

EXERCISE INDUCED BRONCHOSPASM

Physical Activity Participation among Adult Nevadans with Self-Reported Asthma

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Objective. This study looked at physical activity patterns among adults (≥ 18 years old) with self-reported asthma living in Nevada and investigated how physical inactivity is associated with asthma prevalence. **Methods.** We examined data from the 2009 Nevada Behavioral Risk Factor Surveillance System. Different physical activity measures among individuals were compared by asthma status. **Results.** Among 3840 respondents, 13.9% and 9.0% of them self-reported lifetime and current asthma, respectively. Significantly higher proportions of people with lifetime (12.9%) and current (17.7%) asthma did not engage in regular physical activity or exercise than those without lifetime (7.0%) and current (6.8%) asthma ($p < .01$). Over 30% of the respondents with asthma had no leisure-time physical activity compared with about 23% of those without asthma ($p < .05$). Moreover, these findings were statistically significant after adjusting for body mass index as well as other common sociodemographic variables. It was also found that asthmatic people spent significantly less time on moderate and vigorous physical activity than their nonasthmatic counterparts (223 minutes/week vs. 283 minutes/week for moderate physical activity; 214 minutes/week vs. 281 minutes/week for vigorous physical activity; $p < .001$). More than half of the respondents with asthma and close to half of those without asthma did not meet the current physical activity recommendation. **Conclusion.** A majority of adults with self-reported asthma living in Nevada are physically inactive. It appears that physical inactivity is associated with an increased prevalence of asthma.

Keywords Behavioral Risk Factor Surveillance System, body mass index, exercise, moderate physical activity, physical activity recommendation, obesity, vigorous physical activity

INTRODUCTION

The prevalence of asthma in the United States has increased over the years (1). According to the 2008 National Health Interview Survey (2), more than 28 million adults have ever had asthma and approximately 16.4 million adults currently have asthma. The economic cost of asthma is estimated to 19.7 billion dollars annually (3), thereby placing a large burden on society. Consequently, asthma is becoming a major public health concern that needs to be addressed.

Research indicates that obesity may be one of the risk factors for asthma (4). Beuther and Sutherland (4) conducted a meta-analysis using observational studies and concluded that there was a dose-dependent increase between overweight/obesity and the odds of incident asthma in both men and women. Similar to asthma, increasing trends of obesity have been observed for the past few decades (5). The World Health Organization defines body mass index (BMI) between 25.0 kg/m² and 29.9 kg/m² as overweight and of 30.0 kg/m² or higher as obesity (6). Studies have reported the positive relationship between BMI and incident asthma, indicating an increased risk of asthma among obese individuals (7–9). Furthermore, some researchers discuss the possi-

bility of a causal relationship between obesity and asthma (10–12). However, there is no physiological evidence thus far showing that obesity is linked with airway obstruction and that obesity causes asthma (13).

Physical activity is another lifestyle variable of interest in asthma research that is receiving much attention lately (14). Lucas and Platts-Mills (15) proposed that physical inactivity, which is also prevalent in recent years (16), may play a role in recent increases in asthma prevalence, as it could decrease cardiovascular fitness and thus negatively affect lung function. In addition, people with asthma may limit their physical activity due to exercise-induced asthma, referred to as “transient narrowing of the airways that follows vigorous exercise” (17). Physical activity levels are closely related to physical fitness levels (18), and a study reported a lower cardiorespiratory fitness in asthmatic individuals (19). Moreover, it is well known that physical activity is an important component for weight management and that physical inactivity is a risk factor for obesity (20,21). Therefore, it may be that physical inactivity contributes to an increased risk of obesity in the asthmatic population. By understanding how physical inactivity interacts with asthma, public health professionals can develop effective strategies for promoting physical activity among people with asthma. The aims of this study were (1) to assess physical activity patterns among adults with self-reported asthma living in Nevada and (2) to investigate how physical inactivity is associated with self-reported asthma prevalence.

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METHODS

Materials

This study utilized data from the 2009 Nevada Behavioral Risk Factor Surveillance System (BRFSS). The BRFSS, administered by the Centers for Disease Control and Prevention, is a standardized random-digit dialing telephone survey conducted by state health departments nationwide each year. Details of the BRFSS are described elsewhere (22). Briefly, the primary objective of the BRFSS is to collect information on health risk behaviors and self-reported conditions. Noninstitutionalized adults aged 18 years or older are randomly selected for interview to collect health-related data.

Asthma Status

Respondents were classified based on lifetime and current asthma status. Specifically, people were asked to answer “yes” or “no” to the following questions regarding their asthma status: “Have you ever been told by a doctor, nurse, or other health professional that you had asthma?” and “Do you still have asthma?” Based on the response, each individual was categorized as either with or without lifetime asthma and either with or without current asthma.

Physical Activity Measures

Physical activity participation among respondents was assessed according to each of the following criteria (yes/no): (1) whether they engage in regular physical activity or exercise; (2) whether they have participated in leisure-time physical activity during the past 30 days

other than their regular job; and (3) whether they meet the current physical activity recommendation (engaging in moderate physical activity for 30 or more minutes per day on 5 or more days per week or vigorous physical activity for 20 or more minutes per day on 3 or more days). These amounts of physical activity are recommended by the American College of Sports Medicine and the American Heart Association (23). In addition, total minutes per week of moderate and vigorous physical activity were calculated from durations and frequencies of engaging in those activities provided by respondents during the survey.

Data Analyses

Weighted percentages were calculated for the different physical activity measures, along with selected sociodemographic variables, by asthma status. These percentages were compared and examined using a Rao–Scott χ^2 test. In addition, weighted means for total minutes per week of moderate and vigorous physical activity were calculated and compared based on asthma status using a *t*-test. A logistic regression analysis was performed to calculate an odds ratio (OR) and 95% confidence interval (CI) for each physical activity measure by asthma status while using gender, age, race/ethnicity, education, and BMI as covariates.

RESULTS

A total of 3840 adults responded to the survey. Table 1 shows sociodemographic characteristics of the

TABLE 1.—Selected sociodemographic characteristics by asthma status.

Characteristics	Lifetime asthma status		<i>P</i> -value ^a	Current asthma status		<i>P</i> -value ^a
	Yes 13.9 (1.0)	No 86.1 (1.0)		Yes 9.0 (0.9)	No 91.0 (0.9)	
Gender			.029			.154
Male	42.4 (4.0)	51.9 (1.5)		43.5 (5.2)	51.3 (1.5)	
Female	57.6 (4.0)	48.1 (1.5)		56.5 (5.2)	48.7 (1.5)	
Age (years)			.078			.391
18–29s	24.6 (4.3)	16.5 (1.5)		19.3 (5.6)	17.3 (1.5)	
30–39	20.1 (3.2)	22.8 (1.5)		22.2 (4.2)	22.5 (1.4)	
40–49	20.8 (3.0)	19.7 (1.2)		25.0 (4.2)	19.4 (1.1)	
50–59	12.9 (1.8)	18.0 (1.0)		10.8 (2.0)	18.0 (1.0)	
60–69	11.4 (1.8)	12.2 (0.7)		12.1 (2.2)	12.1 (0.7)	
≥70	10.2 (1.5)	10.8 (0.6)		10.6 (2.0)	10.7 (0.6)	
Race/ethnicity			.547			.849
White	69.7 (3.9)	71.8 (1.6)		71.7 (4.8)	71.4 (1.5)	
Black	4.8 (1.4)	4.9 (0.7)		4.3 (1.6)	5.0 (0.7)	
Hispanic	18.4 (3.8)	14.4 (1.3)		17.1 (4.7)	14.8 (1.3)	
Other	7.1 (1.6)	8.9 (1.1)		6.9 (2.0)	8.8 (1.0)	
Education			.347			.360
Did not graduate high school	7.3 (2.1)	7.4 (0.9)		8.1 (2.9)	7.3 (0.9)	
Graduated from high school	31.4 (3.8)	29.2 (1.4)		32.0 (4.8)	29.1 (1.4)	
Attended college/technical school	34.9 (3.6)	30.1 (1.4)		35.5 (4.5)	30.4 (1.4)	
Graduated from college/technical school	26.4 (3.4)	33.3 (1.4)		24.4 (4.3)	33.2 (1.4)	
Body mass index ^b			.048			.011
<25.0/m ² (not overweight/obese)	39.3 (4.0)	36.6 (1.5)		34.4 (4.8)	37.3 (1.5)	
25.0–29.9 kg/m ² (overweight)	28.4 (3.2)	37.9 (1.5)		27.1 (3.9)	37.4 (1.5)	
≥30 kg/m ² (obese)	32.3 (4.0)	25.5 (1.4)		38.5 (5.4)	25.3 (1.3)	

Notes: Values given as % (SE).

^aRao–Scott χ^2 test.

^bBody mass index classification by World Health Organization (6).

respondents by lifetime and current asthma status. Overall, 13.9% and 9.0% of the respondents self-reported lifetime and current asthma, respectively. A significantly larger proportion of those with lifetime asthma was female (57.6%; $p = .029$), and this trend was also observed among those with current asthma (female = 56.5%) despite not being statistically significant ($p = .154$). People with lifetime and current asthma were significantly more likely to be obese than those without asthma (32.3% vs. 25.5% for those with and without lifetime asthma, $p = .048$; 38.5% vs. 25.3% for those with and without current asthma, $p = .011$).

Physical activity patterns by asthma status among the respondents are presented in Table 2. About 13% of those with lifetime asthma reported that they did not engage in regular physical activity or exercise compared with 7% of those without lifetime asthma ($p = .007$). In addition, people with lifetime asthma were significantly less likely to participate in leisure-time physical activity than those without lifetime asthma (30.4% vs. 23.5%; $p = .048$). Similar findings were also observed between the respondents with and without current asthma. Relative to people without current asthma, more than twice of those with current asthma did not engage in regular physical activity or exercise (17.7% vs. 6.8%; $p < .001$). Moreover, 38.5% of people with current asthma had no leisure-time physical activity, and this percentage was significantly higher than that of those without current asthma (22.9%; $p < .001$). On the other hand, the proportions of the respondents who did not meet the physical activity recommendation were not significantly different by lifetime asthma status ($p = .579$). There was a tendency, however, for a higher percentage of people with current asthma not meeting the physical activity recommendation compared with those without current asthma (56.7% vs. 47.5%; $p = .093$), although it did not reach statistical significance.

There were significant differences in total minutes per week of moderate and vigorous physical activity by asthma status (Table 2). People with lifetime asthma spent

an average of 223 minutes per week on moderate physical activity, significantly lower than 283 minutes per week for those without lifetime asthma ($p < .001$). The difference in amounts of vigorous physical activity between the two groups was significant as well (86 minutes/week vs. 117 minutes/week; $p < .001$). People with current asthma also spent significantly less time on moderate and vigorous physical activity than those without current asthma (214 minutes/week vs. 281 minutes/week for moderate physical activity, $p < .001$; 86 minutes/week vs. 115 minutes/week for vigorous physical activity, $p < .001$).

The logistic regression analyses revealed that after adjusting for gender, age, race/ethnicity, education, and BMI, people with lifetime asthma were twice more likely to not engage in regular physical activity or exercise than those without lifetime asthma (OR = 2.167, 95% CI = 1.259–3.731). In addition, people with lifetime asthma tended not to participate in leisure-time physical activity compared with those without lifetime asthma (OR = 1.472, 95% CI = 1.016–2.133). The difference in physical activity participation by asthma status was manifested when comparing the respondents with and without current asthma. People with current asthma were three times as likely to not engage in regular physical activity or exercise as those without current asthma (OR = 3.010, 95% CI = 1.634–5.546). Furthermore, people with current asthma were twice more likely to not participate in leisure-time physical activity than those without current asthma (OR = 2.172, 95% CI = 1.400–3.369). In contrast, even after accounting for the covariates described above, no significant association was found between meeting the physical activity recommendation and lifetime asthma status ($p = .493$). There was also no significant relationship between meeting the physical activity recommendation and current asthma status, though a tendency for statistical significance was observed ($p = .098$). When looking at the sociodemographic variables examined in the logistic regression models, it was found that the respondents with lifetime and current asthma were significantly more likely

TABLE 2.—Physical activity participation by asthma status.

Physical activity measures	Lifetime asthma status		<i>P</i> -value	Current asthma status		<i>P</i> -value
	Yes 13.9 (1.0)	No 86.1 (1.0)		Yes 9.0 (0.9)	No 91.0 (0.9)	
Regular physical activity/exercise			.007 ^a			<.001 ^a
Yes	87.1 (2.6)	93.0 (0.7)		82.3 (3.8)	93.2 (0.7)	
No	12.9 (2.6)	7.0 (0.7)		17.7 (3.8)	6.8 (0.7)	
Leisure-time physical activity			.048 ^a			<.001 ^a
Yes	69.6 (3.4)	76.5 (1.3)		61.5 (4.7)	77.1 (1.3)	
No	30.4 (3.4)	23.5 (1.3)		38.5 (4.7)	22.9 (1.3)	
Recommended physical activity ^b			.579 ^a			.093 ^a
Yes	49.4 (4.0)	51.8 (1.6)		43.3 (5.2)	52.5 (1.6)	
No	50.6 (4.0)	48.2 (1.6)		56.7 (5.2)	47.5 (1.6)	
Moderate physical activity			<.001 ^c			<.001 ^c
Minutes/week	223 (23)	283 (18)		214 (31)	281 (17)	
Vigorous physical activity			<.001 ^c			<.001 ^c
Minutes/week	86 (12)	117 (12)		86 (17)	115 (11)	

Notes: Values given as % (SE), unless otherwise indicated.

^aRao–Scott χ^2 test.

^bModerate physical activity for ≥ 30 minutes per day on ≥ 5 days per week or vigorous physical activity for ≥ 20 minutes per day on ≥ 3 days per week (23).

^c*t*-test.

to be obese than their nonasthmatic counterparts, with OR ranging from 1.248 to 1.326 for those with lifetime asthma and from 1.600 to 1.647 for those with current asthma.

DISCUSSION

The results of the data analyses showed that among adults living in Nevada, those self-reporting lifetime asthma were less likely to engage in regular physical activity or exercise than those without lifetime asthma. This trend was more apparent between people with and without self-reported current asthma. Furthermore, these findings were still statistically significant after adjusting for gender, age, race/ethnicity, education, and BMI. The results also revealed that more than half of the adults with lifetime or current asthma and close to half of those without asthma did not meet the current physical activity recommendation. Whether individuals met the physical activity recommendation did not significantly differ by asthma status. People with lifetime and current asthma were found to spend significantly less time on moderate and vigorous physical activity than their nonasthmatic counterparts.

In this study, physical inactivity is more prevalent among adults self-reporting lifetime and current asthma compared with those without such reported conditions. This finding was significant even after adjusting for BMI and other common sociodemographic variables. Ford et al. (24) also reported lower physical activity levels among people with asthma, whereas Chen et al. (25) pointed out that asthmatic people were not necessarily inactive compared with nonasthmatic people. As little research has been done to examine physical activity patterns for people with asthma, we are uncertain about this discrepancy in the study results. With respect to the findings in our study as well as in the study by Ford and colleagues (24), we speculate that asthmatic people tend to avoid physical activity or exercise because of the negative experience caused by exercise-induced asthma, such as coughing, wheezing, and shortness of breath (26). Consequently, people with asthma are at increased risk of obesity, as physical inactivity contributes to weight gain and obesity (21). In addition, researchers have proposed that long-term corticosteroid use, a common treatment for asthma (27), may be associated with an increased risk of obesity (11,28,29). In our study, the prevalence of obesity among the respondents with lifetime and current asthma was significantly higher than among those without asthma (32.3% vs. 25.5% for those with and without lifetime asthma; 38.5% vs. 25.3% for those with and without current asthma). Moreover, our results showed that physical inactivity and BMI were significant independent predictors of lifetime and current asthma status in the logistic regression models. Therefore, it appears that physical inactivity and obesity are both associated with an increased prevalence of self-reported lifetime and current asthma.

It is estimated that as much as 90% of people with asthma experience exercise-induced asthma

(30). Certainly, exercise-induced asthma can discourage asthmatic individuals from being physically active. Furthermore, even with the absence of exercise-induced asthma, people with asthma may perceive their asthmatic condition as a barrier to participating in physical activity (31). On the other hand, it has been suggested that exercise-induced asthma can be effectively managed and should not limit physical activity participation (32). Safer exercise modes for individuals with asthma include swimming, walking, and badminton (30). Intermittent exercise, such as interval running, is considered preferable (i.e., less likely to cause exercise-induced asthma) to continuous exercise, such as long-distance running (33). A proper warm-up may also reduce the risk of exercise-induced asthma, as continuous moderately intense exercise, such as 15 minutes of running at an intensity of 60% of maximal oxygen uptake, was shown to have a protective effect on exercise-induced asthma (34). It should be noted that most people with asthma believe that they should engage in more physical activity (35). To promote physical activity among asthmatic people, it seems important to help them better understand exercise-induced asthma and to teach them how to safely perform physical activity while minimizing the impact of exercise-induced asthma.

There are a number of health benefits of physical activity (36). As mentioned previously, better weight management and reducing the risk of obesity are some of those benefits (20). This is relevant in that losing weight will potentially improve the clinical status of asthma (37). Furthermore, physical activity protects against various chronic diseases, such as coronary artery disease, hypertension, diabetes, and certain types of cancer (38). Even walking, a safe exercise mode for those with asthma, can bring about significant health benefits, including lowering the risk of all-cause mortality, cardiovascular disease, and type 2 diabetes (36). More importantly, research indicates that physical activity may improve the condition of asthma, as shown by the reductions in the need for medication, visits to emergency departments, and absences from school (39). Hence, it is the role of health and exercise professionals to design safer physical activity programs and promote physical activity among people with asthma.

It should be mentioned that there are limitations associated with this study. First and foremost, the data for asthma status, along with physical activity participation and BMI, were obtained from self-reports. For example, it is not uncommon that individuals misclassify and/or misunderstand their asthmatic condition (40,41). This is especially the case for obese and/or unfit individuals, as obesity and cardiovascular deconditioning relate to dyspnea (42–45), defined as “an uncomfortable or unpleasant sensation of breathing” (46). As a result, in this study it was not possible to distinguish between clinical airway obstruction (i.e., clinically diagnosed asthma) and feelings of dyspnea (i.e., misclassified as asthma) among the self-reported asthmatic cases. In addition, as physical activity assessment in the BRFSS relies on a person’s cognitive ability to recall his/her behaviors, there may

be subjective bias in the physical activity data collected by the survey. Furthermore, in self-reports people tend to overestimate height and underestimate weight, leading to the overestimation of BMI (47). Second, the BRFSS does not include the severity of asthma. There is a wide range of the severity of conditions among asthmatic individuals (48,49), which can influence one's ability to engage in physical activity aside from whether he/she has asthma. Third, modes and intensities of physical activities done by the respondents were not known in this study. The 2000 BRFSS was actually the last survey in which specified physical activity data were collected (50). Thus, we were unable to estimate physical activity energy expenditure of each individual. Examining energy expenditure, in addition to physical activity patterns, among people with asthma may uncover a more accurate relationship of physical activity to asthma prevalence. Lastly, this was a cross-sectional study; therefore, it was not possible to determine a temporal or causal relationship between physical activity participation and asthma prevalence.

It is worth highlighting that self-reports are commonly used in epidemiological studies, and the major advantage of using self-reports is that they allow for collecting a large dataset, yielding greater statistical power. This enables researchers to analyze variables of interest in a community setting and to address health issues from a population perspective. In addition, even though misclassification is inevitable, studies have reported acceptable to even high sensitivity and specificity of self-reported asthma (40,51). In the case of the BRFSS, it is a large probability sample of the community, employs random-digit dialing to ensure random sampling, and employs weighing methodology, which makes the BRFSS data representative of a state population (22). The validity and reliability for most measures in the BRFSS, including physical activity measures and BMI, have been shown to be moderate to high (52,53). Moreover, several studies have been conducted in the past using the BRFSS to examine asthma and its risk factors (54–58). Therefore, one can conclude that the findings in our study have important implications with regard to health status and behavior in the asthmatic population despite the shortcomings of self-reports.

CONCLUSION

This study indicates that adults with self-reported asthma living in Nevada are more likely to be physically inactive than their nonasthmatic counterparts. According to the data, a majority of adults with lifetime and current asthma, similar to those without asthma, do not meet the current physical activity recommendation. It appears that physical inactivity is associated with an increased prevalence of lifetime and current asthma independent of obesity status as well as other common sociodemographic factors. From the public health standpoint, it is necessary to promote physical activity among people with asthma. As researchers suggest (15,54,58), the causes of recent increases in asthma prevalence, along with the etiology

of asthma, in relation to physical activity and obesity appear to be complex and multifactorial. Future research is necessary to elucidate more precise relationships (e.g., temporal/causal relationship) between asthma and physical activity/obesity. Physical activity intervention studies should also be conducted to investigate the effects of physical activity as well as weight loss on the severity of asthma, while utilizing objective measurements of asthma status (e.g., clinical indices and diagnosis by physicians), physical activity level (e.g., use of pedometers), and obesity (e.g., height and weight measurements by investigators). Furthermore, developing physical activity recommendations specific to people with asthma will help to promote physical activity in this population.

DECLARATION OF INTEREST

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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