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Depression and Quality of Life Among Adults with Asthma Presence in Nevada

Elizabeth D. Kahane

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DEPRESSION AND QUALITY OF LIFE AMONG ADULTS WITH ASTHMA PRESENCE

IN NEVADA

By

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Bachelor of Arts - Government
Dartmouth College
2009

A thesis submitted in partial fulfillment
of the requirements for the

Master of Public Health

Department of Epidemiology and Biostatistics
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Abstract

Asthma is a lung disease that causes coughing, chest tightness, wheezing, and breathlessness. It is often controlled by medication use and avoidance of environmental triggers. It is a leading chronic, non-communicable disease affecting over 19 million adults in the United States (CDC, 2020a). Asthma and severe asthma have been shown to negatively affect mental health and quality of life among adults including limiting physical activity, lowering sleep quality, exacerbating economic challenges, missing work, and increasing healthcare use (Stanescu, et al., 2019). Approximately 8% of adult Nevadans reported current asthma symptoms and 12.6% reported having a diagnosis during their lifetime (CDC, 2018c). The purpose of this study was to evaluate the association between self-reported asthma and depression among adult Nevadans; as well as to explore quality of life factors affecting adult Nevadans with asthma. Using 2017 Behavioral Risk Factor Surveillance System (BRFSS) data, this study evaluated the association between asthma and depression in Nevada with respect to other associated factors that may also play a role. Upon adjustment of relevant covariates, adult Nevadans with current asthma were 3.22 times as likely (95% CI: 2.26-4.58) to be depressed compared to those without asthma. Adult Nevadans with lifetime asthma were 2.6 times as likely (95% CI: 1.88-3.61) to be depressed compared to those without a lifetime asthma diagnosis. Data from the BRFSS Asthma Call-Back Survey (ACBS) were used to determine quality of life factors affecting a sub-sample of survey respondents self-reporting with asthma in Nevada for the same year. Respondents on the ACBS indicated the prevalence of quality of life indicators and quality of life risk factors including depression (38%), activity limitations (40%), sleep disturbance (26%), missing work or other activities (31%), cost-related challenges (20%), healthcare usage (33%), exposure to environmental triggers (96%), and severe asthma as indicated by use of oral corticosteroids

(5%). Asthma presence is associated with depression and negatively affects quality of life among adult Nevadans. A public health approach including asthma education and clinical outreach is critical in order to reduce the impact of asthma on mental health and quality of life.

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Introduction

Asthma is a non-communicable chronic respiratory disease. According to the Centers for Disease Control and Prevention (CDC), it is a lung disease that may cause coughing, chest tightness, wheezing, and breathlessness, and may be controlled by medication use and avoidance of environmental triggers (CDC, 2020a). While symptoms range in severity, it is considered an asthma attack when they are exacerbated. During an attack the airway becomes inflamed, constricts and narrows, it may become obstructed making breathing difficult, and causing bronchial spasms. Asthma may be caused by an immune response to substance in the lungs or environmental triggers (National Heart, Lung, and Blood Institute, 2020). It is a leading global chronic disease with over 235 million affected globally (Stanescu, et al., 2019).

Asthma burden in the United States

Asthma may be childhood- or adult-onset. According to the most recent CDC data publicly available from 2018, there were 19,223,248 adults (18+) with diagnosed asthma, 7.7% of adults in the US. This includes 6,664,571 men and 12,558,677 women (CDC, 2018b). For adults, rates were highest among Puerto Ricans (14.2%), followed by multiple races non-Hispanic (13.3%), then for American Indian/Alaska Native non-Hispanic (10.5%), and black non-Hispanic individuals (9.6%) (CDC, 2018b).

To drill deeper into the individual asthma burden and risk factors in the United States, Zahran, et al. (2014), completed a nation-wide study using Behavioral Risk Factor Surveillance System (BRFSS) Asthma Call-Back Survey (ACBS) data, in which those who indicated they have diagnosed asthma in the BRFSS survey received a secondary survey about their experience with asthma. In this study, 50% of adults with current asthma reported it as uncontrolled, with

53% of respondents reporting medication use. The authors found an association for adults with older age (over 45 years old), lower household income (under \$25,000 per year), current or former smoking status, reporting race as “other”, holding less than a 4-year college degree, obesity, comorbid disease such as depression or chronic obstructive pulmonary disease, and reporting cost as a barrier (Zahran, et al., 2014).

Asthma burden in Nevada

Nevada has a dry, arid environment with high heat in the Southern part of the state. While the Northern part of the state has a different climate, the majority of the population resides in the South. According to the Asthma and Allergy Foundation of America (2017), both high heat and dryness can be asthma triggers, leading to questions of the asthma burden in the state (Asthma and Allergy Foundation of America, 2017). In Nevada in 2018 according to the BRFSS, 8% of adults reported a current asthma diagnosis, with 12.6% reporting a diagnosis at some point in their life. By sex, 10.1% of adult women reported currently diagnosed asthma, compared to 5.8% of men, and 15.4% of women reported a lifetime diagnosis of asthma, compared to 9.7% of men. Among those who have a current or lifetime diagnosis of asthma, the rates were highest among black non-Hispanic individuals in Nevada, followed by white non-Hispanic individuals. In terms of education level, adults with a current asthma diagnosis reported the highest rates among those with less than a high school degree (11.4%) and among those with lifetime asthma the highest rates were reported by those with a high school diploma or GED (13.6%), followed by those with less than a high school diploma (13.4%) (CDC, 2018c).

There have been a relatively small number of studies focused on adult asthma in Nevada. Teramoto and Moonie (2011) looked at the impact of physical activity on adults with self-

reported asthma using BRFSS data. This study found inactivity among a majority of adults with self-reported asthma living in Nevada and physical inactivity was associated with increased asthma prevalence (Teramoto & Moonie, 2011).

Moonie, et al. (2015) evaluated emergency room and hospital utilization longitudinally. The goal of this study was to evaluate health care use for those with asthma by treatment setting and identify subgroups with disproportionate use. This study found higher asthma-related emergency room visits and hospitalizations in Nevada for children, women, and black individuals. (Moonie, et al., 2015).

Lastly, Sokolowsky, et al. (2017) completed a study in Southern Nevada focused on housing conditions with the goal of discussing associated negative health outcomes. Data were collected within three zip codes in Henderson, Nevada. Potential environmental asthma triggers were found in over 90% of residences that met their inclusion criteria, including the presence of cockroaches, rodents, dust mites, dog and cat allergens, tobacco smoke, dampness, nitrogen dioxide, mold, improperly stored garbage, and cleaning and clutter problems inside the home. The authors cite that many of these could be potential asthma triggers of concern given that individuals in developed countries spend much of their time indoors. Structural problems, such as broken windows, were also identified in the study, which could allow pests to enter homes (Sokolowsky, et al., 2017).

Association between adult asthma and depression

The relationship between asthma and depression is well documented, though to the author's knowledge has not been evaluated in the literature in Nevada. Both asthma and depression are well-established public health problems and are burdens to individual health and

quality of life, the healthcare system, and the well-being of communities. As discussed in more depth above, in the US 7.7% of adults have diagnosed asthma (CDC, 2018b). According to the Substance Abuse and Mental Health Service (2017), 17.3 million adults (ages 18 and older) in the US experienced one more major episodes of depression, 7.1% of the population, with higher rates among women and those reporting being of two or more races (National Institute of Mental Health, 2019).

While the relationship between asthma and depression has been long-studied, questions remain about the temporal relationship between the two. To help evaluate the directionality of the association Brunner, et al. (2014) used the Coronary Artery Risk Development in Young Adults cohort to look at depression related to asthma and asthma related to depression. The authors followed 3,614 individuals who did not have asthma at baseline for 20 years and then 3,016 who did not have depression at baseline for 20 years. The authors concluded that depression was a risk factor for asthma, but that asthma was not a risk factor for depression (Brunner, et al., 2014). While there was no determination made by the authors on why this relationship exists, they postulated that it may relate to shared exposures and comorbidities, inflammation, the autonomic, neuroendocrine or central nervous systems, the impact of in utero exposures (such as cigarette smoke), or because depression may lead to poor asthma control due to low treatment adherence (Brunner, et al., 2014).

Supporting Brunner, et al's (2014) conclusion that depression is a risk factor for asthma, but not necessarily the other way around, Gao, et al., (2015) completed a meta-analysis of prospective cohort studies. After exclusions, six of eight studies (representing 83,684 participants) concluded that adult-onset asthma could be predicted by depression with a 43%

increased risk of developing asthma for those who were depressed. After adjusting for confounding factors, there was a strong association between depression and adult-onset asthma. Two studies indicated the reverse association might be true, but the authors concluded that was too few on which to draw a conclusion, so indicated the need for more research in this area (Gao, et al., 2015). The authors cited possible reasons depression could be a risk factor of asthma, including depression's association with inflammatory mediators, neuroendocrine effects, obesity, smoking, and increased stress (Gao, et al., 2015).

In summary, these studies concluded that asthma and depression have an association in several geographic areas; but no studies to the author's knowledge have been performed in Nevada. Nevadans are prone to respiratory conditions due to the dry arid environment contributing to respiratory distress (Asthma and Allergy Foundation of America, 2017). Furthermore, most published studies that have reported the association did not document the underlying factors contributing to depression and reduced quality of life among those living with asthma.

Asthma and quality of life

According to the World Health Organization, quality of life is defined as, "...an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards[,] and concerns" (World Health Organization, 2014, para. 1). Having asthma may impact an individual's quality of life. A systematic review of literature, including 43 studies from across the globe, found an association between asthma and lower quality of life (Stanescu, et al., 2019). Rimington, et al. (2001) noted

that quality of life could even be used as a tool to support the monitoring of asthma symptoms, as a reduction in symptoms may cause a better perceived quality of life (Rimington, et al., 2001).

Asthma-related quality of life factors for adults include work, social, physical, and emotional health, which may be impacted by symptoms, emotions, the environment, and physical activity limitations (Juniper, et al., 1992). Within these areas, individual variables may affect quality of life and are risk factors for lower quality of life, including depression, activity limitation, sleep disturbance, missed work, cost-related challenges, healthcare usage, interactions with environmental asthma triggers, and asthma severity.

A lower quality of life for asthma patients with depression has been observed (Ilmaninen, et al., 2019). A range of studies in different locations explore the association between asthma and depression and discuss the resulting quality of life affect for asthma patients. Deshmukh, et al. (2008), in cross-sectional study of adult asthma patients (110 individuals), found a negative significant association between depression symptoms and asthma-related quality of life, after controlling for depression/anxiety, gender, smoking, age, and emergency department visits over the past year. Depressed asthma patients were more likely to experience hyperventilation and panic-fear asthma symptoms, which may cause increased use of medication and healthcare utilization. Depression may also impact the use of asthma medication adherence, increasing symptoms (Deshmukh, et al., 2008).

Lavoie, et al. (2005), worked with 406 adult asthma patients from a hospital in Montreal, of whom 34% also had a psychiatric diagnosis, including 15% with major depression and 5% with minor depression. The authors found that for those with asthma, depression and anxiety were associated with poorer asthma control and lower quality of life. For example, those with

asthma and psychiatric disorders had more nighttime waking, increased limitations in daily activities, and worse symptoms (Lavoie, et al., 2005).

Within Stanescu, et al.'s (2019) review, they found a high prevalence of anxiety or depression symptoms within the asthma population, which "...appeared to play a key role in understanding the relationship between asthma and QoL [quality of life]. Overall, having a diagnosis of anxiety or depression was associated with poorer QoL [quality of life]..." (Stanescu, et al., 2019, p. 6). The authors note that those with asthma were six times as likely to have anxiety or depression when compared to the general population (Stanescu, et al., 2019).

Lastly, a cross-sectional nationwide survey in Korea, using the Korean National Health Survey of 229,131 participants (5,989 with asthma and 223,142 without asthma), indicated that those with asthma were more likely to report having depression and anxiety (Chung & Han, 2018). The authors found that those with asthma were at greater odds of having anxiety/depression problems and those with both asthma and anxiety and depression reported lower quality of life (Chung & Han, 2018).

According to the review by Stanescu, et al. (2019), activity limitation has an impact on quality of life for all people but particularly those with asthma. Limitations in activity negatively influence quality of life and are associated with other comorbidities that may affect quality of life, such as depression and obesity (Stanescu, et al., 2019). Additionally, past literature highlights the link between physical activity, obesity, and asthma, and physical activity alone, beyond reducing obesity, can help reduce chronic conditions (Pharr, et al., 2018).

Kavanagh, et al. (2018) completed a review of the literature focused on sleep and asthma and discussed the prevalence of sleep disturbance and poor sleep quality among those with

asthma, particularly for those with poorly controlled and severe asthma. There is an association between quality of life reductions and poor quality of sleep or insufficient sleep (Kavanaugh, et al., 2018). Chung & Han (2018) discuss the impact of poor sleep quality and its negative effect on quality of life for asthma patients with sleep disturbances reported (Chung & Han, 2018).

Asthma is the most common reason for adults to miss work or perform poorly in their job, with about 14 million missed days annually (Asthma and Allergy Foundation of America, n.d.). Each day in the US, there are 40,000 missed work or school days attributable to asthma. Days missed of work reduces productivity and may impact an individual's income, causing additional quality of life reductions beyond those associated with missed work (Asthma MD, n.d.).

To that point, individuals with asthma experience cost-related challenges. Those with no insurance are more likely to utilize emergency rooms, which can be expensive, and experience higher out of pocket costs (Asthma and Allergy Foundation of America, n.d.). Beyond the individual burden, a high national cost to asthma exists. There is an estimated annual cost of \$56 billion (\$50.1 billion direct and \$5.9 indirect cost) in the US due to asthma (Asthma and Allergy Foundation of America, n.d.). Those with asthma experience cost-related challenges that may impact quality of life, and which may cause stress and difficulty in paying for treatments.

Those with asthma may experience increased healthcare use, including emergency room and urgent care visits, negatively affecting quality of life. There were 10.6 million visits to doctors' offices, 2.1 million emergency room visits, and 479,300 hospitalizations due to asthma in 2009 in the US (Moonie, et al., 2015). Further, a cohort study in Finland, found a lower quality of life for women with asthma, when compared to men with asthma, along with higher

use of health care (Ilmaninen, et al., 2019). These visits and stays are expensive so may exacerbate economic challenges caused by things like missed work days due to asthma.

Exposure to environmental triggers that exacerbate asthma and cause attacks may lower quality of life. According to the CDC, major triggers for asthma include tobacco smoke, dust mites, outdoor air pollution, cockroach allergen, pets, mold, and burning wood or glass smoke (CDC, 2020a). Gautier and Charpin (2017) in their review add rodents and possibly mice to this list and noted that it is difficult for those with asthma to avoid all these triggers in their daily lives (Gautier and Charpin, 2017). Luskin, et al. (2014), using data from the Epidemiology and Natural History of Asthma: Outcomes and Treatment Regimes evaluated the association between asthma triggers and quality of life for asthma patients, ages 13 and older. The authors detailed that patients with more asthma triggers have increased asthma exacerbations and reported lower quality of life. They concluded that avoiding asthma triggers might help decrease exacerbations and increase patients' quality of life (Luskin, et al., 2014).

In the review by Stanescu, et al. (2019), they not only found an association between asthma and lower quality of life, but found an even poorer association when taking asthma control level and disease severity into account (Stanescu, et al., 2019). Asthma severity may be indicated by the type of medication used for treatment. The use of oral corticosteroids, rather than use of other types of medications, may indicate severe asthma (Caminati & Senna, 2019).

Study Purpose

Based on the literature discussed above, the purpose of this study is to explore the association between self-reported asthma and depression among adult Nevadans as well as to evaluate the presence and extent of key quality of life indicators available for a subset of adult Nevadans living with asthma. The association between self-reported asthma and depression will be addressed, adjusting for relevant covariates. The second part of the paper will explore the underlying quality of life factors that may contribute to comorbid depression among those living with asthma.

Research Questions

The research questions that guided this study are as follows:

1. Is there an association between asthma status and depression among adult Nevadans?
2. What is the extent that quality of life measures affect adult Nevadans living with asthma?
 - 2a. Which quality of life risk factors and measures are correlated with each other?

Objectives

This study has two main objectives in order to answer the research questions above:

Objective 1

To determine the relationship between asthma presence and depression among adults in Nevada.

Objective 2

To complete a sub-analysis of factors affecting adult Nevadans with asthma to include depression, activity limitation, sleep disturbance, missed work days, cost, healthcare utilization, asthma triggers, and asthma severity.

Hypotheses

Based on the existing literature, and in order to inform the research questions and objectives of this study, the following hypotheses were developed:

H₀: There is no association between self-reported asthma status and depression among adult Nevadans.

H_a: There is an association between self-reported asthma status and depression among adult Nevadans.

H₀: There will be minimal factors affecting quality of life among adult Nevadans with asthma presence.

H_a: There will be multiple factors identified that affect quality of life among adult Nevadans with asthma presence.

Ethical Considerations

Data were collected and retrieved from the CDC website. Institutional review board approval was not required as data were publicly available at www.cdc.gov/brfss. The Nevada State Health Division, Division of Public and Behavioral Health provided the BRFSS ACBS data. All data were de-identified, maintaining anonymity and confidentiality. A data exclusion letter was obtained from the UNLV Institutional Review Board (Appendix A).

Methods

BRFSS data from 2017 were utilized for this study, as this is the most current year available for both the BRFSS core questionnaire and ACBS data. The BRFSS is a telephone survey system (of both cell phones and landlines) that randomly samples individuals using a standardized questionnaire. Self-reported health-related data are collected from individuals in each state and participating territory of the United States. Surveys are developed and agreed upon in collaboration with states, each with a BRFSS coordinator. The questionnaire structure begins with a core component, which each state administers without changes; there are optional modules that states may elect to use, and then questions the states may add. All new questions are tested and voted upon by states before becoming part of the BRFSS (CDC, 2018a).

According to the BRFSS methodology documented, phone numbers are randomly selected to receive a phone call. Some states use disproportional strategies sample design, while others use random-sample design (CDC, 2018a). In 2011, BRFSS began using both cell phone and landline surveys. Landline participants are randomly selected from the adults in the household. Individuals who answer the cell phone calls are surveyed. The calling process is managed by states and the CDC provides technical assistance as needed. Once data collection is complete, the data are sent to the CDC and each state is provided with a summary report and edited data file. To help create a representative dataset, the CDC weights the data for selection probability, bias of non-response or non-coverage, and demographics (CDC, 2018a).

Data from the BRFSS core questionnaire were used in the first part of the study. The CDC BRFSS questionnaire evaluates two asthma measures, and interviewers ask participants questions related to both. The first is lifetime asthma, which is defined as answering yes to the

question “[h]ave you ever been told by a doctor {nurse or other health professional} that you have asthma?” (CDC, 2020b, para. 4). The second is current asthma, defined as answering yes to the question “[d]o you still have asthma?” (CDC, 2020b, para. 4). To assess rates of depression, BRFSS interviewers ask respondents if a doctor or other healthcare professional has told you “...you have a depressive disorder, including depression, major depression, dysthymia, or minor depression?”, and those who answer yes to this question are defined as having depression (CDC, 2017, p. 17).

In addition to the core questionnaire, states have the option to administer a call-back survey to those who indicate in the core questionnaire that they have diagnosed asthma and are willing to be called back. During the second call, more detailed asthma-related questions are asked of each respondent. Nevada participates in the BRFSS ACBS program (CDC, 2019).

2017 ACBS data were used in the second part of the study. There is no identifier linking the BRFSS core questionnaire data and the ACBS data, so the two parts of the analysis were completed separately. The descriptive sub-analysis was performed using ACBS data, providing more in depth frequency information related to the prevalence of asthma triggers, oral corticosteroid use indicating severe asthma, and other quality of life indicators or quality of life risk factors affecting adults living with asthma, including depression, activity limitation, sleep disturbance, missed work, cost-related challenges, and healthcare use (Caminati & Senna, 2019). Questions asked on the ACBS related to these variables that were used in the descriptive analysis may be found in Table 1. Definitions for these quality of life variables and quality of life risk factors, based on BRFSS ACBS data for Nevada, may be found in Appendix B Table A1. The full ACBS questionnaire may be found on the CDC website:

https://www.cdc.gov/brfss/acbs/2017_documentation.html.

Table 1*BRFSS Asthma Call-Back Survey Quality of Life Questions*

Quality of Life Variable	Question Number	Question*
Depression	11.4	Have you ever been told by a doctor or other health professional that you were depressed?
Activity limitation	5.9	During just the past 30 days, would you say you limited your usual activities due to asthma not at all, a little, a moderate amount, or a lot?
Sleep disturbance	4.3	During the past 30 days, on how many days did symptoms of asthma make it difficult for you to stay asleep?
Missed work	5.8a	During the past 12 months, how many days were you unable to work or carry out your usual activities because of your asthma?
Cost-related challenges	9.1	Was there a time in the past 12 months when you needed to see your primary care doctor for your asthma but could not because of the cost?
Cost-related challenges	9.2	Was there a time in the past 12 months when you were referred to a specialist for asthma care but could not go because of the cost?
Cost-related challenges	9.3	Was there a time in the past 12 months when you needed to buy medication for your asthma but could not because of the cost?
Healthcare use	5.1	During the past 12 months, how many times did you see a doctor or other health professional for a routine checkup for your asthma?
Healthcare use	5.3	During the past 12 months, how many times did you visit an emergency room or urgent care center because of your asthma?
Healthcare use	5.4	During the past 12 months, how many times did you see a doctor or other health professional for urgent treatment of worsening asthma symptoms or for an asthma episode or attack?
Healthcare use	5.6a	During the past 12 months, how many different times did you stay in any hospital overnight or longer because of your asthma?
Environmental triggers	7.12	In the past week, has anyone smoked inside your home?
Environmental triggers	7.1	Is an air cleaner or purifier regularly used inside your home?
Environmental triggers	7.14	Do you use a mattress cover that is made especially for controlling dust mites?
Environmental triggers	7.15	Do you use a pillow cover that is made especially for controlling dust mites?
Environmental triggers	7.8	In the past 30 days, has anyone seen a cockroach inside your home?
Environmental triggers	7.9	In the past 30 days, has anyone seen mice or rats inside your home? Do not include mice or rats kept as pets.
Environmental triggers	7.6	Does your household have pets such as dogs, cats, hamsters, birds or other feathered or furry pets that spend time indoors?
Environmental triggers	7.7	Are pets allowed in your bedroom?
Environmental triggers	7.5	In the past 30 days, has anyone seen or smelled mold or a musty odor inside your home? Do not include mold on food.
Environmental triggers	7.10	Is a wood burning fireplace or wood burning stove used in your home?
Severe asthma	Prologue	Use of pill corticosteroids

Study sample

In Nevada, 375 individuals who completed the 2017 core BRFSS questionnaire indicated they have currently diagnosed asthma, with 3,369 reporting they had not been told they have current asthma. Additionally, 516 people indicated they have ever been told they have diagnosed asthma, while 3,237 responded that they have never been told they have asthma (CDC, 2018c). According to the CDC BRFSS website, all respondents were included in the denominator excluding those who responded they did not know, refused to answer the question, or the answer was missing (CDC, 2018c). Of this group, 178 individuals who reported ever being diagnosed with asthma (34% of the 516 who indicated lifetime asthma on the BRFSS core questionnaire) agreed to be called back and completed the ACBS in Nevada.

Statistical Analysis

To address the research questions and objectives, this study evaluated data from BRFSS using the BRFSS Web Enabled Analysis Tool (WEAT) to analyze associations between asthma and depression measures using multiple logistic regression. The WEAT is a free tool available on the BRFSS website that allows users to create a multiple logistic regression model for specified locations, years, and variables using BRFSS data, without use of additional statistical software. Data are weighted to reflect the nature of the probability sampling when using the WEAT. ACBS data were evaluated using frequency tables to explore descriptive statistics and SPSS was used to complete correlation analyses between quality of life indicators and quality of life risk factors.

In the first part of the analysis, a multiple logistic regression model was created with the binary independent variable of asthma presence, either current asthma or lifetime asthma, as the main predictor for depression (presence or absence). The model was created first for current asthma and subsequently for lifetime asthma. A block approach was employed using BRFSS data to understand the independent contribution of demographic, behavioral, and comorbid disease factors (Victora, Huttly, Fuchs, & Olinto, 1997).

The second research question was descriptive in nature providing frequencies to identify the possible measures that could impact quality of life among those living with asthma. For example, if those with asthma presence may have an association with self-reported depression, it guides the next question to ask what factors specifically are contributing towards the depression.

In the second part of the study, a descriptive analysis was completed using ACBS data to further identify the presence of factors that may affect quality of life among a smaller subset of respondents who agreed to take a follow-up survey. Survey responses from the ACBS, rather than a quality of life scale, included multiple measures that may describe quality of life indicators or quality of life risk factors, and these questions may be found in Table 1. These measures were used to create frequency tables for quality of life-related variables including depression, asthma triggers, activity limitation, sleep disturbance, missed work days, cost-related challenges, healthcare utilization, and severe asthma as indicated by use of an oral corticosteroid.

To address research question 2a, correlations between quality of life indicators and quality of life risk factors were performed among the subsample of those with asthma presence on the ACBS. For only this part of the analysis, respondents who indicated they did not know the

answer to the question or those who did not complete the question were excluded. Only those who indicated current asthma symptoms during the duration of the question asked were included.

First, correlation analysis was completed between quality of life indicators including depression, activity limitation, sleep disturbance, missed work, healthcare use, and asthma severity and the risk factor of asthma trigger exposure. A single continuous variable for the quality of life risk factor of asthma triggers representing the total number of triggers per person was created and used for this analysis. Spearman's nonparametric correlation was used due to the limited range. Based on the inclusion criteria, the sample size for this correlation analysis was 80 individuals who completed the ACBS.

Second, correlation analysis was completed between quality of life indicators including depression, activity limitation, sleep disturbance, missed work, healthcare use, and asthma severity and the quality of life risk factor of cost-related challenge, including the inability to see a doctor or specialist for asthma due to cost and the inability to afford asthma medication. The three cost-related measures were binary and the other variable types and correlations tests selected may be found in Table 2. Based on the inclusion criteria, the sample size for this correlation analysis was 82 individuals who completed the ACBS.

Table 2*Quality of Life and Cost-Related Measures Correlation Test Selection*

Variable(s)	Variable Type	Correlation Test Selected
Depression	Binary	Phi Coefficient (ϕ)
Activity Limitation	Categorical	Kendall's Tau (τ)
Sleep Disturbance	Continuous	Point Biserial (r_{pb})
Missed Work/Activities	Continuous	Point Biserial (r_{pb})
Healthcare Use Measures	Continuous	Point Biserial (r_{pb})
Oral Corticosteroid Use	Binary	Spearman's Rho (ρ)*

*Selected based on the small sample size

Covariates

The model created for the first section of this thesis, evaluating the relationship between diagnosed asthma and depression measures among adults in Nevada, included covariates using blocking. The blocking method grouped variables that may be aligned with each other by theme in each block (Victora, Huttly, Fuchs, & Olinto, 1997). Three levels of covariate blocking associated with depression were included in the model. Block 1 included demographic variables, including age, sex, and education level. Block 2 included behavioral variables that result from individual choice, including physical activity, tobacco use, and alcohol use. Block 3 included comorbid disease factors that an individual may experience, including obesity. Previous studies indicated these independent factors might be associated with depression so were included as covariates in this study (Brunner, et al., 2014; Connor, et al., 2009; Luppino, et al., 2010). Included covariates may be found in Table 3, which lists the associated self-reported BRFSS

variable, categorizations, as well as each variable’s assigned block. The model was run using the WEAT independently by block to understand each variable’s individual contribution towards the dependent variable (Victora, Huttly, Fuchs, & Olinto, 1997). Significant variables from each block were then used to create a final adjusted model in order to produce the most parsimonious model.

Table 3

Covariate BRFSS Variables and Categories

Block	Covariate	BRFSS Variable*	Categories
Demographic	Age	Calculated variable for 4-level imputed age	18-24, 25-44, 45-64, 65+
Demographic	Sex	Sex	Male, female
Demographic	Education level	Calculated variable for level of education completed	Did not graduate high school, high school graduate, attended college or technical school, college or technical school graduate
Behavioral	Physical activity	Calculated variable for adults who met aerobic and strengthening guidelines	Met both guidelines, met aerobic guidelines only, met strengthening guidelines only, did not meet either guideline**
Behavioral	Tobacco use	Calculated variable for adults who are current smokers	Current smoker, former smoker or never smoked
Behavioral	Alcohol use	Calculated variable for heavy drinkers, men having >14 drinks per week and women having >7 drinks per week	Yes, no
Comorbid disease	Obesity	Calculated variable for body mass index	Underweight, normal weight, overweight, obese***

*BRFSS variables as included in the BRFSS WEAT (CDC, n.d.)

**According to the U.S. Department of Health and Human Services Physical Activity Guidelines for Americans, 2nd edition (2018), physical activity guidelines include at least 150 minutes of moderate exercise or 75 minutes of vigorous exercise per week and strengthening activities two or more days per week (U.S. Department of Health Human Services, 2018)

***Underweight (BMI <18.5), normal weight (BMI 18.5 to <25), overweight (BMI 25 to <30), obese (BMI >30) (CDC, 2020c)

First, a model was created evaluating the association between current asthma and depression, taking into consideration covariates. Based on the results from each of the three covariate blocks for demographic variables, behavioral variables, and comorbid disease variables (tables may be found in Appendix C), the sex, tobacco use, alcohol use, and obesity variables were found to have significant results in at least one category. These variables were used to build the final adjusted model, with results in Table 5, which analyzes the association between those with current asthma and those who have ever been told they have depression, considering these covariates.

Second, a model was created evaluating the association between lifetime asthma and depression, taking into consideration covariates. Based on the results from each of the three covariate blocks for demographic variables, behavioral variables, and comorbid disease variables (tables may be found in Appendix C), the sex, physical activity, tobacco use, and obesity variables were found to have significant results in at least one category. These variables were used to build the final adjusted model, with results in Table 6, which analyzes the association between those with lifetime asthma and those who have ever been told they have depression, considering covariates.

Results

The relationship between asthma and depression measures among adults in Nevada

Table 4 provides an overview of demographic information about the 2017 BRFSS population in the state of Nevada.

Table 4

2017 Nevada BRFSS Demographics

Variable	N (%)
Age	
18-24	228 (11.3%)
25-34	401 (18.1%)
35-44	420 (17.3%)
45-54	565 (17%)
55-64	746 (16.1%)
65+	1,404 (20.2%)
Sex	
Male	1,667 (49.8%)
Female	2,097 (50.2%)
Educational Attainment	
Less than high school	314 (15.3%)
High school or GED	926 (29.3%)
Some post-high school	1,277 (34.6%)
College+	1,233 (20.9%)
Race	
White, non-Hispanic	2,668 (53.5%)
Black, non-Hispanic	176 (8.5%)
Hispanic	576 (24.8%)
American Indian or Alaska Native, non-Hispanic	59 (1.3%)
Asian, non-Hispanic	107 (8.6%)
Native Hawaiian or other Pacific Islander, non-Hispanic	26 (0.8%)
Other race, non-Hispanic	34 (0.6%)
Multiracial, non-Hispanic	118 (1.9%)

Employment Status	
Employed	1,397 (48%)
Self-employed	328 (8.9%)
No work <year	74 (2.5%)
No work >year	87 (2.6%)
Homemaker	209 (7.6%)
Student	95 (4.9%)
Retired	1309 (20.3%)
Unable to work	234 (5.4%)

Table 5 below is the final adjusted model for current asthma and depression.

Table 5*The Association between Adults with Current Asthma and Depression in Nevada*

	N	P-Value	Odds Ratio	95% Confidence Interval
Asthma				
No*	2,990	-	1.00	(1.00-1.00)
Yes	339	<0.0001	3.22	(2.26-4.58)
Sex				
Male*	1,519	-	1.00	(1.00-1.00)
Female	1,810	<0.0001	1.79	(1.34-2.39)
Tobacco Use				
Former smoker or never smoked*	2,805	-	1.00	(1.00-1.00)
Current smoker	524	<0.0001	2.17	(1.58-2.97)
Alcohol Use				
No*	3,079	-	1.00	(1.00-1.00)
Yes	250	0.0471	1.72	(1.01-2.94)
Obesity				
Underweight	62	0.7212	.82	(0.28-2.44)
Normal weight*	1,134	-	1.00	(1.00-1.00)
Overweight	1,279	0.5638	1.11	(0.78-1.59)
Obese	863	0.0094	1.60	(1.12-2.28)
Model	3,329	<0.0001	-	-

*Reference variable

After adjustment for relevant covariates, those with current asthma were 3.22 times as likely (95% CI: 2.26-4.58) to be depressed compared to those without current asthma. Other factors in the model significantly associated with depression included female sex, obesity, current smoking, and alcohol use (Table 5).

Table 6 below is the final adjusted model for lifetime asthma and depression.

Table 6*The Association between Adults with Lifetime Asthma and Depression in Nevada*

	N	P-Value	Odds Ratio	95% Confidence Interval
Asthma				
No*	2,747	-	1.00	(1.00-1.00)
Yes	433	<0.0001	2.60	(1.88-3.61)
Sex				
Male*	1,469	-	1.00	(1.00-1.00)
Female	1,711	0.0001	1.78	(1.32-2.40)
Physical Activity				
Met both guidelines*	739	-	1.00	(1.00-1.00)
Met aerobic guidelines only	982	.7818	1.06	(0.70-1.60)
Met strengthening guidelines only	296	0.0723	1.65	(0.96-2.85)
Did not meet either guideline	1,163	0.1036	1.38	(0.94-2.03)
Tobacco Use				
Former smoker or never smoked*	2,677	-	1.00	(1.00-1.00)
Current smoker	503	<0.0001	2.12	(1.52-2.97)
Obesity				
Underweight	58	0.8200	0.89	(0.31-2.53)
Normal weight*	1,070	-	1.00	(1.00-1.00)
Overweight	1,220	0.3463	1.19	(0.82-1.72)
Obese	832	0.0063	1.67	(1.16-2.41)
Model	3,180	<0.0001	-	-

*Reference variable

Based on the adjusted model, those with lifetime asthma were 2.6 times as likely (95% CI: 1.88-3.61) to be depressed when compared to those without a lifetime asthma diagnosis. Female sex, current smoking, and obesity were also significantly associated with self-reported depression in the model (Table 6).

By way of comparison, the crude relationships between asthma and depression were run without covariates. The association between current asthma and depression had an odds ratio of 3.36 ($p < .0001$, 95% CI: 2.39-4.73) and the association between lifetime asthma and depression had an odds ratio of 3.05 ($p < .0001$, 95% CI: 2.24-4.15). The odds ratio for the association between current asthma and depression was very similar with and without covariates in the model, while the odds ratio before adjustment for lifetime asthma was higher than after adjustment.

Based on the 2017 BRFSS sample, the null hypothesis that there was no association between self-reported asthma status and depression among adult Nevadans was rejected. It can be concluded there was an association between self-reported asthma status and depression among adult Nevadans, among both those with current asthma and those with lifetime asthma. These findings were significant after adjustment for relevant covariates.

Quality of Life Factors Affecting Adult Nevadans with Asthma

The objective of the second part of this study was to complete a sub-analysis of quality of life indicators and quality of life risk factors affecting adult Nevadans with asthma to include, based on past literature, depression, activity limitation, sleep disturbance, missed work days, cost-related challenges, healthcare utilization, asthma triggers, and asthma severity. ACBS data were evaluated, which included 178 adult Nevadans with asthma. Of this group, 142 (80%)

respondents reported active asthma status, with inactive asthma reported by 36 (20%). All participants included were adults over the age of 18, and a breakdown of ages may be found in Table 7. The mean age was 57.43, with a median age was 62, and the mode age was 64. Of those who participated in the ACBS, 52 were employed full-time (29.2%), 15 were employed part-time (8.4%), and 111 were not employed (62.3%). Sex, educational attainment, and race were not available in the ACBS data provided.

Table 7

Asthma Call-Back Survey Age Distribution

Age range	Frequency	Percent
18-24	8	4.5%
25-34	12	7.7%
35-44	16	9%
45-54	27	15.2%
55-64	47	26.4%
65-74	48	27%
75+	20	11.2%

Of the ACBS sample, 38% (n=68) of individuals surveyed indicated they had been told they are depressed, meeting the definition of having depression in Table A1. Of ACBS respondents, 31% (n=55) indicated missing one or more days of work due to their asthma, meeting the definition in Table A1. Of those with current asthma, the mean missed work days or activities was 14.1 (Table 8). Among participants, 5% (n=9) reported use of oral corticosteroids indicating severe asthma, meeting the definition of severe asthma as defined in Table A1. By

contrast, 17 individuals (9.6%) report never using asthma medication (including a prescription inhaler, pills, syrup, nor a nebulizer), possibly indicating least severe asthma.

Additionally, 22% (n=39) of respondents indicated their physical activity was a little limited, 12% (n=21) responded that their physical activity was limited a moderate amount, and 6.7% (n=12) answered that their physical activity was limited a lot. Overall, 40% (n=72) of respondents indicated having at least some (a little, a moderate amount, or a lot) activity limitation due to their asthma in the previous 30 days, meeting the definition for physical activity limitation in Table A1.

In response to the ACBS, 26% (n=46) of respondents surveyed indicated having one or more days or nights during which it was difficult for them to sleep due to their asthma symptoms, meeting the definition of sleep disturbance in Table A1. The mean nights of sleep disturbance among those with current asthma was 5.54 (Table 8).

Table 8
Quality of Life Variables among Adult Nevadans with Current Asthma Summary

Variable	Mean Days	Standard Deviation
Sleep Disturbance due to Asthma in the Past 30 Days	5.54	9.32
Missed Work or Activities due to Asthma in the Past 12 Months	14.1	45.53
Healthcare Use		
Asthma Checkup Frequency during the Past 12 Months	6.67	13.68
Emergency Room or Urgent Care Center Visit Frequency due to Asthma during the Past 12 Months	1.46	5.97
Urgent Treatment Visit Frequency due to Asthma during the Past 12 Months	2.48	9.42
Hospital Stay Frequency due to Asthma during the Past 12 Months	.44	3.21

In response to questions about cost-related challenges, of those surveyed, 8.4% (n=15) indicated that they were unable to see their primary care doctor for asthma because of cost, 5.6% (n=10) responded that they were unable to see a specialist for their asthma because of cost, and 14.6% (n=26) were unable to buy asthma medication because of the cost. Thirty-five individuals (20%) indicated cost as a burden in one or more cost-related questions, meeting the definition of having cost-related challenges in Table A1 as a risk factor for lower quality of life. Responses to these questions may be found in Table 9.

Table 9

Cost-Related Challenges among Adult Nevadans with Asthma

Asthma Call-Back Survey Question*	Yes (%)	No (%)	No Current Asthma	Don't Know
Was there a time in the past 12 months when you needed to see your primary care doctor for your asthma but could not because of the cost?	15 (8%)	129 (72%)	33 (18.54%)	1 (0.56%)
Was there a time in the past 12 months when you were referred to a specialist for asthma care but could not go because of the cost?	10 (6%)	134 (75%)	33 (18.54%)	1 (0.56%)
Was there a time in the past 12 months when you needed to buy medication for your asthma but could not because of the cost?	26 (15%)	119 (67%)	33 (18.54%)	0

*Questions from the Nevada 2017 BRFSS ACBS (Nevada State Health Division, Division of Public and Behavioral Health, 2019)

Four ACBS questions were evaluated to better understand health care use among respondents, which can be found in Table 1. Based on these responses, over the last 12 months, 44% (n=79) of individuals reported seeing a doctor or other health professional for a routine asthma checkup, 13% (n=24) indicated visiting an emergency room or urgent care center due to their asthma, 36% (n=28) reported seeing a doctor or other health professional for urgent treatment of worsening asthma symptoms or for an asthma attack, and only 3% (n=5) reported

staying overnight in the hospital one or more times. Overall, 58 individuals (33%) indicated health care use due to asthma in the past 12 months in one or more of these ways, meeting the definition of health care usage listed in Table A1. Summary details for those with current asthma may be found in Table 8, and Table A8 (Appendix D) provides frequency details.

Among ACBS questions, 10 questions asked about possible environmental asthma triggers highlighted in the literature and discussed above. Of the 178 ACBS participants, 171 (96%) individuals reported exposure to at least one environmental trigger, meeting the definition in Table A1. Respondents reported exposure to 1.74 environmental triggers on average (standard deviation=1.24), including mold, pets in the home and in the bedroom, cockroaches, rodents, wood smoke, and tobacco smoke. They reported 3.84 exposures on average (standard deviation=1.65) when also including no use of preventative measures such as an air cleaner or purifier, mattress cover, or pillow cover. Respondents indicated use of preventive measures, including an air cleaner or purifier, mattress cover, or pillow cover, a mean of 0.876 times (standard deviation=1.00).

Of the ACBS population, 7 individuals reported exposure to one environmental trigger (3.9%), 20 reported exposure to two triggers (11.2%), 49 reported exposure to three triggers (27.5%), 28 reported exposure to 4 triggers (15.7%), 38 reported exposure to 5 triggers (21.3%), 20 reported exposure to 6 triggers (11.2%), 7 reported exposure to 7 triggers (3.9%), and 2 reported exposure to 8 triggers (1.1%). No individuals reported exposure to 9 or 10 of these environmental triggers in their homes. Overall, 144 (81%) reported exposure to three or more environmental triggers. The most common environmental trigger reported with 120 (67%) respondents was having pets in the home. Table 10 outlines the prevalence of environmental triggers within the homes of Nevadans with asthma who participated in the ACBS.

Table 10*Asthma Call-Back Survey Home Environmental Trigger Frequency among Adult Nevadans with Asthma*

Question*	Yes (%)	No (%)	Don't know (%)
Is an air cleaner or purifier regularly used inside your home?	43 (24.16%)	133 (74.72%)	2 (1.12%)
In the past 30 days, has anyone seen or smelled mold or a musty odor inside your home? Do not include mold on food.	11 (6.18%)	167 (93.82%)	-
Does your household have pets such as dogs, cats, hamsters, birds or other feathered or furry pets that spend time indoors?	120 (67.42%)	58 (32.58%)	-
Are pets allowed in your bedroom?	106 (59.60%)**	72 (40.45%***)	-
In the past 30 days, has anyone seen a cockroach inside your home?	12 (6.74%)	166 (93.26%)	-
In the past 30 days, has anyone seen mice or rats inside your home? Do not include mice or rats kept as pets.	9 (5.06%)	169 (94.94%)	-
Is a wood burning fireplace or wood burning stove used in your home?	28 (15.73%)	150 (84.27%)	-
In the past week, has anyone smoked inside your home?	24 (13.48%)	154 (86.52%)	-
Do you use a mattress cover that is made especially for controlling dust mites?	63 (35.39%)	112 (62.92%)	3 (1.69%)
Do you use a pillow cover that is made especially for controlling dust mites?	50 (28.09%)	125 (70.22%)	3 (1.69%)

*Questions from the Nevada 2017 BRFSS ACBS (Nevada State Health Division, Division of Public and Behavioral Health, 2019)

**Includes answer yes and answer some are/some aren't

***58 respondents have no pets and are included in the no category

Correlations between the quality of life variables and the environmental trigger quality of life risk factor are included in Table 11. None of these correlations were found to be significant.

Table 11*Quality of Life Variable and Environmental Triggers Correlations*

Quality of Life Variable	Environmental Trigger Exposure
Depression	p=-.049
Activity Limitation	p=-.072
Night Symptoms	p=-.116
Missed Work/Activities	p=-.010
Routine Checkups	p=-.114
ER/Urgent Care Visits	p=-.037
Urgent Healthcare Visits	p=-.011
Hospital Stays	p=.072
Oral Corticosteroid Use	p=.096

*Significant correlation found ($p < .05$)

Correlations between the quality of life variables and the cost-related quality of life risk factors are included in Table 12. Significant correlations were found between depression and cost as a barrier to seeing a primary care doctor and a specialist. A significant negative correlation was found between missed work and activities and cost as a barrier to affording medication. Finally, a significant negative correlation was found between use of oral corticosteroids and all three cost-related measures.

Table 12*Quality of Life Variable and Cost-Related Measures Correlations*

Quality of Life Variable	Cost Barrier: Primary Care Visit	Cost Barrier: Specialist Visit	Cost Barrier: Medication
Depression	$\phi = .326$ $p=.003^*$	$\phi = .354$ $p=.001^*$	$\phi = .084$ $p=.447$
Activity Limitation	$\tau = -.045$ $p=.666$	$\tau = -.061$ $p=.562$	$\tau = -.196$ $p=.061$
Sleep Disturbance	$r_{pb} = -.046$ $p=.680$	$r_{pb} = -.021$ $p=.850$	$r_{pb} = -.152$ $p=.172$
Missed Work/Activities	$r_{pb} = -.041$ $p=.716$	$r_{pb} = -.026$ $p=.814$	$r_{pb} = -.234$ $p=.035^*$
Routine Checkups	$r_{pb} = .053$ $p=.634$	$r_{pb} = .070$ $p=.531$	$r_{pb} = .006$ $p=.955$
Emergency Room or Urgent Care Visits	$r_{pb} = .009$ $p=.937$	$r_{pb} = .024$ $p=.831$	$r_{pb} = -.194$ $p=.081$
Urgent Healthcare Visits	$r_{pb} = .031$ $p=.782$	$r_{pb} = .052$ $p=.645$	$r_{pb} = -.182$ $p=.101$
Hospital Stays	$r_{pb} = .040$ $p=.724$	$r_{pb} = .043$ $p=.701$	$r_{pb} = -.166$ $p=.135$
Oral Corticosteroid Use	$\rho = -.375$ $p=.001^*$	$\rho = -.335$ $p=.002^*$	$\rho = -.473$ $p<.001^*$

*Significant correlation found ($p<.05$)

In all, based on the 178 ACBS responses of adults in Nevada with asthma, 38% (n=68) of individuals surveyed indicated depression, 40% (n=72) of respondents indicated having at least some level of activity limitation due to their asthma, 26% (n=46) of respondents reported having one or more days or nights during which it was difficult for them to sleep due to their asthma symptoms, 31% (n=55) of respondents indicated missing one or more days of work or activities due to their asthma, 20% (n=35) indicated cost as a burden in at least one cost-related question, 33% (n=58) indicated healthcare usage due to asthma, 96% (n=171) had exposure to one or more environmental triggers, most commonly having pets in the home and in the bedroom, with 81% (n=144) reporting exposure to three or more environmental triggers, and 5% (n=9) reported using oral corticosteroids, indicating severe asthma. There was a significant correlation found between six quality of life indicators and cost-related measures, and there were no significant correlations found between the quality of life variables and the environmental trigger exposure

measure. Based on this sample, the null hypothesis that there would be minimal factors affecting quality of life among adult Nevadans with asthma presence is rejected. It can be concluded that there were multiple factors affecting quality of life among adult Nevadans with asthma presence.

Discussion

The objective of this study was two-fold. First to evaluate the association between asthma and depression among adult Nevadans and then to explore quality of life factors affecting adult Nevadans with asthma. These findings within Nevada for the association between asthma and depression are consistent with those found in the literature for other geographies (Brunner, et al., 2014; Gao, et al., 2015). Better understanding this association is particularly important in Nevada given the higher rates of asthma in the state than in the US and the dry hot climate that makes Nevadans in the southern part of the state, where most of the population resides, more susceptible to asthma (Asthma and Allergy Foundation of America, 2017). Given the public health burden of both asthma and depression, better understanding the relationship between the two can help develop effective treatments and improve outcomes.

All quality of life indicators and quality of life risk factors explored were found to be present among adult Nevadans with asthma. The literature discusses that these factors reduce quality of life for those with asthma. Finding these variables present among adults with asthma in Nevada indicates quality of life challenges for this population in the state. Presence of quality of life indicators may contribute to higher levels of depression as underlying variables.

The high level of depression among those with asthma in Nevada reported on the ACBS (38%) was notable, particularly when compared to the average level in the US. By comparison, in the US in 2017, 7.1% of individuals experienced one or more major episodes of depression (National Institute of Mental Health, 2019). These results are consistent with the association found between asthma and depression among adult Nevadans in the first part of this study. For

those with asthma, depression and anxiety are associated with poorer asthma control and lower quality of life (Lavoie, et al., 2005).

Additionally, the high level of activity limitation (40%) among adults with asthma in Nevada is concerning as it may cause lower quality of life on its own and is associated with depression and obesity, also negatively affecting quality of life (Stanescu, et al., 2019). Activity limitations may exacerbate the high level of depression already seen among those with asthma. The combination of these factors may reduce quality of life more than just one on its own.

Of the asthma triggers discussed, by far the most common was having a pet in the home, which was reported by 120 (67%) individuals, along with individuals with pets allowing the pets into their bedroom. This was followed by use of a wood burning fireplace or wood burning stove in the home with 28 (16%) respondents reporting exposure to this asthma trigger. Given that most of the population in Nevada lives in the southern part of the state, which has a warm climate, this exposure might be more common in the northern part of the state. The next most common asthma trigger reported in the ACBS was smoking in the home with 24 (13%) respondents reporting this exposure.

There was a high percentage (96%) of adult Nevadans with asthma who had exposure to at least one environmental trigger. Beyond that, 81% (n=144) of individuals reported exposure to three or more triggers inside the home. On average, respondents reported exposure to 1.7 triggers and using less than one preventative measure such as an air cleaner or purifier, mattress cover, or pillow cover. Low use of preventative measures to protect against environmental triggers may cause unnecessary exposure and increase asthma attacks, lowering quality of life.

Avoiding asthma triggers may help decrease exacerbations and increase patients' quality of life, but a high proportion of adult Nevadans with asthma are exposed to triggers (Luskin, et al., 2014). Exposure to asthma triggers may cause exacerbations and attacks, possibly increasing healthcare utilization and missed work days, both lowering quality of life. Juniper, et al. (1992) discussed asthma-related quality of life factors as including those related to work, social, physical, and emotional health. Adults Nevadans with asthma experience issues that fall into each of these categories, negatively affecting the quality of their lives. The presence of quality of life-related variables affecting adult Nevadans with asthma may contribute as underlying factors to the higher rates of depression seen among this group, though more research is needed in this area.

Correlations were found between select quality of life variables and cost-related quality of life risk factors. Depression was significantly positively correlated with reporting cost as a barrier to seeing primary care doctors and specialists. Those who are unable to seek care for their asthma may have more negative feelings about their circumstances or asthma presence contributing to underlying depression.

Oral corticosteroid use was significantly negatively correlated with reporting cost as a barrier to seeing primary care doctors and specialists and reporting cost as a barrier to affording medication. Oral corticosteroids, such as prednisone, are relatively inexpensive when compared to other types of asthma medications like inhalers, which may help explain this relationship. Interestingly, missing work and activities was also negatively correlated with reporting cost as a barrier to affording medications. Those who are missing work and activities may have more severe asthma, causing these disruptions to daily life. Using medications such as oral

corticosteroids, which are typically less expensive than other types of asthma medications, may mean that medication cost is less burdensome than for some other groups.

A significant correlation between quality of life variables and the environmental trigger exposure variable was not found in this analysis. The literature indicates that trigger exposure lowers quality of life, so it may do so in different ways than the variables explored for this analysis. A correlation analysis between each quality of life indicator and each environmental trigger might yield different results, so more research is needed in this area.

Public Health Impact

The higher rates of depression among adults with asthma in Nevada, when compared to those without asthma, and the quality of life factors experienced by adult Nevadans with asthma, have public health implications. Both depression and asthma carry a public health burden. Reducing rates of one could potentially help reduce rates of the other in Nevada, given their association. Knowing the relationship between asthma and depression, depression screening could be incorporated into asthma treatment to ensure that if depression is present it can also be treated. This would not only treat the depression but may also make the asthma treatment more effective, as depression may lead to poor asthma control and low medication adherence, increasing symptoms (Brunner, et al., 2014).

Additionally, in the second part of this analysis, depression was found to be significantly positively correlated with reporting cost as a barrier to seeing primary care doctors and specialists. Cost-related challenges may be a risk factor for decreasing quality of life among those with depression, and could be included as a topic of conversation during healthcare visits

for educational purposes and to provide information on available resources to help patients manage costs.

Reducing asthma prevalence could improve quality of life. For example, a reduction in asthma rates could increase productivity through fewer days of missed work, which would be beneficial to both the individual with asthma and to the community. Alternatively, a reduction in asthma rates could reduce healthcare utilization, possibly reducing cost for the individual and for the healthcare system more broadly. The interrelationships between these variables should be taken into consideration in asthma treatment.

Quality of life factors over which individuals may have some control, such as exposure to environmental triggers, could be reduced through educational campaigns and preventive conversations with health care providers. This could reduce asthma attacks or exacerbations, improve individual quality of life, and reduce healthcare use and costs, also improving quality of life. For example, when looking at use of items that prevent environmental triggers such as air purifiers, mattress covers, and pillow covers, most respondents indicate using none of these. Education about these options could increase rates of use, decrease exposure to asthma triggers, and increase quality of life. The most common environmental trigger reported in the ACBS was having a pet in the home. Education about the effect of having a pet in the home on someone with asthma, and having a pet in their bedroom, could help reduce these triggers and improve quality of life.

In addition to education about asthma triggers, exposure to smoking could be reduced by policy changes. Smoke in the home was the next most common asthma trigger exposure reported in the ACBS. While it would be challenging to pass legislation to prevent smoking in residences,

smoke-free laws such as the Nevada Clean Indoor Air Act of 2006, which restricted smoking in indoor public places in the state, could help reduce asthma triggers in public places outside the home (Southern Nevada Health District, 2020). Smoking cessation campaigns could also help reduce tobacco use more generally and thus reduce smoking in homes, lowering asthma triggers and increasing quality of life for those with asthma.

Beyond addressing triggers, Nevada passed a law in 2019 (Senate Bill 262) to increase transparency in the price of asthma drug costs through tracking and reporting. It required companies to publish prices each year. While not reducing costs directly, the goal was to increase information and data availability on medication costs to aid in reducing those costs (Lochhead, 2019). Given the prevalence (20%) of those with asthma in Nevada who report cost-related challenges on the ACBS, and the quality of life impact related to these challenges, legislation such as this could increase quality of life for those with asthma. However, this work should focus on asthma medications other than oral corticosteroids, since a negative correlation was found between use of oral corticosteroids and finding cost as a barrier to affording medications.

Asthma treatment objectives were included in the State of Nevada's Healthy Nevadans 2020 goals with the plan to reduce symptoms, maintain healthy lungs, prevent interference with activities, and reduce attacks, among others (Healthwise, 2020). The findings from this study underscore the prevalence of asthma's interference with daily life, reducing work days and sleep disturbance for example, related to lower quality of life. Additionally, reductions in environmental triggers, to which the majority of people with asthma are exposed, can reduce attacks. Goals such as these bring more awareness to asthma and asthma-related challenges, helping increase education.

Based on the results from this study, future research should include additional studies on the temporal nature of the association between asthma and depression. In addition, work further evaluating quality of life variables, asthma, and depression would be valuable, as well as a study comparing rates of quality of life variable prevalence among populations with and without asthma.

Study Strengths

This was the first study to the author's knowledge addressing the association between asthma and depression among adult Nevadans. As the rates for adults living with diagnosed asthma in Nevada are higher than the nation, this population provided an ideal platform to address this study. In addition, multiple measures that may describe quality of life for a subsample of adults with diagnosed asthma were available, allowing for a descriptive analysis of indicators present among this population. This is a useful addition to a gap in the literature, as the potential causes of depression among adults living with asthma may be less known or understood.

Limitations

Limitations for this study included the cross-sectional design of the BRFSS and ACBS, which collect data for only one point in time. The temporal nature of relationships was unable to be addressed with cross-sectional data. The ACBS provides a relatively small sample size and selection bias was likely as those who agreed to be called back may not be representative of the whole adult population in Nevada with asthma. Both the BRFSS and ACBS data were only representative of diagnosed current and lifetime asthma, not all asthma. Additionally, the BRFSS does not differentiate between major versus minor depression or asthma severity, which may

limit a nuanced understanding between the two. There may have been survivorship bias, as the BRFSS sample was older on average than the ACBS sample. Lastly, all measures were self-reported by adult participants. While there are limitations to this study, the findings add to the body of knowledge about asthma, depression, and underlying quality of life indicators among adults with asthma in Nevada.

Conclusion

The purpose of this study was to explore the association between asthma and depression among adult Nevadans and evaluate the prevalence of key quality of life factors among adult Nevadans living with asthma. Using data from the BRFSS and the BRFSS ACBS in Nevada, this study found an association between diagnosed asthma and depression for adults in Nevada who report having current or lifetime asthma considering relevant covariates. Descriptive statistics were explored for those with asthma in Nevada and variables were present affecting quality of life, including depression, activity limitation, sleep disturbance, missed work days, cost-related challenges, healthcare usage, exposure to environmental triggers, and severe asthma as indicated by use of oral corticosteroids. Asthma presence was associated with depression and negatively affects quality of life among adult Nevadans. This study contributes to the literature, as it is the first to the author's knowledge that evaluates the association between asthma and depression in Nevada and looks at quality of life variables among those with asthma in the state. This is particularly important as Nevada has higher rates of asthma than the US and a climate conducive to asthma where the majority of the population resides. A public health approach including asthma education and clinical outreach is critical in order to reduce the impact of asthma on mental health and quality of life. Further research is needed on the temporal nature of the relationships between asthma, depression, and quality of life variables.

Appendices

Appendix A: Internal Review Board Exclusion



UNLV Biomedical IRB - Administrative Review Notice of Excluded Activity

DATE: November 13, 2020

TO: Sheniz Moonie, PhD, MS
FROM: UNLV Biomedical IRB

PROTOCOL TITLE: [1683695-1] DEPRESSION AND QUALITY OF LIFE IMPACT AMONG
ADULTS WITH ASTHMA PRESENCE IN NEVADA

SUBMISSION TYPE: New Project

ACTION: EXCLUDED - NOT HUMAN SUBJECTS RESEARCH
REVIEW DATE: November 13, 2020
REVIEW TYPE: Administrative Review

Thank you for your submission of New Project materials for this protocol. This memorandum is notification that the protocol referenced above has been reviewed as indicated in Federal regulatory statutes 45CFR46.

The UNLV Biomedical IRB has determined this protocol does not meet the definition of human subjects research under the purview of the IRB according to federal regulations. It is not in need of further review or approval by the IRB.

We will retain a copy of this correspondence with our records.

Any changes to the excluded activity may cause this protocol to require a different level of IRB review. Should any changes need to be made, please submit a Modification Form.

If you have questions, please contact the Office of Research Integrity - Human Subjects at IRB@unlv.edu or call 702-895-2794. Please include your protocol title and IRBNet ID in all correspondence.

Office of Research Integrity - Human Subjects
4505 Maryland Parkway . Box 451047 . Las Vegas, Nevada 89154-1047
(702) 895-2794 . FAX: (702) 895-0805 . IRB@unlv.edu

Appendix B: A Selection of Quality of Life Variable Definitions

Table A1

Selection of Quality of Life Variable Definitions

Variable	Definition*
Depression	Answering yes to “have you ever been told by a doctor or other health professional that you were depressed?” on the ACBS
Activity limitation	On the ACBS answering a little, a moderate amount, or a lot to the question “during just the past 30 days, would you say you limited your usual activities due to asthma not at all, a little, a moderate amount, or a lot?”
Sleep disturbance	Indicating any number of days to the following question on the ACBS “during the past 30 days, on how many days did symptoms of asthma make it difficult for you to stay asleep?”
Missed work	Indicating any number of days to the following question on the ACBS “during the past 12 months, how many days were you unable to work or carry out your usual activities because of your asthma?”
Cost-related challenges	Answering yes to any of the following questions on the ACBS “was there a time in the past 12 months when you needed to see your primary care doctor for your asthma but could not because of the cost?” or “was there a time in the past 12 months when you were referred to a specialist for asthma care but could not go because of the cost?” or “was there a time in the past 12 months when you needed to buy medication for your asthma but could not because of the cost?”
Healthcare use	Indicating any number of times to any of the following questions on the ACBS “during the past 12 months, how many times did you see a doctor or other health professional for a routine checkup for your asthma?” or “during the past 12 months, how many times did you visit an emergency room or urgent care center because of your asthma?” or “during the past 12 months, how many times did you see a doctor or other health professional for urgent treatment of worsening asthma symptoms or for an asthma episode or attack?” or “during the past 12 months, how many different times did you stay in any hospital overnight or longer because of your asthma?”
Triggers	Answering yes to any of the following questions on the ACBS “in the past week, has anyone smoked inside your home?” or “in the past 30 days, has anyone seen a cockroach inside your home?” or “in the past 30 days, has anyone seen mice or rats inside your home?” or “does your household have pets such as dogs, cats, hamsters, birds or other feathered or furry pets that spend time indoors?” or “are pets allowed in your bedroom?” or “in the past 30 days, has anyone seen or smelled mold or a musty odor inside your home?” or “is a wood burning fireplace or wood burning stove used in your home?” or, answering no to any of the following questions “do you use a mattress cover that is made especially for controlling dust mites?” or “do you use a pillow cover that is made especially for controlling dust mites?” or “is an air cleaner or purifier regularly used inside your home?”
Severe asthma	Indicating use of Oral Corticosteroid on the ACBS

*A sample of questions from the Nevada 2017 BRFSS ACBS (Nevada State Health Division, Division of Public and Behavioral Health, 2019)

Appendix C: Block Models

Table A2

Block One Demographic Variables, Adults with Current Asthma, and their Independent Contribution to Depression

	P-Value	Odds Ratio	95% Confidence Interval
Asthma			
No*	-	1.00	(1.00-1.00)
Yes	<0.0001	3.09	(2.18-4.37)
Age			
18-24*	-	1.00	(1.00-1.00)
25-44	0.7984	1.08	(0.61-1.89)
45-64	0.3337	1.31	(0.76-2.27)
65+	0.8475	1.06	(0.60-1.88)
Sex			
Male*	-	1.00	(1.00-1.00)
Female	0.0011	1.57	(1.20-2.05)
Education level			
Did not graduate high school)*	-	1.00	(1.00-1.00)
High school graduate	0.9669	0.99	(0.63-1.56)
Attended college or technical school	0.3007	1.27	(0.81-1.98)
College or technical school graduate	0.5163	0.86	(0.55-1.36)
Model	<0.0001	-	-

*Reference variable

Table A3*Block Two Behavioral Variables, Adults with Current Asthma, and their Independent Contribution to Depression*

	P-Value	Odds Ratio	95% Confidence Interval
Asthma			
No*	-	1.00	(1.00-1.00)
Yes	<0.0001	3.38	(2.36-4.85)
Physical activity			
Met both guidelines*	-	1.00	(1.00-1.00)
Met aerobic guidelines only	0.5275	1.13	(0.77-1.68)
Met strengthening guidelines only	0.1018	1.55	(0.92-2.60)
Did not meet either guideline	0.0574	1.43	(0.99-2.08)
Tobacco use			
Former smoker or never smoked*	-	1.00	(1.00-1.00)
Current smoker	<0.0001	2.01	(1.45-2.77)
Alcohol use			
No*	-	1.00	(1.00-1.00)
Yes	0.0400	1.78	(1.03-3.08)
Model	<0.0001	-	-

*Reference variable

Table A4*Block Three Comorbid Disease Variables, Adults with Current Asthma, and their Independent Contribution to Depression*

	P-Value	Odds Ratio	95% Confidence Interval
Asthma			
No*	-	1.00	(1.00-1.00)
Yes	<0.0001	3.29	(2.30-4.70)
Obesity			
Underweight	0.9244	1.05	(0.38-2.86)
Normal weight*	-	1.00	(1.00-1.00)
Overweight	0.9160	1.02	(0.72-1.44)
Obese	0.0216	1.50	(1.06-2.11)
Model	<0.0001	-	-

*Reference variable

Table A5*Block One Demographic Variables, Adults with Lifetime Asthma, and their Independent Contribution to Depression*

	P-Value	Odds Ratio	95% Confidence Interval
Asthma			
No*	-	1.00	(1.00-1.00)
Yes	<0.001	0.36	(0.26-0.49)
Age			
18-24*	-	1.00	(1.00-1.00)
25-44	0.7314	1.10	(0.63-1.94)
45-64	0.309	1.33	(0.77-2.30)
65+	0.7208	1.11	(0.63-1.97)
Sex			
Male*	-	1.00	(1.00-1.00)
Female	0.0009	1.57	(1.21-2.06)
Education level			
Did not graduate high school*	-	1.00	(1.00-1.00)
High school graduate	0.9584	1.01	(0.64-1.60)
Attended college or technical school	0.3139	1.26	(0.80-1.99)
College or technical school graduate	0.5699	0.87	(0.55-1.39)
Model	<0.0001	-	-

*Reference variable

Table A6*Block Two Behavioral Variables, Adults with Lifetime Asthma, and their Independent Contribution to Depression*

	P-Value	Odds Ratio	95% Confidence Interval
Asthma			
No*	-	1.00	(1.00-1.00)
Yes	<0.0001	2.92	(2.11-4.03)
Physical activity			
Met both guidelines*	-	1.00	(1.00-1.00)
Met aerobic guidelines only	0.4990	1.15	(0.77-1.70)
Met strengthening guidelines only	0.0916	1.57	(0.93-2.64)
Did not meet either guideline	0.0436	1.46	(1.01-2.11)
Tobacco use			
Former smoker or never smoked*	-	1.00	(1.00-1.00)
Current smoker	<0.0001	1.97	(1.42-2.73)
Alcohol use			
No*	-	1.00	(1.00-1.00)
Yes	0.0629	1.66	(0.97-2.83)
Model	<0.0001	-	-

*Reference variable

Table A7*Block Three Comorbid Disease Variables, Adults with Lifetime Asthma, and their Independent Contribution to Depression*

	P-Value	Odds Ratio	95% Confidence Interval
Asthma			
No*	-	1.00	(1.00-1.00)
Yes	<0.0001	2.93	(2.12-4.03)
Obesity			
Underweight	0.8845	1.08	(0.39-2.95)
Normal weight*	-	1.00	(1.00-1.00)
Overweight	0.8213	1.04	(0.74-1.47)
Obese	0.0151	1.52	(1.08-2.14)
Model	<0.0001	-	-

*Reference variable

Appendix D: Select Quality of Life Frequency Tables

Table A8

Healthcare Use among Adult Nevadans with Asthma

Variable	Frequency
Asthma Checkup Frequency during the Past 12 Months	
51-60 times	1
41-50 times	6
31-40 times	5
21-30 times	7
11-20 times	10
1-10 times	50
No current asthma	33
None	64
Don't know	2
Emergency Room or Urgent Care Center Visit Frequency due to Asthma during the Past 12 Months	
51-60 times	2
41-50 times	0
31-40 times	0
21-30 times	3
11-20 times	4
1-10 times	15
No current asthma	33
No MD visit past year	44
MD visit, no ER visit past year	77

Urgent Treatment Visit Frequency due to Asthma during the Past 12 Months

81-90 times	1
71-80 times	0
61-70 times	0
51-60 times	0
41-50 times	0
31-40 times	3
21-30 times	4
11-20 times	4
1-10 times	16
No current asthma, nothing happened past year	33
Don't know	1
None	116

Hospital Stay Frequency due to Asthma during the Past 12 Months

31-40 times	1
21-30 times	0
11-20 times	2
1-10 times	2
MD visit, no symptoms past year	13
MD visit, symptoms, no hospital visit past year	82
No current asthma, nothing happened past year	33
No MD visit past year	44
Don't know	1

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Curriculum Vitae

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EDUCATION

Master of Public Health, University of Nevada, Las Vegas (UNLV), expected May 2021. Thesis: Depression and Quality of Life among Adults with Asthma Presence in Nevada. Advisor: Dr. Sheniz Moonie.

Bachelor of Arts, Government, Dartmouth College, June 2009.

PROFESSIONAL EXPERIENCE

Director of Development, Graduate College, UNLV, 3/2017-present.

Builds and manages relationships with prospects, donors, and alumni in support of graduate education at the University of Nevada, Las Vegas. Develops engagement opportunities, promotes awareness, solicits support, and collaborates with the College leadership team.

Master of Public Health Intern, Baton Rouge Area Foundation, 9/2020-12/2020.

Conducted a project exploring the intersection of philanthropy, disaster response, and community health impact. Completed an impact review report, including qualitative and quantitative data collection and analysis, on response efforts related to the 2016 Louisiana Flood and the COVID-19 Pandemic.

Account Manager, Donor Recruitment, American Red Cross, 7/2015-3/2017,

Collaborated with sponsor organizations from across sectors to implement blood drive programs. Built relationships with organizational decision-makers, chair people, and volunteers to execute programming and meet mutual goals. Collaborated with partners to develop outreach and communications strategies. Developed new business and deepened relationships to exceed targets.

Alumni Relations Coordinator, Bennington College, 8/2013-5/2015

Focused on constituent engagement with the College through volunteer management, programming, communications, and social media as a member of the Office of External Relations. Collaborated across departments and externally with partners to plan, align, and execute effective relationship building strategies.

Program Associate, Nonprofit Effectiveness, The Boston Foundation, 6/2010-6/2013

Managed funds focused on capacity building for organizations in Greater Boston. Reviewed proposals, managed budgets, oversaw a grantmaking committee, created reporting materials, and worked closely with staff and stakeholders to increase the effectiveness of nonprofit organizations within a range of sectors.

PRESENTATIONS

Korgan, K. and E. Kahane. Expert Advisory Boards: Creating a nexus for Professional & Philanthropic Development. Presented at the 2021 Western Association of Graduate Schools.

UNIVERSITY SERVICE

- Search committee member, College of Integrated Health Science Director of Development search committee, UNLV (2021).
- Alumni Awards Selection Committee, Alumni Association, UNLV (2021).
- Committee member, Top Tier MSI resource development and external relations subcommittee, UNLV (2020-present).
- Search committee member, Division of Philanthropy and Alumni Engagement, Director of Annual Giving search committee, UNLV (2020).
- Alumni Awards Selection Committee, Alumni Association, UNLV (2020).
- Search committee member, School of Dental Medicine, Associate Director of Development search committee, UNLV (2019-2020).
- Search committee member, Division of Philanthropy and Alumni Engagement Annual Giving Officer search committee, UNLV (2019).
- Alumni Awards Selection Committee, Alumni Association, UNLV (2019).
- Search committee member, Division of Philanthropy and Alumni Engagement Director of Prospect Research search committee, UNLV (2018).
- Search committee member, Division of Philanthropy and Alumni Engagement Director of Human Resources search committee, UNLV (2018).

COMMUNITY SERVICE

Class Secretary, Class of 2009 Executive Committee, Dartmouth College, 2014-present
Volunteer serving as a liaison between members of the Class of 2009, the College, and the Executive Committee. Writes bimonthly class columns for the Dartmouth Alumni Magazine.

Alumni Interviewer, Dartmouth College, 2012-present

Serves as a volunteer interviewing undergraduate applicants for Dartmouth College.

Vice President of Communications, The Junior League of Las Vegas, 2015-2020

Served in the role of Vice President of Communications on the Board of Directors.

Previously served as the Community Council Member at Large on the Board of Directors, a member of the done in a day committee, and a member of the Shannon West Homeless Youth Center committee.

HONORS

The Honor Society of Phi Kappa Phi, University of Nevada, Las Vegas (UNLV), inducted April 2021.