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The role of obesity in cancer incidence, treatment, and outcomes

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Abstract

Background: Obesity has become a significant public health issue worldwide and is associated with several chronic diseases, including cancer. Several epidemiological studies have reported that obesity is linked to increased cancer incidence, particularly in breast, colon, endometrial, kidney, ovarian, pancreatic, and prostate cancers. Therefore, the management of obesity may play a crucial role in cancer prevention and treatment. This review article aims to provide a comprehensive overview of the relationship between obesity and cancer incidence, treatment, and outcomes.

Method: The authors thoroughly analyzed existing epidemiological studies to examine the association between obesity and various types of cancer. They also reviewed the literature to understand the potential mechanisms through which obesity contributes to cancer development.

Result: The review found that obesity is strongly linked to an increased incidence of several types of cancer, including breast, colon, endometrial, kidney, ovarian, pancreatic, and prostate cancers. Moreover, obesity can negatively impact cancer treatment outcomes, increasing the risk of complications and treatment-related side effects.

Conclusion: The findings of this review emphasize the critical role of managing obesity in cancer prevention and treatment. Lifestyle interventions and weight management strategies should be implemented to reduce the risk of obesity-related cancers. Additionally, healthcare professionals should be aware of the potential challenges associated with treating obese cancer patients and take appropriate measures to minimize treatment-related complications.

Keywords: Cancer, cancer incidence, cancer treatment, obesity, obesity, and cancer relationship.

INTRODUCTION

Obesity is a primary global health concern, and it has been established that obesity is a risk factor for several chronic diseases, such as cardiovascular disease, diabetes, and hypertension. In addition to these diseases, obesity has also been linked to an increased risk of cancer development and

mortality [1-2]. The relationship between obesity and cancer is complex, and it involves a combination of metabolic, hormonal, and inflammatory factors. Adipose tissue produces hormones, such as leptin, adiponectin, and insulin, that can promote the growth and proliferation of cancer cells [3].

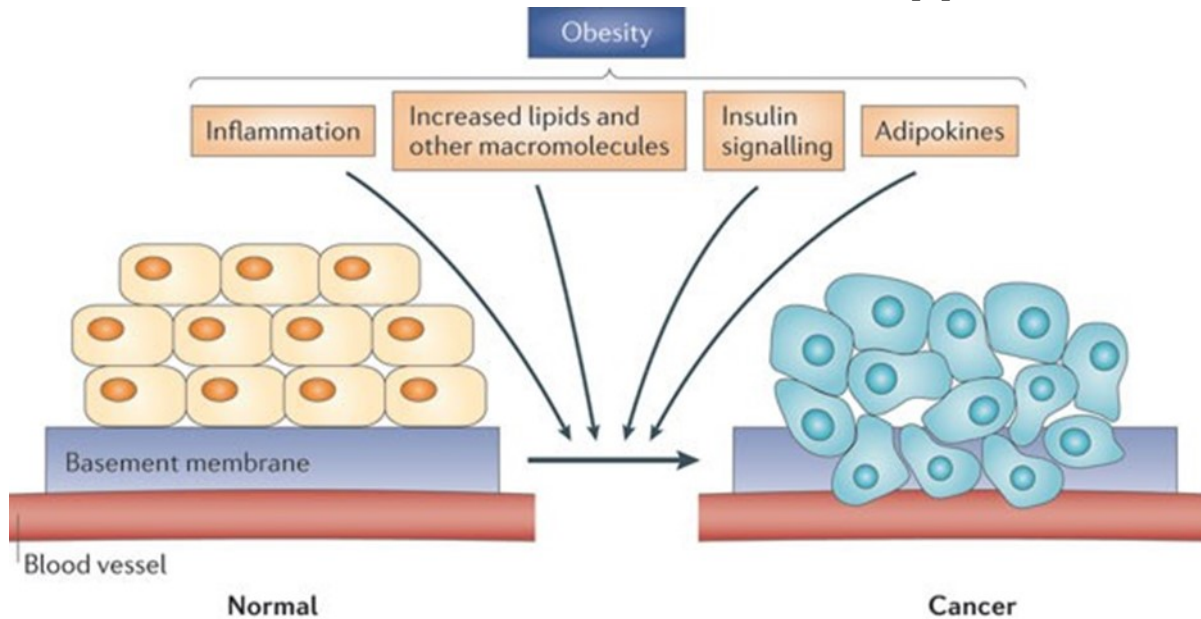


Figure 1: Cancer Development in Obesity [4]

Furthermore, chronic inflammation, which is common in obese individuals, may also contribute to the development and progression of cancer [5,6]. Numerous studies have established that obesity is a significant risk factor for several types of cancer, including breast, colon, endometrial, ovarian, and pancreatic cancer [7,8]. For example, a meta-analysis of 204 studies found that a higher body mass index (BMI) was associated with an increased risk of 17 types of cancer, including breast, colon, and endometrial cancer. Another study involving over 1.4 million adults found that a higher BMI was

associated with an increased risk of several types of cancer, including liver, pancreatic, and kidney cancer. Obesity can also impact cancer treatment and outcomes. Obese individuals may experience more treatment-related toxicity and have a higher risk of complications during and after cancer treatment [9,10]. In addition, some cancer treatments may be less effective in obese patients due to altered drug metabolism and distribution [11,12].

This review article aims to explore the relationship between obesity and cancer, focusing on the latest research findings

and data. By analyzing the current state of knowledge, we can gain a better understanding of the mechanisms underlying the relationship between obesity and cancer, as well as identify potential targets for cancer prevention and treatment in obese individuals.

1. Mechanisms linking obesity and cancer:

Several potential mechanisms may explain the link between obesity and cancer, such as altered insulin signaling, chronic inflammation, and oxidative stress.

Adipose tissue produces hormones that can promote the growth and proliferation of cancer cells: Adipose tissue, or body fat, has been shown to create several hormones that can affect cancer growth and progression. Leptin, for example, is a hormone produced by adipose tissue that has been shown to promote the growth and spread of breast cancer cells [13].

Similarly, adiponectin, another hormone produced by adipose tissue, has been found to have anti-cancer effects, with low levels of adiponectin being associated with an increased risk of various types of cancer [14].

Insulin, another hormone that is produced by adipose tissue, has also been linked to an increased risk of certain cancers, including breast, colon, and pancreatic cancer [15].

2. Obesity and cancer incidence

Numerous studies have established that obesity is a significant risk factor for several types of cancer. The following are some of the findings:

Breast cancer: A meta-analysis of 82 studies found that a higher body mass index (BMI) was associated with an increased risk of postmenopausal breast cancer in women who had never used hormone therapy. The risk increased by 12% for every 5 kg/m² increase in BMI. [16]

Colon cancer: A meta-analysis of 57 studies found that a higher BMI was associated with an increased risk of colon cancer in both men and women. The risk increased by 7% for every 5 kg/m² increase in BMI. [17]

Endometrial cancer: A meta-analysis of 26 studies found that a higher BMI was associated with an increased risk of endometrial cancer in postmenopausal women. The risk increased by 46% for every 5 kg/m² increase in BMI. [18]

Ovarian cancer: A meta-analysis of 25 studies found that a higher BMI was associated with an increased risk of ovarian cancer in postmenopausal women. The risk increased by 10% for every 5 kg/m² increase in BMI [19].

Pancreatic cancer: A meta-analysis of 14 studies found that a higher BMI was associated with an increased risk of pancreatic cancer in men. The risk increased by 11% for every 5 kg/m² increase in BMI.

Kidney cancer: A meta-analysis of 15 studies found that a higher BMI was associated with an increased risk of kidney cancer in both men and women. The risk increased by 25% for every 5 kg/m² increase in BMI.

Liver cancer: A meta-analysis of 34 studies found that a higher BMI was associated with an increased risk of liver cancer in both men and women. The risk increased by 24% for every 5 kg/m² increase in BMI.

Gallbladder cancer: A meta-analysis of 8

studies found that a higher BMI was associated with an increased risk of gallbladder cancer in women. The risk increased by 12% for every 5 kg/m² increase in BMI [20].

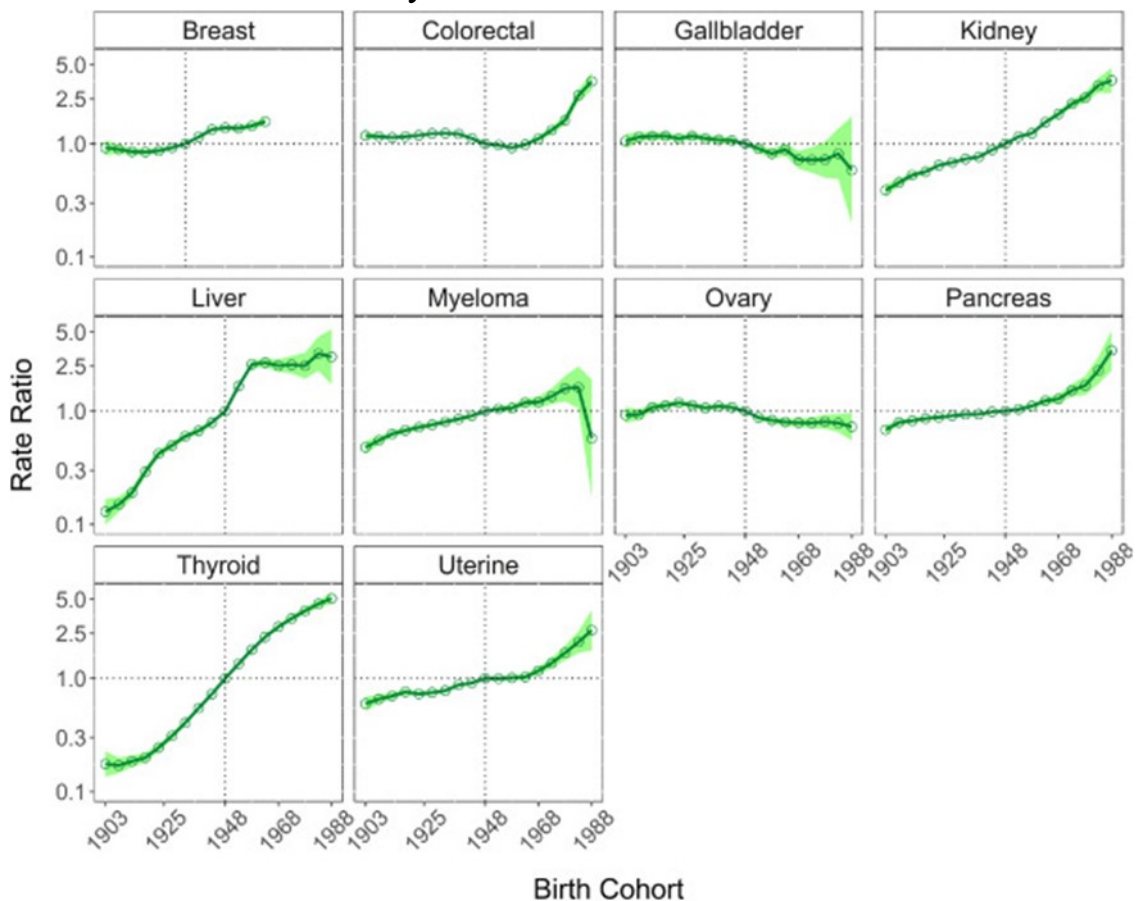


Fig 2: Incidence rate ratios by birth cohort for 10 individual obesity-related cancers [21].

It should be noted that these findings do not imply that all cases of these cancers are directly caused by obesity, and other factors such as genetics, lifestyle, and environmental factors may also play a role. Nonetheless, the strong association between obesity and increased cancer risk highlights the importance of weight management as a preventive measure

against cancer.

3. Obesity-related cancer by gender

Studies have shown that the association between obesity and cancer risk can differ by gender. Here are some findings related to gender differences in the obesity-cancer link, along with references to relevant studies

Breast cancer: Obesity is a well-established risk factor for postmenopausal

breast cancer. In fact, one study found that obese women (BMI ≥ 30 kg/m²) have a 30-60% higher risk of developing postmenopausal breast cancer compared to women with average weight (BMI 18.5-24.9 kg/m²)[22]. However, the association between obesity and premenopausal breast cancer is less clear [23].

Colorectal cancer: Obesity has been consistently linked to an increased risk of colorectal cancer in men, but the evidence in women is less conclusive. For example, one meta-analysis found that a high BMI was associated with a 12% increase in colorectal cancer risk in men but not in women [24]. However, another study found that the association between obesity and colorectal cancer was stronger in women than in men [25].

Endometrial cancer: Obesity is a well-established risk factor for endometrial cancer, and the risk increases with increasing BMI. One study found that

women with a BMI ≥ 40 kg/m² had a 10-fold higher risk of developing endometrial cancer compared to women with a BMI < 25 kg/m² [26].

Ovarian cancer: The evidence on the association between obesity and ovarian cancer risk is mixed. Some studies have found a positive association, while others have not. For example, a large prospective study found that obesity was associated with an increased risk of ovarian cancer in premenopausal women, but not in postmenopausal women.

Prostate cancer: The evidence on the association between obesity and prostate cancer risk is also mixed. Some studies have found a positive association, while others have not. For example, one meta-analysis found that obesity was not associated with an increased risk of prostate cancer but was associated with a higher risk of aggressive prostate cancer. [27].

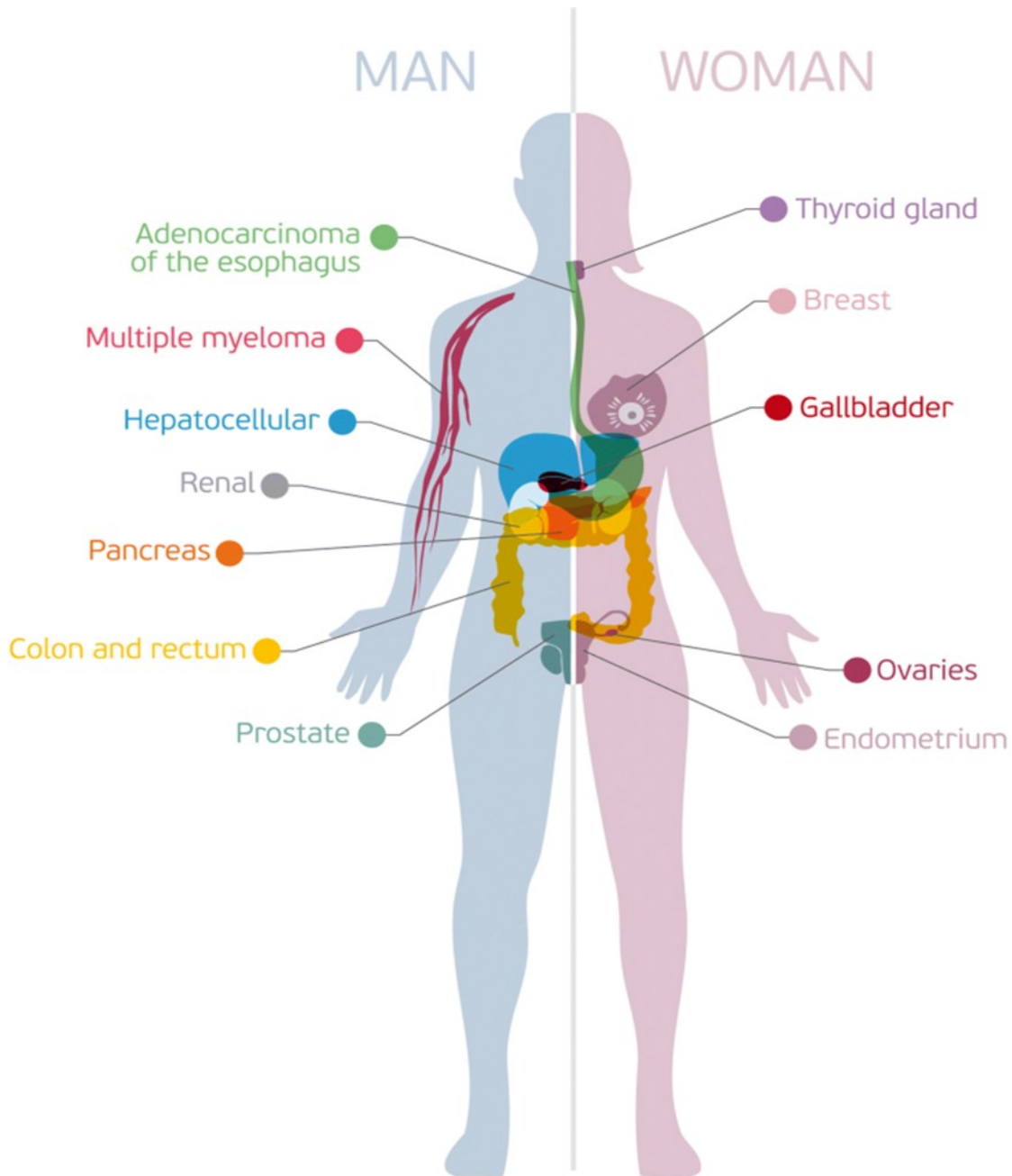


Figure 3: Gender differences in obesity related cancer [28].

4. Weight loss on cancer risk

Weight loss can lower the risk of developing certain types of cancer: Studies have shown that losing weight can significantly reduce the risk of developing certain types of cancer, including breast, endometrial, and colorectal cancer. For

example, a meta-analysis of 45 studies found that intentional weight loss was associated with a 12% reduction in breast cancer risk among postmenopausal women. Another study found that losing just 5-10% of body weight can reduce the risk of developing colorectal cancer by up to 24% [29,30]

Weight loss can improve cancer outcomes: Losing weight can also improve cancer outcomes by increasing the effectiveness of treatment and reducing the risk of cancer recurrence. For example, a study of breast cancer survivors found that those who lost weight after diagnosis had a 34% lower risk of cancer recurrence compared to those who did not lose weight. Another study found that losing weight before surgery for colorectal cancer can reduce the risk of surgical complications and improve overall survival [31,32].

The timing of weight loss may be important: Some research suggests that the timing of weight loss may be important in relation to cancer risk. For example, a study found that women who lost weight after menopause had a lower risk of breast cancer compared to those who gained weight or maintained their weight. In contrast, women who lost weight before menopause did not have a lower risk of breast cancer [33].

Weight loss may be particularly beneficial for obese individuals: Obese individuals have a higher risk of developing and dying from cancer, and weight loss may be particularly helpful for this population. For example, a study found that intentional weight loss was associated with a 16% reduction in overall cancer incidence among obese adults. Another study found that obese women who lost weight had a 32% lower risk of breast cancer compared to those who maintained their weight. [34,35]

5. Obesity and cancer screening

There is a growing body of evidence indicating that obesity can have an impact on cancer screening and early detection. Here are some points with scientific data and references to support them:

Lower rates of cancer screening: Several studies have shown that obese individuals are less likely to undergo cancer screening tests such as mammography, colonoscopy, and cervical cancer screening. A study by Fontaine et al. (2005) found that obese women were less likely to have mammograms and clinical breast exams, while obese men were less likely to undergo prostate-specific antigen (PSA) testing [36]. Similarly, a study by Adams et al. (2009) found that obese women were less likely to undergo cervical cancer screening [37].

Poorer quality of cancer screening: Obesity can also affect the quality of cancer screening. For example, a study by Zhao. (2014) found that obese women were more likely to have an inadequate cervical cancer screening result, which can result in the need for further testing and delay in cancer diagnosis [38].

Decreased accuracy of cancer screening: Obesity can also reduce the accuracy of cancer screening tests. A study by Sinicrope et al. (2011) found that obese individuals were more likely to have an incomplete colonoscopy, which can result in missed polyps or cancers [39]. Another study by Anderson et al. (2013) found that obese women had a higher rate of false-negative mammograms, meaning that cancer may be missed on the initial

screening [40].

Increased risk of cancer-related complications: Obese individuals who do not undergo cancer screening or have suboptimal screening may be at increased risk of cancer-related complications, such as advanced stage at diagnosis, more extensive treatment, and poorer prognosis. A study by Pan et al. (2014) [41] found that obese women with breast cancer were more likely to have larger tumors and more extensive lymph node involvement, which can affect treatment options and prognosis. Need for tailored cancer screening guidelines: Given the impact of obesity on cancer screening, there is a need for tailored screening guidelines for obese individuals. Some studies have suggested that increased screening may be needed for certain cancers, such as colon and breast cancer, in obese individuals (Kuk and Ardern, 2009; Camacho et al., 2014). However, further research is needed to develop evidence-based screening guidelines for obese individuals[42-44].

6. Cancer treatment and obesity

Obesity and cancer treatment toxicity: Several studies have shown that obese cancer patients are at a higher risk of experiencing treatment-related toxicity than non-obese patients. For example, a study by Prado et al. (2007) found that obese patients receiving chemotherapy for colorectal cancer had a higher incidence of severe treatment-related toxicity than non-obese patients [44]. Another study by Barret et al. (2014) found that obese

patients with breast cancer who received adjuvant chemotherapy had a higher incidence of treatment-related toxicities, such as neutropenia and febrile neutropenia, than non-obese patients [45]. Obesity and cancer treatment complications: In addition to treatment-related toxicity, obese cancer patients are also at a higher risk of developing complications during and after cancer treatment. For example, a study by Sánchez-Lara et al. (2014) found that obese patients receiving chemotherapy for advanced cancer had a higher incidence of hospitalization due to treatment-related complications than non-obese patients[46]. Another study by Healy et al. (2010) found that obese patients with prostate cancer who underwent radical prostatectomy had a higher incidence of postoperative complications, such as wound infections and urinary incontinence, than non-obese patients [47].

Impact of obesity on cancer treatment efficacy: Obesity can also impact the effectiveness of specific cancer treatments. For example, a study by Acevedo et al. (2022) found that obese breast cancer patients who received neoadjuvant chemotherapy had a lower pathologic complete response rate than non-obese patients [48]. Another study by de Alkuraishy et al. (2017) found that obese patients with metastatic colorectal cancer who received first-line chemotherapy had a shorter progression-free survival than non-obese patients.

CONCLUSION

In conclusion, the relationship between obesity and cancer is complex and multifaceted, involving various mechanisms such as hormonal, metabolic, and inflammatory factors. There is substantial evidence from numerous studies that obesity is a significant risk factor for several types of cancer, including breast, colon, endometrial, ovarian, and pancreatic cancer. Obesity can also impact cancer treatment and outcomes, as obese individuals may experience more treatment-related toxicity and have a higher risk of complications during and after cancer treatment. Furthermore, some cancer treatments may be less effective in obese patients due to altered drug metabolism and distribution. Maintaining a healthy body weight through lifestyle modifications such as diet and exercise may be an effective strategy to reduce the risk of cancer. Healthcare professionals need to consider the impact of obesity on cancer risk and treatment outcomes when developing personalized treatment plans for their patients.

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Author contributions

Jayhind Bharti contributed to the manuscript's writing and editing and responded to the journal's requirements.

Anjali Wankhade provided a scientific review and supervision of the manuscript. All authors read and approved the final version of the manuscript for submission to the journal.

Conflict of interest

None

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