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Is physical activity related to renal cell carcinoma? A systematic review

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ABSTRACT

Introduction: Relationship between renal cell carcinoma and physical activity is not clear.
Objectives: This study aimed to review the relationship between renal cell carcinoma and physical activity.
Methods: We searched valid databases such as PubMed/Medline, Web of Science and Scopus for search of English papers by 30/12/2018. Eleven articles were selected for final assessment. We used Kidney cancer, Exercise, Kidney Neoplasm, Renal cancer, Physical activity, Renal cell carcinoma, Physical inactivity and Sedentary Lifestyle or a combination of them in the title/abstracts as the keywords.
Results: There were 37,742 subjects reviewed in this systematic review of eleven published papers including five standard case-control, three cohorts and three population-based case-control design.
Conclusion: According to the results, physical activity has a reverse relationship with renal cell carcinoma.

Implication for health policy/practice/research/medical education:
Studies have shown that physical activity has a reverse relationship with renal cell carcinoma.
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Introduction

Ninety percent of all cancers related to kidney is renal cell carcinoma (RCC), and it was increasing in recent years worldwide (1). Hypertension, cigarette and obesity are some important modifiable risk factors for developing RCC (2). According to the studies, regular physical activity may prevent RCC by losing weight and treating hypertension, since, there is a negative relationship between physical activity and RCC (3-13). There are some researches without unanimous results regarding the relationship between physical activity and developing RCC (5, 14). A potential way to reduce developing RCC and its consequences can be influenced by the modification of lifestyle factors such as diet, exercise and smoking (15). The risk of RCC depends on ethnicity while, black Americans develop more than white Americans (2, 16). Considering that the certain relationship between RCC and physical activity is controversial and crucial, this study reviewed the relationship between renal cell carcinoma and physical activity.

Methods

Search strategy

We searched valid databases such as Scopus, Web of Science and PubMed/Medline for search of English papers by 30/12/2018. Eleven articles were selected for final assessment. We used Kidney cancer, Exercise, Kidney Neoplasm, Renal cancer, Physical activity, Renal cell carcinoma, Physical inactivity and Sedentary lifestyle or a combination of them in the title/abstracts as keywords.

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For example search strategy in PubMed database was as follows:

(Renal Cell Carcinoma [Title/Abstract] OR Kidney cancer [Title/Abstract] OR Kidney Neoplasm [Title/Abstract] OR Renal cancer [Title/Abstract]) AND (Physical activity [Title/Abstract] OR Physical inactivity [Title/Abstract] OR Exercise Title/Abstract] OR (recreational [All Fields] AND ("physical examination"[Mesh Terms] OR ("physical"[All Fields] AND "examination"[All Fields]) OR "physical examination"[All Fields] OR "physical"[All Fields]))) AND activity [Title/Abstract] OR Sedentary Lifestyle [Title/Abstract].

Selection of articles

The references of articles were imported to Endnote. The duplicates were removed. Using the title of selected articles, irrelevant studies assessed by two independent investigators were removed. The selected articles carried out on humans and published in English.

Data extraction

Information dealing with the studies were the author's name, year, design of the study, participants number and the conclusion of each article, in such a way that were extracted by two independent investigators. The differences in the extraction were solved by a third independent investigator.

Results

There were 37742 subjects participated in the selected articles for systematic review of 11 published papers including five standard case-control, three cohorts and three population-based case-control design (Table 1). Figure 1 shows the steps of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.

Discussion

The first study by Chiu et al in 2006 was conducted in the United States about the relationship between obesity with risk of RCC and the moderating effect of physical activity. This research was a population-based case-control study that was performed on 406 patients and 2434 controls. Non-occupational physical activity had an inverse relationship with the risk of RCC among women (OR = 2.5; 95% CI = 1.2-5.2) while there was a moderating effect of physical activity with body mass index on the RCC (3). The second study by Pan et al was conducted in 2006. The report was a population-based case-control study aimed to study the effects of energy intake, overweight, and low physical activity on the risk of RCC and non-renal cell cancer in Canada during 1994-1997. In this study, 810 cases and 3160 controls were investigated. The role of recreational physical activity needs to be further investigated (4). Tavani et al in 2007 conducted a study to investigate the relationship between RCC and suitable physical activity in Italy. In this case-control study, 767 cases with 1534 controls from 1992 to 2004 were studied. The results showed that, compared with the lowest level of occupational physical activity, the ratio of the risk of RCC for the highest activity level at age 12 was 0.65 (95% CI: 0.49-0.87), for 15-19 years, 0.67 (95% CI: 0.53-0.84) for 30-39 years was 0.74 (95% CI: 0.59-0.93) and for 50-59 years it was 0.71 (95% CI: 0.55-0.92). Additionally, no significant relationship was found between leisure time physical activities (5). The fourth study by George et al, in 2011 was done to assess the effect of long-term sitting on the risk of RCC on elderly persons. The study was a cohort and conducted from 1996 to 2006. There was no relationship between long-term sitting and risk of RCC in both men and women (HR = 1.11, 95% CI: 0.87, 1.41) (6).

Shu et al conducted a study regarding the balance of energy, polymorphism in the mammalian target of rapamycin (mTOR) pathway, and the risk of RCC. In this case-control study, 577 non-Hispanic white cases versus 593 healthy controls were studied. The results of the study showed that low physical activity is highly linked with an increase of cancer by 4.08 times (7). In the study of Sormunen et al, the relationship between suitable physical activity and the risk of cancer was investigated in Finnish athletic males in a cohort study. In this cohort, 2448 athletes and 1712 referents were followed up for cancer during 1986-2010. The results showed

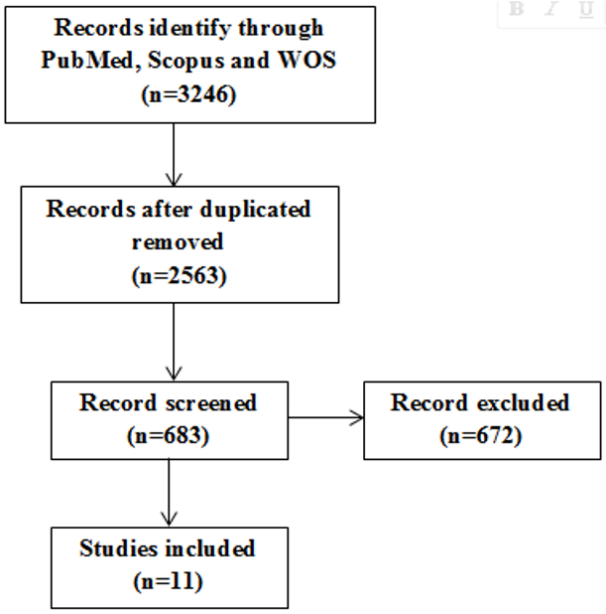

Figure 1. The steps of PRISMA in this study.

Table 1. The extracted information from articles included in this review

Reference	Sample	Age (Mean± SD)	Design	Conclusion
Chiu et al (2006) (3)	2840	Male (Cases: 64±9.5, Controls: 68±9.7) Female (Cases: 65±9.6, Controls: 68±10.4)	Population-based case–control	The results showed that non-occupational physical activity has negative relationship with RCC in women.
Chiu et al (2006) (4)	3916	Male (Cases: 58.7±10.5, Controls: 57.9±14.6) Female (Cases: 57.9±11.3, Controls: 56.2±12.2)	Population-based case–control	The results showed that the role of recreational physical activity needs to be further explored.
Tavani et al (2008) (5)	2301	Not reported	Case–control	The results of the study showed that the ratio of the risk of RCC for different ages is preventive compared to the low level of physical activity. Also, there was no meaningful association between free time physical activities.
George et al (2011) (6)	300 000	Not reported	Cohort	There was no relationship between long-term sitting of women and men with RCC (HR = 1.11, 95% CI: 0.87, 1.41)
Shu et al (2013) (7)	1150	Not reported	Case–control	The results of the study showed that low physical activity is dealing with an increase of cancer risk 4.08 times.
Sormunen et al (2013) (8)	4160	Athletes*: 55.2 (35.6–93.8) Referents*: 53.3 (38.0–87.5)	Cohort	The standardized incidence rate of kidney cancer for athletes was 0.23. Athletic men were obviously less likely to develop cancer compared to non-athletic males.
Williams (2014) (9)	54 956	MET-hours/wk: <7.5: 49.96±13.92 7.5 to 12: 48.93±13.18 12.6 to 25.1: 47.01±12.03 ≥25.2: 44.04±11.13	Cohort	Walking and running can reduce the incidence of kidney cancer independently of other risk factors.
Xiao et al. (2014) (10)	2452	Not reported	Population-based case–control	Physical activity has negative relationship with RCC risk in white women, but in this study no such relationship was found for blacks.
Melkonian et al (2014) (11)	1237	Cases:58.46±10.71 Controls:58.57±10.17	Case–control	The results of this study showed that mtDNAcn is dealing with development of ccRCC in young people, women, non-smoking people, people with low physical activity, and people without a history of hypertension.
Cannioto et al (2017) (12)	1134	Cases:60.76±13.53 Controls:60.89±13.77	Hospital-based case-control	There was a direct relationship between RCC and physical inactivity.
Peters et al (2018) (13)	3274	Not reported	Case-control	Physical activity has a reverse relationship with kidney cancer.

* Median (min–max).

that the standardized incidence ratio among athletes for kidney cancer was 0.23 (95% CI: 0.06-0.57). The study concluded that athlete males were clearly less likely to have cancer than nonathletic males (8). Likewise, in the study of Williams et al, the reduced risk of kidney cancer due to walking and running was studied. In this study, the data of National Runners' Health Study cohort was reviewed for 54,956 people. The results of the study showed that walking and running can reduce the incidence of kidney cancer independently of other risk factors (9).

Accordingly, Xiao et al reviewed the relationship between physical activity and RCC among whites and blacks in the United States. In this population-based case-control study, frequency matching was performed for 1217 cases and 1235 controls by age, gender, and race. The results of the study showed that physical activity may be has a reverse relationship with RCC risk in white women, but in this study, no such relationship was found for blacks (10). Another study by Melkonian et al was conducted to evaluate the number of mitochondrial DNA copies in peripheral blood leukocytes and the risk of clear cell RCC (ccRCC). In this case-control study, 608 cases and 629 controls were matched based on age and gender frequency for the relationship between mitochondrial DNA copy number (mtDNAcn) and the risk of ccRCC. The results of this study showed that mtDNAcn is associated with a high risk of ccRCC in young people, women, non-smoking people, those with low activity, and people

without a history of hypertension (11).

Cannioto et al conducted a study on the relationship between physical inactivity and the risk of RCC in 2017. In this hospital-based case-control study, 160 patients with kidney cancer and 208 patients with bladder cancer were evaluated. Patients were matched based on age with 766 frequency-matched controls. They found a direct relationship between RCC with lifetime recreational physical inactivity (12). Peters et al in Canada conducted a study, using the National Enhanced Cancer Surveillance System (NECSS) data in 2018. In this study, 727 cases of kidney cancer (83% of RCCs) and 2547 controls were analyzed. Physical activity has a negative relationship with kidney cancer (13).

Conclusion

According to the results, physical inactivity has a positive relationship with RCC. On the other hand, physical activity has a reverse relationship with RCC. It is essential to do an exercise program for those who are on the risk of RCC such as those who live in the family with familial aggregation of cancer especially kidney cancer.

Authors' contribution

Study concept and design: NM, BH and RV. Search strategy: BH and RV. Extraction of data: NM, PH, GD and BB. Interpretation of data: RV, BB and GD. Draft of the manuscript: RV and NM. Final revision: BH and BB. Study supervision: BH and NM.

Conflicts of interest

There is no conflict of interest in this review study.

Ethical considerations

Ethical issues (including plagiarism, data fabrication, double publication) have been completely observed by the authors.

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