulthood (both in early and late adulthood) and a lower risk of cancer [15].

The time spent in a seated position and a sedentary lifestyle constitute an independent risk factor for cancer. Sedentary lifestyle is associated with a greater risk of chronic diseases as well as an increased risk of all-cause mortality, due to type 2 diabetes, cardiovascular diseases and a greater risk of some cancers, regardless of the performed physical activity and BMI [1]. Longer time spent in a seated position is associated with an approximately 30% greater risk of endometrial cancer [16]. Another meta-analysis of data obtained from five prospective cohorts revealed that the risk of endometrial cancer was 36% higher in patients spending longer time in a seated position [17]. Similarly, spending more time in a sedentary position is associated with a 30% greater risk of colon cancer [18]. In young people, a sedentary lifestyle consisting of watching television increases the risk of colorectal cancer to a greater extent than the risk of rectal cancer [19]. In contrast, a sedentary lifestyle slightly increases the risk of lung cancer with a relative risk (RR) of 1.13 (CI 95%, 0.94–1.36) [17]. In a cohort study conducted in the United States among women, a sedentary lifestyle increased the risk of ovarian cancer by 55% [20].

## Impact of physical activity on the prognosis of cancer patients

Number of studies investigating the relationship between mortality, a given type of cancer and physical activity performed before and after the diagnosis has increased in the last decade. Physical activity affects both general and cancer-related mortality [1]. Epidemic data indicate that a high level of physical activity before the diagnosis of cancer is associated with an 18% lower risk of death due to breast cancer and a 23% lower risk of death due to colorectal cancer, compared to individuals with a low level of physical activity [1]. No similar relationship has been demonstrated for patients with prostate cancer [1]. The risk of all-cause mortality in cancer patients (assessed in cohort studies involving patients with breast, colorectal and prostate cancer) was considerably lower in the group of patients with a high level of physical activity, compared to patients with a low level of physical activity, and amounted to 13% for prostate cancer and 25% for colorectal cancer [1]. A similar relationship was demonstrated for physical activity performed after cancer diagnosis. It was observed that in individuals performing intense physical activity the risk of cancer-related mortality was 26–69% lower, and the general risk of death in patients with breast, colorectal and prostate was 21–45% lower, compared to those with low levels of physical activity [1]. Physical exercises can extend the survival of patients with breast, colorectal and prostate cancer [1, 13].

Physical activity before and after the diagnosis of cancer, reduces all-cause mortality (the number of all deaths) to a greater extent, compared to cancer-related mortality. Its greater impact on all-cause mortality may be explained by the positive impact of physical activity on the cardiovascular system. Cardiovascular diseases are the leading cause of mortality in specific groups of patients who survived cancer treatment, especially in the case of breast, colorectal and prostate cancer. The benefits of performed physical activity in the aforementioned groups of patients increase regardless of their BMI, presence of estrogen receptor for breast cancer, subtype of cancer and sex of patients with colorectal cancer [1]. Based on the studies conducted to date, however, it is not possible to determine the minimum level of physical activity necessary to reduce all-cause mortality and cancer-related mortality [1].

The time spent by patients in a seated position is an independent factor affecting mortality (as well as the development of cancer). There is little epidemic data concerning this relationship. It has been observed that the risk of death related to colorectal cancer is

12–13% greater in individuals who spend more time in a seated position than in those who spent less time this way [17]. In a cohort study, it was demonstrated that a sedentary lifestyle can constitute an independent risk factor for cancer-related mortality — replacing 30 minutes of sitting with moderate to vigorous physical activity can reduce the risk of cancer-related mortality by 31%, and replacing 30 minutes of sitting with low-intensity physical activity could reduce the risk of cancer-related mortality by 8% [21]. Physical activity of any intensity, from light and moderate to intense exercises, can reduce the risk of cancer-related mortality [21].

Physical exercises can be safely performed by cancer patients during anticancer treatment, and their scope and type should be adjusted to the capabilities of a given individual as well as the cancer treatment [1]. Physical activity does not have a negative impact on the course of treatment and number of chemotherapy cycles, nor does it cause serious adverse effects [22].

### Impact of physical activity on the symptoms occurring in cancer patients

Physical exercises (moderate-intensity aerobic training twice or 3 times per week for 12 weeks, combined with resistance training for 6 to 12 weeks) reduced the severity of patients' anxiety, depression, and fatigue during and after the completion of cancer treatment [2]. Such activity can significantly improve the health-related quality of life (HRQoL) as well as physical functioning of patients after the completion of anticancer treatment [2].

Exercises performed under the supervision of a trainer can have a positive impact on lymphoedema in patients diagnosed with breast cancer, who can safely perform aerobic and resistance exercises. In the case of the latter, however, patients should start low and progress slowly [2]. Exercises did not provide beneficial effects in patients with oedema caused by other types of cancer, e.g. head and neck, urinary bladder as well as gynaecological cancers and melanoma [2]. The effects of exercises on anxiety, depression and quality of life are better when patients are supervised by trainers, compared to unsupervised patients [2].

Exercising has been found to have beneficial effects on the quality of sleep and bone structure (it reduces the process of bone demineralization, or increases bone density measured in the femur and spine) [2]. Data concerning relationship between bone structure and physical activity mostly concern patients diagnosed with breast and prostate cancer during the adjuvant treatment. The best results are achieved in patients who follow a programme composed of mo-

derate-intensity resistance exercises combined with a high-intensity training performed 2–3 times a week. Simple aerobic exercises, such as walking, do not have a positive impact on the structure of bones [2, 23]. Data concerning impact of exercises on the quality of sleep in patients after anticancer treatment are inconclusive. Since it has been observed that physical activity improves the quality of sleep in the general population [13], cancer patients should do 30–40 minutes of moderate-intensity aerobic exercise (walking) 3–4 times a week to improve the quality of sleep [2].

Although there is no evidence that physical activity has a positive impact on cardiotoxicity of cytostatic medications, data from experimental studies are promising [24]. There is also no evidence confirming that physical activity has an impact on prevention and effects of polyneuropathy treatment after chemotherapy, cognitive function, risk of falls, nausea, pain intensity after chemotherapy, sexual functions and tolerance of anticancer treatment. The fact that evidence confirming the beneficial effects of physical activity on the above-listed elements is either lacking or scarce does not mean that there are no potential benefits of physical activity in a given patient. In addition, it does not mean that patients should lead a sedentary lifestyle and avoid physical activity.

In clinical practice, in addition to conventional medicine, a growing number of patients are doing exercises (e.g. yoga) that can be performed during and after cancer treatment. Danhauer et al. demonstrated that yoga reduces fatigue, improves the quality of life of cancer patients [25] and can reduce the severity of anxiety, depression, stress, cognitive symptoms, as well as improve the quality of sleep, which was confirmed in a Cochrane review involving patients with breast cancer [26]. Like other methods of stress reduction, yoga is recommended for patients with cancer [2, 25, 26]. Table 1 presents the beneficial effects of physical activity in cancer patients doing a given type of exercise. The presented outcomes of physical activity were confirmed in five randomized clinical studies [2].

An optimal programme of physical activity that is beneficial and improves aspects of cancer patients' health involves moderate-intensity aerobic exercises performed at least 3 times a week, each time for 30 minutes, for at least 8–12 weeks [2]. Adding resistance training to aerobic exercises at least twice a week, with two series of 8–15 repetitions, provides similar beneficial effects. Resistance training alone, on the other hand, may not affect all components of the quality of life in terms of anxiety and depression (Table 1) [2]. In clinical practice, the quality and quantity of exercises should be adjusted to cancer patients on the basis of

**Table 1. Type of exercises and effects in cancer patients (based on [2])**

Expected effects of physical activity	Aerobic exercises	Resistance exercises	Combination of aerobic and resistance exercises
Reduction of anxiety	√		√
Reduction of the symptoms of depression	√		√
Reduction of fatigue	√	√	√
Improvement in the quality of life	√	√	√
Subjective improvement in physical functioning	√	√	√
No risk of upper limb lymphoedema deterioration		√	

their performance status. Cancer patients with a performance status of 0–2 on the Eastern Cooperative Oncology Group (ECOG) scale should do moderate aerobic exercise (vigorous walks, light cycling, exercises in water) 3 times a week for 30 minutes as well as resistance exercise twice a week for 20–30 minutes. In the case of patients with worse performance status, rehabilitation specialists may decide to implement a personalized programme, which concerns the period during and after the completion of anticancer treatment [2, 27].

### Physical activity in patients after the completion of anticancer treatment

Physical activity is safe and should be recommended to patients after the completion of anticancer treatment [4], which has been confirmed in clinical studies and is recommended by experts [2]. Physical activity has a positive impact on improving particular elements of physical performance, including cardio-respiratory fitness, muscular strength and endurance, as well as body composition. However, the response of the organism depends on individual factors and can differ depending on the type of the applied anticancer treatment, adverse effects, complications of cancer (e.g. anaemia, fatigue), and the age of the patient. Since patients’ tolerance to exercise may vary during anticancer treatment, changes occurring in their organism as a result of treatment and benefits of physical exercises should be taken into account (Table 1) [2]. Potential complications and consequences of anticancer treatment affect all organs and systems, which may have an impact on the safety and tolerance to the performed exercises [2]. When planning physical activity in cancer patients, possible complications of anticancer treatment should be taken into account [2]:

- cardiovascular system: heart damage or an increased risk of cardiovascular diseases;
- endocrine system: deterioration of bone condition, weight gain or loss, loss of muscle mass, develop-

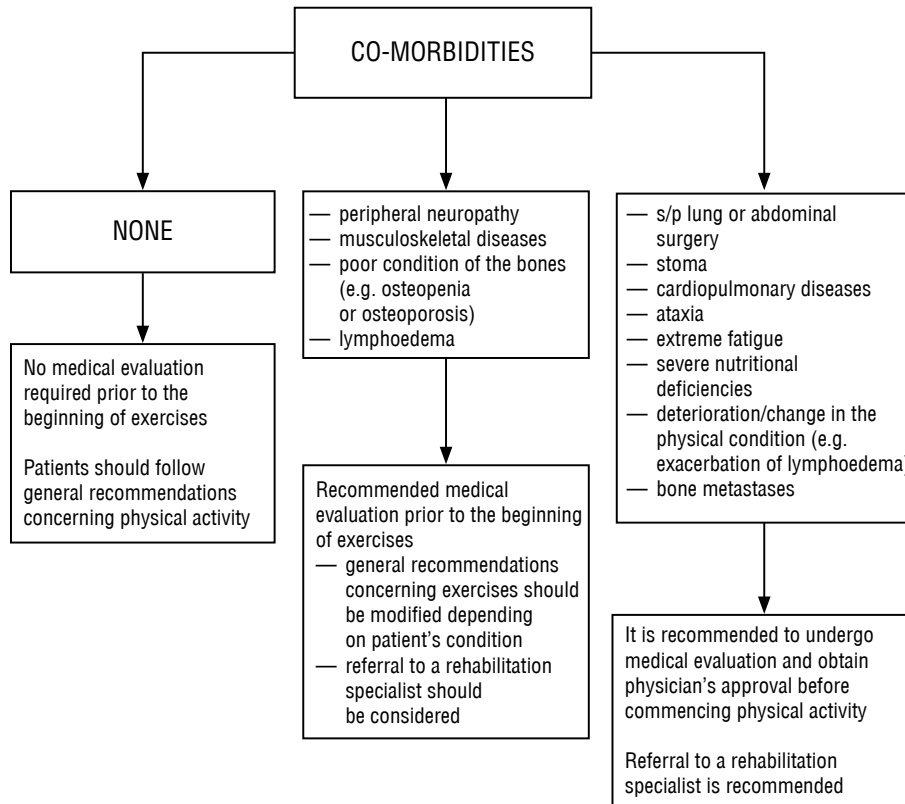
- ment and exacerbation of the metabolic syndrome;
- gastrointestinal tract: nausea and vomiting, constipation and diarrhoea, other gastrointestinal disorders, e.g. after a surgery;
- haematopoietic system: anaemia, immune weakness;
- nervous system: peripheral neuropathy, cognitive impairment;
- respiratory system: pulmonary dysfunction, pneumonia;
- skin: redness, irritation, rash, limitation of the range of movement due to wounds;
- pain: generalized, muscle and/or joint pain, painful polyneuropathy;
- systemic symptoms: fatigue, lymphoedema.

On the basis of medical history, clinical assessment and cooperation with physiotherapists, and medical rehabilitation specialists, a form of physical activity that is the safest and most convenient for each patient can be developed and recommended. The recommended protocol is presented in Figure 1 [2].

### Physical activity in cancer patients receiving palliative care

Physical exercise can be beneficial for cancer patients during and after treatment, but there are few studies assessing the impact, amount and type of physical activity in cancer patients receiving palliative care. Results of clinical studies suggest that physical activity has a positive impact in patients with advanced cancer:

- a supervised, structured, 6-week group exercise programme improved the physical performance (longer distance walked in 6 minutes, increased muscle strength), reduced the level of anxiety and improved the emotional functioning of patients with advanced lung cancer [28];
- exercises (walking, strength training at home) performed more than 4 days a week for 8 weeks improved the ability to move, the quality of sleep and reduced fatigue in patients with advanced



**Figure 1.** The algorithm for clinical assessment of patients and physical activity recommendations for patients after cancer treatment depending on the presence of comorbidities and possible risks associated with exercising (based on [2])

**Table 2.** Mirels’ classification system for impending pathologic fractures [38]

Point value	1	2	3
Location	Upper limb	Lower limb	Trochanteric
Pain	Mild	Moderate	During activities
Radiological type	Osteoblastic	Mixed	Osteolytic
Extent of damage to the cortical layer	< 1/3	1/3–2/3	> 2/3

- lung and colorectal cancer [29];
- physical activities performed by patients with advanced cancer reduced fatigue, pain, drowsiness and depression, and improved patients’ appetite as well as their general condition [30];
- in cancer patients with the cancer anorexia–cachexia–asthenia syndrome, physical activity increased skeletal muscle strength, independence and mood [31].

Systematic reviews confirmed that increased physical activity has an impact on the quality of life of patients with advanced cancer, reduces pain, stress and anxiety, improves physical performance, and has a satisfactory safety profile [32–36]. The beneficial effects of physical activity may persist after it is di-

continued. In patients with disseminated prostate and breast cancer, improved physical performance and quality of life persisted for 6 months after the discontinuation of exercises [37].

In patients with bone metastases, physical activity should be planned taking into account the risk of pathologic fractures according to the Mirels system, used for the assessment of the risk of pathologic fractures, mainly of long bones (Table 2) [38]. Patients with bone metastases who score less than 7 are at a low risk of fractures, and they can be encouraged to be as physically active as possible considering the intensity of pain. Patients who score 7 or higher should be referred for an evaluation of an orthopaedist, as bone stabilization may be necessary [39]. Patients with



bone metastases who have undergone a stabilization procedure should be encouraged to be as active as possible after the procedure [40].

For patients with bone metastases, experts recommend supervised exercise programmes focused on healthy limbs. Strenuous exercises involving the limbs with metastases as well as movements that cause pain should be avoided. If bone pain does not subside quickly after exercises, or the number of episodes of pain increases, patients should consult a physician [39]. Patients with bone metastases should avoid exercises that induce torsion, e.g. twisting of the limb with the metastasis, as during this movement the bone is at its weakest, and a small defect can reduce the twisting force by 50% [41]. The type and intensity of exercises in patients receiving palliative care depends on their physical performance — in individuals who score more than 2 points on the ECOG scale, the programme should be individually adjusted by a rehabilitation specialist.[27]

## Conclusions

Physical activity plays an important role in the prevention and treatment of cancer patients. Exercising lowers the risk of death, colorectal, endometrial, breast, bladder, renal, cardiac, gastrointestinal, esophageal and lung cancer. Recommended duration, type and intensity of exercising was determined as part of prevention. Recommended minimum amount of exercise in adults for cancer prevention is 150–300 minutes of moderate physical activity per week, or 75–150 minutes of an equivalent vigorous physical activity per week (300 minutes per week should not be exceeded). A sedentary lifestyle increases the risk of endometrial, ovarian, colorectal, and rectal cancer. Exercising does not have a negative impact on the course or tolerance of anticancer treatment. Moderate-intensity physical activity reduces anxiety, depression, fatigue, improves quality of life and physical functioning of patients during and after the completion of anticancer treatment.

Physical activity reduces general and cancer-related mortality. Greater physical activity preceding the diagnosis of cancer reduces the risk of death due to breast cancer by 18%, and the risk of death due to colorectal cancer — by 23%. In addition, greater physical activity after the diagnosis of cancer reduces the risk of death due to cancer by 26–69%.

When planning exercises for patients after the end of anticancer treatment, specialists should take into account changes occurring in the organism that affect performance and exercise tolerance. Appropriately selected exercises can be recommended for each group

of cancer patients, also those receiving palliative care. Physical exercises reduce fatigue, stress and pain, improve quality of life and well-being, increase muscle strength, physical performance and independence. To date, the optimal physical activity for patients with advanced cancer has not been determined. Physicians' approach and knowledge regarding physical activity are an important aspect in this group of patients. In addition, the presence of bone metastases may raise concerns regarding the safety of exercising.

When recommending a given type of physical activity, specialists should take into account patients' medical history and clinical assessment, including physical performance according to the ECOG scale and the possibility of cooperating with physiotherapists and rehabilitation specialists. In cancer patients with ECOG score of 3 or 4, or suffering from other complications, the exercise programme should be individually adjusted by the rehabilitation specialist. Since appropriate activity and physical functioning constitute an integral part of the care provided to cancer patients, clinicians should have knowledge about exercise programmes. Physicians should regularly assess patients' level of physical activity, select optimal physical activity and, if needed, refer patients to rehabilitation specialists who will assess and recommend optimal exercise programmes. Specialists should educate patients, emphasizing that appropriate and individually adjusted physical activity improves patients' prognosis and quality of life.

## Declaration of conflict of interests

The authors declare that there is no conflict of interest.

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