

THE INCIDENCE RATE OF INVASIVE COLON AND RECTUM CANCER IN THE UNITED STATES OF AMERICA: AN OBSERVATIONAL DESCRIPTIVE EPIDEMIOLOGICAL ANALYSIS OF DATA FROM THE CENTERS FOR DISEASE CONTROL AND PREVENTION 1999-2014

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ABSTRACT

Background: This study provides descriptive epidemiological data of invasive colon and rectum cancer cases diagnosed from 1999 to 2014 in the United States of America.

Methods: This is a retrospective descriptive epidemiological analysis of invasive colon and rectum cancer cases recorded in the Centres for Disease Control and Prevention from 1999 to 2014. The statistical analyses were performed using descriptive statistics to calculate the overall age-adjusted incidence rate stratified by state, race, and gender.

Results: The state of New Jersey, Pennsylvania, Illinois, Iowa, Nebraska, West Virginia and Kentucky had the highest overall age-adjusted incidence rate of invasive colon and rectum cancer among male and female White and Black American, from 1999 to 2014. The state of Connecticut, Detroit, and Hawaii had the highest overall age-adjusted incidence rate of invasive colon and rectum cancer among male and female Hispanic, from 1999 to 2014.

Conclusion: This study revealed that the best geographic areas in the United States of America for studying the most important risk factors for invasive colon and rectum cancer among male and female White and Black American are the state New Jersey, Pennsylvania, Illinois, Iowa, Nebraska, West Virginia and Kentucky, while the best geographic areas for studying the most important risk factors for invasive colon and rectum cancer among male and female Hispanic are the state of Connecticut, Detroit, and Hawaii. Therefore, multiple case-control studies adjusted by race and gender should be conducted in the mentioned states to identify the major risk factors that can be controlled.

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INTRODUCTION

Colorectal cancer is a major health problem and the leading cause of morbidity and mortality worldwide.¹⁻² It is the third most common cause of cancer and the fourth leading cause of cancer-related deaths globally. Colorectal cancer accounts for approximately 9% of all cancer cases.¹⁻² The burden of the disease has increased in developed and developing countries.³ In the United States of America, the International Agency for Research on Cancer estimated that the age-adjusted incidence rate for colon and rectum cancer was 25.0 per 100,000 population in 2012, and the age-adjusted mortality rate was 9.2 per 100,000 population.⁴⁻⁵ The purpose of this study is to describe the pattern of invasive colon and rectum cancer in the United States of America from 1999 to 2014, while focusing on the age adjusted incidence rate, stratified by state, race, and gender.

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This is a retrospective descriptive epidemiological study of invasive colon and rectum cancer cases diagnosed between 1999 and 2014 in the United States of America. The data were available and easily accessible from the website of the Centres for Disease Control and Prevention, through the Official Federal Statistics on cancer incidence registries. Based on these data, there are comprehensive cancer data for the 50 States in the United States of America, from 1999 to 2014, exploring the age-adjusted incidence rate stratified by state, race, and gender. For data analysis, the Statistical Package for the Social Sciences version 20.0 (SPSS) was used to calculate the mean age-adjusted incidence rate of colon and rectum cancer from 1999 to 2014.

RESULTS

Invasive Colon and Rectum Cancer in the North East of the United States of America

The overall age-adjusted incidence rate of invasive colon and rectum cancer cases from 1999 to 2014 per 100,000 persons was calculated from the Centres for Disease Control and Prevention. The highest overall age-adjusted incidence rate of

invasive colon and rectum cancer cases was documented in the state of New Jersey and Pennsylvania with an estimated average for male (60.0 and 60.5 per 100,000 persons), and for the female (44.8 and 44.9 per 100,000 persons). The estimated overall age-adjusted incidence rates in the state of New Jersey and Pennsylvania from 1999 to 2014 were higher among male and female white and black American compared to other races living in the North East and Middle Atlantic of the United States. In addition, the state of Connecticut had the highest overall age-adjusted incidence rate of invasive colon and rectum cancer cases among male and female Hispanic American from 1999 to 2014, with an estimated average of (62.6 and 47.0 per 100,000 persons) (**Table 1**). However, most of the male races living in the northeast of the United States were more affected by colon and rectum cancer compared to other female races.

state of Illinois, Nebraska, and Iowa with an estimated average for male (62.4, 62.2, and 61.4 per 100,000 persons), and for the female (44.9, 45.0, and 46.6 per 100,000 persons). The estimated overall age-adjusted incidence rates of invasive colon and rectum cancer in the state of Illinois, Nebraska, and Iowa, from 1999 to 2014 were higher among male and female white and black American compared to other races living in the other states of the Midwest. In addition, the state of Detroit had the highest overall age-adjusted incidence rate of invasive colon and rectum cancer cases among male and female Hispanic from 1999 to 2014, with an estimated average of (63.2 and 48.3 per 100,000 persons) (**Table 2**). However, most of the male races living in the Midwest of the United States were more affected by colon and rectum cancer compared to other female races.

Invasive Colon and Rectum Cancer in the South of the United States of America

Table 1 Overall age-adjusted incidence rate of invasive colon and rectum cancer in the north east of the United States from 1999 to 2014

Overall age-adjusted incidence rate of invasive colon and rectum cancer in the North East of the United States from 1999 to 2014									
Geographic Area	All Races		White		Black		Hispanic		
	Male	Female	Male	Female	Male	Female	Male	Female	
United States	54.8	41.0	54.0	40.2	63.9	48.4	48.5	34.3	
Northeast	58.0	43.6	57.9	43.4	59.9	45.8	54.2	38.4	
New England	55.7	42.4	55.6	42.2	53.0	42.2	53.1	41.5	
Connecticut	56.2	42.4	55.9	41.9	58.9	47.7	62.6	47.0	
Maine	56.2	44.0	56.1	43.9	-	-	-	-	
Massachusetts	56.2	42.1	56.3	42.2	50.9	39.0	-	-	
New Hampshire	52.8	41.6	52.4	41.3	-	-	-	-	
Rhode Island	57.0	43.1	57.6	43.3	49.1	-	-	-	
Vermont	49.9	40.8	49.9	41.0	-	-	-	-	
Middle Atlantic	58.8	44.1	58.8	43.9	60.8	46.3	54.4	37.9	
New Jersey	60.0	44.8	60.1	44.7	64.1	50.1	54.2	41.0	
New York	57.0	43.2	57.3	43.2	57.6	44.0	54.3	36.9	
Pennsylvania	60.5	44.9	60.0	44.3	65.5	48.8	56.1	37.9	

(-) Means in all tables: Rates are suppressed if fewer than 16 cases were reported in a specific category (area, race, ethnicity)

Table 2 Overall age-adjusted incidence rate of invasive colon and rectum cancer in the Midwest of the United States from 1999 to 2014

Overall age-adjusted of invasive colon and rectum cancer in the Midwest of the United States from 1999 to 2014								
Geographic Area	All Races		White		Black		Hispanic	
	Male	Female	Male	Female	Male	Female	Male	Female
United States	55.3	41.0	54.4	40.2	64.5	48.4	49.1	34.3
Midwest	57.9	42.9	56.8	41.9	69.1	51.3	44.4	33.4
East North Central	57.9	43.0	56.6	41.8	69.1	51.4	45.0	33.0
Illinois	62.4	44.9	61.0	43.5	75.4	55.0	45.1	32.7
Indiana	58.5	44.3	57.8	43.6	67.2	52.7	39.7	39.1
Michigan	54.3	41.3	52.3	39.6	68.1	51.3	52.3	36.9
Detroit	58.3	44.2	55.4	41.6	72.1	54.0	63.2	48.3
Ohio	57.8	42.8	56.9	42.0	62.6	46.2	44.0	29.6
Wisconsin	54.6	40.6	53.7	39.9	68.9	50.7	42.5	36.5
West North Central	57.8	42.8	57.1	42.1	69.2	51.3	42.1	35.2
Iowa	61.4	46.6	61.3	46.5	80.2	64.7	-	-
Kansas	56.6	40.9	55.6	39.9	70.1	50.8	49.9	36.7
Minnesota	52.2	40.0	51.6	39.4	48.9	42.3	42.5	40.6
Missouri	59.2	43.0	58.1	42.1	72.5	52.7	46.0	-
Nebraska	62.2	45.0	61.3	44.5	90.1	70.3	-	-
North Dakota	62.0	43.2	61.9	42.6	-	-	-	-
South Dakota	58.1	42.8	57.4	42.1	-	-	-	-

Invasive Colon and Rectum Cancer in the Midwest of the United States of America

The highest overall age-adjusted incidence rate of invasive colon and rectum cancer cases was observed in the

state of Kentucky and West Virginia with an estimated average for male (66.7 and 63.4 per 100,000 persons), and for the female (48.0 and 47.4 per 100,000 persons). The estimated overall age-adjusted incidence rates in the state of Kentucky and West

Table 3 Overall age-adjusted incidence rate of invasive colon and rectum cancer in the south of the United States from 1999 to 2014

Overall age-adjusted of invasive colon and rectum cancer in the south of the United States from 1999 to 2014								
Geographic Area	All Races		White		Black		Hispanic	
	Male	Female	Male	Female	Male	Female	Male	Female
United States	55.3	41.0	54.5	40.2	64.5	48.4	49.1	34.3
South	52.4	38.6	50.7	37.0	63.1	46.8	49.3	33.5
South Atlantic	53.8	40.2	52.4	38.6	62.2	46.8	53.0	39.4
Delaware	56.8	41.5	56.3	40.6	65.0	46.0		
District of Columbia	57.0	46.9	39.1	32.7	67.2	52.7		
Florida	53.1	39.9	52.4	39.1	58.5	44.6	57.0	41.4
Georgia	55.7	40.3	53.1	37.7	66.0	48.8	40.5	31.9
Atlanta	52.6	39.7	48.5	35.7	65.1	49.1	45.0	33.8
Maryland	52.8	40.3	51.8	38.2	58.7	46.0	35.0	30.9
North Carolina	53.0	38.7	51.2	36.9	62.5	46.2	34.6	28.9
South Carolina	56.0	40.6	53.3	38.4	65.8	46.8	-	-
Virginia	50.6	38.8	48.8	37.0	61.5	46.9	33.8	29.4
West Virginia	63.4	47.4	63.5	47.3	69.8	62.8	-	-
East South Central	58.0	42.0	56.2	40.3	69.0	50.8	27.5	24.9
Alabama	57.9	40.5	56.0	38.4	67.0	48.3	-	-
Kentucky	66.7	48.0	66.8	47.5	75.0	58.8	-	-
Mississippi	61.4	44.3	57.2	39.8	73.9	55.0	-	-
Tennessee	53.9	40.1	52.7	38.9	64.2	48.9	-	-
West South Central	55.6	39.2	53.9	37.4	70.5	51.4	50.3	32.0
Arkansas	54.9	40.3	53.0	38.5	65.8	50.4	-	-
Louisiana	64.6	45.3	61.7	42.3	75.0	54.2	47.7	40.9
Oklahoma	56.7	41.8	54.4	39.7	65.4	47.7	47.2	40.9
Texas	54.1	37.6	53.1	36.4	70.0	51.1	50.6	31.7

Table 4 Overall age-adjusted incidence rate of invasive colon and rectum cancer in the west of the United States from 1999 to 2014

Overall age-adjusted of invasive colon and rectum cancer in the west of the United States from 1999 to 2014								
Geographic Area	All Races		White		Black		Hispanic	
	Male	Female	Male	Female	Male	Female	Male	Female
United States	55.3	41.0	54.4	40.2	64.5	48.4	49.1	34.3
West	50.0	37.6	49.4	37.2	59.6	47.8	45.8	31.7
Mountain	47.8	35.9	47.7	35.9	51.8	41.5	49.2	34.9
Arizona	46.5	34.6	46.5	34.7	50.5	40.5	46.4	32.7
Colorado	46.7	36.2	46.7	36.1	49.0	40.2	54.4	38.3
Idaho	46.9	36.6	46.7	36.2	-	-	35.7	40.4
Montana	52.7	39.8	51.3	38.7	-	-	-	-
Nevada	53.4	39.9	53.5	39.9	59.4	44.6	43.0	35.5
New Mexico	46.8	33.5	47.3	33.8	-	-	50.6	34.7
Utah	42.3	32.2	42.3	32.3	-	-	47.6	35.4
Wyoming	48.0	38.4	47.8	38.2	-	-	-	-
Pacific	50.5	38.0	49.8	37.5	61.0	48.5	44.3	30.4
Alaska	57.4	46.2	50.6	38.0	-	-	-	-
California	50.4	37.8	50.1	37.3	61.8	49.2	44.5	30.2
San Francisco-Oakland	50.5	39.1	49.8	38.7	60.0	48.2	48.4	33.3
San Jose-Monterey	46.3	35.9	46.8	36.7	-	-	45.9	29.8
Los Angeles	52.2	38.7	50.6	37.2	66.3	51.7	42.0	29.3
Hawaii	58.1	39.8	51.8	39.3	-	-	68.4	61.7
Oregon	49.3	38.3	48.7	37.9	67.4	-	41.5	36.6
Washington	49.9	38.2	49.4	38.1	53.9	41.0	41.4	30.6
Seattle-Puget Sound	50.0	38.6	49.8	38.5	54.6	44.5	45.8	39.2

Virginia from 1999 to 2014 were higher among male and female white and black American compared to other races living in the other states in the south of the United States. However, most of the male races living in the south of the United States were more affected by colon and rectum cancer compared to other female races (**Table 3**).

Invasive Colon and Rectum Cancer in the West of the United States of America

The highest overall age-adjusted incidence rate of invasive colon and rectum cancer cases was recorded in the state of Hawaii, with an estimated average for male (68.4 per 100,000 persons), and for the female (61.7 per 100,000 persons). The estimated overall age-adjusted incidence rates of invasive colon and rectum cancer in the state of Hawaii were higher among male and female Hispanic, compared to other races living in other states in the west of the United States. However, most of the male races living in the west of the

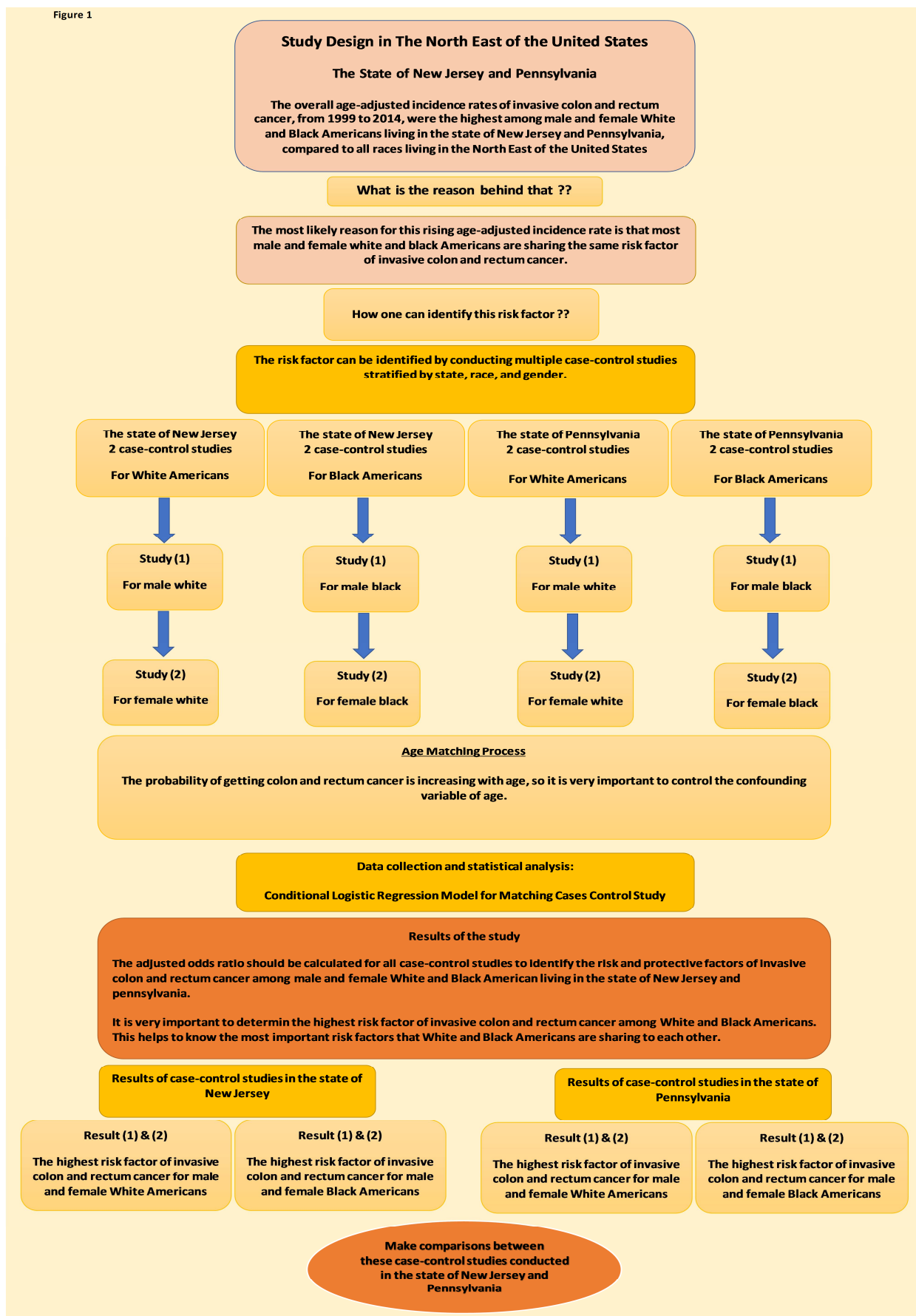


Figure 1 Study Design in The North East of the United States

Figure 2

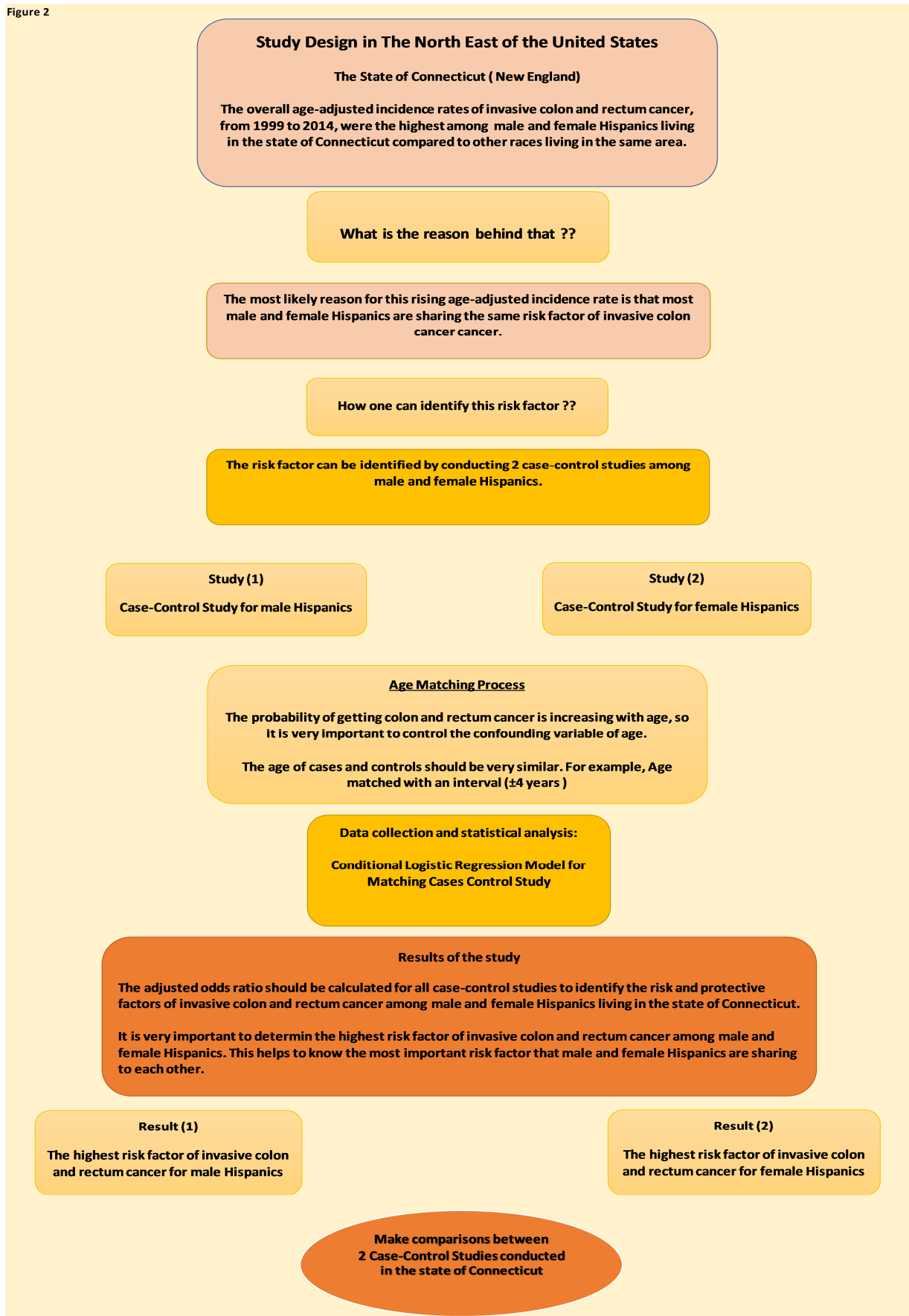


Figure 2 Study Design in The North East of the United States (The state of Connecticut)

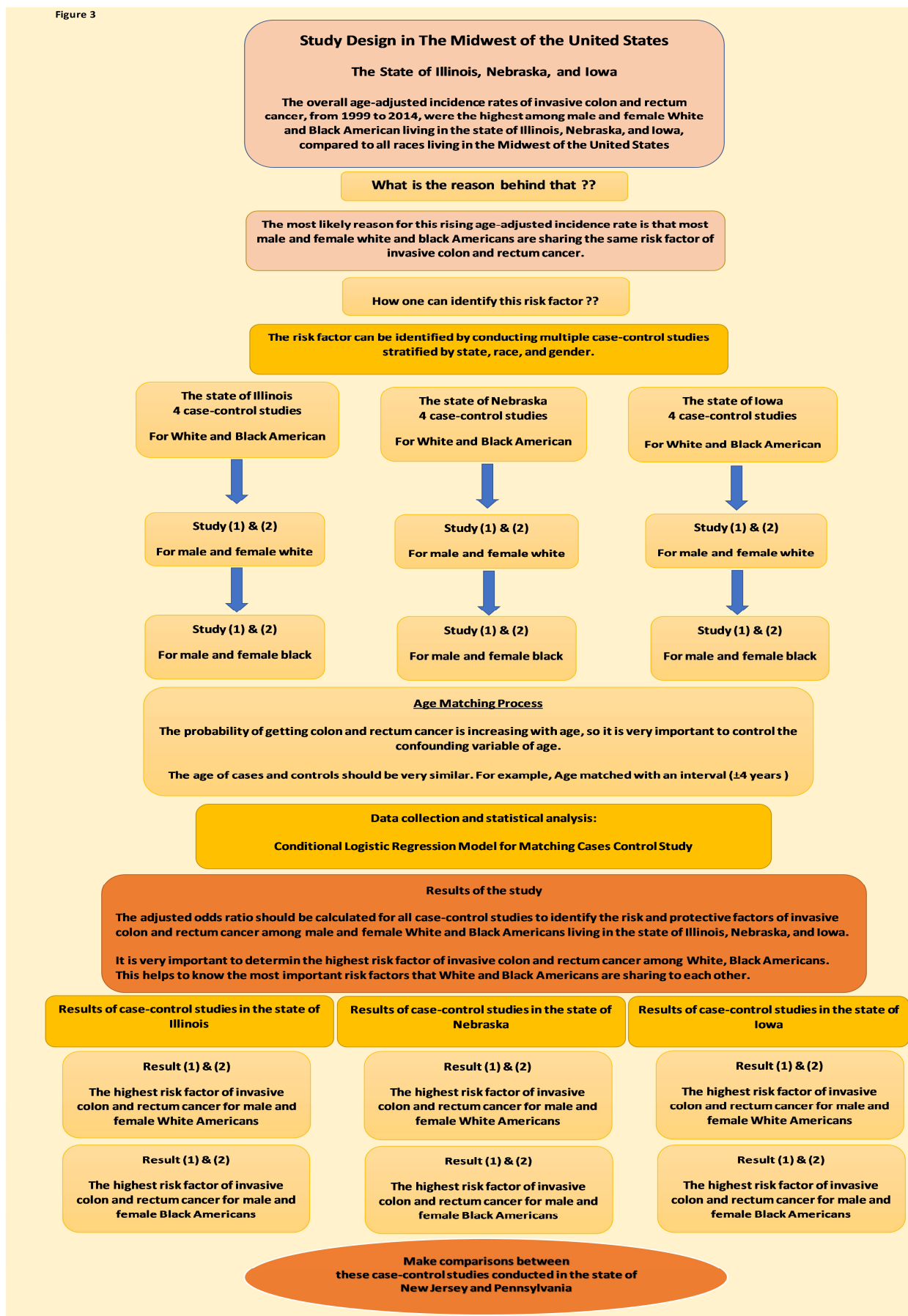


Figure 3 Study Design in The Midwest of the United States

Figure 4

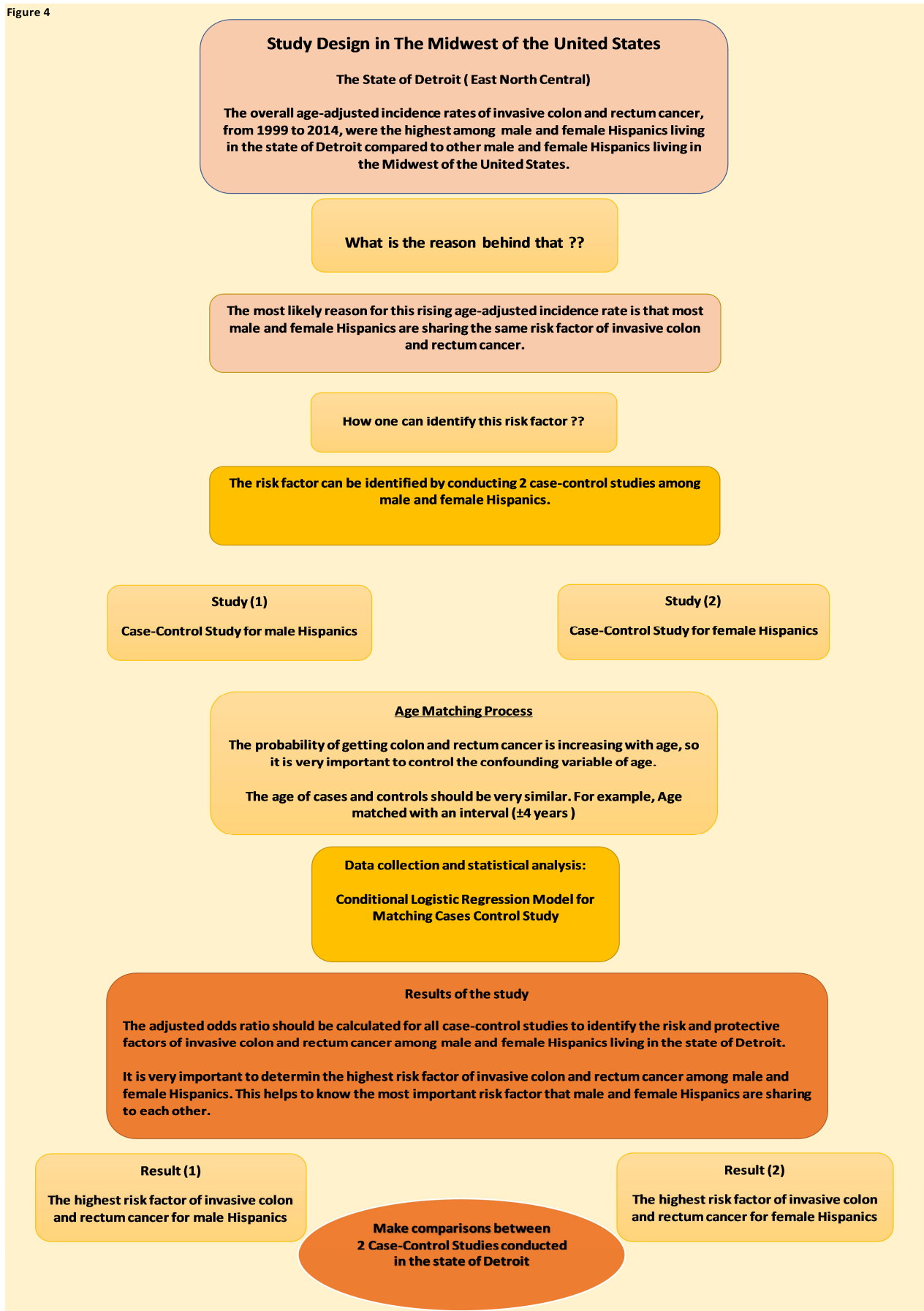


Figure 4 Study Design in The Midwest of the United States (The state of Detroit)

Figure 5

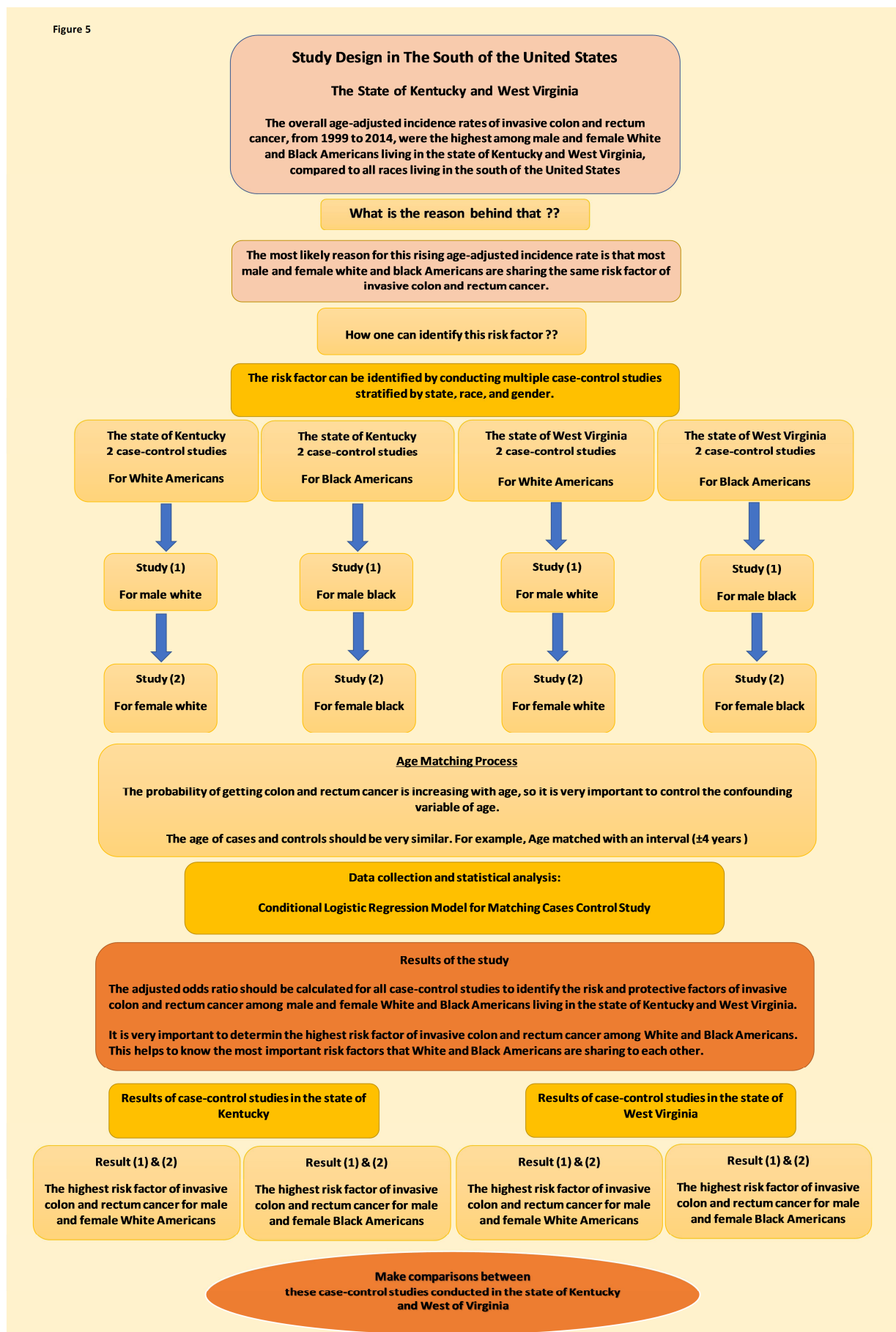


Figure 5 Study Design in The South of the United States

Figure 6

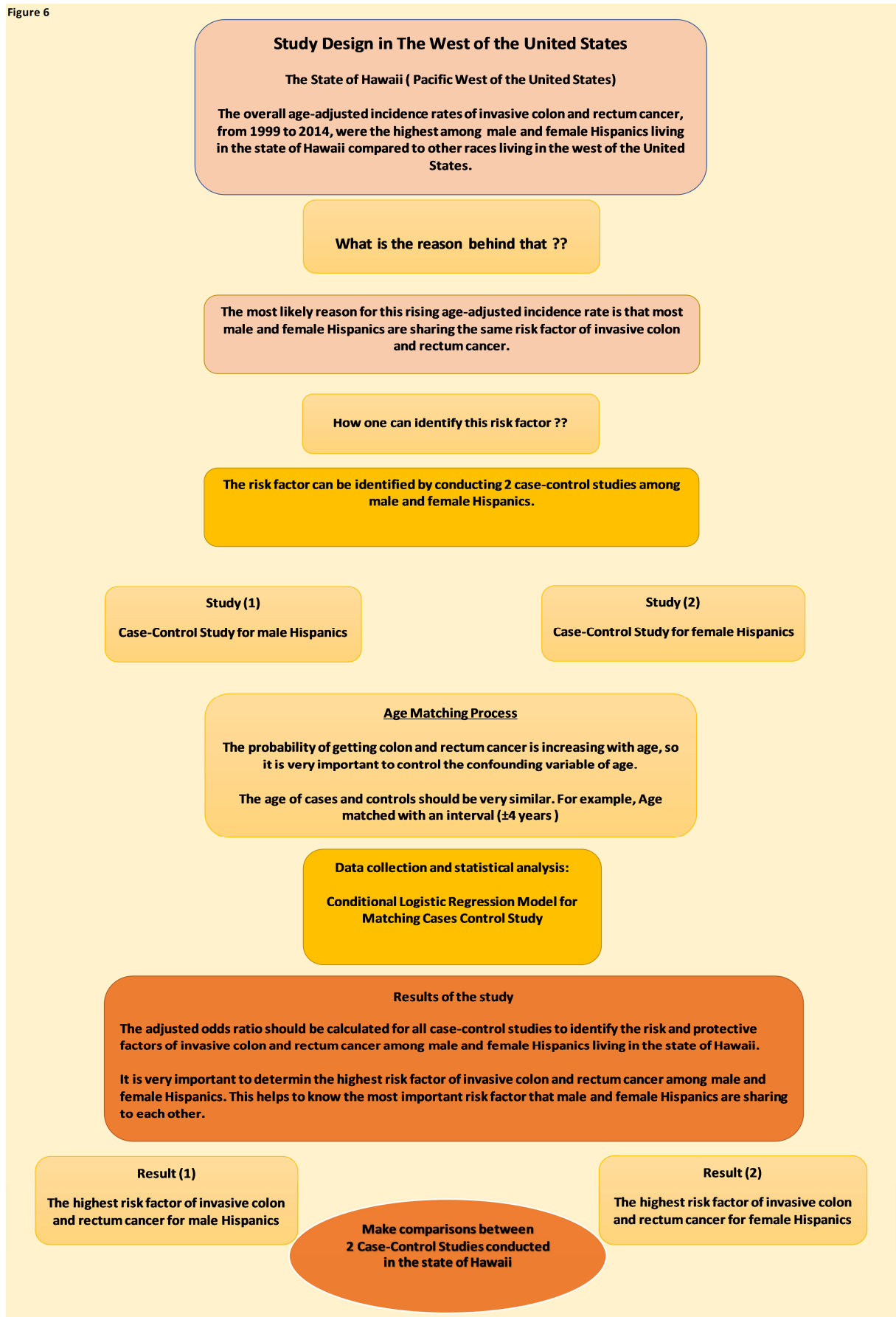


Figure 6 Study Design in The West of the United States

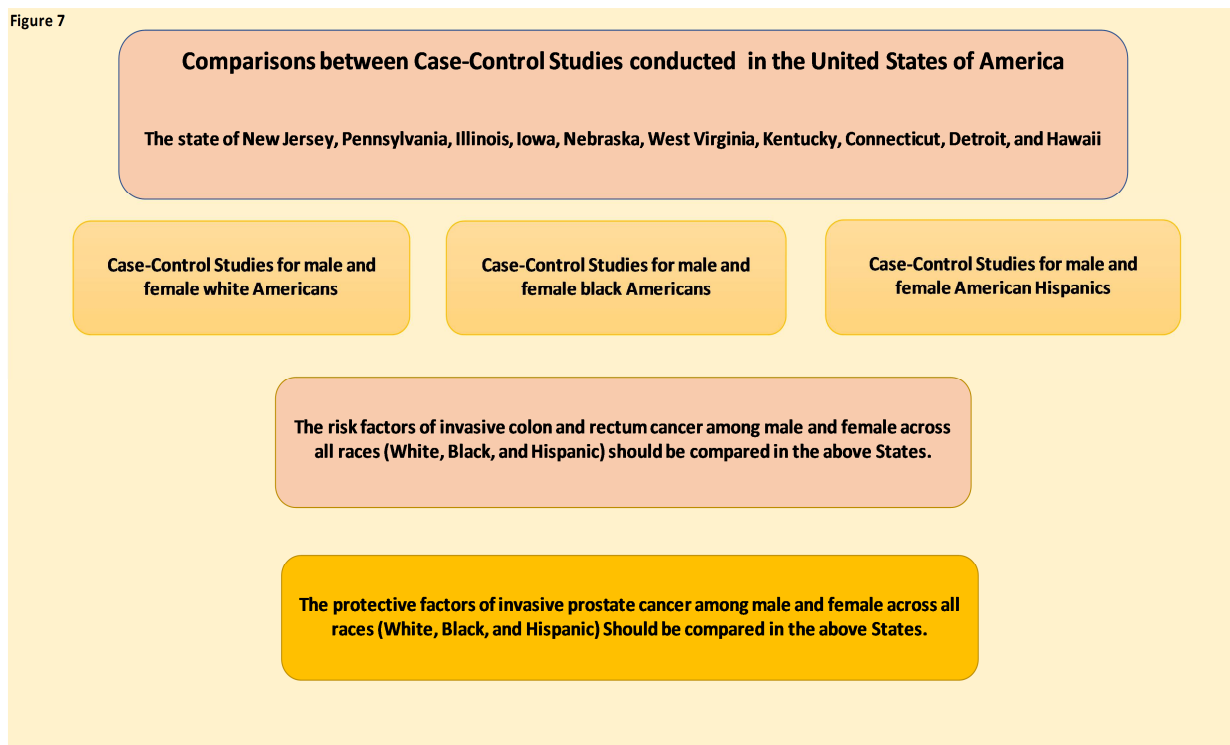


Figure 7 Comparisons between Case-Control Studies in the United States of America

United States were more affected by colon and rectum cancer compared to other female races (Table 4).

DISCUSSION

This descriptive epidemiological study of invasive colon and rectum cancer among male and female across all races in the United States of America, explores a valuable information about the pattern of the disease in the entire population. It focuses on the age-adjusted incidence rate of invasive colon and rectum cancer stratified by state, race, and gender. The result of the study is based on the data recorded in the Centres for Disease Control and Prevention, from 1999 to 2014.

In the North East of the United States, we have observed that the highest overall age-adjusted incidence rates of invasive colon and rectum cancer cases among male and female, white and black American were documented in the state of New Jersey and Pennsylvania, from 1999 to 2014. The most likely reason for this rising age-adjusted incidence rate is that most male and female, white and black Americans were sharing the same risk factor of invasive colon and rectum cancer. This means that the most important risk factor for colon and rectum cancer in both genders among white and black American is very high and concentrated in the state of New Jersey and Pennsylvania. Figure 1, shows how one can identify the most important risk factor for invasive colon and rectum cancer among male and female, white and black American living in the state of New Jersey and Pennsylvania. The risk factor can be identified by conducting multiple case-control studies adjusted by gender and race (white and black). In addition, the state of Connecticut was the highest area affected by invasive colon and rectum cancer among male and female Hispanic American, from 1999 to 2014, compared to other

racess living in the same area. The most likely reason for this rising age-adjusted incidence rate is that most of male and female Hispanics living in the state of Connecticut were more exposed to a specific risk factor that may does not appear in male and female white and black American. Figure 2, shows how one can identify the most important risk factor for invasive colon and rectum cancer among male and female Hispanic living in the state of Connecticut.

In the Midwest of the United States, the highest overall age-adjusted incidence rates of invasive colon and rectum cancer cases among male and female, white and black Americans were documented in the state of Illinois, Nebraska, and Iowa, from 1999 to 2014. The most likely reason for this rising age-adjusted incidence rate is that most male and female, white and black Americans were sharing the same risk factor of invasive colon and rectum cancer. This means that the most important risk factor for colon and rectum cancer in both genders among white and black American is very high and concentrated in the state of Illinois, Nebraska, and Iowa. Figure 3, shows how one can identify the most important risk factor for invasive colon and rectum cancer among male and female, white and black American living in the state of Illinois, Nebraska, and Iowa. The risk factor can be identified by conducting multiple case-control studies adjusted by gender and race (white and black). In addition, the state of Detroit was the highest area affected by invasive colon and rectum cancer among male and female Hispanics, from 1999 to 2014, compared to the same races living in the Midwest of the United States. The most likely reason for this rising age-adjusted incidence rate is that most male and female Hispanics living in the state of Detroit were more exposed to a specific risk factor that may does not appear in male and female white and black American. Figure 4, shows how one can identify the most important risk factor of invasive colon

and rectum cancer among male and female Hispanics living in the state of Detroit. In the South of the United States, the highest overall age-adjusted incidence rates of invasive colon and rectum cancer cases among male and female, white and black American were observed in the state of Kentucky and West Virginia, from 1999 to 2014. The most likely reason for this rising age-adjusted incidence rate is that most male and female, white and black Americans were sharing the same risk factor of invasive colon and rectum cancer. This means that the most important risk factor for colon and rectum cancer in both genders among white and black American is very high and concentrated in the state of Kentucky and West Virginia. **Figure 5**, shows how one can identify the most important risk factor for invasive colon and rectum cancer among male and female, white and black American living in the state of Illinois, Nebraska, and Iowa. The risk factor can be identified by conducting multiple case-control studies adjusted by gender and race (white and black).

In the West of the United States, the highest overall age-adjusted incidence rates of invasive colon and rectum cancer cases were observed in male and female Hispanics living in the state of Hawaii, from 1999 to 2014, compared to other races living in the west of the United States of America. The most likely reason for this rising age-adjusted incidence rate is that most male and female Hispanics were sharing the same risk factor of invasive colon and rectum cancer. This means that most males and females Hispanic living in the state of Hawaii were more exposed to a specific risk factor that does not appear in male and female, white and black American. **Figure 6**, shows how one can identify the most important risk factor of invasive colon and rectum cancer among male and female Hispanic living in the state of Hawaii. Finally, it is very important to conduct multiple case-control studies in the highest area affected by invasive colon and rectum cancer adjusted by race and gender. This procedure helps to make a good comparison between the risk factors of colon and rectum cancer across all races living in the United States of America (**Figure 7**).

CONCLUSION

Our study revealed that the State of New Jersey, Pennsylvania, Illinois, Iowa, Nebraska, West Virginia and Kentucky had the highest overall age-adjusted incidence rate of invasive colon and rectum cancer cases among male and female white and black American, from 1999 to 2014. The state of Connecticut, Detroit, and Hawaii had the highest overall age-adjusted incidence rate of invasive colon and rectum cancer cases among male and female Hispanic, from 1999 to 2014. Therefore, these states are the best geographic areas in the United States of America for studying the most important risk factors of invasive colon and rectum cancer. However, multiple case-control studies should be conducted in the highest area affected by invasive colon and rectum cancer stratified by race and gender.

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