8-25-2025

The Association of Smoking, Education, and Income Level with Cancer in Mexican Migrants at the U.S./Mexico Border

Carlo Opont
Walden University

Walden University

College of Health Sciences and Public Policy

This is to certify that the doctoral study by

Carlo Opont

has been found to be complete and satisfactory in all respects, and that any and all revisions required by the review committee have been made.

Review Committee

Dr. Claire Robb, Committee Chairperson, Public Health Faculty

Dr. M. Christine Dorley, Committee Member, Public Health Faculty

Chief Academic Officer and Provost

Sue Subocz, Ph.D.

Walden University

August 2025

Abstract

The Association of Smoking, Education, and Income Level with Cancer in Mexican Migrants at the U.S./Mexico Border

by

Carlo Opont

BA, Rutgers University, 1989

MD, Autonomous Metropolitan University, 1998 MPH, New York University (NYU), 2001

BS, City University of New York (CUNY), 2007

Doctoral Study Submitted in Partial Fulfillment of the Requirements for the Degree of

Doctor of Public Health

Walden University

August 2025

Abstract

Cancer is a major public health problem in the United States and around the world. The condition is reported to be among the leading causes of death and has a significant impact on quality of life. The purpose of this study was to explore the association of smoking, education, and income level with cancer in the Mexican migrant population at U.S./Mexico border while controlling for age and gender. This quantitative, retrospective, cross-sectional study with a sample size of 988 used secondary data from the Mexican Migrant Project to explore the potential association between smoking, education and income level with cancer in the population of interest. The health belief model was selected as the theoretical framework for the study. Binomial logistic regression was used to analyze the data. Multiple imputation techniques were used for the replacement of missing data with imputed values. Five models were created with variables subsequently recoded. From these models a pooled category was created from which the findings of the study are reported. It was found that smoking, age, education, and sex were not statistically significant and therefore have no association with cancer in the Mexican migrant population at the U.S./Mexico border. However, regarding income level, people earning 1-25,000 pesos annually were 34.12 times more likely to experience cancer compared to people earning greater than 50,000 pesos annually (p = 0.001; 95% CI [5.34, 217.73]). This finding suggests that low income has a strong association with cancer in the Mexican migrant population at the U.S./Mexico border. Targeted education to Mexican migrants earning low wages could help with decreasing risk for cancer and improving socioeconomic conditions.

The Association of Smoking, Education, and Income Level with Cancer in Mexican Migrants at the U.S./Mexico Border

by

Carlo Opont

BA, Rutgers University, 1989

MD, Autonomous Metropolitan University, 1998 MPH,

New York University (NYU), 2001

BS, City University of New York (CUNY), 2007

Doctoral Study Submitted in Partial Fulfillment of

the Requirements for the Degree of

Doctor of Public Health

Walden University

August 2025

Dedication

I dedicate my study to my Mom and Dad, Justine Opont and Roldor Leon. My Dad had a primary school education; he was perhaps the most educated man in the country town where I was born on the island nation of Haiti. That perhaps explains why he was the sherif and considered as the first citizen of the community. Very early in life, as I started developing enough sense to appreciate my surroundings, I watched my Dad read and write and that motivated me to build an inquiry about those skills.

My mother, who was my rock, the source of my inspiration, did not know how to read and write. She normally would make a cross when her signature was required for a legal document. She gave birth to ten kids, six of us survived in a country where malnutrition, childhood diseases and evil spirits may have been the reasons why the other four kids did not have a real chance to experience life. My Mom always told us that she probably would not have any fortune to leave for us as an inheritance, but she would make sure that we are all highly educated. And she delivered.

I will always love and cherish you, Mom.

Acknowledgements

First and foremost, I thank God for giving me a nourished soul, a fortified body and an enriched spirit. I have come this far because of the Lord that I serve; he has been so very good to me.

Next, I acknowledge that the completion of this investigation would not have been possible without the support of my immediate family members. I am grateful to my wife, Oznite, my kids, Carl, Justin, and Benjamin. My baby Ben has been really instrumental in my getting this doctoral degree. Thank you, Ben!

I also extend my deepest gratitude to my Chair and Mentor, Dr. Claire Robb, and my Committee Member and Professor Dr. Christine Dorley for their unwavering support and insightful critiques throughout my research journey.

Finally, I am grateful for the immeasurable contribution of my friend and Walden graduate, Dr. Sharon Antone-Mills, the powerful prayers of my congregants, friends and supporters at my church, Bethel International Missionary, the Mexican migrants at the US/Mexico border and the tandem Princeton University/Universidad Autonoma de Guadalajara/Brown University, for providing the secondary data for my study.

Table of Contents

List of Tables

List of Figures

Section 1: Foundation of the Study and Literature Review

Cancer is a disease in which some of the body's cells grow uncontrollably and spread to other parts of the body (American Institute of Cancer Research [AICR], 2022). According to the National Cancer Institute (NCI, 2021), cancer can start almost anywhere in the human body, which is made up of trillions of cells. Normally, human cells grow and multiply through a process called cell division to form new cells as the body needs them. When cells grow old or become damaged, they die, and new cells take their place (NCI, 2021). Sometimes this orderly process breaks down, and abnormal or damaged cells grow and multiply when they should not; these cells may form tumors (lumps of tissue), which can be cancerous or not cancerous (AICR, 2022). According to the Centers for Disease Control (CDC, 2023), cancerous tumors spread into, or invade, nearby tissues and can travel to distant places in the body to form new tumors (a process called metastasis). Benign tumors do not spread into or invade nearby tissues, and when removed, benign tumors usually do not grow back. However, benign tumors can sometimes be quite large and cause serious symptoms or be life threatening, such as benign tumors in the brain. As per CDC, generally, cancerous tumors may also be called malignant tumors; many cancers form solid tumors, but cancers of the blood, such as leukemias, generally do not.

The latest report from CDC on cancer data and statistics shows that in the United States in 2021, 1,777,566 new cancer cases were reported, and that in 2022, 608,366 people died of cancer (CDC, 2023). The latest year for which cancer incidence data are available is 2021; 2022 is the latest year for which cancer death data are available.

Many cancers have been associated with lifestyle and various socioeconomic conditions (Sharman et al., 2024). Numerous other articles discussing cancer as a public health issue often focus on its global prevalence, the significant impact of preventable risk factors like smoking and diet, disparities in access to healthcare and treatment based on socioeconomic status, the importance of early detection through screening programs, and the need for targeted prevention strategies across different cancer types, particularly in low- and middle-income countries (NCI, 2024). After having provided the background information on the subject of my study, in the next section, I will discuss the problem statement, research question (RQs), and hypotheses. I will also discuss the theoretical framework, nature of the study, and definitions of terms used. Finally, I will shed light on the study's assumptions, scope, delimitations, limitations, significance and the implications for positive social change. I will close the section with a summary of the different elements of information that make up the content of that section.

Problem Statement

The situation or issue that prompted me to search the literature is the public health crisis at the U.S.-Mexico border where individuals escape from various hazardous living conditions in their home country to seek asylum. However, they become vulnerable to chronic health problems, infectious diseases, criminal activity, and mental health risks (Diamond et al., 2020). These migrants reside in shelters, and there is a great need for essential services (Diamond et al., 2020). There are findings that cancer has become a threat to the Mexican migrant population on the Northern Mexican border (Pinheiro et al.,

2017). Studies show higher rates of certain cancers like stomach, liver, and cervical cancer compared to the general U.S. population, particularly among Mexican-born residents; this is likely due to factors like lifestyles, dietary differences, access to healthcare, and potential exposure to carcinogens in their home countries or early migration periods (Pinheiro et al., 2017). The CDC (2024) noted that cancer is recognized as the leading cause of death of Hispanic/Latino individuals living in the United States. Hispanics die from some form of cancer more than any other race and ethnicity living in the United States, with Hispanics having a high rate of cervical cancer, the second highest rate of succumbing to liver cancer, and being diagnosed with stomach cancer (CDC, 2024).

Although researchers have investigated this issue, the association of smoking, educational level, and income level with cancer in Mexican migrants at the U.S.-Mexico border has not been fully explored. An exhaustive search of literature yielded no empirical studies on the topic, and the association between smoking, education, income, and cancer is not adequately explored in this population. However, many migrants experience elevated risks of some neoplasms. A significant number of migrants enter the U.S. borders from countries where programs that screen for cancer and offer prevention or early detection information are limited (Perez de Celis, 2024). Findings from Martinez-Donate et al. (2023) noting that Mexican migrant health deteriorates the longer they live in the United States, with a 60% likely deterioration within 1-2 years of migration.

Purpose of the Study

The purpose of this quantitative study was to examine the association of smoking, education and income level on the occurrence of cancer in Mexican migrants at the U.S.Mexico border. The study findings will inform public health workers at the U.S.Mexico border whether smoking is a risk factor for cancer and whether education and higher income level can lower that risk factor in the study population. Findings can be used to develop educational programs for Mexican migrants at the U.S.-Mexico border and other border states.

Research Questions and Hypotheses

The research questions for this study are:

- RQ 1: What is the association of smoking with cancer in Mexican migrants at the U.S./Mexico border while controlling for age and gender?
    - $H_0$1: There is no association of smoking with cancer in Mexican migrants at the U.S.-Mexico border while controlling for age and gender.
    - H_a1: There is an association of smoking with cancer in Mexican migrants at the U.S.-Mexico border while controlling for age and gender.
- RQ 2: What is the association of education with cancer in Mexican migrants at the U.S./Mexico border while controlling for age and gender?
    - $H_0$2: There is no association of education with cancer in Mexican migrants at the U.S.-Mexico border while controlling for age and gender.
    - H_a2: There is an association of education with cancer in Mexican migrants at the U.S.-Mexico border while controlling for age and gender.

- RQ 3: What is the association of income level with cancer in Mexican migrants at the U.S./Mexico border while controlling for age and gender?
    - $H_0$3: There is no association of income level with cancer in Mexican migrants at the U.S./Mexico border while controlling for age and gender.
    - H_a3: There is an association of income level with cancer in Mexican migrants at the U.S./Mexico border while controlling for age and gender.

Theoretical Framework

Rosenstock's (1974) health belief model (HBM) promotes health and disease prevention and predicts health behavior changes among individuals. The HBM is derived from psychological and behavioral therapy with six constructs: (a) perceived susceptibility, (b) perceived severity, (c) perceived benefits, (d) perceived barriers, (e) cue to action, and (f) self-efficacy (LaMorte, 2022). Perceived susceptibility refers to an individual's belief in obtaining a specific illness/condition (Washburn, n.d.). Perceived severity refers to an individual's understanding of the severity of the illness/disease (Washburn, n.d.). Perceived benefit refers to an individual's understanding that the new behavior better lowers the risk of illness (Washburn, n.d.). Perceived barriers are obstacles that will stop the individual from a positive behavior change (Washburn, n.d.). Cues to action refer to factors that promote behavior change (Washburn, n.d.). Selfefficacy is an individual's belief and confidence to promote behavior change (Washburn, n.d.).

Rosenstock's (1974) HBM was appropriate for this study when addressing Mexican migrants' beliefs about cancer. According to Rosenstock, the decision to perform healthy behaviors is based on a multidimensional approach to making health

decisions. Pribadi and Devy (2020) noted that HBM can be applicable to foster the intention to stop smoking behavior aimed at reducing cancer risks. HBM helps to facilitate an understanding of which condition an individual will engage in health preventives and treatments (Rosenstock, 1966). When applied to smoking cessation (as it is associated with cancer), the HBM suggests that a person's decision to quit smoking is largely influenced by their perception of their susceptibility to smoking-related illnesses, the severity of those illnesses, the perceived benefits of quitting, the barriers to quitting, and their confidence in their ability to successfully stop smoking. Essentially, according to HBM, the more strongly people believe they are at risk for negative health consequences from smoking, the more likely they are to attempt to quit and adhere to a cessation plan (Pribadi & Devy, 2020).

Limitations of HBM

As with any model attempting to understand and influence a process as complex as human behavior, HBM has several limitations. One of the most notable limitations is the lack of an individual's belief in his capacity (Alyafei et al., 2024). This limitation was addressed earlier by several psychologists but amended by Janz and Becker in the 1980s by adding self-efficacy to the model (Janz & Becker, 1984). The model fundamentally focuses on cognitive constructs such as perceived susceptibility, severity, benefits, and barriers. Thus, it may not capture the emotional and social aspects that affect health behaviors (Janz & Becker, 1984).

Some have criticized the model for not adequately addressing the impact of social and cultural factors on health beliefs and behaviors (Russell et al., 2006). The model also assumes that individuals make rational decisions based on weighing the advantages and disadvantages of health actions even though emotions, habits, and other external pressures can complicate decisions (Harrison et al., 1992). HBM has also been criticized

for its static nature, which does not account for changes in beliefs, attitudes, and behaviors over time or in response to interventions. Furthermore, it can, at times, overemphasize individual responsibility for health, neglecting broader environmental and structural factors that influence health behaviors (Rosentock et al., 1988).

Nature of the Study

To address the research questions in this quantitative, cross-sectional study, the specific research design included secondary data from the Mexican Migrant Project (MMP), a collaborative study at Princeton University and the University of Guadalajara (MMP, 2021) to understand the association between smoking, education, income level, and cancer in Mexican migrants at the U.S.-Mexico border. Secondary data consisted of surveys. The independent variables are smoking, educational status, income level, and the dependent variable is cancer. The control variables are age and gender. The Statistical Package for Science Software (SPSS) Version 28 was used to run a binomial logistic regression to answer the research questions aimed at examining the association of smoking, education, income level and cancer in Mexican migrants at the U.S.-Mexico border. One reference entry for the work on which this research design is based on the Codebook attached in Appendix A.

The cross-sectional survey data aided in answering the research questions:

- What is the association of smoking with cancer in Mexican migrants at the U.S.-Mexico border adjusted for age, and gender?
- What is the association of education with cancer in Mexican migrants at the U.S.-Mexico border adjusted for age and gender?

- What is the association of income level with cancer in Mexican migrants at the U.S.-Mexico border adjusted for age and gender?

A binomial logistic regression model was utilized to examine the association of smoking, income level, and education with cancer. This model helped to describe the existence and strength of an association, if any, between the independent and dependent variables.

From the secondary sources, I used the following data points to answer the research questions: smoking, education, and income level ,and cancer. The independent variable (IV) smoking was measured as health and is a categorical variable with 1 = Yes and 2 = No. Education, the second IV, was measured in years of education completed and is a continuous variable. Income level, the third independent variable, was measured as wages and is a continuous variable. Cancer, the dependent variable (DV), was measured as health: has/had cancer or malignant tumor and is a categorical variable with 1 = Yes, 2 = No. Control variables were age and gender. Age was measured in years and is a continuous variable. Gender was coded 1 = Male or 2 = Female.

Literature Search Strategy

For this study, I conducted an extensive literature search; I used the following online search engines and a dataset from the Mexican Migrant Project: *American Journal of Public Health*, BMC Public Health, Cochrane Library, Google Scholar, and PubMed. I also used websites like the Center for Disease Control (CDC), World Health Organization (WHO), NCI, AICR, American Cancer Society Cancer Action Network (ACSCAN), and the Mayo Clinic. The keywords searched included *Smoking, educational status, income level, migrants, US/Mexico border,* and *Mexican migrants* used either individually or in combination. Updated information in a research study is crucial because it ensures the

research is relevant to current knowledge, identifies gaps in existing research, allows for informed decision-making based on the latest findings, and ultimately contributes to the advancement of the field by building upon previous discoveries rather than relying on outdated information (Garner et al., 2016). That explains why for my literature research, I focused mostly on studies conducted and published within the last 5 years to base my findings on the most updated research in circulation.

Literature Review

There is a growing public health emergency at the northern Mexico border, where migrants live in shelters, and a demand for essential services exists (Diamond et al., 2020). There is insufficient health care access and basic sanitation among migrants on the Northern Mexican border, putting this population at risk for poor health outcomes (Diamond et al., 2020). Since the outbreak of COVID-19, health care services on the Northern Mexican border have been reduced, reducing resources for the high-risk population (Diamond et al., 2020). Noncommunicable diseases are overlooked due to the lack of health screenings (Diamond et al., 2020). It is estimated that 25% of the migrants have an underlying health condition, and these conditions are left undiagnosed and untreated due to the lack of health screenings, language barriers, and the fear of diagnosis (Diamond et al., 2020).

The high prevalence of non-communicable diseases is a health issue that has been a reality among Mexican immigrants crossing the Northern border of Mexico (Bonfiglio et al., 2020). Migrants are at a higher risk for non-communicable diseases by developing certain conditions at an earlier age compared to the host population (Agyemang & van den Born, 2019). Migrants face many health disparities, from obstacles to receiving

quality health care and education to income gaps (CDC, 2021). Migration and border health have become a public health focus to improve the border health system, understand the migratory population (migrants), and prevent the spread of infectious disease threats (CDC, 2022). The Mexican migrant population is understudied and vulnerable (Quandt et al., 2018).

Uneducated Mexican migrants are challenged with obstacles in managing their chronic diseases (Martinez-Cardoso et al., 2020), supporting the importance of addressing Mexican migrants' educational status and its association with cancer risks in that population. Previous findings have also demonstrated inadequate levels of health literacy among the migrant populations (Medina et al., 2022). Other barriers to participating in healthy behaviors include poor understanding of cancer, unhealthy lifestyles, inappropriate nutrition, and obtaining health information from unreliable sources (Miranda et al., 2021). Unhealthy lifestyles such as smoking, lower educational levels leading to lower levels of health literacy, and lower income levels are identified as barriers to achieving standard health status as it is outlined by the National Health Plan 2012–2016 (Medina et al., 2022). This indicates that educational status may play a significant role in Mexican migrants managing their predisposition to becoming cancer victims and should be considered when addressing the prevalence, incidence, and response to that health condition. The goal of this study was to focus on whether there is an association of smoking, education, and income level with cancer in Mexican migrants at the U.S.-Mexico border. Some studies have been done regarding the Northern border Mexican migrants, but very few of those studies have looked into the impact of health

literacy on health status in that community. This study will be useful in decreasing the gap in knowledge on this topic.

Research indicates that Mexican migrants at the US-Mexico border often have a higher smoking rate compared to the general Mexican population, potentially due to the stressful conditions of migration and the social environments they encounter in border towns, where drug trafficking and violence are prevalent; this can lead to increased tobacco use as a coping mechanism (Medina et al., 2020). Studies have shown that Mexican migrants preparing to cross the border into the US tend to smoke more than the average Mexican citizen (Tong et al., 2012). The stressful process of migration, including potential dangers and uncertainties, can contribute to increased tobacco use as a way to manage anxiety. Furthermore, the social contexts of border towns, often characterized by drug trafficking and violence, can further exacerbate smoking habits among migrants (Tong et al., 2012).

Some of the potential risks of high smoking rates among Northern border Mexican migrants may be increased risk of respiratory diseases, cardiovascular issues, and cancer associated with tobacco use (Tong et al., 2012). Beyond cancer, high smoking rates within migrant communities can have broader health implications for the population. The hope is that this study will provide evidence that smoking is a serious health hazard, and that the findings will underscore the importance of developing approaches to prevention and cessation that target the distinctive biological, cultural, and behavioral characteristics of these smokers (Shane et al., 2010).

Some studies have put emphasis on biochemical markers (such as cotinine), as they may serve as screening tools to supplement a patient's smoking history and to help

healthcare providers to identify not only light smokers but also heavier smokers and passive smokers (Shane et al., 2010). Once identified, clinicians can work aggressively to encourage these patients to quit smoking completely and lower their cancer risks.

Low income is linked to higher cancer mortality rates, and people with low incomes are more likely to die from cancer earlier; this is due to a number of factors, including lack of access to health care, food insecurity, and unhealthy behaviors (Clegg et al., 2009). The Mexican migrants on the Northern border are not an exception to the rule. Socioeconomic patterns in incidence varied for specific cancers, while such patterns for stage are generally consistent across cancers, with late-stage diagnoses being associated with lower SES (Clegg et al., 2009). These findings illustrate the potential for analyzing disparities in cancer outcomes according to a variety of individual-level socioeconomic, demographic, and health care characteristics of different populations (Clegg et al., 2009). Most people in the world have had to leave the place where they were born or grew up. Some people move as far as the next town or city. Other people will need to leave for more pressing reasons– sometimes for a short time, but sometimes permanently.

According to (CDC, 2023), age is one of the most significant risk factors for developing cancer, with the incidence rates rising steadily as individuals age, especially after 50, and peaking around 80-84 years. CDC supports that age is the primary risk factor for cancer, with the majority of cancer cases diagnosed in people aged 65 and older. The CDC provides three explanations for the increased risk of cancer with age:

- Accumulation of Cell Damage: Over time, there is more opportunity for cell damage to accumulate, increasing the risk of cancer development.

- Mutations: The older we are, the higher the proportion of cells with mutations, which can create populations at high risk for cancer initiation.
- Exposure to Harmful Substances: We accumulate exposure to harmful things like UV radiation, chemicals (including those in tobacco smoke), and viruses over time, which can contribute to cancer risk.

(White et al., 2014) further supports the association of advanced age with cancer. The researchers explain that midlife is a period of life when the prevalence of multiple cancer risk factors is high, and incidence rates begin to increase for many types of cancer. The study shows, however, that current evidence suggests that for most adults, cancer does not have to be an inevitable consequence of growing older. White et al. (2014) explains that interventions that support healthy environments, help people manage chronic conditions, and promote healthy behaviors may help people make a healthier transition from midlife to older age and reduce the likelihood of developing cancer.

While both men and women are susceptible to cancer, there are notable genderspecific differences in cancer risk, incidence, and mortality, influenced by factors like hormones, genetics, lifestyle, and environmental exposures. As per (CD,2021), the cancer incidence rate for females was 82% higher than for males (CDC, 2023). Those increases were primarily due to increasing trends of breast cancer and thyroid cancer in women, although thyroid cancer has been decreasing in recent years. Yeh & Chen (2010) explains that the gender difference in cancer susceptibility is one of the most consistent findings in cancer epidemiology. The researchers suggest that hematologic malignancies are generally more common in males, and this can be generalized to most other cancers. Zahm & Fraumeni (1995) finds that there are many common diseases that are more

common in males or females; in cancer, susceptibility is generally higher in males although some cancers are more common in women.

More often than we know, millions of people make one of the most difficult decisions in their lives: to leave their homes and loved ones looking for a better life, to seek a new job, higher wages or seek better education (Alarcon, 2022). Unfortunately, many people are forced to flee their country to escape persecution or human rights violations such as torture. Other people are forced to leave their hometowns because they no longer feel safe, for being targeted because who they are, personal choices, or different beliefs (ethnicity, religion, sexuality and/or political opinions, etc.) (Alarcon, 2022).

However, these journeys in hope for a better life are not always safe, and can be full of traumatizing experiences, danger and fear; some people risk falling prey to some form of exploitation, such as human and drug trafficking (Alarcon, 2022). The Mexican migrants on the Northern Mexico border fit the profile that has just been discussed perfectly. Unfortunately, the socioeconomic reality that is discussed above has direct implications on health status. That is why it is critical that we provide culturally sensitive health care which will help bring about positive health outcomes for diverse migrant populations. It can help narrow the gap in health care outcomes and promote health equity, which must remain as the ultimate goal of our effort as public health professionals. We must always remember that dignity and quality of health care are rights of all and not the privileges of a few (Alarcon, 2022).

Scope and Delimitations

For the scope of our study, the inclusion and exclusion criteria, I refer to the boundaries and parameters within which the research project is conducted, essentially

defining what aspects are investigated and what others are excluded, thus outlining the breadth and depth of the research area that I explored; the scope clarifies the focus of this study by specifying the target population, geographical location, time period, variables considered, and the methodologies used (AJE, 2022). I focused on Mexican migrants at the US/Mexico border over the past two decades. I looked at the smoking habits in our target population, their educational level, their income level, and we investigated the association of the above variables with the occurrence of cancer using age and gender as control variables. In terms of methodology, I analyzed secondary data in this quantitative cross-sectional study using Princeton University and the University of Guadalajara's February 2021 MMP (MMP, 2021). MMP is an ongoing study that has been collecting data since 1982. For the purpose of this study, the most recent data was used, from February 2021.

The scope of the study is based on the secondary data survey from the Mexican migrant project to understand the association between smoking, education, income level and cancer in Mexican migrants at the US-Mexico border. The data examined is dependent on the researchers who collected the primary data, thus only variables available in the dataset were used.

For the delimitations of our study, I predetermined the boundaries or restrictions that were intentionally set for the study, defining what aspects will be included and excluded, essentially narrowing the focus to make the research more manageable and relevant to the specific research question at hand (AJE, 2022). I focused on Mexican migrants, not Hispanic migrants. The independent variables (the factors that I manipulated) are smoking, education and income; the dependent variable (the outcome

measured) is cancer. I used demographic variables like age and gender for control. I delimited the study by excluding environmental factors, behavioral variables, physiological measures, and even categorical variables like treatment groups.

Inclusion Criteria: These are the characteristics that define the target population for a study. In this case, the following inclusion criteria were established:

- Demographic characteristics: Age, sex, race, ethnicity.
- Clinical characteristics: Specific disease, cancer.
- Timeframe: Study limited to a specific period, last 10 years.
- Language: (English, Spanish).

Exclusion Criteria: These are the characteristics that disqualify potential participants or data from a study, even if they meet the inclusion criteria. In this case, there are:

- Ethical considerations: Being a minor, being unable to provide informed consent.
- Practical considerations: Inability to read, lack of access to necessary resources.
- Potential confounders: Conditions that might interfere with the study's outcome.
- Sample size limitations: Excluding individuals if the sample size is already met.
- Presence of other conditions: Excluding individuals with specific comorbidities or conditions that could interfere with the study.

Generalizability

Generalizability in research refers to the extent to which the findings of my study can be applied to a broader population or context beyond the specific participants or setting of the study. It's a crucial aspect of research because it determines how useful the results are for informing decisions or understanding phenomena in other situations. Some of the followings are important for generalizability. A key factor in generalizability is how well the study sample represents the larger population or context to which the findings are being generalized. My study was contained to Mexican Migrants. Several factors will affect the generalizability of my findings, including sample size, low diversity of the sample, study methodology, and the specific context of the study.

Limitations

Some key limitations of using secondary data for this study include potential for outdated information, lack of specific details relevant to our research questions, possible inconsistency in data collection methods, possible bias from the original data source, and difficulty verifying the accuracy of the data; essentially, the secondary data may not perfectly align with our research needs and could be unreliable if not carefully evaluated. Educational status, an independent variable, may yield inaccurate data since participants may inaccurately provide their academic achievement. The same accuracy concern stands for age as one of the control variables. Finally, as our study is using secondary data, key ethical concerns may include potential harm to participants due to privacy breaches if identifying information is present, lack of informed consent from original participants, potential for misinterpretation of data due to not fully understanding the original context, not adequately acknowledging the original data source, and the risk of re-identifying

individuals through data combination, especially when dealing with sensitive information. Tripathy (2023) explains that when using secondary data, confidentiality issues arise because researchers may not have direct access to the original participants' consent, potentially exposing sensitive personal information even if the data appears anonymized, leading to a risk of re-identification if not handled properly, especially when combining data from multiple sources or using advanced analysis techniques; this can result in potential harm to individuals represented in the data.

Assumptions

This research assumed that the Mexican Migrant Project records were collected from Mexican migrants at the US/Mexico border. From this assumption, I analyzed secondary data in this quantitative cross-sectional study using Princeton University (PU) and the University of Guadalajara's February 2021 MMP (MMP, 2021). MMP is an ongoing study that has been collecting data since 1982. For the purpose of this study, the most recent data was used, from February 2021. Princeton University and University of Guadalajara use a complex, multistage probability sampling design to ensure that the sample is representative of the Mexican migrant population. Both Princeton University and University of Guadalajara employ rigorous quality control measures, but data collection and processing errors can still occur. Both Institutions have undergone changes in survey methods over the years, including changes in the sampling design, assessment tools, and laboratory procedures, including taking measures to protect the confidentiality of participants (PU, 2025). The remainder of the assumptions of this study include the following: The participants told the truth when they participated in the primary research from which this secondary data study will be conducted; the data entry was conducted

ethically, efficiently and effectively with minimal errors; the missing data will be assessed to ensure the study is not biased by them. Finally, it is assumed that the secondary data is accurate due to its consistent use in several previous studies with scientifically proven outcome.

Significance of Study

This study is significant in that after an extensive search of Walden's library and Google Scholar little to no information is found on the association between smoking, education, income level and cancer in the Mexican migrant population at the US-Mexico border. A lack of empirical information on this topic highlights an existing gap in literature. Moreover, the tobacco epidemic is a public health menace and is accountable for approximately 9 million deaths per year (Ravi et al., 2021). Data shows that approximately one in three Hispanic men and women will receive a cancer diagnosis during their lifetime. However, mortality occurs in one in five men and one in seven women (American Cancer Society Cancer Action Network [ACSCAN], 2022). Hispanic men and women are also more likely than non-Hispanic whites to receive a cancer diagnosis related to infectious agents, including liver, stomach, and cervical cancers (ACSCAN, 2022).

The American Institute for Cancer Research (AICR, 2022), notes that smoking is the leading cause of cancer worldwide and it is associated with the esophagus, lungs, larynx, mouth, throat, kidney, bladder, liver, pancreas, stomach, cervix, colon, and rectum, and acute myeloid leukemia cancer. Therefore, determining the association between smoking, education, income level and cancer in the Mexican migrant population at the US-Mexico border is significant since a study by Sanchez et al. (2021) showed that

31% of Latinx immigrants smoked in their country of origin, while 26% represented current US smokers. Moreover, LaPelusa et al. (2023), noted that the needs of cancer patients at the Mexican Northern border are unmet.

The findings of this study may be significant at many levels. At an individual level they can substantially improve personal health. At a family level, the findings can protect family members from the harmful effects of secondhand smoking. Implementing the findings of this study at an organizational level can fuel initiatives can lead to noticeable improvements in employee health and increased productivity. The findings of this study will be of great significance because they can greatly reduce the prevalence of smoking-related diseases such as cancer, the dependent variable which is the reason for our investigation. This study can be a catalyst for the engineering of socioeconomic measures that are cancer protective, as lower SES is consistently associated with a higher incidence of certain cancers, poorer prognosis, and reduced access to screening and treatment (Heidary et al., 2013; Anon, 2003; Ruan et al., 2024). Last, but not least, this study may have the potential for deep implications for policy making conducive to smoking cessation, raising awareness about health education/health literacy and creating more parity in income levels across our communities.

Implications for Positive Social Change

The findings of the study can lead to positive social change by promoting smoking cessation leading to the decrease of cancer risks in Mexican migrants on the US/ Mexico border at multiple levels. The study's findings will contribute to positive social change to the extent that they can highlight the public health need for increased cancer awareness programs for Mexican migrants at the US- Mexico border and in all other

populations where smoking, lack of education and sub-par income level pose a threat to public health. Those findings will be very useful to better understand the underlying causes of increased cancer risks in similar populations and to develop strategies to mitigate SES disparities in such communities. Socioeconomic status is considered a key social determinant of health, meaning it significantly influences health outcomes beyond individual factors like genetics. (Bakarat et al., 2023) shows that there is a strong correlation between lower SES and poorer health, including higher rates of chronic diseases like heart disease, diabetes, and cancer, as well as increased risk of mental health issues. From all rudimentary evidence, social mobility appears to impact health. In general, evidence suggests that individuals who experience consistently high SES and those who experience upward social mobility have better health outcomes throughout life and in adulthood than those who experience consistently low SES and downward social mobility (Bakarat et al., 2023).

This study will have implications for social changes in the Mexican migrant population at the US/Mexico border by coming up the findings that will contribute to strides in smoking cessation, raising awareness about the importance of health education and literacy, consistent and diverse measures of SES changes and health outcomes. The relationship between SES and health is one of the most important and complicated issues in social policy. Poorer SES, whether measured by education, income, occupation, race and ethnicity, or locality, has been associated with a variety of negative health outcomes including cancer and a shorter life expectancy (Donahoe & McGuire, 2020). The findings of this study, if put into application, will be an immense contribution to positive social

change in migrant populations at the northern Mexican border and all other communities marked by that vexing relationship between SES and Health.

Summary

Section One of this paper is marked by an extensive literature review, which will be helpful in understanding how Mexican migrants at the US-Mexico border who often exhibit a higher rate of smoking compared to the general Mexican population have an elevated risk of falling prey to cancer. It is reported that the higher rate of smoking in Mexican Migrants at the border can vary depending on the stage of their migration journey, with some studies showing a potential decrease in smoking once they arrive at the border; this trend is often attributed to factors like stress related to the migration process and limited access to healthcare during transit**.** Several studies have shown that a significant percentage of Mexican migrants at the US/Mexico border report cancer producing smoking habits, with the rate sometimes exceeding the national average in Mexico. Stressful conditions of migration, including uncertainty and potential dangers, can lead to increased tobacco use as a coping mechanism. Unfortunately, limited access to healthcare during migration can hinder efforts to quit smoking or address related health concerns such as cancer (Soto et al., 2022).

Research studies that might provide solutions for the challenges of Mexican migrants at the US/Mexico border are scarce. Given the rapidly changing political rhetoric and policies concerning immigration, the likely impact of this rhetoric on immigrants' adjustment and health status, it is essential to understand the experiences of immigrant individuals and families at the northern Mexico border (Soto et al., 2022).

Researching Mexican migrants presents several challenges, including difficulty accessing populations due to their often undocumented status, navigating complex social and political landscapes, language barriers, cultural sensitivity concerns, stigma associated with migration, and the need to consider diverse migration patterns like circular migration and return migration, all while ensuring ethical research practices in a sensitive topic area (Soto et al., 2022). Given the rapidly changing political rhetoric and policies concerning immigration, and the likely impact of this rhetoric on immigrants' adjustment, it is essential to understand the experiences of recently arrived immigrant individuals and families (Soto et al., 2022).

The next section presents the research procedures that will be used in our study. That section will be discussing the specific steps that will be taken to collect data and conduct our study, outlining the methods, processes, and activities involved in gathering information to answer our research questions, ensuring the reliability and validity of the findings; essentially, the next section will be a detailed plan of how our research will be carried out, including participant recruitment, data collection techniques, and data analysis methods.

Section 2: Research Design and Data Collection

According the Policy Migration Institute (2024), Mexicans are the largest group of immigrants in the United States, accounting for about 23% of all 47.8 million foreignborn residents as of 2023; the population shrank by more than 1 million people from its peak of 11.7 million in 2010 to 10.7 million in 2022 but has started growing again. As of

2023, 10.9 million U.S. residents were immigrants from Mexico (Policy Migration Institute, 2024). The United States remains by far the most popular destination for Mexican migrants worldwide (Policy Migration Institute , 2024). The purpose of this quantitative cross-sectional study was to examine the role of smoking, educational level, and income level on cancer among Mexican migrants using age and gender as control variables. In Section 2, I discuss the research design, rationale, and methodology, including the target population, sampling procedures, instrumentation and operationalization of constructs, and data analysis plan. Threats to validity, ethical guidelines, and a summary are also included.

Research Design and Rationale

In this quantitative cross-sectional study, I examined the association of smoking, low educational level, and low income level on cancer in the Mexican migrant population at the U.S./Mexico border, using age and gender as control variables. The research design included using secondary data from the MMP (Princeton University, n.d.). The secondary data consisted of cross-sectional survey data that were instrumental in answering the three research questions and hypotheses:

- RQ 1: What is the association of smoking with cancer in Mexican migrants at the US/Mexico border while controlling for age and gender?
    - $H_0$1: There is no association of smoking with cancer in Mexican migrants at the U.S.-Mexico border while controlling for age and gender.
    - H_a1: There is an association of smoking with cancer in Mexican migrants at the U.S.-Mexico border while controlling for age and gender.

- RQ 2: What is the association of education with cancer in Mexican migrants at the U.S./Mexico border while controlling for age and gender?
    - $H_0$2: There is no association of education with cancer in Mexican migrants at the U.S.-Mexico border while controlling for age and gender.
    - H_a2: There is an association of education with cancer in Mexican migrants at the U.S.-Mexico border while controlling for age and gender.
- RQ 3: What is the association of income level with cancer in Mexican migrants at the U.S./Mexico border while controlling for age and gender?
    - $H_0$3: There is no association of income level with cancer in Mexican migrants at the US/Mexico border while controlling for age and gender. ○ H_a3: There is an association of income level with cancer in Mexican migrants at the US/Mexico border while controlling for age and gender. Using SPSS, I first conductd a descriptive analysis, including measures of central tendency (i.e., mean, median, and mode). This is important because it summarizes the samples and measures of the data set with frequencies and percentages (Cooksey, 2020;

Mishra et al., 2019). A binomial logistic regression model is most appropriate to examine the relationship between the independent variables (smoking, education and income) and the dependent variable (cancer; Castro & Ferreira, 2023). I used a stacked bar chart (segmented bar chart), as it is the most appropriate to demonstrate the association between my independent and dependent variables (Pennsylvania State University, n.d.). The stacked bar chart extends the standard bar chart from looking at numeric values across one

categorical variable to two. Each bar in a standard bar chart is divided into a number of subbars stacked end to end, each one corresponding to a level of the second categorical variable.

Secondary data in this quantitative cross-sectional study cam from Princeton University and the University of Guadalajara's February 2021 MMP. MMP is an ongoing study that has been collecting data since 1982. For this study, the most recent data were used, from February 2021. The February 2021 MMP data set was referred to as MMP174. MMP174 is a reputable and the best source for my study because it contains high-quality data on documented and undocumented Mexican migrants (MMP, 2021). MMP174 is available for public viewing and downloading along with the codebook for research and educational purposes online, and it contains data regarding the characteristics and behaviors of Mexican migrants (MMP, 2021).

Methodology

Population

The data set includes social and economic information regarding Mexican-U.S. migration (MMP, 2021). MMP174 – PERS file contains 179,321 observations and 132 variables. PERS is a person-level file that provides general sociodemographic information and domestic, U.S., and Canadian migration. The target population for this quantitative cross-sectional study was Mexican migrants who were at the Northern Mexican border and had a history of different types of cancers.

Sampling Procedures

Researchers gathered the MMP174 data set using both anthropological and sociological methods (MMP, 2021). Anthropological research is both objective and

subjective, documenting data for replication (University of Toronto, 2003). Sociological methods include surveys, experiments, field research, and secondary data analysis (Little, 2014). The MMP174 data set employed an ethnosurvey, blending qualitative and quantitative data to study migration's social, economic, and cultural processes (MMP, 2021). An ethnosurvey is a research method that combines survey and ethnographic techniques to study migration. It is a way to understand the social, economic, and cultural processes that drive migration. This method combines ethnographic fieldwork with representative survey sampling, offering greater validity than using either approach alone (Kaczmarczyk & Massey, 2019; MMP, 2021).

The survey interviews were conducted in three phases. The first phase collected demographic data from each household member, identifying all members and their relationship to the head of the household, as well as any migration experience in the United States or Mexico (MMP, 2021). The second phase gathered life histories, including occupational mobility, health status, migration history, and family formation (MMP, 2021). The third phase dealt with the experiences during the most recent trip to the U.S. border crossing. That phase provided all details regarding the number of relatives who accompanied the trip, the number of relatives residing there, and social ties with the United States, such as English language proficiency, job characteristics, and use of U.S. social services (MMP, 2021).

Ensuring Validity and Reliability

To ensure validity and reliability in their dataset, Durand and Massey(data) focused on establishing clear data collection processes, using reliable instruments, conducting pilot tests, and implementing robust data quality checks. They did regular

audits, data cleaning, and offered proper documentation that is crucial for maintaining data integrity and reproducibility. They have identified their reliable sources of information and consider the potential biases associated with each. They developed consistent procedures for data collection to minimize variation and ensure consistency. They selected validated tools and instruments that have been tested for reliability and validity. They report having conducted pilot tests on a small, representative group to identify potential issues with data collection instruments and processes. The surveyors verified the authenticity and accuracy of data through data validation checks. They clearly defined the types of data that will be collected and the formats in which they will be stored. They have ensured an adequate and representative sample size to minimize the impact of random errors. Durand and Massey (1984) employed statistical tests to assess reliability and identify potential issues. They have declared their awareness of potential sources of bias and have taken steps to minimize their impact. They have provided detailed documentation on all data collection and processing steps to ensure reproducibility.

Power Analysis

It is essential to conduct a power analysis to determine whether the results obtained from a data set are significant (Kemal, 2020). A small sample size can lead to effective/inaccurate results, while a large sample size might show significance with unnecessary data and subjects (Kemal, 2020). The MMP174 data set included a sample size of 9,052 observations (MMP, 2021).

The alpha level determines whether to reject or fail to reject the null hypothesis (Serdar et al., 2021). The most common alpha level is 0.05, which means there is a 5%

chance of the null hypothesis not being true. For my study, the alpha level will be kept at 0.05. This meant the remaining 95% would be the confidence level. A 0.95 (95%) confidence level means that if the test is run multiple times, one would be confident to get values that are close to this sample estimate (see O'Brien & Yi, 2016). It is also essential to look at the probability value (*p*-value), which is the probability of incorrectly accepting the alternative hypothesis (Serdar et al., 2021). The alternative hypothesis is accepted if the *p*-value is equal to or lower than the alpha level. If the *p*-value is higher than the alpha level, the null hypothesis fails to be rejected (Serdar et al., 2021). This was considered for each of the hypotheses being tested for the MMP study.

In this study, I used G*Power for analysis. It is a free online source to calculate statistical power and sample size for a sample study (Serdar et al., 2021). G*Power 3.1.9.6 will be used to calculate my study's minimum sample size to run a binomial logistic regression. A G*Power graph for binomial logistic regression will visually display the relationship between sample size, statistical power, and effect size (typically represented as an odds ratio) in a logistic regression analysis; allowing researchers to see how changing one parameter impacts the others and helping to determine the necessary sample size to achieve a desired level of power for the study. By using binomial logistic regression for our study, I will be able to determine the optimal place to put our threshold and thus help to reduce uncertainty and make more informed decisions.

> Using G*Power, the sample size for our study is calculated as shown below:
> [5] -- Saturday, March 01, 2025 -- 18:06:31 z
>
> tests – Binomial Logistic Regression
>
> Options: Large sample z-Test, Demidenko (2007) with var corr
> Analysis: A priori: Compute required sample size

Input: Tail(s) = One

Odds ratio = 1.3 Pr(Y=1|X=1)

H0 = 0.2 α err prob = 0.05

Power (1-β err prob) = 0.95
R^2 other X = 0

X distribution = Normal

X parm μ = 0

X parm σ = 1

Output:Critical z = 1.6448536

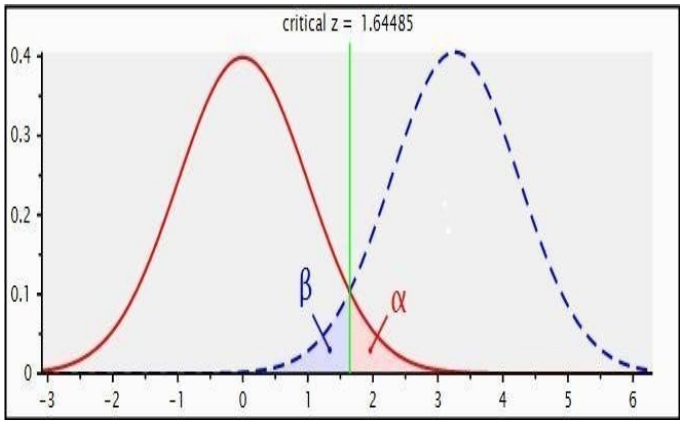
Total sample size = 988

Actual power = 0.9501283

Using G*Power for central and non-central distribution, the graph below is plotted based on the binomial regression model (see figure #2).

Figure 1

*G*Power for Binomial Regression Model*



Instrumentation and Operationalization of Constructs

The MMP, initiated in 1982 by Professors Jorge Durand and Douglas Massey, aims to understand Mexican migration to the U.S. (MMP, 2021). This secondary

data set was ideal for my study as it includes social and economic characteristics of migrants (MMP, 2021). The MMP data is reliable, valid, and covers both documented and undocumented migrants, illustrating the nature of migration (MMP, 2021). The data has been widely used in various publications (MMP, 2021). The MMP data set is reliable and valid because it gathers and maintains high-quality data (MMP, 2021). The data set contains both documented and undocumented Mexican migrants to the United States and the nature of migration (MMP, 2021). The MMP data sets have been used in different books, articles, and dissertations (MMP, 2021).

Operationalization of Variables

The MMP study collected data using ethnosurveys. The enthosurveys collected age, sex, marital status, income, education level etc. In my study the independent variables are smoking, educational level, and income level. The dependent variable is cancer, while the control variables are age and gender. The variables were operationalized in the following manner:

- Smoking, the first IV is measured as Health. It is a categorical variable. Response 1= Yes, 2 = No
- Education, the second IV is measured in years of education completed and is a continuous variable
- Income level, the third IV is measured as wages and is a continuous variable.
- Cancer the DV is measured as Health: Has/had cancer or malignant tumor? It is a categorical variable. Response 1 = Yes, 2 = No
- Control Variables: age, and gender. Age was measured in years and is a continuous variable.

- Gender is coded male or female with male = 1 and female = 2.

Data Analysis Plan

My study will use a quantitative cross-sectional design. It is based on the MMP174 data set that I downloaded from the MMP website. I will analyze this data set using SPSS version 28). SPSS (Statistical Package for the Social Sciences), also known as IBM SPSS Statistics since 2009, is a user-friendly software package used for the analysis of statistical data and to make data-driven decisions. To assess any missing data, I will first conduct a missing value analysis. Missing value analysis is a statistical procedure that examines patterns and characteristics of missing data within a dataset, identifying where missing values occur, how frequently they appear, and whether there are any discernible patterns in which variables are missing together, allowing researchers to choose the most appropriate method to handle the missing data in their analysis. This data cleaning exercise will be vital to reduce any errors that could possibly impact the results of my study (see Van den Broeck et al., 2005).

Research Questions and Hypotheses

This quantitative study was designed for the examination of the association of smoking, education and income level with cancer in Mexican migrants at the US/Mexico border (Mexican Northen Border). The goal is that the findings will provide the answers to the following research questions and hypotheses:

- RQ 1: What is the association of smoking with cancer in Mexican migrants at the US/Mexico border while controlling for age and gender?
    - $H_0$1: There is no association of smoking with cancer in Mexican migrants at the U.S.-Mexico border while controlling for age and gender.

- H_a1: There is an association of smoking with cancer in Mexican migrants at the U.S.-Mexico border while controlling for age and gender.

- RQ 2: What is the association of education with cancer in Mexican migrants at the U.S./Mexico border while controlling for age and gender?
  - $H_0 2$: There is no association of education with cancer in Mexican migrants at the U.S.-Mexico border while controlling for age and gender.
  - $H_a 2$: There is an association of education with cancer in Mexican migrants at the U.S.-Mexico border while controlling for age and gender.
- RQ 3: What is the association of income level with cancer in Mexican migrants at the U.S./Mexico border while controlling for age and gender?
  - $H_0 3$: There is no association of income level with cancer in Mexican migrants at the US/Mexico border while controlling for age and gender. ○ $H_a 3$: There is an association of income level with cancer in Mexican migrants at the US/Mexico border while controlling for age and gender.

Statistical Test

Cooksey (2020) recommended that a descriptive analysis and measures of central tendency be conducted with the dataset to summarize it. In a binomial logistic regression model, the primary statistical test used to assess the significance of individual independent variables is the Wald test, which examines the z-score of each coefficient, essentially determining if the coefficient is significantly different from zero; the overall model fit is typically evaluated using the likelihood ratio test (chi-square test), comparing the model's deviance to a null model, and the Hosmer-Lemeshow goodness-of-fit test to check how well the predicted probabilities align with the observed data. For our research

questions, a binomial logistic regression will be performed to examine the relationship between two categorical outcome variables: (a) smoking and (b) cancer. A stacked bar chart will demonstrate the association between educational status, income level and cancer. The alternative hypotheses (there is a relationship between smoking, educational status, income level and cancer in Mexican migrants at the northern Mexican border adjusted for age, gender) would be accepted with a $p < 0.05$,. If the p value is > 0.05, I would fail to reject the null hypothesis (there is no relationship between smoking, educational status, income level and cancer in Mexican migrants at the northern Mexican border adjusted for age, gender).

Threat to Validity

Threats to research validity include selection bias, maturation, history, testing effects, instrumentation error, experimental mortality (attrition), social interaction, regression to the mean, and confounding variables, which can all undermine the confidence in the results of a study by introducing alternative explanations for observed outcomes. One of the external threats to the validity of my study was the use of selfreported cross-sectional surveys. Responses to the survey could have been misreported, which could have caused the data to be an inaccurate representation of the population (see Andrade, 2018). Threats to internal validity in my study, such as missing data, improper randomization, and selection bias, could have resulted in inaccurate results (see Andrade, 2018). Improving external validity was paramount for this study, therefore I used a broad inclusion criterium to resemble real-life patients/population. To enhance internal validity, I made sure of adequate quality control regarding data collection, analysis, and sample size (Patino & Ferreira, 2018).

Ethical Procedures

For this study, I obtained secondary data from the MMP website. MMP has been conducting surveys among Mexican migrants since 1982. Many data sets are available through the MMP website, and I used the most recent data set, which was from February 2021 and was named MMP174. These data sets consist of extensive ethnosurveys administered yearly in Mexico and the United States to gather social and economic information regarding Mexican-U.S. migration. The MMP data are available for public use and are free of charge for research and educational purposes. I inquired about obtaining proper consent from the original data collectors, ensuring data is de-identified, not re-identifying participants through analysis, respecting privacy concerns, clearly citing the data source, and being mindful of potential biases or limitations within the existing data; essentially, treating the data with the same ethical considerations as if I had collected it myself, even if it's publicly available. I made sure that participants in the surveys were protected confidentially. Gaining access to MMP174 was trouble free, and I have no conflict of interest as I conduct the investigation.

Summary

Section 2 is a discussion of how I used secondary data from MMP174 to examine the relationship between smoking, educational status, income level and cancer in Mexican migrants at the northern Mexican border adjusted for age, gender. I discussed my research questions and hypotheses, identified each variable used in my RQs, and reviewed the research design for my RQs. I also identified the target population, sampling procedure, instruments and operationalization of constructs, and data analysis plan. I also

identified threats to validity and ethical procedures. In the next section of this paper (Section 3), I will discuss the study results.

Section 3: Presentation of the Results and Findings

The purpose of this quantitative cross-sectional study was to examine the association of smoking, education, and income level with cancer in Mexican migrants at the U.S./Mexico border. The results from the analysis can be used to inform public health officials and health care workers of the association of cancer due to smoking, educational level and income level among Mexican migrants at the U.S.-Mexico border. The results can also be used to improve lifestyle and promote better health outcomes among migrants to reduce cancers associated with smoking, low educational and low income levels.

The research questions for this study are:

- RQ 1: What is the association of smoking with cancer in Mexican migrants at the US/Mexico border while controlling for age and gender?
    - $H_0$1: There is no association of smoking with cancer in Mexican migrants at the U.S.-Mexico border while controlling for age and gender.
    - H_a1: There is an association of smoking with cancer in Mexican migrants at the U.S.-Mexico border while controlling for age and gender.
- RQ 2: What is the association of education with cancer in Mexican migrants at the U.S./Mexico border while controlling for age and gender?
    - $H_0$2: There is no association of education with cancer in Mexican migrants at the U.S.-Mexico border while controlling for age and gender.

- H_a2: There is an association of education with cancer in Mexican migrants at the U.S.-Mexico border while controlling for age and gender.

- RQ 3: What is the association of income level with cancer in Mexican migrants at the U.S./Mexico border while controlling for age and gender?
  - $H_0 3$: There is no association of income level with cancer in Mexican migrants at the US/Mexico border while controlling for age and gender.
  - $H_a 3$: There is an association of income level with cancer in Mexican migrants at the US/Mexico border while controlling for age and gender.

The discussion in Section 3 covers accessing the secondary data set, demographic data for the sample, statistical assumptions, and results of the binary logistic regression analysis.

Accessing the Data for Secondary Analysis

Data Collection

After approval from the Institutional Review Board at Walden University, I registered with the Office of Population Research and given access to download the most recent dataset, by the University of Guadalajara. The dataset has 612 variables and 9,052 observations (MMP, 2021). The dataset was analyzed with SPSS version 28.

Discrepancies of Dataset

A major discrepancy in the dataset is the issue of missing values or missing data. Missing data (or missing values) is defined as the data value that is not stored for a variable in the observation of interest. The problem of missing data is relatively common in almost all research and can have a significant effect on the conclusions that can be drawn from the data (Kang, 2013). Even in a well-designed and controlled study, missing

data occurs in almost all research. That issue is, however, critical, as missing data can reduce the statistical power of a study and can produce biased estimates, leading to invalid conclusions (Kang, 2013). In the MMP dataset, mose of my variables had missing data (see Figure 2 and Table 1). Frequencies showed that the cancer variable had only eight responses for the "Yes" category. Also, crosstabs from the original data showed that there was no representation for women who had cancer. As a remedy for the missing data dilemma in my study, I resorted to multiple imputation.

Figure 2

Overall Summary of Missing Values

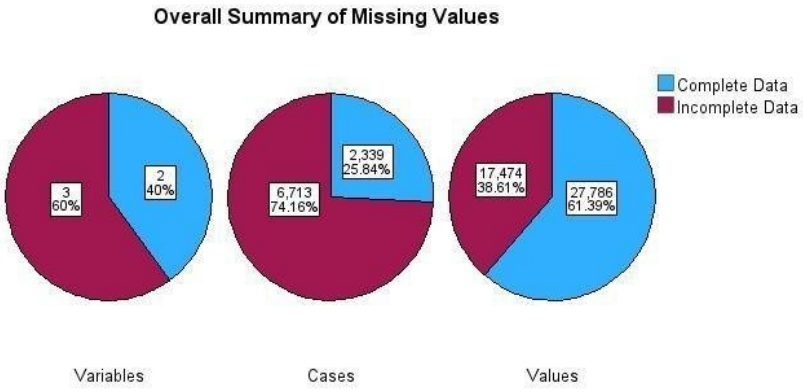


Table 1

Missing Values

	Missing					
	N	%	Valid N	Mean	SD	
Cancer Smokes?	6713	74.2%	2339			
Wage (for last formal job in Mex)	6713 4048	74.2%	2339			
		44.7%	5004	5304.6754	10654.59060	

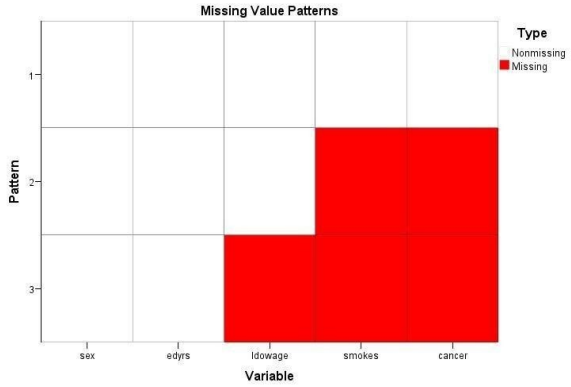
Variable Summary [a,b]

a. Maximum number of variables shown: 25

b. Minimum percentage of missing values for variable to be included: 5.0%

Figure 3

Missing Value Pattern



Using Imputation to Generate Missing Data Within the Dataset and Satisfy the Assumptions of Binomial Logistic Regression

It is important to note that I used multiple imputation as a rigorous data cleaning process to identify and correct errors, inconsistencies, and missing values, to ensure a sound statistical analysis for my study. Imputation is the process of replacing the missing data with estimated values. Instead of deleting any case that has any missing value, this approach preserves all cases by replacing the missing data with a probable value estimated by other available information (Donders et al., 2006). After all missing values have been replaced by this approach, the data set is analyzed using the standard techniques for complete data. In regression imputation, the existing variables are used to make a prediction, and then the predicted value is substituted as if an actual obtained value. This approach has a number of advantages, because the imputation retains a great deal of data over the listwise or pairwise deletion and avoids significantly altering the standard deviation or the shape of the distribution (Allison, 2000). However, as in a mean substitution, while a regression imputation substitutes a value that is predicted from other

variables, no novel information is added, while the sample size has been increased and the standard error is reduced (Yu et al., 2020). Missing data reduces the power of a trial. Some amount of missing data is expected in virtually all studies; in such cases, the target sample size is increased to allow for it (Yuan, 2010). In the context of my study, imputation was the best option, so it was used. Finally, the small values were compressed with other values into new categories to allow for statistical analysis aiming at achieving statistical significance.

Sample Characteristics After Imputation Regression and Compressing

The standard practice of multiple imputation allowed me to compensate for the missing values in the dataset. I applied that practice to overcome the limitations in the secondary dataset. Imputation created five models and a "pooled" category. After the dataset was imputed, I transformed my variables (education, age, wage, sex and smoking) into categorical variables (see Table 2).

Table 2

Categorical Variables

Categorical Variables Coding

			Parameter coding		
Imputation Number		Frequency	(1)	(2)	(4)
Original data	1-6 (Primary)	1271	1.000	.000	.000
	7-12 (Secondary)	793	.000	1.000	.000
	13-16 (College)	36	.000	.000	.000
	all other values (unknown)	176	.000	.000	1.000

edyrs1	17-28 (Grad school)	63	.000	.000	.000
	21-35 (early adulthood)	455	.000	.000	.000
	17-20 (adolescent)	1	1.000	.000	.000
	36-50 (mid-life)	951	.000	1.000	.000
age1					
	51-80 (mature)	890	.000	.000	.000
	81 and greater (late adulthood)	42	.000	.000	1.000
ldowage2	-25000	2261	1.000	.000	
	25001-50000	5	.000	1.000	
	Unknown	65	.000	.000	
	greater than 50000	8	.000		
Sex	1	2226	.000	.000	
	2	113	.000		
smoke1	no/unknc	461	1.000		
		1878	1.000		
			.000		

I ran the binomial logistic regression to find the *p*-value, the confidence interval, and the odds ratios for each variable. It is important to note that the analysis was run with all the variables being included in the model. Finally, I drew my conclusions from the pooled category with statistical significance established a priori as $p < 0.05$.

Results and Interpretation

Assumptions of Binomial Logistic Regression

When one chooses to analyze data using binomial logistic regression, part of the process involves checking to make sure that the data can be analyzed using a binomial

logistic regression. It is only appropriate to use a binomial logistic regression if the data passes the assumptions that are required for binomial logistic regression to give a valid result:

- Assumption #1: The dependent variable should be measured on a dichotomous (two level scale) scale.
- Assumption #2: There must be one or more independent variables, which can be either continuous (i.e., an interval or ratio variable) or categorical (i.e., an ordinal or nominal variable).
- Assumption #3: There must be independence of observations, and the dependent variable should have mutually exclusive and exhaustive categories. This is reflected in the imputed data set; there was no overlap.
- Assumption #4: There must be a linear relationship between any continuous independent variables and the logit transformation of the dependent variable. There was no issue with this assumption, considering that all of the variables in my study were transformed into categorical variables after reconstruction of the dataset through imputation.

All assumptions were met for binomial logistic regression.

Results

RQ 1: What is the Association of Smoking with Cancer in Mexican Migrants at the U.S./Mexico Border While Controlling for Age and Gender?

Smokers were 26,734 times more likely to have cancer than non-smokers even when controlling age and gender (p =.988). Therefore, the null hypothesis is retained. Neither age nor gender were statistically significant in the model. There is no association

between smoking and cancer in Mexican migrants at the U.S./Mexico border while controlling for age and gender.

RQ 2: What is the Association of Education with Cancer in Mexican Migrants at the U.S./Mexico Border While Controlling for Age and Gender?

Persons with a primary school education were 1.023 times more likely to have cancer compared to persons with a graduate school education ($p = 0.986$; 95% CI [0.067, 15.530]. Persons with secondary school education were 1.3 times more likely to have cancer compared to persons with a graduate school education ($p = 0.792$; 95% CI [0.181, 9.360]). Persons with a college education were 16.771 times more likely to have cancer compared to persons with a graduate school education ($p = .998$). Lastly, persons with unknown education status are .568 times less likely to have cancer compared to persons with graduate education ($p = 0.656$; 95% CI[0.040, 8.026]). Based on these results, there is no association between education and cancer in Mexican migrants at the U.S./Mexico border while controlling for age and gender; therefore, the null hypothesis is retained.

RQ 3: What is the Association of Income Level with Cancer in Mexican Migrants at the U.S./Mexico Border While Controlling for Age and Gender?

Persons earning 1-25000 pesos annually were 34.12 times more likely to have cancer compared to persons earning more than 50,000 pesos ($p < 0.001$; 95% CI[5.35, 217.73]). Persons earning 25,001 to 50,000 pesos annually 444.15 times more likely to have cancer compared to persons earning more than 50,000 pesos annually ($p = 0.996$). Persons with an unknown earning were 870,235 times more likely to have cancer compared to persons earning more than 50,000 pesos annually ($p = 0.996$). The null hypothesis that there is no association between income level and cancer in Mexican

migrants at the U.S. border is partially rejected. There is a statistically significant association between low wage levels (1-25,000 pesos annually) and cancer.

Table 3

Variables in the Equation (Pooled Model)

						95% confidence Interval	
Variable		B	S.E.	p value	Odds ratio	Lower	Upper
Smoke	Yes	10.194	705.096	0.988	267.4.48	0.000	
	No (ref)		-	-	-	-	-
Age	17-20 (adolescent)	-1.962	1.302	0.148	0.141	.009	2.136
	36-50 (mid-life)	-279	.557	.622	.756	.237	2.419
	51-80 (mature)	-453	.732	.552	.636	.121	3.351
	81 and greater (late adulthood)	-693	1.360	.623	.500	.023	10.981
	21-35 (early adulthood) ref	-	-	-	-	-	-
Education	1-6 (Primary)	0.23	1.261	.986	1.023	.067	15.530
	7-12 (Secondary)	0.262	0.991	.792	1.300	.181	9.360
	13-16 (College)	566	2.820 - 1087.403	1.247 .998	16.771	.000	
	Unknown			656	.568	.040	8.026
	17-28 (Graduate school) ref	-			-	-	-
Income	1-25000	3.530	- .929	- *<.001	34.123	5.348	217.730
	25001-50000	1195.934		.996	444.156 870235.409	.000	
	Unknown	13.677 =	-2814.304 = 6 .996			.000	
	>50,000 (ref)			=	=	=	
Sex	Male	.580	826.255	.999	1.787	.000	
	Female (ref)	-	-	-	-	-	-

*Statistically significant

Summary

In Section 3, I examined the association between cancer, smoking, educational status (School Years C), and income (Last U.S. mig wage) while controlling for age and gender among the Mexican migrants at the U.S./Mexico border. A binary logistic regression

was conducted for all three research questions which had a binary dependent variable, cancer with binary response (Yes/No). After using imputation for the process of replacing missing data points with substituted values, I ran the analysis and found that for RQ 1, that is asking if there is an association of smoking with cancer in Mexican migrants at the U.S./Mexico border while controlling for age and gender, there was no association, leading to the null hypothesis being accepted. For RQ 2, the null hypothesis was also accepting, meaning there is no association of education with cancer in Mexican migrants at the U.S.-Mexico border while controlling for age and gender. For RQ 3, the null hypothesis was rejected with the analysis showing some association of low income level (Last U.S. mig wage) with cancer among the Mexican migrants at the U.S./Mexico border while controlling for age and gender.

In the final section of the study, I will discuss the key findings, the interpretation of those findings, how the key findings can contribute to knowledge extension, and the interpretation of the key findings in the context of the HBM. I will also discuss the limitations of the study, the recommendations for future research, the implications for social change, and I will make some closing remarks.

Section 4: Application to Professional Practice and Implications for Social Change

The purpose of this quantitative cross-sectional study was to examine the association of smoking, education and income level with cancer in Mexican migrants at the U.S./Mexico border. The results from the analysis can be used to inform public health officials and health care workers of the association of cancer with smoking, low educational, and low income levels among Mexican migrants at the U.S.-Mexico border.

The results can be used also to improve lifestyle and promote better health outcomes among migrants to reduce cancers associated with smoking, low educational, and low income levels.

Summary of Key Findings and Interpretation

Secondary data were retrieved from the MMP (2021) to examine the association of smoking, education, and income level with cancer in Mexican migrants at the U.S./Mexico border. The dependent variable was cancer, and the independent variables were smoking, education, and income level. For this quantitative cross-sectional study, I used the latest data set from February 2021 and included 9,052 participants, yet there were a lot of missing data. That is why I had to include the standard practice of IMPUTATION for the replacement of missing data point with substituted values.

For RQ 1 inquiring about the association of smoking with cancer in Mexican migrant population at the U.S./Mexico border, the results from the pooled model showed no statistical significance. The *p*-value of the distribution shows .988 which is greater than the conventional significant level of 0.05 hence we conclude that the addition of smoking to the model is not statistically significant. Thus, the null hypothesis was accepted, meaning that there is no association of smoking with cancer in Mexican migrants at the U.S.-Mexico border while controlling for age and gender.

For RQ 2, The binomial logistic regression performed was to assess the effects of education (SYC) while controlling for age and gender on the likelihood of the Mexican migrants at the U.S.-Mexico border of having cancer. Here again, looking at the results from the pooled model, the most educated or the least educated from the participants in the study did not show statistical significance in terms of the association of educational

levels with cancer. From the pooled model, the *p*-value for the least educated was .986, while the *p*-value for the most educated was .656. Both of those *p*-values are greater than the conventional level of significance set at 0.05. Therefore, the null hypothesis was accepted.

For RQ 3, which was looking into the possible association between wages and cancer in the Mexican migrant population at the U.S./Mexico border while controlling for age and gender. After using IMPUTATION and the recoding of the IVs, I divided the participants into six groups from the lowest incomes to the highest incomes. Due to low results, groups 4, 5, and 6 were compressed into group 3. In the pooled model showing Groups 1,2,3 after compression for wages, only the group with the lowest income (group 1) had a *p*-value (<.001) that was lower than .05 and showing statistical significance. Therefore, I rejected the null hypothesis of no association between cancer and wages in Mexican Migrants at the U.S./Mexico border.

Potential Contribution to Knowledge Extension

In this study, I examined the association between cancer, smoking, educational status (School Years C), and income while controlling for age and gender among the Mexican migrants at the U.S./Mexico border. A binary logistic regression was conducted for all three research questions which had a binary dependent variable, cancer with binary response (Yes/No). In terms of knowledge extension, the findings of the study indicated that there is no association between cancer and smoking in the Mexican migrant population at the U.S./Mexico border and no association between cancer and educational level. However, there was an association between cancer and income level in the Mexican

migrant population at the U.S./Mexico border, with the lowest group showing a *p*-value much less than the conventional statistically significant value of .05.

Different studies support the association of cancer with smoking and low educational and low income levels. These studies suggest a complex relationship between educational attainment and cancer incidence, with some types of cancer showing stronger associations than others. My literature search in Section 1 shows that generally, lower education is associated with higher cancer-related mortality, and some studies indicate it may be linked to specific cancer types like lung, stomach, and esophagus cancer. Those studies have also indicated that the relationship is not always straightforward and can be influenced by factors like access to healthcare, lifestyle choices, and genetics. Mouw et al. (2008) found that, for example, men with the least education had increased risks of developing cancers of the esophagus, head and neck, stomach, colon, rectum, liver, lung, pleura, bladder, and combined smoking-related cancers, compared to those with the most education. Liu et al. (2024) found that educational level was a significant prognostic factor for patients with cancer, independent of other known prognostic factors; they found that such association was further improved by modifying the nutritional status. Gupta et al. (2023) found a strong, significant association between participant educational attainment and cancer mortality in the REGARDS study; they also found that such association was mediated by the social determinants of health of the participants. The notions of social determinants of health argue that the following factors can contribute to cancer disparities (Pinheiro et al., 2022):

- **Limited Access to Healthcare:** Individuals in low-income communities may face barriers to accessing quality healthcare, including lack of health insurance, limited transportation to appointments, and lack of nearby healthcare facilities.
- Socioeconomic factors: Poverty, lack of education, and unstable housing can contribute to unhealthy lifestyle choices, such as smoking, poor diet, and limited physical activity, increasing cancer risk.
- Delayed diagnosis and treatment: Due to limited access to healthcare and potentially a lack of awareness about cancer symptoms, individuals in lowincome communities may be diagnosed at later stages of cancer, when treatment is less effective.
- Comorbidities: Individuals in low-income communities may have other health conditions, such as obesity or diabetes, which can increase cancer risk and complicate treatment.
- Environmental factors: Exposure to environmental hazards, such as pollution or toxic substances, may be more prevalent in low-income communities, increasing cancer risk.
- Racial and ethnic disparities: Racial and ethnic minorities, who are disproportionately represented in lower income brackets, also experience higher cancer rates and mortality due to systemic factors and historical inequalities

Regardless of the findings of my study, according to the most recent findings from the CDC (2024), smoking can cause cancer and then block the body from fighting it; poisons in cigarette smoke can weaken the body's immune system, making it harder to kill cancer cells. When this happens, cancer cells keep growing without being stopped.

Poisons in tobacco smoke can damage or change a cell's DNA. The CDC reported that smoking is a major risk factor for cancer and is directly linked to a significant portion of cancer cases and deaths; the report estimated that smoking causes about 20% of all cancers and about 30% of all cancer deaths in the United States. Smoking related cancer is one of the most prominent public health concerns. The Mexican migrant population at the U.S./Mexico border can greatly benefit from smoking focused preventive programs deeply rooted in health education, health promotion and disease prevention. The findings from my study will provide new insights about my population of study, such insights can contribute to combating cancer in Mexican migrants in the border states of this country.

Interpretation of Findings in the Context of the HBM

Rosenstock's (1974) HBM is a theoretical model that promotes health and disease prevention and predicts health behavior changes among individuals. Rosenstock's HBM consists of six constructs: (a) perceived susceptibility, (b) perceived severity, (c) perceived benefits, (d) perceived barriers, (e) cue to action, and (f) self-efficacy (LaMorte, 2022). I analyzed the three RQs of the study based on Rosenstock's HBM. For Question #1, the model was appropriate for determining the association between cancer and smoking. The Health Belief Model (HBM) suggests that an individual's belief about their susceptibility to a health threat, the severity of that threat, and the perceived benefits of a preventive action, along with perceived barriers and selfefficacy, influence their decision to adopt or maintain specific health behavior like smoking. In the context of smoking, the HBM predicts that Mexican migrants are more likely to quit or avoid starting smoking if they perceive themselves as susceptible to smoking-related diseases, believe those diseases are severe, and believe quitting will have benefits. In their study,

(Pribadi &Devy, 2020), the results showed the intention to stop smoking has a significant correlation with perceived susceptibility (P=0.036), perceived severity (P=0.028), perceived benefits (P=0.011), perceived barriers (P=0.003), and perceived self-efficacy (P=0.005). This means there was a significant correlation between the intention of participant smokers to quit smoking and the perceived factors of HBM.

For Question #2, the model was appropriate for determining the association between cancer and education. As I mentioned above, HBM addresses perceived barriers, benefits, susceptibility, severity, and self-efficacy, leading to better health behaviors. HBM-based education has been effective in various contexts, including managing chronic diseases, promoting cancer screenings, and preventing infectious diseases (Kam & Lee, 2024). (Masoudiyekt et al., 2018) conducted a quasi-experimental study on 226 women who were selected with cluster sampling method from those referred to Dezful health centers; they found that there was a significant relationship between women's performance and variables of knowledge, perceived sensitivity, perceived benefits, perceived barriers, self-efficacy, and cues to action. The conclusion was that poor knowledge of the women in the study indicates a crucial need for formal educational programs to sensitize women regarding the importance of breast cancer screening. By recognizing the significance of individual perceptions, beliefs, and cues to action, the Health Belief model enables healthcare professionals to tailor interventions effectively to address specific health concerns and motivate individuals to adopt healthier behaviors (Kam & Lee, 2024). That general assessment is just as applicable in the Mexican migrant population as it is in other communities. Using the constructs of the HBM for education in the Mexican migrant population can: (a) mitigate the risk of developing cancer and the

severity of the same, (b) promote health behavior changes to lower the risk of cancer, (c) explain how to address barriers that may impede a positive behavior change such as environmental and social factors, (d) promote behavior change, and (e) increase the migrants willingness to keep up with the behavior change for a better quality of life and health. Screening and prevention programs that promote education can also be effective in increasing Mexican migrants' self-efficacy and their belief in their ability to manage their cancer risks.

For Question #3, the Health Belief Model was appropriate for determining the association between cancer and income level in the Mexican migrants at the US/Mexico border. The Health Belief Model (HBM) can be used to understand how income level might influence an individual's perception of cancer risk and their willingness to engage in preventative behaviors (Sharifikia et al., 2019). By exploring how income impacts HBM constructs like perceived susceptibility, severity, benefits, and barriers, researchers can gain insights into how socioeconomic factors in marginalized communities, such as the Mexican migrants, might contribute to health disparities in cancer prevention. Migrants with lower incomes may perceive themselves as less likely to develop cancer, potentially due to a lack of awareness or misinformation about risk factors, as well as a perceived lack of access to health information. Those with lower incomes may not fully appreciate the severity of cancer, both in terms of its impact on their health and the financial implications of treatment and care. Lower-income individuals may not fully appreciate the potential benefits of preventative measures like screening and early detection, especially if they perceive the costs of these measures as outweighing the potential benefits. Income can act as a barrier to access to healthcare and resources,

including screening tests, treatments, and supportive services. Lower-income Mexican migrants may be less likely to receive cues to action from their environment, such as encouragement from healthcare providers, support groups, or community organizations. Low-income migrant may lack confidence in their ability to manage their health and engage in preventative behaviors, which can further limit their participation in healthrelated activities. By considering the HBM constructs in relation to income level, researchers and healthcare providers can develop targeted interventions that address the specific needs and challenges faced by lower-income individuals in the Mexican migrant population in accessing cancer prevention and treatment.

Limitations of the Study

A major limitation for this study was that the dataset had many missing responses on the key variables for the study which led me to perform multiple imputation of the dataset. While it is a powerful method of handling missing data, multiple imputation (MI), has several limitations. According to (Lip et al., 2015), MI is not a perfect solution and can introduce bias if not used carefully. One major limitation is that it relies on the assumption that data are missing at random (MAR), and if this assumption is violated (i.e., data are missing not at random (MNAR)), MI may not provide reliable results. Other limitations include the potential for increased computational burden, the need for careful model specification, and the possibility of inaccurate imputation if the missing data mechanism is complex. I can attest that the MI techniques in this study were used carefully and meticulously.

Some other limitations of using secondary data for this study include potential for outdated information, lack of specific details relevant to our research questions, possible

inconsistency in data collection methods, possible bias from the original data source, and difficulty verifying the accuracy of the data; essentially, our secondary data, was not perfectly aligned with our research needs and could have been unreliable if not carefully evaluated. Educational status, one of our independent variables, may yield inaccurate data since participants may inaccurately provide their academic achievement. The same accuracy concern stands for age as one of the control variables. Finally, as our study is using secondary data, key ethical concerns may include potential harm to participants due to privacy breaches if identifying information is present, lack of informed consent from original participants, potential for misinterpretation of data due to not fully understanding the original context, not adequately acknowledging the original data source, and the risk of re-identifying individuals through data combination, especially when dealing with sensitive information. (Tripathy, 2023) explains that when using secondary data, confidentiality issues arise because researchers may not have direct access to the original participants' consent, potentially exposing sensitive personal information even if the data appears anonymized, leading to a risk of re-identification if not handled properly, especially when combining data from multiple sources or using advanced analysis techniques; this can result in potential harm to individuals represented in the data. The other limitation was that the study was not specific on a particular type of cancer. The data dealt with cancer as a general subject. Cancer research is challenging due to its heterogeneity, meaning each cancer is unique, and even within the same tumor, cells differ (Fisher et al., 2013). This, coupled with the diverse ways cancer cells interact with their environment and the difficulty in pinpointing specific causes, makes it difficult to develop one-size-fits-all approaches. Finally, it is reported that the data for the Mexican

migrant project were collected through the anthropological research method. These methods are well known for several challenges, including the potential for cultural bias, ethical dilemmas, language barriers, difficulties in access to research communities, and the need for accurate interpretation of cultural practices and maintenance of objectivity. Researchers also grapple with ensuring the validity and reliability of their findings, particularly in ethnographic studies (Appell, 1998).

Recommendations for Future Research

Further research can be geared towards the prevention or reduction of limitations such as the ones I encountered with the secondary dataset that I used for this investigation. As I mentioned before, missing data reduces the power of a trial. More attention should be paid to the missing data in the design and performance of the studies and in the analysis of the resulting data. Further research can be conducted to find the best solution to the missing data dilemma, and how to maximize the data collection when the study protocol is designed and the data collected. Further research can also elaborate on the application of sophisticated statistical analysis techniques, and how these techniques should be performed only after the maximal efforts have been employed to reduce missing data in the design and prevention techniques (Kang, 2013).

Further research can also contribute to developing the best notions on how to focus on screening and prevention to encourage early detection and prevention through cancer screening, vaccination, and healthy lifestyle choices. Further research should be done on how to practice cultural sensitivity, addressing cultural barriers to healthcare access and providing culturally sensitive cancer prevention strategies that can improve outcomes. Further research is also needed to understand the complex interplay of factors

influencing cancer risk in Mexican migrants. Future researchers should work on providing the guidelines for collaboratives efforts to strengthen partnered research between the U.S. and Mexico, which can help identify strategies to reduce the cancer burden in this population. It is important to remember that while Mexican migrants may have lower overall cancer rates compared to some other populations, specific cancer types and risk factors vary. Understanding these variations and addressing barriers to care is crucial for improving cancer outcomes in this population.

Finally, further research can design a joint venture via which, public health professionals and primary care providers can play a significant role in educational interventions for cancer risk management in the Mexican migrant community. Professionals from both disciplines could promote knowledge about cancer, medication adherence, and screening to the patients and their spouses (if applicable). It is also essential to provide these educational programs and interventions in English and Spanish to reduce poor health literacy, which is common among the Mexican migrant community (Medina et al., 2022).

Implications for Social Change

The findings of the study can lead to positive social change by promoting smoking prevention/cessation leading to the decrease of cancer risks in Mexican migrants on the US/ Mexico border at multiple levels. (Kale et al., 2023) finds that cancer research can create positive social change by reducing the burden of cancer, improving patient outcomes, and promoting health equity. This is achieved through advancements in prevention, diagnosis, treatment, and survivorship, along with community engagement and policy advocacy.

The study's findings will contribute to positive social change to the extent that they can highlight the public health need for increased cancer awareness programs for Mexican migrants at the US- Mexico border and in all other populations where smoking, lack of education and sub-par income level pose a threat to public health. Those findings will be very useful to better understand the underlying causes of increased cancer risks in similar populations and to develop strategies to mitigate SES disparities in such communities. Socioeconomic status is considered a key social determinant of health, meaning it significantly influences health outcomes beyond individual factors like genetics. (Barakat & Konstantinidis, 2023) shows that there is a strong correlation between lower SES and poorer health, including higher rates of chronic diseases like heart disease, diabetes, and cancer, as well as increased risk of mental health issues. From all rudimentary evidence, social mobility appears to impact health. In general, evidence suggests that individuals who experience consistently high SES and those who experience upward social mobility have better health outcomes throughout life and in adulthood than those who experience consistently low SES and downward social mobility (Barakat & Konstantinidis, 2023). Poorer SES, whether measured by education, income, occupation, race and ethnicity, or locality, has been associated with a variety of negative health outcomes including cancer and a shorter life expectancy (Donahoe & McGuire, 2020). The findings of this study, if put into application, will be an immense contribution to positive social change in migrant populations at the northern Mexican border and all other communities marked by that vexing relationship between SES and Health.

Findings of the study can be very significant in promoting smoking cessation, leading to decrease cancer risk at multiple levels. Smoking cessation/education at an

individual level is significant because it can substantially improve personal health by reducing the risk of numerous diseases like lung cancer, heart disease, stroke, and chronic obstructive pulmonary disease (COPD), potentially adding years to life expectancy, enhancing quality of life, and saving money on healthcare costs; essentially, quitting smoking is one of the most impactful positive health choices a person can make for himself or herself. Smoking cessation/education at a family level is significant because it protects family members from the harmful effects of secondhand smoke, sets a positive example for children, reduces the likelihood of children starting to smoke themselves, and can significantly improve overall family health and well-being by minimizing the risk of smoking-related diseases across generations.

Implementing smoking cessation/education initiatives at an organizational level will be significant as those initiatives can lead to noticeable improvements in employee health, increased productivity, reduced healthcare costs, enhanced employee morale, and a positive company image, ultimately contributing to a more successful business operation by minimizing the negative impacts of tobacco use on the workforce.

Smoking cessation at a community level is significant because it can greatly reduce the prevalence of smoking-related diseases, improve overall population health, decrease healthcare costs, protect non-smokers from secondhand smoke exposure, and create a supportive environment that encourages people to quit smoking by normalizing smoke-free behaviors across the community, leading to a wider positive impact on public health compared to individual interventions alone.

Smoking cessation/education is highly important in policy making because it can significantly reduce the burden of tobacco-related diseases, improve public health, save

healthcare costs, and promote a healthier population by implementing policies that encourage people to quit smoking, such as smoke-free environments, access to cessation treatments, and public awareness campaigns, ultimately leading to a substantial decrease in smoking prevalence and its associated health risks.

In terms of income level, lower SES is consistently associated with a higher incidence of certain cancers, poorer prognosis, and reduced access to screening and treatment (Heidary et al., 2013). Common knowledge is that individual-level poverty is associated with substantial cancer risk due to increased exposure to carcinogens, low educational attainment, and lack of access to care. It has been established that the poor tend to suffer worse health and die at a younger age than their more counterparts; they have a higher incidence of a child and maternal mortality rate, a higher incidence of diseases, and more inadequate access to health care and social protection (Anon, 2003). Socioeconomic status (SES) is associated with a range of health outcomes, including cancer diagnosis and survival. (Ruan et al., 2024) conducted a study on the relationships between neighborhood-level income, cancer stage at diagnosis, and cancer-specific mortality in Alberta, Canada; the investigators found that lower income quintiles had significantly worse cancer-specific survival for breast, colorectal, liver, lung, nonHodgkin lymphoma, oral cavity, pancreas, and prostate cancers. Disparities were observed in cancer outcomes across neighborhood-level income groups, which demonstrates that health inequities by SES exist and are threat to public health.

The study's findings will be significant to the extent that they can highlight the public health need for increased cancer awareness programs for Mexican migrants at the US- Mexico border and in all other populations where smoking, lack of education and

sub-par income level pose a threat to public health. Those findings will be very useful to better understand the underlying causes of increased cancer risks in similar populations and to develop strategies to mitigate SES disparities in such communities.

Conclusion

The purpose of this quantitative correlational study was to examine the potential association between smoking, education and income levels with cancer, while controlling age and gender. As I mentioned earlier in this manuscript, cancer is one of the most prominent and significant public health issues. It is a leading cause of death worldwide and in the United States, and it poses a substantial burden on individuals, families, communities, and healthcare systems (NCI, 2025). Unfortunately, cancer's impact on public health will continue to grow as the US population ages and some cancer incidence rates rise. Cancer disproportionately affects certain populations, contributing to health disparities. The analysis of the findings of this study, using secondary data from the Mexican Migrant Project led to the acceptation of the Null hypothesis for the association of smoking and income level with cancer in the Mexican migrant population at the US/Mexico border, while supporting an association with low educational level with cancer. Based on the findings of several studies, cancer is a significant health concern among Mexican migrants in the U.S. There are currently over 34 million people of Mexican origin in the US, comprising 11% of the US population (Gonzalez-Barrera & Lopez, 2013). In an interconnected, globalized world, risk factors and cancer control are increasingly moving in tandem; effective efforts in combatting cancer, both in terms of research as well as medical practice, may be best accomplished with stronger research partnerships between the United States and Mexico (Gonzalez-Barrera & Lopez, 2013).

The findings from the current study demonstrate the importance of public health guided cancer bilingual educational programs and interventions for the Mexican migrant community that are based on the constructs of the HBM. I hope that this study will be a noticeable contributor in reducing the burden of cancer. I hope that further research along the same line will lead to the development of effective cancer prevention strategies such as (like those against HPV) and lifestyle interventions (like smoking cessation and healthy diet). Finally, my hope is that the research findings from this study can be used to inform policy decisions and advocate for policies that promote equity in cancer care, such as improving access to screening and treatment in the vulnerable populations.

References

Agyemang, C., & van den Born, B. J. (2019). Non-communicable diseases in migrants: An expert review. *Journal of Travel Medicine*, *26*(2), 107. https://doi.org/10.1093/jtm/tay107

Alarcon, F. J. (2022) The migrant crisis and access to health care. *Dela Journal of Public Health, 8*(4), 20–25. https://doi.org/10.32481/djph.2022.10.006

Alley, A. B., Seo, J. W., & Hong, S. T. (2015) Reporting results of research involving human subjects: An ethical obligation. *Journal of Korean Medical Science, 30*(6), 673–675. https://doi.org/10.3346/jkms.2015.30.6.673

Allison, P. D. (2000). Multiple imputation for missing data: A cautionary tale. *Sociological Methods & Research, 28*(3), 301–309.

Alyafei A, Easton-Carr R. The Health Belief Model of Behavior Change. [Updated 2024 May 19]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK606120/

American Cancer Society Cancer Action Network. (2022, October 19). *The cost of cancer in the Hispanic/Latino community.* https://www.fightcancer.org/policyresources/costs-cancerhispaniclatinocommunity-0

American Institute of Cancer Research. (2022, December 13). *Separate cancer myth from cancer facts.* https://www.aicr.org/cancerprevention/healthylifestyle/otherlifestyle-risks/?gad_source=1&gclid=Cj0KCQiAi_G5BhDXARIsAN5SX7qmkKOCESNzixwgZUasMkT128c7oKg2rxRCq37PTrCemJ8Shwp3f8aAviTEALw_wcB#1579723955856-4437ecce-54a4

Andrade, C. (2018). Internal, external, and ecological validity in research design, conduct, and evaluation. *Indian Journal of Psychological Medicine*, *40*(5), 498–499. https://doi.org/10.4103/IJPSYM.IJPSYM_334_18

Appell, G. N. (1998). *Ethical dilemmas in anthropological inquiry: A case book*. Crossroads Press.

Barakat, C., & Konstantinidis, T. A. (2023). Review of the relationship between socioeconomic status change and health. *International Journal of Environmental Research and Public Health, 20*(13), 6249. https://doi.org/10.3390/ijerph20136249

Bener, A. (2017). Health status and working condition of migrant workers: Major public health problems. *International Journal of Preventive Medicine*, *8*, Article 68. https://doi.org/10.4103/ijpvm.IJPVM_396_16

Bonfiglio, G., Rosal, K., Henao-Martínez, A., Franco-Paredes, C., Poeschla, E. M., Moo-Young, J., Seefeldt, T., Dunlevy, H., Haas, M., & Young, J. (2020). The long journey inside immigration detention centres in the USA. *Journal of Travel Medicine*, *27*(7). https://doi.org/10.1093/jtm/taaa083

Boston University School of Public Health. (n.d.). The health belief model. https://sphweb.bumc.bu.edu/otlt/mph modules/sb/behavioralchangetheories/behavioralchangetheories2.html

BravoGutiérrez, O. A., Falfán-Valencia, R., Ramírez-Venegas, A., Sansores, R. H., Hernández-Zenteno, R. d. J., Hernández-Pérez, A., García-Gómez, L., OsioEchánove, J., Abarca-Rojano, E., & Pérez-Rubio, G. (2021). Hypomethylation of *AHRR* (cg05575921) is related to smoking status in the Mexican Mestizo population. *Genes*, *12*(8), 1276.

https://doi.org/10.3390/genes12081276

Castro, H. M., & Ferreira, J. C. (2023). Linear and logistic regression models: When to use and how to interpret them? *Jornal brasileiro de pneumologia: Publicacao oficial da Sociedade Brasileira de Pneumologia e Tisilogia*, *48*(6), Article e20220439. https://doi.org/10.36416/1806-3756/e20220439

Centers for Disease Control and Prevention. (2021). *About immigrant, refugee, and migrant health| immigrant and refugee health*.| https://www.cdc.gov/immigrantrefugeehealth/about-irmh.html

Centers for Disease Control and Prevention. (2022). *Migration and border health.* https://www.cdc.gov/immigrantrefugeehealth/migration-border-health.html

Centers for Disease Control and Prevention. (2024, January 10). *Cancer and Hispanic or Latino People.* https://www.cdc.gov/cancer/healthequity/hispaniclatino.html#:~:text=the%20United%20States.-,Compared%20to%20members%20of%20other%20races%20and%20ethnicities%2C%20Hispanic%20and,after%20non%2DHispanic%20Black%20women

Clegg, L. X., Reichman, M. E., Miller, B. A., Hankey, B. F., Singh, G. K., Lin, Y. D., Goodman, M. T., Lynch, C. F., Schwartz, S. M., Chen, V. W., Bernstein, L., Gomez, S. L., Graff, J. J., Lin, C. C., Johnson, N. J., & Edwards, B. K. (2009) Impact of socioeconomic status on cancer incidence and stage at diagnosis: Selected findings from the surveillance, epidemiology, and end results: National longitudinal mortality study. *Cancer Causes Control, 20*(4), 417–435. https://doi.org/10.1007/s10552-008-9256-0

Connor, A. E., Baumgartner, K. B., Baumgartner, R. N., Pinkston, C. M., Boone, S. D.,

John, E. M., Torres-Mejía, G., Hines, L. M., Giuliano, A. R., Wolff, R. K., & Slattery, M. L. (2021). Cigarette smoking and breast cancer risk in Hispanic and Non-Hispanic White women: The breast cancer health disparities study. *Journal of Women's Health,* 25(3), 299-310. https://doi/10.1089/jwh.2015.5502.

Cooksey, R. W. (2020). Descriptive statistics for summarizing data. In *Illustrating statistical procedures: Finding meaning in quantitative data* (pp. 61–139). Springer Singapore. https://doi.org/10.1007/978-981-15-2537-7_5

Cornell Law School. (2021). *Income*. https://www.law.cornell.edu/wex/income. Dannels, Sharon Anderson. "Research design." The reviewer's guide to quantitative methods in the social sciences. Routledge, 2018. 402-416. Demidenko, E. (2019). *Advanced statistics with applications in R* (Vol. 392). John Wiley & Sons.

Diamond, M. B., Testa, L., Novak, C., Kempton-Amaral, K., Porteny, T., & Olayo Méndez, A. (2020). *A population in peril: A health crisis among asylums seekers on the northern border of Mexico*. Harvard Global Health Institute.

Donahoe, J.T., McGuire, T.G. The vexing relationship between socioeconomic status and health. Isr J Health Policy Res 9, 68 (2020). https://doi.org/10.1186/s13584-020-00430-0

Donders, A. R. T., Van Der Heijden, G. J., Stijnen, T., & Moons, K. G. (2006). A gentle introduction to imputation of missing values. Journal of clinical epidemiology, 59(10), 1087-1091.

Fisher R, Pusztai L, Swanton C. Cancer heterogeneity: implications for targeted therapeutics. Br J Cancer. 2013 Feb 19;108(3):479-85. doi: 10.1038/bjc.2012.581. Epub 2013 Jan 8. PMID: 23299535; PMCID: PMC3593543.

Galway, L., Bell, N., Sae, A. S., Hagopian, A., Burnham, G., Flaxman, A., Weiss, W. M., Rajaratnam, J., & Takaro, T. K. (2012). A two-stage cluster sampling method using gridded population data, a GIS, and Google Earth(TM) imagery in a population-based mortality survey in Iraq. *International Journal of Health Geographics, 11*, 1–9. https://doi.org/10.1186/1476-072X-11-12

Garner P, Hopewell S, Chandler J, MacLehose H, Schünemann HJ, Akl EA, Beyene J, Chang S, Churchill R, Dearness K, Guyatt G, Lefebvre C, Liles B, Marshall R, Martínez García L, Mavergames C, Nasser M, Qaseem A, Sampson M, SoaresWeiser K, Takwoingi Y, Thabane L, Trivella M, Tugwell P, Welsh E, Wilson

EC, Schünemann HJ; Panel for updating guidance for systematic reviews (PUGs). When and how to update systematic reviews: consensus and checklist. BMJ. 2016 Jul 20;354:i3507. doi: 10.1136/bmj.i3507. Erratum in: BMJ. 2016 Sep 06;354:i4853. doi: 10.1136/bmj.i4853. PMID: 27443385; PMCID: PMC4955793.

Guerrero, N., Zhang, X., Rangel, G., Gonzalez-Fagoaga, J .E., & Martinez-Donate, A. (2016). Cervical and breast cancer screening among Mexican migrant women. *Preventing Chronic Disease,* 13:160036.

https://doi.org/10.5888/pcd13.160036external icon.

Gonzalez-Barrera A, Lopez MH. A demographic portrait of Mexican-origin Hispanics in the United States. Washington, DC: Pew Hispanic Center; 2013

Gupta A, Wilson LE, Pinheiro LC, Herring AH, Brown T, Howard VJ, Akinyemiju TF. Association of educational attainment with cancer mortality in a national cohort study of black and white adults: A mediation analysis. SSM Popul Health. 2023

Oct 26;24:101546. doi: 10.1016/j.ssmph.2023.101546. PMID: 37954012; PMCID: PMC10637994.

Gutierrez-Torres, D. S., Brochier, M., Stern, D., Cortes-Valencia, A., Hernandez-Avila, J. E., Morales-Carmona, E., Barrientos-Gutierrez, T., Inoue-Choi, M., Lajous, M., & Freedman, N. D. (2024). Low-intensity daily smoking and mortality risk factors among Mexican women. *Tobacco Control,* 33(6), 752-759. https://doi.org/10.1136/tc-2022-057839.

Hansen, E., & Donohoe, M. (2003). Health issues of migrant and seasonal farm workers. *Journal of Health care for the Poor and Underserved*, *14*(2), 153–164. https://doi.org/10.1353/hpu.2010.0790

Harrison JA, Mullen PD, Green LW. A meta-analysis of studies of the Health Belief Model with adults. Health Educ Res. 1992 Mar;7(1):107-16

Hayden, J. (2019). *Introduction to health behavior theory*. Jones & Bartlett Learning.

IBM. (2023). *IBM SPSS Statistics for Windows*. https://alaureatena.sharepoint.com/sites/waldenuniversity/studentdocuments/spss/Pages/default.aspx

Heidary F, Rahimi A, Gharebaghi R. Poverty as a risk factor in human cancers. Iran J Public Health. 2013 Mar 1;42(3):341-3. PMID: 23641414; PMCID: PMC3633807.

Janz NK, Becker MH. The Health Belief Model: a decade later. Health Educ Q. 1984 Spring;11(1):1-47.

John, E. M., Phipps, A. I., Davis, A., & Koo, J. (2005). Migration history, acculturation, and breast cancer risk in Hispanic women. Cancer epidemiology, biomarkers &

prevention : a publication of the American Association for Cancer Research, cosponsored by the American Society of Preventive Oncology, 14(12), 2905–2913. https://doi.org/10.1158/1055-9965.EPI-05-0483

Kaczmarczyk, P., & Massey, D. S. (2019). The ethnosurvey revisited: New migrations, new methodologies. *Central and Eastern European Migration Review*, *8*(2), 9–38. https://doi.org/10.17467/ceemr.2019.15

Kale S, Hirani S, Vardhan S, Mishra A, Ghode DB, Prasad R, Wanjari M. Addressing Cancer Disparities Through Community Engagement: Lessons and Best Practices. Cureus. 2023 Aug 14;15(8):e43445. doi: 10.7759/cureus.43445. PMID: 37711952; PMCID: PMC10498131.

Kam BS, Lee SY. Integrating the health belief model into health education programs in a clinical setting. World J Clin Cases. 2024 Nov 26;12(33):6660-6663. doi: 10.12998/wjcc.v12.i33.6660. PMID: 39600476; PMCID: PMC11514333.

Kemal, Ö. (2020). Power analysis and sample size, when and why? *Turkish Archives of Otorhinolaryngology*, *58*(1), 3–4. https://doi.org/10.5152/tao.2020.0330 Kang H. The prevention and handling of the missing data. Korean J Anesthesiol. 2013 May;64(5):402-6. doi: 10.4097/kjae.2013.64.5.402. Epub 2013 May 24. PMID: 23741561; PMCID: PMC3668100.

LaMorte, W. (2022). *The health belief model*. Boston University School of Public Health. https://sphweb.bumc.bu.edu/otlt/MPHModules/SB/BehavioralChangeTheories/BehavioralChangeTheories2.html

LaPelusa, M., Verduzco-Aguirre, H., Diaz, F., Fernando, A., & Soto-Perez-de-Celis, E. (2023). Cross-border utilization of cancer care by patients in the US and Mexico – a survey of Mexican oncologist. *Globalization and Health,* 19(78).

https://doi.org/10.1186/s12992-023-00983-0

Lee, A. R. S., Rodriquez, E. J., Gallo, L. C., Giachello, A. L., Isasi, C. R., Perreira, K. M., Daviglus, M. L., Kaplan, R. C., Talavera, G. A., Perez-Stable, E. J., & Oren, E. (2023). Acculturation level and change in cigarette consumption behaviors among diverse Hispanics/Latinos: the Hispanic community health study/study of Latinos, *Annals of Epidemiology,* 84(33-40). https://doi.org/10.1016/j.annepidem.2023.05.005.

Lin, C. Y., & Yeh, W. J. (2017). How does health-related advertising with regulatory focus and goal framing affect attitudes toward ads and healthy behavior intentions? *International Journal of Environmental Research and Public Health 14*(12), Article 1507. https://doi.org/10.3390/ijerph14121507

Li P, Stuart EA, Allison DB. Multiple Imputation: A Flexible Tool for Handling Missing Data. JAMA. 2015 Nov 10;314(18):1966-7. doi: 10.1001/jama.2015.15281. PMID: 26547468; PMCID: PMC4638176.

Little, W. (2014). *Introduction to Sociology – 1st Canadian Edition.* BCcampus.

Martinez-Donate, A. P., Rangel, G., Correa, C., Bakely, L., Gonzalez-Fagoaga, J. e., Gonzalez, A. A., Amuedo-Dorantes, C., Zhang, X., Magis-Rodriguez, C., LeScherban, F., Guendelman, S., & parrado, E. (2023). The next phase of the Migrante project: Study protocol to expand an observatory of migrant health on the Mexico – U.S. border. *Frontiers in Public Health,* 11:1032420. https://doi.org/10.3389/fpubh.2023.1032420

Liu XY, Zhang X, Ruan GT, Zheng X, Chen Y, Zhang XW, Liu T, Ge YZ, Shi HP; INSCOC Group. Relationship between educational level and survival of patients with cancer: A multicentre cohort study. Cancer Med. 2024 Apr;13(7):e7141. doi: 10.1002/cam4.7141. PMID: 38545856; PMCID: PMC10974719.

Masoudiyekta L, Rezaei-Bayatiyani H, Dashtbozorgi B, Gheibizadeh M, Malehi AS, Moradi M. Effect of Education Based on Health Belief Model on the Behavior of Breast Cancer Screening in Women. Asia Pac J Oncol Nurs. 2018 JanMar;5(1):114-120. doi: 10.4103/apjon.apjon_36_17. PMID: 29379843; PMCID: PMC5763428

Medical Dictionary Online. (n.d.). *Marital status*. https://www.onlinemedicaldictionary.org/definitions-m/marital-status

Medina, P., Maia, A. C., & Costa, A. (2022). Health literacy and migrant communities in primary health care. *Frontiers in Public Health*, *9*, Article 798222. https://doi.org/10.3389/fpubh.2021.798222

Mexican Migrant Project. (2021). https://mmp.opr.princeton.edu/home-en.aspx https://mmp.research.brown.edu/images/pers-codebook-mmp174-.pdf

Mishra, P., Pandey, C. M., Singh, U., Gupta, A., Sahu, C., & Keshri, A. (2019). Descriptive statistics and normality tests for statistical data. *Annals of Cardiac Anesthesia*, *22*(1), 67–72. https://doi.org/10.4103/aca.ACA_157_18

Moore, J. R., Guerra, Z. C., Heydarian, N. M., Londono, T., & Castro, Y. (2022). Associations of positive and negative affect on health risk behaviors among Latinos. *Health Psychology, 41*(2), 145–154. https://doi.org/10.1037/hea0001165

Mouw T, Koster A, Wright ME, Blank MM, Moore SC, Hollenbeck A, Schatzkin A. Education and risk of cancer in a large cohort of men and women in the United States. PLoS One. 2008;3(11):e3639. doi: 10.1371/journal.pone.0003639. Epub 2008 Nov 4. PMID: 18982064; PMCID: PMC2572908.

Moyce, S. C., & Schenker, M. (2018). Migrant workers and their occupational health and safety. *Annual Review of Public Health*, *39*, 351–365. https://doi.org/10.1146/annurev-publhealth-040617-013714

O'Brien, S. F., & Yi, Q. L. (2016). How do I interpret a confidence interval?. *Transfusion*, *56*(7), 1680–1683. https://doi.org/10.1111/trf.13635

Organization for Economic Co-operation and Development. (2014). DAC guidelines and reference series. http://dx.doi.org/10.1787/9789264183636-en

Panahi, R., Hosseini, N., Ramezankhani, A., Anbari, M., Amjadian, M., Dehghankar, L., & Niknami, S. (2022). Measuring the structures of the health belief model integrated with health literacy in predicting university students' adoption of smoking preventive behaviors. *Journal of Preventive Medicine and Hygiene,* 63(1), E51-E58. https://doi/10.15167/2421-4248/jpmh2022.63.1.2236

Patino, C. M., & Ferreira, J. C. (2018). Internal and external validity: can you apply research study results to your patients?. *Jornal brasileiro de pneumologia : publicacao oficial da Sociedade Brasileira de Pneumologia e Tisilogia*, *44*(3), Article 183. https://doi.org/10.1590/S1806-37562018000000164

Pennsylvania State University. (n.d.). *Two categorical variables*. Stat Online. https://online.stat.psu.edu/stat200/book/export/html/38#:~:text=A%20stacked%20bar%20chart%20is,%2C%20segments)%20of%20each%20bar.

Perez de Celis, E. S. (2024). Cancer care for refugees and displaced people: a looming humanitarian crisis. *Mexican Gazette of Oncology,* 23(1). https://doi.org/10.24875/j.gamo.m24000264

Pinheiro, P. S., Callahan, K. E., Stern, Mariana, M. C., & deVries, E. (2017). Migration from Mexico to the United States: A high-speed cancer transition. *International Journal Cancer,* 142(3), 477-488. https://doi.org/10.1002/ijc.31068

Pinheiro LC, Reshetnyak E, Akinyemiju T, Phillips E, Safford MM. Social determinants of health and cancer mortality in the Reasons for Geographic and Racial Differences in Stroke (REGARDS) cohort study. Cancer. 2022 Jan 1;128(1):122-130. doi: 10.1002/cncr.33894. Epub 2021 Sep 3.

Princeton University. (n.d.). *MMP174*. OPR Data Archive. https://oprdata.princeton.edu/archive/mmp/

Pribadi, E. T., & Devy, S. R. (2020). Application of the Health Belief Model on the intention to stop smoking behavior among young adult women. *Journal of Public Health Research*, *9*(2), 1817. https://doi.org/10.4081/jphr.2020.1817

https://ir.princeton.edu/data/princeton-university-survey-guidelines Quandt, S. A., Groeschel-Johnson, A., Kinzer, H. T., Jensen, A., Miles, K., O'Hara, H. M., Chen, H., & Arcury, T. A. (2018). Migrant farmworker nutritional strategies: Implications for DM. *Journal of Agromedicine*, *23*(4), 347–354. https://doi.org/10.1080/1059924X.2018.1501453

Ravi, K., Indrapriyadharshini, K., & Madankumar, P. D. (2021). Application of Health Behavioral Models in Smoking Cessation - A Systematic Review. *Indian journal of public health*, *65*(2), 103–109. https://doi.org/10.4103/ijph.IJPH_1351_20

Rawl, S. M., Maupome, G., Golzarri-Arroyo, L., Parker, E., O'Leary, H.,

EspinozaGutarra, M. R., Valenzuela, R. E., Malloy, C., Haunert, L., & Haggstrom, D. A. (2023). Factors associated with cancer prevention/risk reduction behaviors among

Latinos. *Journal of Racial and Ethnic Health Disparities.* https://doi.org/10.1007/s40615-023-01895-w

Ronda Pérez, E., Benavides, F. G., Levecque, K., Love, J. G., Felt, E., & Van Rossem, R. (2012). Differences in working conditions and employment arrangements among migrant and non-migrant workers in Europe. *Ethnicity & Health*, *17*(6), 563–577. https://doi.org/10.1080/13557858.2012.730606

Rosenstock, I. M., (1974). Historical origins of the health belief model. *Health Education Monographs,* 2(4), 328-335. https://doi.org/10.1177/109019817400200403

Rosenstock, I. M. (1966). Why people use health services. *The Milbank Memorial Fund Quarterly*, *44*(3), 94–127. https://doi.org/10.1111/j.1468-0009.2005.00425.x

Rosenstock, I. M. (1974). Historical origins of the health belief model. *Health Education Monographs*, *2*(4), 328–335. https://doi.org/10.1177/109019817400200403

Rosenstock, I. M., Stretcher, V. J., & Becker, M. H. (1988). Social learning theory and the health belief model. *Health Education Quarterly*, *15*(2), 175–183. https://doi.org/10.1177/109019818801500203

Rota, M., Possenti, I., Valsassina, V., Santucci, C., Bagnardi, V., Corrao, G., Bosetti, C., Specchia, C., Gallus, S., & Lugo, A. (2024). Dose-response association between cigarette smoking and gastric cancer risk: a systematic review and meta-analysis. Gastric Cancer: Official Journal of the International Gastric Cancer Association and the Japanese Gastric Cancer Association, 27(2), 197–209.

https://doi.org/10.1007/s10120-023-01459-1

Ruan Y, Heer E, Warkentin MT, Jarada TN, O'Sullivan DE, Hao D, Ezeife D, Cheung W, Brenner DR. The association between neighborhood-level income and cancer stage at diagnosis and survival in Alberta. Cancer. 2024 Feb 15;130(4):563-575. doi: 10.1002/cncr.35098. Epub 2023 Nov 22. PMID: 37994148.

Ruegg TA. Historical Perspectives of the Causation of Lung Cancer: Nursing as a Bystander. Glob Qual Nurs Res. 2015 May 14;2:2333393615585972. doi: 10.1177/2333393615585972.

Rural Health Information Hub. (2020). *Self-management model*. https://www.ruralhealthinfo.org/toolkits/diabetes/2/selfmanagement#:~:text=Diabetes%20self%2Dmanagement%20typically%20occurs,Drinking%20water%20and%20avoiding%20dehydration

Russell KM, Champion VL, Skinner CS. Psychosocial factors related to repeat mammography screening over 5 years in African American women. Cancer Nurs. 2006 May-Jun;29(3):236-43

Sanchez, M., Romano, E., Wang, W., Barton, A., Ali, B., Villalba, K., & Westick, A. (2021). Pre- and post-immigration factors associated with cigarette use among young adult recent Latinx immigrants during their initial year in the U.S. *The American Journal of Drug and Alcohol Abuse*, *48*(1), 17–26. https://doi.org/10.1080/00952990.2021.1913601

Scala, M., Bosetti, C., Bagnardi, V., Possenti, I., Specchia, C., Gallus, S., & Lugo, A. (2023). Dose-response relationships between cigarette smoking and breast cancer risk: a systematic review and meta-analysis. *Journal of Epidemiology,* 33(12), 640-648. https://doi.org/10.2188/jea.JE20220206.

Schane RE, Ling PM, Glantz SA. Health effects of light and intermittent smoking: a review. Circulation. 2010;121(13):1518–1522 [https://doi.org/10.1161/CIRCULATIONAHA.109.904235]

Sharifikia I, Rohani C, Estebsari F, Matbouei M, Salmani F, Hossein-Nejad A. Health Belief Model-based Intervention on Women's Knowledge and Perceived Beliefs about Warning Signs of Cancer. Asia Pac J Oncol Nurs. 2019 Oct-Dec;6(4):431-439. doi: 10.4103/apjon.apjon_32_19. PMID: 31572765; PMCID: PMC6696815.

Sharman R, Harris Z, Ernst B, Mussallem D, Larsen A, Gowin K. Lifestyle Factors and Cancer: A Narrative Review. Mayo Clin Proc Innov Qual Outcomes. 2024 Mar 4;8(2):166-183. doi: 10.1016/j.mayocpiqo.2024.01.004. PMID: 38468817; PMCID: PMC10925935.

Serdar, C. C., Cihan, M., Yücel, D., & Serdar, M. A. (2021). Sample size, power and effect size revisited: simplified and practical approaches in pre-clinical, clinical and laboratory studies. *Biochemia Medica*, *31*(1), Article 010502. https://doi.org/10.11613/BM.2021.010502

Soto DW, Unger JB, Pattarroyo M, Meca A, Villamar JA, Garcia MF, Schwartz SJ. ¡Pásale!: Gaining Entrance to Conduct Research and Practice With Recent Hispanic Immigrants: Lessons Learned From the COPAL Study. Front Public Health. 2022 May 6;10:879101. doi: 10.3389/fpubh.2022.879101. PMID: 35602133; PMCID: PMC9120638.

Systematic literature review. Journal of Public Health Research, 10(2), Article jphr-2021. https://doi.org/10.4081/jphr.2021.2240

Tong E, Saito N, Tancredi DJ, Borges G, Kravitz RL, Hinton L, Aguilar-Gaxiola S, Medina-Mora ME, Breslau J. A transnational study of migration and smoking behavior in the Mexican-origin population. Am J Public Health. 2012 Nov;102(11):2116-22. doi: 10.2105/AJPH.2012.300739. Epub 2012 Sep 20. PMID: 22994190; PMCID: PMC3477978.

Tsai, M. C., Chuang, H. L., Huang, C. Y., Lee, S. H., Liao, W. C., Lee, M. C., & Kuo, C. *Health*, *18*(13), Article 7207. https://doi.org/10.3390/ijerph18137207 United States Department of Health and Human Services Office of Minority Health. (2018). *Diabetes and Hispanic Americans.* https://minorityhealth.hhs.gov/omh/browse.aspx?lvl=4&lvlid=63

University of Toronto. (2003). *Introduction to anthology*. http://individual.utoronto.ca/boyd/anthro4.htm

Van den Broeck, J., Cunningham, S. A., Eeckels, R., & Herbst, K. (2005). Data cleaning: Detecting, diagnosing, and editing data abnormalities. *PLoS Medicine*, *2*(10), Article e267. https://doi.org/10.1371/journal.pmed.0020267

Wagner, W. E. (2020). *Using IBM SPSS statistics for research methods and social science statistics*. SAGE Publications.

Washburn, L. (n.d.). Understanding the health belief model. In *The University of Tennessee System* (pp. 1–4). University of Tennessee. https://extension.tennessee.edu/publications/Documents/W931-C.pdf

White MC, Holman DM, Boehm JE, Peipins LA, Grossman M, Henley SJ. Age and cancer risk: a potentially modifiable relationship. Am J Prev Med. 2014 Mar;46(3 Suppl 1):S7-15. doi: 10.1016/j.amepre.2013.10.029. PMID: 24512933; PMCID: PMC4544764.

Withrow DR, Freedman ND, Gibson JT, Yu M, Nápoles AM, Berrington de González A, Shiels MS. Leading cancers contributing to educational disparities in cancer mortality in the US, 2017. Cancer Causes Control. 2021 Nov;32(11):1193-1196. doi: 10.1007/s10552-021-01471-9. Epub 2021 Jul 9. PMID: 34244895; PMCID: PMC8492562.

World Health Organization. (2023). *Diabetes*. https://www.who.int/healthtopics/diabetes#tab=tab_1

Yeh S. H., Chen P. J. (2010). Gender disparity of hepatocellular carcinoma: the roles of sex hormones. Oncology 78(Suppl. 1), 172–179 10.1159/000315247 [DOI

Yu, L., Liu, L., & Peace, K. E. (2020). Regression multiple imputation for missing data analysis. Statistical methods in medical research, 29(9), 2647-2664.

Yuan, Y. C. (2010). Multiple imputation for missing data: Concepts and new development (Version 9.0). SAS Institute Inc, Rockville, MD, 49(1-11), 12.

Zahm S. H., Fraumeni J. F., Jr. (1995). Racial, ethnic, and gender variations in cancer risk: considerations for future epidemiologic research. Environ. Health Perspect. 103(Suppl. 8), 283–286 10.1289/ehp.95103s8129 [DOI

Appendix: Field-Based Products

Field Based Product #1

Title: Informative Program on Cigarette Smoking for Hispanic Migrants near Border Crossings.

- **Introduction**

Even-though Mexican immigrants in the US tend to have lower cigarette smoking rates than both their US-born Mexican counterparts and individuals in Mexico, the rate of smoking and its association with cancer remains a public health issue of concern (Tong et al., 2012). While the findings from the study that I have just mentioned may suggest that

initial migration might suppress smoking, further studies have found that acculturation into US culture can lead to an increase in smoking rates, particularly for women.

- **Scope of the Problem**

Smoking contributes to a higher prevalence of chronic diseases, increasing healthcare spending and reducing overall economic output. (Navas-Nacher et al., 2015) explains that the economic burden of smoking is significant across various populations, including Hispanic migrants, and encompasses both direct medical costs and indirect costs like lost productivity and premature death. While Hispanic migrants may experience a relatively lower smoking prevalence compared to some other groups in the U.S., the economic impact of smoking within this community still exists and should be considered.

- **Current Approaches**

There are currently no structured approaches to smoking prevention or cessation in the Mexican migrant communities near the border crossings. I feel that the disinterest in creating structured approaches to address the smoking problem and its consequences in Mexican migrants will probably get worse considering the recent significant reduction that has been made in the public health expenses for such communities around the country.

- **Proposed Program or Policy**

To address the smoking problem in the Mexican migrant communities, I propose: 1- Development of anti-smoking support groups in Spanish
2- Speaking at churches and community events where Migrants could attend 3- Exposition of posters in Spanish where they could easily be seen.
4- Effective tobacco control policies, such as increasing cigarette taxes and implementing smoke-free environments, can help reduce smoking rates and lessen the economic burden on Hispanic communities care.

- **Major Constituencies**

It takes a concerted effort to deal with smoking cessation which requires a multifaceted approach that includes individual strategies, support from others, and potentially professional help such as behavioral counselling or even medications. This effort involves identifying triggers, developing coping mechanisms, and seeking support from friends, family, healthcare professionals and the government. The federal government, the state and city governments, the community leaders, the schoolteachers, the faithbased leaders, the primary care practitioners, the non-profit organizations and the public health officials.

- **Conclusions**

Smoking is a community concern due to its widespread negative health impacts and the costs associated with them, affecting both individual smokers and non-smokers alike. I concur with (Mendez et al., 2023) that secondhand smoke poses a health risk to others, and smoking contributes to various preventable diseases and premature deaths.

Field Product #2 Community Health Intervention Plan for An Informative Program on Smoking for Hispanic Migrants near Border Crossings to Reduce Cancer Rates

Problem Definition:

The situation or issue that prompted me to create this Field-Based Product is the serious public health crisis at the United States-Mexico border where individuals escape from various hazardous living conditions in their home country to seek asylum. However, they become vulnerable to chronic health problems, infectious diseases criminal activity, and mental health risks (Diamond et al., 2020), (Pinheiro et al., 2017).

Goal Setting:

The ultimate intention behind the goals is to effectively raise awareness about the link between smoking and cancer. The goals will focus on: 1- Educate about smoking and its consequences

2- Promote prevention/cessation

3- Prevent secondhand smoke exposure

Target Population:

Hispanics, particularly, Mexican migrants at the US/Mexico border

Intervention Strategies:

1- Development of anti-smoking support groups in Spanish

2- Speaking at churches and community events where Migrants could attend 3- Exposition of posters in Spanish where they could easily be seen.

4- Effective tobacco control policies, such as increasing cigarette taxes and implementing smokefree environments, can help reduce smoking rates and lessen the economic burden on Hispanic communities care.

Implementation Plan:

1- Create anti-smoking support groups using influential members in the community within 3 months. They would be educated on smoking and its consequences, and they would be trained to pass this knowledge on to the community members, as well as empower them to make choices to promote smoking prevention or cessation.

2- Connect with the places of worship and the community centers where migrants normally attend within 3 months. I would request time to speak (in Spanish) on smoking and how it is associated with cancer.

3- Deliver the message in Spanish to facilitate the full understanding of at least 50 percent of the target population.

4- Obtain resources within 3 months from the health department and non-profit organizations that are supportive of health education and disease prevention.

5- Assign roles and responsibilities to everyone involved in the implementation of my plan, including the health department workers, the teachers, the faith-based leaders, the community organizers, the politicians.

6- Develop a hyphenated sense of awareness of smoking in the general community within 3 months

7- Create a Hot line for community members to get access to information and encouragement.

Evaluation Plan:

1-Create a robust framework involving clear goals, specific indicators, regular data collection, analysis, and reporting to effectively monitor and evaluate the intervention.

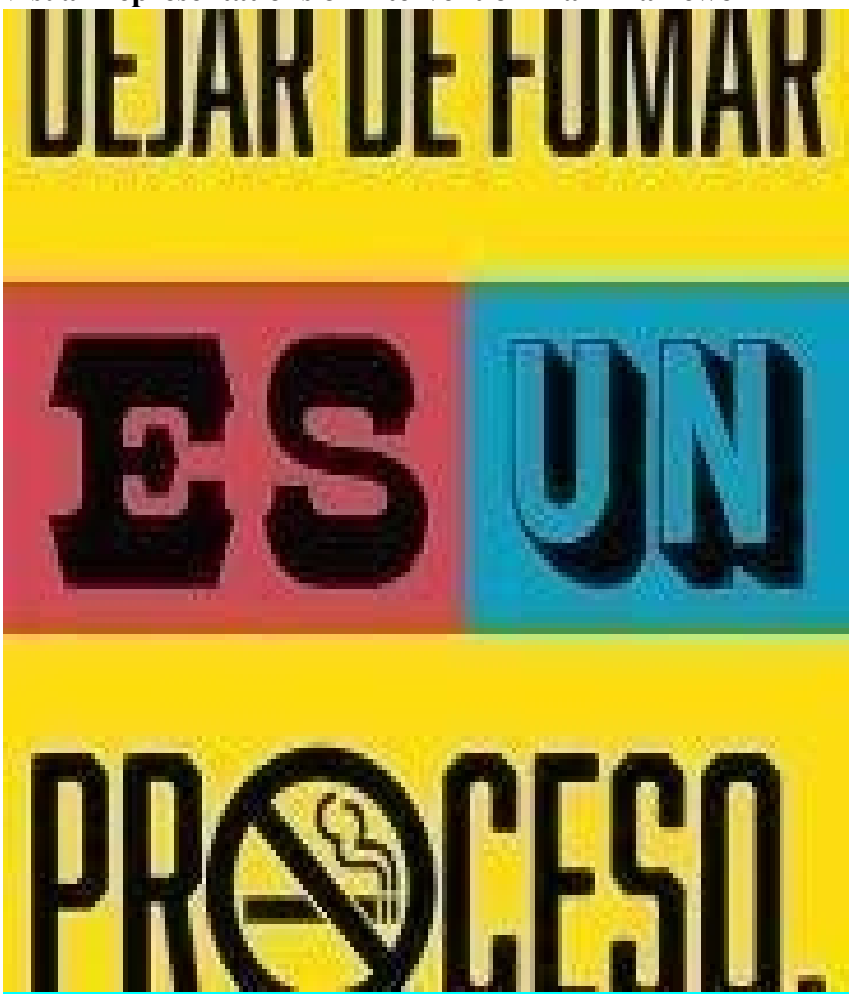
2- Create mechanisms for using the evaluation findings to improve the intervention and ensure it continues to meet its intended purpose.

3-Design Pre- and Post-Assessments: These assessments provide a baseline measure of the community member's skills or behaviors before the intervention, and then again after the intervention is complete. This allows for a comparison to see if progress has been made. 4-Maintain Ongoing Data Collection: This involves tracking progress throughout the intervention period. This could include collecting data on specific behaviors, expected performance, or other relevant factors.

5- Gather Qualitative Data: While numbers are important, I would not underestimate the value of qualitative data. Observations, interviews, and anecdotal notes can provide rich insights into how the individual is experiencing the intervention and the changes they are seeing in themselves.

Field Product #3

Visual Representations of Intervention Plan Framework



Dejar de fumar es un proceso, require practica.

Dejar de fumar es posible.

A menudo se necesitan varios intentos para lograrlo por completo, pero cada vez que lo intenta, aprende más sobre lo que funciona para usted.

Empiece aquí!

Empiece ahora!

Quitting smoking is a process, it requires practice. Quitting smoking is possible. It often requires several attempts to achieve the goal, but every time one attempt is made, the smoker learns more about what works and what does not. The time to start is now.

Un consejero gratuito para dejar de fumar puede:

- Ayudarle a hacer un plan para dejar de fumar que funcione para usted
- Darle consejos sobre cómo manejar los antojos o la abstinencia
- Aconsejarle sobre medicamentos para dejar de fumar
- Informarle sobre otros recursos que le ayudarán a dejar de fumar

Field Product #4
Fact and Information Sheet #1

Fact and Information Sheet #2

References

Diamond, M. B., Testa, L., Novak, C., Kempton-Amaral, K., Porteny, T., & Olayo Méndez, A. (2020). *A population in peril: A health crisis among asylums seekers on the northern border of Mexico*. Harvard Global Health Institute

Institute of Medicine (US) Committee on Health and Behavior: Research, Practice, and Policy. Health and Behavior: The Interplay of Biological, Behavioral, and Societal Influences. Washington (DC): National Academies Press (US); 2001. 7, Evaluating and Disseminating Intervention Research. Available from: https://www.ncbi.nlm.nih.gov/books/NBK43735/

Méndez, D., Alshanqeety, O., & Warner, K. E. (2013). The potential impact of smoking control policies on future global smoking trends. Tobacco control, 22(1), 46-51.

Navas-Nacher EL, Kelley MA, Birnbaum-Weitzman O, Gonzalez P, Ghiachello AL, Kaplan RC, Lee DJ, Bandiera FC, Bangdiwala SI, Barr RG, Daviglus ML. Association between exposure to household cigarette smoking behavior and cigarette smoking in Hispanic adults: Findings from the Hispanic Community Health Study/Study of Latinos. Prev Med. 2015 Aug;77:35-40. doi: 10.1016/j.ypmed.2015.04.011. Epub 2015 Apr 24.

Pinheiro, P. S., Callahan, K. E., Stern, Mariana, M. C., & deVries, E. (2017). Migration from Mexico to the United States: A high-speed cancer transition. *International Journal Cancer,* 142(3), 477-488. https://doi.org/10.1002/ijc.31068

Tong E, Saito N, Tancredi DJ, Borges G, Kravitz RL, Hinton L, Aguilar-Gaxiola S, Medina-Mora ME, Breslau J. A transnational study of migration and smoking behavior in the Mexican-origin population. Am J Public Health. 2012 Nov;102(11):2116-22. doi: 10.2105/AJPH.2012.300739. Epub 2012 Sep 20

Zahm S. H., Fraumeni J. F., Jr. (1995). Racial, ethnic, and gender variations in cancer risk: considerations for future epidemiologic research. Environ. Health Perspect. 103(Suppl. 8), 283–286 10.1289/ehp.95103s8129 [DOI