Gynecologic Oncology 137 (2015) 559–573

Contents lists available at ScienceDirect

Gynecologic Oncology

journal homepage: www.elsevier.com/locate/ygyno

Review

Epithelial ovarian cancer and recreational physical activity: A review of the epidemiological literature and implications for exercise prescription

Rikki A. Cannioto, Kirsten B. Moysich *

Department of Cancer Prevention and Control, Roswell Park Cancer Institute, Buffalo, NY 14263, United States

HIGHLIGHTS

- Documented associations between activity and ovarian cancer are inconsistent.
- Ovarian cancer patients and survivors do achieve benefits from physical activity.
- Future studies of activity and cancer risk should use inactive referent groups.

ARTICLE INFO

Article history:
Received 22 December 2014
Accepted 12 March 2015
Available online 20 March 2015

Keywords:
Ovarian cancer risk
Ovarian cancer survival
Physical activity guidelines
Physical activity benefits

ABSTRACT

Despite the publication of two dozen observational epidemiological studies investigating the association between recreational physical activity (RPA) and epithelial ovarian cancer (EOC) risk and survival over the past two decades, taken collectively, data from retrospective and prospective studies are mixed and remain inconclusive.

Objective. Our primary purpose was to conduct a careful review and summary of the epidemiological literature depicting the association between EOC and RPA in the framework of identifying factors which may be impeding our ability to observe consistent associations in the literature. Secondly, in the backdrop of the more broad scientific evidence regarding the benefits of RPA, we provide a summary of guidelines for practitioners to utilize in the context of exercise prescription for cancer patients, including a discussion of special considerations and contraindications to exercise which are unique to EOC patients and survivors.

Methods. We performed a comprehensive literature search via PubMed to identify epidemiologic investigations focused on the association between RPA and EOC. To be included in the review, studies had to assess RPA independently of occupational or household activities.

Results. In total, 26 studies were identified for inclusion. Evidence of a protective effect of RPA relative to EOC risk is more consistent among-case control studies, with the majority of studies demonstrating significant risk reductions between 30 and 60% among the most active women. Among cohort studies, half yielded no significant associations, while the remaining studies provided mixed evidence of an association.

Conclusions. Given the limitations identified in the current body of literature, practitioners should not rely on inconclusive evidence to dissuade women from participating in moderate or vigorous RPA. Rather, emphasis should be placed on the greater body of scientific evidence which has demonstrated that RPA results in a plethora of health benefits that can be achieved in all populations, including those with cancer.

Contents

* Corresponding author at: Department of Cancer Prevention and Control, Roswell Park Cancer Institute, 352 Carlton House, Elm and Carlton Streets, Buffalo, NY 14263, United States. Tel.: +1 716 845 8004; fax: +1 716 845 1126.
E-mail address: Kirsten.moysich@roswellpark.org (K.B. Moysich).

http://dx.doi.org/10.1016/j.ygyno.2015.03.016
0090-8258/

1. Introduction

Invasive epithelial ovarian cancer is the deadliest gynecological cancer in developed nations and the seventh most common and deadly malignancy among women worldwide [1,2]. In the United States, 1 in 70 women will be diagnosed with ovarian cancer at some point in their lifetime [3] and each year, there will be approximately 22,000 new patients and over 14,200 deaths from the disease [4]. Furthermore, ovarian cancer ranks fifth in cancer deaths among women in the U.S. and it remains the most deadly gynecological cancer, with a five year overall survival rate of only 44% for invasive tumors [4]. However, over 60% of women are diagnosed with Stage III and IV disease, and for these women, 5-year survival is more dismal, ranging between 18 and 27% [3].

Approximately 85% to 90% of all ovarian cancers are epithelial ovarian carcinomas (EOC), which are further classified by tumor behavior (borderline tumors vs. invasive epithelial tumors) and histological subtype (low grade serous, high grade serous, endometrioid, clear cell, mucinous or undifferentiated) [4,5]. EOCs are a heterogeneous group of tumors that exhibit a wide variety of clinical manifestations, genetic mutations and tumor morphologies, adding further difficulty to the diagnosis and treatment of this lethal group of ovarian tumors [6].

The most well established risk factors for EOC are unmodifiable factors including age, Caucasian race, Ashkenazi Jewish decent, BRCA1/2 mutations and a family history of breast or ovarian cancer [5]. Mounting evidence also suggests the use of post-menopausal hormones [5], talcum powder in the genital area [5], and fertility drugs [4] have each been associated with significant increased risk of EOC. Furthermore, obesity, nulliparity, infertility, and endometriosis have also been associated with increased risk of EOC [4,5].

Conversely, well established protective factors include the use of oral contraceptives [5], tubal ligation [5], breastfeeding [5], and risk-reducing salpingo-oophorectomy for women with inherited BRCA1/2 mutations [5]. Lastly, full-term pregnancy and giving birth prior to age 26 have been associated with a lower risk of EOC in comparison to nulliparous women, and risk has been shown to decrease with each additional birth [4].

While some progress in the identification of risk and protective factors has been made in recent years, the pathogenesis of EOC is not well characterized in regard to modifiable lifestyle behaviors, such as dietary factors or recreational physical activity (RPA) [2]. In fact, according to the World Cancer Research Fund Global Network's Continuous Update Project Report on Food, Nutrition, Physical Activity and the Prevention of Ovarian Cancer (2014), no meaningful conclusions can be been gleaned from the current body of scientific literature describing the association between RPA and EOC risk [2]. However, this lack of consensus is not due to a shortage of observational epidemiological research. Indeed, over two dozen epidemiological investigations have examined the associations between EOC risk with RPA and sedentary behavior, but these data have been afflicted by conflicting or statistically insignificant findings.

To this end, the primary purpose of the current review is to summarize the findings from the available epidemiological literature depicting the association between RPA and EOC risk and survival. Second, we present a review of potential barriers to – and benefits of – RPA participation, which are unique to cancer patients and survivors. Third, we summarize the established organizational and governmental RPA guidelines for practitioners to utilize in the context of exercise prescription for cancer patients, including a discussion of special considerations and contraindications to exercise which may be distinctly associated with EOC patients and survivors.

2. Methods

We performed a comprehensive literature search via PubMed to identify epidemiologic investigations depicting the association between RPA and EOC. Keyword searches were conducted utilizing the following terms and phrases: “physical activity”, “exercise”, “recreational activity”, or “recreation” with “ovarian cancer”, “ovarian carcinoma”, “ovary”, or “gynecological cancer”.

To be included in the current review, studies had to assess recreational or leisure-time exercise or physical activity independently of occupational activity or household activities associated with daily living. For the purpose of this review, the term “recreational physical activity” encompasses all physical activity performed during a person's leisure time, including all types of sport and exercise. Additionally, the epidemiological studies reviewed herein had to report original measures of association resulting from multivariate regression models. Thus, studies reporting unadjusted odds ratios, overlapping data, and/or risk estimates based only upon occupational or household physical activity were excluded from the current review. Among studies reporting overlapping data, the study with fewer cases was omitted. Based on these criteria, 26 studies assessing the association between RPA and EOC risk or survival were identified (Fig. 1).

3. Results

Among the 26 epidemiological studies identified for inclusion, 23 assessed the association between RPA and EOC risk, 2 papers assessed the association between RPA and EOC survival, and one paper assessed both risk and survival. For the studies examining EOC risk, we will summarize key findings pertaining to three exposure measures of RPA including ‘total’ RPA (i.e., a combination of all intensities of physical activity), moderate-intensity RPA, and vigorous-intensity RPA. In most studies, total RPA is represented by the total number of hours or MET hours of activity performed each week.

3.1. Recreational physical activity and epithelial ovarian cancer risk

Collectively, 24 studies (11 case–control studies and 13 cohort studies) assessing the association between EOC risk and RPA were included in the current review. Tables 1 and 2 summarize the characteristics and key findings of each of the 11 case–control studies and 13 cohort studies, respectively.