MEDICAL UNIVERSITY
OF OHIO

COLLEGE OF GRADUATE STUDIES

FINAL APPROVAL OF SCHOLARLY PROJECT
Master of Science in Biomedical Sciences
Concentration in Physician Assistant Studies

Assessing the Public's Knowledge of the Effects of Second-hand Smoke

Submitted by

Emily Voorhees

In partial fulfillment of the requirements for the degree of
Master of Science in Biomedical Sciences

Date of Presentation:

December 15, 2005

Academic Advisory Committee

Major Advisor
Christopher Bork, Ph.D., P.T.

Department Chairperson
Patricia Hogue, M.S., PA-C

Dean, College of Health Sciences
Christopher E. Bork, Ph.D., P.T.

Dean, College of Graduate Studies
Keith K. Schlender, Ph.D.

Assessing The Public's Knowledge of the Effects of Second-hand Smoke

Emily Voorhees
Advisor: Christopher Bork Ph.D.

Medical University of Ohio

Acknowledgements

Wal-Mart, my survey site

Susan Nichols, my encouragement

Dr. Christopher Bork, my thesis advisor

Table of Contents

Introduction

According to the American Heart Association, there are an estimated 25.6 million men (25.2 percent of the population) and 22.6 million women (20.7 percent) in the United States (US) that smoke cigarettes (AHA, 2004). In 2000, the Center for Disease Control (CDC) reported that 27% of percent of Lucas County residents are daily smokers (CDC, 2000). These are very concerning figures considering that tobacco use is the most preventable cause of disease and premature death in the United States, causing more than 440,000 deaths each year (NCCDPHP, 2004). There is a link between smoking and heart disease, cancer, stroke, and chronic obstructive pulmonary disease (COPD); which are the four leading causes of death among adults in the United States, (CDC, 2005). The CDC estimates that more than 8.6 million people in the US have at least one serious illness caused by smoking. In addition it is estimated that if the current smoking rates continue, 6.4 million people younger than 18 will die prematurely of a tobacco-related disease. The CDC also estimates that over the last 40 years, 12 million deaths can be attributed to cigarette smoking, including 4 million from cancer, 5.5 million from cardiovascular diseases, 2 million from respiratory disorders, and 100,000 infant deaths from mother's smoking during pregnancy (CDC, 2005).

Toxic and Carcinogenic Agents Found in Cigarette Smoke

Cigarette smoke contains over 4,000 compounds and includes such chemicals as formaldehyde, ammonia, hydrogen cyanide, arsenic, lead, and nicotine. All of these compounds are known or suspected to contribute to adverse health effects, including mutagens, systemic and reproductive toxicants, and eye and respiratory irritants. Fifty of the compounds found in cigarette smoke are identified by the International Agency for Research on Cancer as a known or probable carcinogen to humans (IARC, 1992). Second-hand smoke (SHS) is thought to include

these same compounds, because it is produced by the same processes. SHS is created during the burning of tobacco products. The principal contributor to SHS is the smoke emitted from the burning end of the cigarettes between puffs. When a cigarette is smoked, approximately half of the smoke (by weight) is emitted from the cigarette at this time. This smoke is also considered a component of SHS.

Second-hand Smoke

It is estimated that 22% of cancer deaths in women and 45% of cancer deaths in men can be attributed to smoking cigarettes (Shopland et al, 1991). Smoking is an established cause of cancers of the lung, larynx, oral cavity, esophagus, and bladder, and a probable cause of cancer of the kidney, pancreas, stomach, and cervix. It is also associated with the development of heart disease (IARC, 1992). These adverse effects associated with smoking have become well known, but there are also detrimental effects associated with exposure to second hand smoke that are not as well known. In 1986 the International Agency for Research on Cancer concluded:

> "Knowledge of the nature of sidestream and mainstream smoke, of the materials absorbed during 'passive' smoking, and of the quantitative relationships between dose and effect that are commonly observed from exposure to carcinogens, however, leads to the conclusion that passive smoking gives rise to some risk of cancer."(Pg 65)

In 1991 second hand smoke was classified as a human carcinogen by the US Environmental Protection Agency (US EPA, 1992). This report classified SHS as a Group A carcinogen, which means that there is sufficient evidence that the substance causes cancer in humans. The designation as a "Group A carcinogen" has been given by the EPA to only 15 other pollutants, and tobacco is the only substance that has been shown to cause cancer at typical

environmental levels (US EPA, 1992). This conclusion was arrived at after multiple analyses of epidemiological studies from eight different countries which examined the association between smoking and lung cancer in women that never smoked but whose husbands did.

On the basis of the most recent data from the National Health Interview Survey, the national average of people who are active smokers is 21.4% (CDC Natl. Health Interview Survey, 2004). The National Health and Nutrition Examination Survey conducted between 1988 and 1991 found that 90% of non-smokers have detectable levels of serum cotinine, a component of cigarette smoke. This suggests that as much as 65% of the national non-smoking population is exposed to SHS (Pirkle, 1996). Thirty-four percent of Lucas County adults report being exposed to SHS in 1999 (ACS, 2002).

There have been many campaigns lately designed to promote the public's awareness of the effects of smoking and exposure to SHS, such as television advertising and surgeon general warnings. This has helped to promote knowledge about SHS, but much more knowledge is needed. Many people know that there is a causal relationship between smoking and lung cancer. It is unlikely though that they are aware of the other effects of smoking. It is even more unlikely that the general public is aware of the many effects of SHS. Because there are many adverse effects of SHS, it is important for the public to be aware of what exposure to SHS can do.

Problem Statement

It is unclear what the public knows about the risk and dangers of SHS. There have been large surveys conducted in Great Britain and in Canada to discover what the public knows about SHS and the associated health problems, but there has never been a similar study conducted in the United States. The purpose of this pilot study was to determine what the public knows about SHS.

Literature Review

Second Hand Smoke and Lung Cancer

Lung cancer is the most well-documented and most concerning effect of both active smoking and exposure to second hand smoke. It has a very high mortality rate and is the number one killer of all cancers. An estimated 174,000 people developed lung cancer in 2004, with an estimated 160,000 dying from the disease (ACS, 2004). Active smoking has long been known to be the leading cause of lung cancer. Compared to non-smokers, men who smoke are about 23 times more likely to develop lung cancer, and women who smoke are about 13 times more likely. Smoking causes about 90% of lung cancer deaths in men and 80% in women (CDC, 2004). There have been many studies that have reported a relationship between second hand smoke exposure and lung cancer. In particular, there were three influential studies performed in 1981 which exhibited this relationship and started a trend of examining the effects of second hand smoke. The first was performed by Hirayama in Japan and reported that there was an increased incidence of lung cancer among non-smoking wives of smoker husbands. The relative risk (RR) for the wife to develop lung cancer whose husband smoked more than 20 cigarettes a day was 1.93 (Hirayama, 1981). At the same time, a study in Greece reported similar results, with a wife's RR of developing lung cancer being 3.4 if her husband smoked more than 20 cigarettes a day (Trichopoulos, 1981). A study was also performed by the American Cancer Society and found that the RR for wives whose husbands smoked 20 or more cigarettes a day was 1.10 (Garfinkel, 1981). Since the time of these reports, there have been many studies that demonstrate the cause and effect relationship between SHS and the development of lung cancer.

In 1992 Stockwell et al. conducted a retrospective, population-based study of lifetime non-smoking women who had been diagnosed with primary lung cancer. The subjects were

asked about their exposure to SHS from husbands, parents, siblings, and coworkers. There was also a control group of women who were lifetime non-smokers and who did not have lung cancer. Compared to the women who had no household SHS exposure, women who were ever exposed to their husbands' smoking had odds ratios (ORs) of 1.6, and women who were exposed to 40 years or more of smoking had ORs of 2.2. Women who experienced 22 years or more of SHS exposure from all household members combined during childhood/adolescence showed a significantly increased OR for lung cancer (OR = 2.4). The elevated risks associated with SHS exposure were observed for all lung cancer cell types, but the risk was higher for all other cell types than adenocarcinoma (Stockwell et al., 1992). This correlates with the fact that adenocarcinoma is the most common lung cancer found in non-smokers (emedicine, 2005).

In 1992 Brownson et al. performed a population based study of women who were diagnosed with primary lung cancer. The population studied included lifetime non-smokers or ex-smokers who had quit smoking at least 15 years prior to being diagnosed with lung cancer. There was also a control group of lifetime non-smokers that did not have lung cancer. These women were interviewed about their exposure to SHS. In an analysis restricted to lifetime non-smokers, there was no increase in risk of lung cancer in women that were exposed to less than 40 pack years exposure to spousal smoking. However, upon analyzing data of women who were exposed to more than 40 pack years of spousal smoking, there was an OR of 1.3 (Brownson et al., 1992).

A well known and often referenced study performed by Fontham et al. in 1994 concluded that there was a significantly increased risk of developing lung cancer in spouses of smokers, and also for people who are exposed to SHS in the workplace and social situations. Being exposed to spousal smoking was associated with a significantly increased risk of

developing lung cancer, with an OR of 1.29 for ever being exposed to a spouses' smoking and 1.79 for being exposed to 80 pack years or more of spousal smoking. Another significant finding was that being exposed to other sources (besides spousal) of SHS was also associated with an increased OR for developing lung cancer. When all sources of adult SHS exposure were taken into consideration, women who were exposed to 48 years or more of SHS had an OR of 1.74 when compared to women with no SHS exposure (Fontham et al., 1994)

In 1993 Liu et al. conducted a hospital-based study of patients that had been diagnosed with primary lung cancer. The main role of this study was to investigate the role on indoor pollution on risk of lung cancer development in smokers and non-smokers. Compared to non-smokers with no SHS exposure, subjects who had been exposed to 20+ cigarettes per day of spousal smoking had an OR of 2.9 for development of lung cancer. Risk of lung cancer was also increased in association with living in a house with poor air circulation (Liu et al., 1993).

Ko et al. conducted a hospital-based survey in 1997 of men and women in Taiwan who had been diagnosed with primary lung cancer. The subjects were asked about their exposure to second hand smoke from their spouses. When compared to non-smoking controls, there was an increased, though not statistically significant, OR of 1.3 for developing lung cancer (Ko et al, 1997).

In another study about the effects of spousal smoking on lung cancer, Cadrenas et al. concluded that there was an increased relative risk of 1.2 for non-smoking women who were married to smokers to develop lung cancer. More significantly though, the more cigarettes the spouse smoked, the higher the wife's RR of developing lung cancer was. The wife's relative risk of developing lung cancer was 1.1, 1.2, and 1.9 if the husband smoked between 1 and 19, 20-39, and 40+ cigarettes a day, respectively (Cadrenas et al., 1997).

A literature review performed in 1994 concluded that taking all studies together, there was a 20-30% increase and statistically significant risk for non-smokers married to smokers to develop lung cancer (Pershagen, 1994). A study published in 1993 found that food service workers appear to be 50% percent more likely to develop lung cancer than the rest of the population, largely because of their exposure to SHS on the job (Seigel, 1993).

Even if a person is not married to a smoker, he or she may be exposed to SHS frequently, depending on the living situation and/or occupation. In 2004, it was estimated that second hand smoke caused 3000 deaths due to lung cancer in the United States (National Institute of Health, 2004). Although lung cancer is the most well known effect of exposure to second hand smoke, there are also other detrimental effects. Nasal sinus cancer, bladder cancer, breast cancer, cervical cancer, and cardiovascular disease have also been attributed to exposure to SHS (NIH, 2004).

Second Hand Smoke and Nasal Sinus Cancer

Cancer of the nasal sinuses is very rare, accounting for only .2% of invasive cancers (emedicine, 2005). Use of tobacco products has been implicated as a cause of this type of cancer. The role of second hand smoke exposure to the development of nasal sinus cancer has also been studied.

In 1984 Hirayama conducted a study of non-smoking women diagnosed with nasal sinus cancer who were exposed to their husbands' smoking. Hirayama found that as the amounts of cigarettes the husbands' smoked increased, the women's RR also increased. Compared to women whose husbands did not smoke, the RR was 1.7, 2.0, and 2.6 when husbands smoke between 10 and 14, 15-19, and 20+ cigarettes, respectively (Hirayama, 1984).

A second study was conducted by Fukada and Shibata in 1990 using a case-control study

design. The study was designed to assess the effect of SHS exposure on developing nasal sinus cancer. They concluded that active smoking was a significant risk factor for developing nasal sinus cancer (RR=4.6 for 39 cigarettes or more), as well as exposure to SHS. Compared to non-smoking women with no SHS exposure, women who were exposed to one or two or more smokers in the household had a RR of 1.4 and 5.7, respectively (Fukada and Shibata, 1990).

Zheng et al. conducted a study in 1993 of men diagnosed with nasal sinus cancer. Non-smoking and smoking men were included. Of the non-smoking men who had nasal sinus cancer, more cases than controls had wives that smoked cigarettes. There was an OR of 3.0, suggesting that exposure to spousal smoking leads to an increased risk in developing nasal sinus cancer (Zheng et al., 1993)

Second Hand Smoke and Breast Cancer

A study in Canada found that SHS may increase the risk of developing breast cancer. This study compared 1,420 women with breast cancer to a control group of women without breast cancer. The investigators found that long-term exposure to SHS was associated with more than a 100% increase in premenopausal breast cancer risk, and a 30% increase in postmenopausal breast cancer. This study also reported an increased OR for breast cancer depending on the number of years of exposure to SHS. When exposed to between 1-13, 14-32, 33-70, or more than 70 cigarettes a day, there was an OR of 1.5, 2.0, 2.9, and 3.0, respectively (Johnson, et al., 2000).

Several other studies have found an increased risk of breast cancer with exposure to SHS. Hirayama et al. found a small increased risk of breast cancer (RR=1.3) in non-smoking women of smoking husbands (Hirayama et al, 1981). A case-control study conducted in 1985 showed that pre-menopausal women who did not smoke but were married to smokers had a RR of 1.9

(Sandler et al., 1985). In a further analysis of this data, Wells (1992) reported that when compared to non-smoking women who were married to non-smokers, the RR was 1.6 among non-smoking women married to smokers, and 0.64 among smoking women married to non-smokers.

Smith et al. found that when compared to women who had no SHS exposure, women who were exposed to SHS during childhood only, adult life only, and both childhood and adult life had OR's of 1.98, 2.65, and 3.13 respectively (Smith et al, 1994). An increased RR of breast cancer was also found in a study conducted by Morabia et al. in 1996. Compared to non-smoking women who were not exposed to SHS from husbands, the women with spousal SHS exposure had an OR of 2.6 (Morabia et al., 1996). Another study showed that the risk of breast cancer depended on when a woman was exposed to SHS. If a woman was exposed to SHS before the age of 12, there was an OR of 4.5. If exposed from age 12-20, there was an OR of 3.8, and if exposed after the age of 20, there was an OR of 2.4 (Lash & Aschengrau, 1999).

Second Hand Smoke and Cervical Cancer

There are several risk factors for the development of cervical cancer, including cigarette smoking, infection with Human Papilloma Virus, multiple sexual partners, and intercourse at an early age (emedicine, 2005). It has also been investigated as to whether exposure to SHS is a risk factor. Hirayama conducted a study in 1981 and found that there was a RR of 1.2 when a non-smoking women was married to a smoking man (Hirayama, 1981). Sandler et al. also found an increased relative risk of developing cervical cancer when exposed to SHS. Spouses' smoking habits were associated with an increased relative risk (RR=2.1) of cervical cancer in their non-smoking wives (Sandler et al., 1985).

Slattery et al. also found an increase in the relative risk of developing cervical cancer due

to SHS exposure. When adjusted for potential confounders (age, number of sexual partners), there was a 3-fold increased risk (RR=3.0) associated with exposure to 3 or more hours of SHS a day. This study also examined the effects of active smoking and cervical cancer, and found that the increased risk of cervical cancer due to exposure to SHS was comparable to the risks associated with active smoking (Slattery et al. 1989). A similar study was conducted by Coker et al. in 1992 that found a positive association between SHS exposure and cervical cancer (OR = 1.8) after adjustment for confounding variables (Coker et al., 1992).

Two case-control studies, one in Spain (Bosch et al., 1996) and one in Colombia (Munoz et al, 1996), offered some additional information of the role of husband's smoking on the etiology of wife's risk of cervical cancer. In the study conducted in Spain, after adjustment for the women's own active smoking habits, there was a significant trend of increasing risk in association with spousal smoking habits. The OR's ranged from 1.8 to 2.6, and increased as the number of cigarettes smoked by the husband increased. The study conducted in Colombia also found an increased OR with exposure to husband's smoking after adjusting for the woman's active smoking status, but it was not statistically significant (Munoz et al., 1996).

Second Hand Smoke and Bladder Cancer

In 2003, an estimated 57,400 new cases of bladder cancer were diagnosed and an estimated 12,500 individuals died from the disease (CDC, 2004). Active smoking has been firmly established as a risk factor for bladder cancer. The estimated attributed risk for bladder cancer due to smoking is 47% in men and 34% in women (Shopland et al, 1991). Because of this relationship between active smoking and bladder cancer, the effect of SHS and bladder cancer has also been studied.

The first study reporting the relationship was conducted by Kabat et al. in 1986, as part of

a large case-control study of passive smoking and cancer. The results of the study showed that there was a significantly increased OR of 1.5 for men that were exposed to SHS at home to develop bladder cancer. The study also showed an OR of 2.6 for women that were exposed to SHS at work (Kabat, et al., 1986).

It has been hypothesized that certain aromatic amines found in tobacco smoke are the carcinogenic agents that contribute to the development of bladder cancer. When it was discovered that these human carcinogenic agents are found in cigarette smoke, the hypothesis was made that exposure to these amines is a principal mechanism by which cigarette smoking induces bladder cancer. Non-smokers are exposed to these same carcinogenic agents from the inhalation of SHS. Tannenbaum et al. sought to discover if these compounds could be detected in the blood of people with bladder cancer that were non-smokers who were exposed to SHS. They found that non-smokers with bladder cancer exhibited higher levels of these specific aromatic amines than the non-smokers without bladder cancer. This strengthened the hypothesis that the amines found in cigarette smoke are at least partly responsible for the development of bladder cancer in smokers. More significantly, they found that aromatic amine exposure at levels lower than those experienced by smokers are linked to bladder cancer risk, meaning that SHS exposure can increase the risk of bladder cancer (Tannenbaum et al., (2003).

Another component of cigarette smoke that is known to contribute to bladder cancer is arsenic. For non-smokers SHS is a source of arsenic exposure. Chen et al (2005) found that non-smoking men who were exposed to SHS were found to have higher arsenic levels, and a markedly increased risk of bladder cancer. The risk of bladder cancer was seven times higher than those with no SHS exposure.

Second Hand Smoke and Heart Disease

Heart disease is the number one cause of death in the United States for both men and women. More than 2,600 Americans die every day because of cardiovascular disease, about one death every 33 seconds (CDC, 2004). A causal association between active cigarette smoking and heart disease has been established. The association between active smoking and heart disease is nearly as strong as the association between active smoking and lung cancer (U.S. Surgeon General, 1983). The question is whether such associations exist for passive smoking. Studies have indicated that exposure to SHS may be responsible for approximately 40,000 deaths in the US from heart disease every year (Glantz & Parmley, 1991).

There have been several studies which have sought to discover if SHS indeed causes heart disease. Witschi et al. (1995) found that exposure to SHS accelerated the development of atherosclerotic plaques. Since it is now known that plaque formation begins at an early age, SHS exposure in childhood could contribute to heart disease later in life. Dwyer concluded that SHS was a strong risk factor for cardiovascular diseases in adults after reviewing several relevant case-control and cohort studies (Dwyer, 1997). SHS was also found to increase the risk of myocardial infarction as much as 50% in one case-control study (Muscat & Wynder, 1995).

Several reports, including meta-analysis of 17 and 18 individual studies, assessed the association between SHS and heart disease. Both analyses estimated that non-smoking spouses of smokers have an approximately 25% increased risk of heart disease (Thun et al., 1999, He et al., 1999).

A review of six studies examining the relationship between heart disease and SHS exposure in the workplace revealed that there was a positive association in five of the six studies. There was also a significant exposure-response relationship between the amount of cigarettes smoked by coworkers and coronary risk in two of the three studies that examined this trend

(Kawachi et al, 1999).

Kawachi et al. investigated the association between SHS exposure and heart disease using the Nurses' Health Study, a cohort study that was established in 1976 and included over 100,000 nurses. Compared to women who were not exposed to SHS at home or at work, women who had occasional SHS exposure had an RR of 1.56 for developing heart disease. Women, who were exposed to SHS regularly, either at home, at work, or a combination of both, had an RR of 1.97. In this study, exposure to SHS was also associated with both fatal and non-fatal myocardial infarction (Kawachi et al., 1997).

Barnoya and Glantz conducted a literature review of studies published on SHS and heart disease and found that platelet and endothelial function, arterial stiffness, atherosclerosis, oxidative stress, inflammation, heart rate variability, energy metabolism, and increased infarct size - all main components of heart disease - are sensitive to the toxins in SHS (Barnoya & Glantz, 2005).

The impact of SHS on heart disease is also supported by the "natural experiment" that was conducted in Helena, Montana. Public smoking was banned during a six month period in 2002. During the period of the ban, there was a 40% reduction in admissions to the local hospital for acute myocardial infarctions, a trend that was not observed in any of the surrounding area hospitals. The study investigators hypothesized that the reduction in hospital admissions was due to acute coagulation changes associated with reduced SHS exposure (Sargent et al., 2004).

A similar study was conducted in Bowling Green, Ohio. Researchers at Medical College of Ohio found that heart attacks in Bowling Green fell by 45% in the first half of 2003 from the second half of 2002 – after the city's indoor smoking ban was fully implemented (Vezner

&Shockman, 2004). Researchers from the Colorado Prevention Center found that in the 18 months following an indoor smoking ban in Pueblo, Colorado, there was a 27% decrease in the number of heart attacks (Heart attacks… 2005).

Although SHS exposure is not identified as a "major" risk factor for the development of heart disease as active smoking is, the high incidence of exposure to SHS does make it a major public health issue.

Effects of Second Hand Smoke on Children

Youths' exposure to SHS is an important health problem in the United States. Both state and national surveys have documented the prevalence of SHS exposure among youth. A national survey found that 49% of children were exposed to SHS in their home, and of those under 11 years old, 43% lived in a home with at least one smoker (Overpeek and Moss, 1991). Data from the 1996 Behavioral Risk Factor Surveillance System revealed that approximately 15 million children and adolescents were exposed to SHS in their home (CDC, 1997). According to the report, the proportion of households with children and an adult smoker in which smoking was not restricted in the house ranged from 70.6% to 95.6%. The World Health Organization (WHO) estimated that almost half of the world's children breathe in SHS, particularly at home.

Young people are especially vulnerable to SHS in the home because they breathe more air relative to body weight, they are less able to complain that the smoke is bothering them, their immune system is less developed, and they are less able to remove themselves from exposure. A study by DiFranza and Lew in 1996 concluded that children's exposure to SHS is responsible for 13% of ear infections, 24% of tonsillectomies, 13% of asthma cases, 16% of visits to physicians for cough, and 2000 cases of Sudden Infant Death Syndrome (SIDS) (DiFranza & Lew, 1996).

In 1999, the World Health Organization convened an International Consultation on

Environmental Tobacco Smoke and Child Health. The Consultation concluded that SHS is a real and substantial threat to child health. In reviewing over 40 articles, they found that all but one reported increased risk of lower respiratory infections (e.g. croup, bronchitis, bronchiolitis, and pneumonia) among children of parents who smoke. When the results of all studies were pooled, children of mothers who smoke were estimated to have a 1.7 fold increase in these illnesses compared to children of non-smoking mothers. When only the father of the child smoked, there was a 1.3 fold increase in risk. This is strong evidence for a causal relationship between SHS exposure and these illnesses, since this result is not affected by maternal smoking during pregnancy. Another conclusion of the Consultation was that both asthma and cough were more prevalent among children whose parents smoke, on the basis of over 60 studies of school-aged children. The pooled relative risk ranged from 1.2 to 1.4. This has led to the universal clinical practice of recommending avoidance of cigarette smoking for children with asthma. The Consultation examined the relationship between SHS and ear infections as well. After reviewing over 40 studies of SHS and acute otitis media, they found a pooled risk of 1.2 to 1.4 for ear infections, when compared to children of parents who did not smoke. The Consultation also reviewed 8 studies that had examined maternal smoking and sudden infant death syndrome (SIDS). The pooled relative risk from these studies indicated that infants of mothers who smoke had almost 5 times the risk of SIDS compared with infants of mothers who did not smoke (WHO, 1999). A British study found that SIDS deaths could be reduced by two-thirds if parents did not smoke (Blair, 1996).

Second Hand Smoke and Pregnancy

It is well known that a pregnant woman's use of cigarettes can cause her child to have a low birth weight. Low birth weight is a leading cause of infant deaths, resulting in more than

300,000 deaths annually among newborns in the United States (Ventura et al., 2000). Some epidemiological studies strongly suggest that a pregnant woman's exposure to SHS reduces birth weight (Rubin et al., 1986, Martin & Bracken, 1986). This is probably because the carbon monoxide in tobacco smoke binds with the hemoglobin, reducing the blood's oxygen carrying capacity. Over 30 studies have examined the effects of non-smoking mothers' exposure to SHS during pregnancy on fetal growth. The Consultation by the World Health Organization in 1999 reviewed these studies. Using mean birth weight as the outcome, studies from different countries and with different study designs have consistently found reduced birth weights among the children of non-smoking women exposed to SHS during pregnancy. When these results were compared, the RR's ranged from 1.2 to 1.4 for a reduction in mean birth weights compared to women who were not exposed to SHS during pregnancy, with an average reduction in weight ranging from 25 to 40 grams (WHO, 1999).

Attitudes and Knowledge about Second Hand Smoke

The adverse effects of SHS on children and non-smoking adults have been well-documented, but these effects either are not known or are not acknowledged by the general public. A study performed in Canada in 1994 sought to discover what Canadian adults knew about the impact of second hand smoke on one's health and on the health of non-smokers. In this study 91% of those surveyed believed that SHS was harmful to the non-smoker in that it was associated with developing lung cancer. The surveyors also discovered that smokers and those who live with smokers are less likely to acknowledge the adverse effects of smoking. Canadians knew much less about the direct impact of SHS on children's health. Only 1 in 5 surveyed believed that SHS can cause ear infections (Survey on Smoking, 1994).

In 2002, a study in Great Britain sought to describe British views on whether or not

passive smoking increased the risk of certain medical conditions. In this study, 86% of the respondents were correct in answering that SHS was associated with lung cancer. Eighty five percent, 81%, and 69% were correct in answering that SHS increased the risk of bronchitis, asthma, and heart disease, respectively. In regards to SHS effects on children, 90%, 83%, 54%, and 30% were correct in answering that SHS exposure increased the risk of pneumonia, asthma, SIDS, and ear infections. When questioned about diabetes risk with SHS exposure, the majority (64%) incorrectly answered that they were associated (Office for National Statistics, 2003).

A study by Li et al. examined the associations between health beliefs, social pressure, and exposure to SHS among high school youth. Results demonstrated that high perceived susceptibility to disease was significantly associated with lower levels of SHS exposure for both non-smokers and smokers (Li et al., 2002).

A survey conducted in (2002) in Canada showed that 77% of smokers believed that second hand smoke hurts non-smokers, compared to 93% of non-smokers. Smokers were less likely to believe that SHS caused lung cancer in non-smokers (54% vs. 79%). Smokers were much more likely than non-smokers to believe that air pollution is a greater health risk to non-smokers than SHS (51% vs. 35%). Sixty-three percent of smokers believe that people are too concerned about the effect of other peoples smoking, while only 33% of non-smokers believed the same. Forty-six percent of smokers believed that the adverse effects of SHS were exaggerated, compared to 32% of non-smokers (Rickert et al., 2002).

In 2000 the CDC conducted the Behavioral Risk Factor Surveillance Survey (BRFSS), a national study. This survey was designed to determine opinions about smoking policies. The proportion of people who thought that smoking should not be allowed in restaurants was 53%, however there was a disparity between what smokers and non smokers believed. Twenty-six

percent of smokers and 66% of non-smokers believed that smoking should not be allowed in restaurants. The proportion of smokers who believed smoking should not be allowed in indoor work areas was 58%, versus 82% of non-smokers (CDC, 2002)

Research Hypotheses

This project had several research hypotheses.

1. Less than 50% of those surveyed will receive a passing score.
2. There will be no difference in gender in the percentage of those who pass.
3. There will be a lower percentage of smokers who pass versus non-smokers.
4. The lower the education level, the less likely the subject is to pass the survey.

This project also assessed the effect that age, race, and having children had on knowledge regarding the effects of SHS.

Methods

Sample

This was a survey-based descriptive study that sampled the general public of the Toledo, Ohio area. The surveys were administered to a cluster sample of people entering Wal-Mart The investigator sought to obtain a representative sample by passing out surveys at a location where there were likely to be people of different ages, education levels, socioeconomic status, ethnicity, gender, and family status.

Subjects

Data were gathered at Wal-Mart in Toledo, Ohio. The investigator set up a table near the entrance of the store and asked a variety of potential subjects to complete a survey. Exclusion criteria were: 1. age less than 18; and 2. inability to read or write English. If on the survey a subject indicated that he or she was less than 18 years of age, the survey was discarded. The

investigator asked the subject to complete an anonymous survey. If the subject consented she or he was given a survey along with the cover letter. All subjects placed the completed surveys in a marked box. The investigator assured the subject's anonymity by not including any identifying information on the survey and by having the subject place the completed survey into a box. Consent was obtained by giving the subject the survey with a cover letter explaining that by completing and turning in the survey, he or she was giving consent. There were no risks involved in administering or taking the survey. There was no cost or compensation to the subject. Because the study was a pilot study and the results would not be published, the study was exempt from review by Institutional Review Board at Medical University of Ohio.

Instrument

The survey was adapted from a survey conducted in Great Britain by the Office for National Statistics. The survey questionnaire included items regarding the subject's age, ethnicity, gender, smoking status, education level, and number of children. It also included questions assessing the subject's knowledge of the medical conditions that may be affected due to exposure to SHS. There were 18 SHS questions on the survey, 10 pertained to the effects of SHS on adults, and 8 with the effects of SHS on children. Each subject was asked if SHS increased the risk of developing a specific medical condition. The subject could answer a question with "yes", "no, or "don't know". The cover letter was composed according to specifications set forth by the Institutional Review Board at Medical University of Ohio. It informed the participant that completing the survey was voluntary, anonymous, that their answers would be used in a student thesis, and that there would be no compensation or risk in taking the survey. A copy of both the survey and cover letter are included in Appendix A.

Statistical Analysis

There were 18 possible points on the survey. A score of 15 or more points, or at least 83%, was considered a passing score, and the respondent was considered "knowledgeable" about the adverse effects of SHS. For all 89 surveys, the answers to each question, along with the subject's demographic information, were entered into a spreadsheet.

All of the data were compiled and analyzed in order to test the hypotheses using SPSS version 13. Independent t-tests were used to determine if there was a significant difference in the percentage of correct answers between genders, education level, and smoking status. The surveys were also analyzed by dividing the survey into two sections - one that included questions on SHS and adults, and one that included questions on SHS and children - and comparing demographic information along with correct answers.

Results

There were 89 subjects who completed the survey. The minimum age was 18, the maximum age was 74, and the mean age was 40 years old. The majority of the subjects were Caucasian (66%). Twenty-one percent of the respondents were African American. There was also a small percentage of Hispanics and people who classified themselves as an ethnicity other than the aforementioned. One quarter of the subjects were current smokers, one quarter former smokers, and one half were never smokers. Most of the subjects (80%) had children. There were also a variety of education levels among the respondents. Detailed demographic information is summarized in Tables 1-6.

The next portion of the survey included 18 medical conditions that may or may not be associated with SHS exposure. Thirteen of the conditions have been shown to have an association with SHS and five did not. Ten of the questions pertained to SHS and adult medical conditions and eight to the effects of SHS on children.

The question that most subjects answered correctly was whether or not SHS was associated with an increased risk of lung cancer, with 92% answering "yes". Sixty-five percent of respondents knew that nasal sinus cancer and SHS were associated, while most subjects either answered "don't know" or incorrectly answered "no" for SHS exposure and breast cancer, bladder cancer, and cervical cancer. Most respondents (73%) knew that there is a causal relationship between SHS and heart disease, as well as SHS and asthma (83%). There were three adult "control" questions, where the correct answer was that SHS is not associated with that medical condition. Forty-three percent did not know if Alzheimer's disease and SHS are associated, and thirty-five percent knew that they are not related. Forty-nine percent knew that SHS and arthritis have no connection, and forty percent knew they are not connected. Forty-five

percent did not know if diabetes and SHS were associated.

The question that the most respondents answered correctly about the effects of SHS on children was if SHS increased the risk of asthma in children, with 88% answering correctly. Also, 85% answered correctly that SHS is associated with a low birth rate in children of mothers who smoke. About half answered correctly that SHS exposure leads to increased rate of SIDS, croup, and ear infections in children , 49%, 52%, and 45% respectively. The two conditions that have no relationship with SHS were urinary tract infections and deafness. About half of the respondents did not know if they were associated with SHS. Tables 7 and 8 contain summary data for each item.

This project had several hypotheses. The first hypothesis, that less half of the respondents would receive a passing score, was validated. In fact, only 8 respondents received a score of over 80%. The second hypothesis, that there would be no difference in genders in the percentage of those who pass was validated as well. Five of the eight subjects who passed were female, but overall, there was not a statistically significant difference between males and females in the overall percentage of correct answers. Males on average got 52% of the questions correct, and females scored an average of 56%. The third hypothesis was that there will be a lower percentage of smokers who pass versus non-smokers. This was not validated. Six of the respondents who passed were non-smokers, but there was not a statistically significant difference between current smokers, former smokers, and never smokers in the amount of correct answers. Current smokers and former smokers answered 49% of the questions correctly on average, and never smokers averaged 52% correct. A final hypothesis was that the lower the education level, the less likely the subject would be to pass the survey. This hypothesis was validated. Analysis of variance (ANOVA) and the subsequent LSD post hoc test revealed there was a

statistically significant difference between the subjects who had attended graduate school and those who did not graduate high school, those who had graduated high school only, and those who had some college experience in the average amount of correct answers (p=.05). There was also a statistically significant difference between the subjects that had graduated college and those who finished high school only. (p=.05). Five of the eight who had a passing score had graduate school experience, although there was also one person who had not completed high school, one who had some college experience, and one who had graduated college that received a passing score.

This project also assessed the role that age, race, and having children had on knowledge regarding the effects of SHS. Three of the eight respondents who passed were 25 years old, but the other five people who passed ages' ranged from 31 to 59. There was also no significant difference in the average amount of correct answers and the subjects' ages. Ethnicity played no role in the amount of questions answered correctly, and neither did having children.

Discussion

The purpose of this study was to discover what the public knew about the effects of second hand smoke. In order to do this, it was necessary to analyze which questions were answered correctly, and which questions were answered incorrectly. Also, by looking at which demographics had the highest percentage of correct answers, it is possible to learn which groups appear to need more education about the effects of SHS.

The first hypothesis, that less than 50% of the respondents would receive a "passing" score, was valid. In fact, less than 10% of those surveyed "passed". This could be because people do not realize that the same detrimental compounds breathed in while smoking a cigarette are breathed in by a person that is exposed to SHS. Therefore the medical conditions that are associated with actively smoking cigarettes are also associated with exposure to SHS. Also, while there have been many warnings to the American public about the adverse effects of smoking cigarettes, but very few advertisement campaigns designed to promote awareness of the effects of SHS.

The second hypothesis, that there would be no difference in the average number of corrects answers between genders, was also valid. There was no statistically significant difference in the total scores, with men scoring an average of 52% and women 56%. This is most likely because men and women are exposed to similar media campaigns and education programs about the effects of SHS. Also, there are no current gender-directed anti-tobacco campaigns[1]. Previous studies have not examined if there was a difference between genders in knowledge of the effects of SHS. When divided into two sections, questions relating to the

[1] In the last decade the American Cancer Society ran one advertisement that pointed out that women's lung cancer have rates approached those of men. Ironically the title was "you've come a long way baby"; a tag line used for advertising a brand of cigarettes to women.

effect on adults and the effect of SHS on children, women did score statistically significantly higher than men on the questions relating to children ($t = -2.084$, $df = 87$, $p<.05$). Women averaged 62% and men averaged a 51% on this section. This significant difference could be because traditionally women are the primary caregivers of children in the United States, and therefore they could possibly know more about children's illnesses in general.

The next hypothesis, that smokers would average a lower number of correct answers when compared to non-smokers, was not correct. Although current smokers averaged 52% correct answers, and non-smokers averaged 58%, there was no statistically significant difference in the amount of correct answers between current smokers, former smokers, and never smokers. This differs from what has been found in previous studies. It was found in the study Survey on Smoking in Canada in 1994 that smokers are less likely to believe that SHS exposure is harmful to non-smokers than non-smokers (Survey on Smoking, 1994). In another survey conducted in Canada in 2002 it was found that 77% of smokers thought that SHS was harmful to non-smokers versus 93% of non-smokers (Office for National Statistics, 2003). This disparity could be because of the recent advertisement campaign designed to educate the public about the effects of SHS. It could also be because Canadians are generally more informed about what SHS exposure can do.

The final hypothesis, that the less education the subject had, the lower the subject would score, was also correct. Three of the eight respondents who scored over 80% on the survey had attended graduate school. The average percent correct for subjects with graduate school experience was 72%. The average percent correct for subjects ho had completed college was 60%. The average percent correct for subjects who had not completed high school, completed high school, or had attended some college was 47%, 46%, and 50%, respectively. The subjects

who had graduate school experience scored significantly better than all education levels except for the subjects who had completed college. The subjects who had completed college scored significantly better than the subjects who had completed high school. The only disparity was that those who had completed high school averaged a slightly lower score than those who had not graduated high school, but the difference was only 1%. The reason that subjects who had a higher education level had a higher percent of correct answers could be that people who have a higher education level know more about medical conditions in general. For example, a less educated person may not know what croup or sudden infant death syndrome are, and therefore would not know if SHS exposure increased the risk of developing them.

Ethnicity, age, and whether a person had children did not appear to have an effect on the subject's knowledge of SHS. There is not one particular ethnicity or age group that knows more about what SHS exposure can do. This indicates that all ages and races need more education about SHS.

The question that most respondents answered correctly was if SHS caused lung cancer. Ninety-two percent of the respondents knew they were associated. This result is very similar to two previous studies. In the study Survey on Smoking in Canada, 91% of the respondents knew that SHS increased the risk of developing lung cancer (Survey on Smoking, 1994). In a survey conducted in Great Britain in 2002, 86% of the respondents answered correctly that SHS was associated with lung cancer (Office for National Statistics, 2003). Perhaps the association between SHS and lung cancer is well known because many people affiliate lung cancer with smoking cigarettes and they realize that the same smoke that causes a smoker to develop lung cancer can be breathed in by a non-smoker. Also, recent television advertisements warning people of the effects of SHS have focused on lung cancer as the primary detrimental effect of

SHS.

Another question that the majority of respondents answered correctly was if SHS exposure was associated with heart disease. Seventy-three percent of the respondents knew they were linked. This is similar to the results found in the Great Britain survey. Sixty-nine percent of those surveyed knew that SHS causes a non-smoker to develop heart disease (Office for National Statistics, 2003).

When divided into questions about adult medical conditions associated with SHS and children's' medical conditions associated with SHS, there were only 10 people that scored more than 80% for conditions applying to children. The question that most people answered correctly in reference to children was that SHS increased the risk of asthma in children. Eighty-nine percent of the respondents knew SHS increased the risk of developing asthma. This is comparable to the British study, in which 83% of respondents knew that SHS increased the risk of asthma. The second most correctly answered question in this section was about pneumonia. Sixty-nine percent knew they were associated in this study. Ninety percent knew that SHS increased the risk of pneumonia in the British study. The most incorrectly answered question was about ear infections. Only 45% knew that SHS increases a child's risk of developing an ear infection. This result is similar to the 1994 Canadian study, in which only 20% knew SHS caused ear infections (Survey on Smoking, 1994) and the British study, where only 30% knew SHS caused ear infections. Only 49% of respondents knew SHS can cause SIDS. This result was similar to the British study, where 54% knew SHS increased the risk of SIDS (Office for National Statistics, 2003). Respondents may not have known these questions because they are not respiratory conditions, and people usually associate cigarette smoke with respiratory problems.

The commonality in the most correctly answered questions among both the adult and children sections is that they pertain to medical conditions involving the respiratory system, such as lung cancer, asthma, bronchitis, croup, and pneumonia. There are several possible reasons that most respondents associated SHS exposure with respiratory problems. One possibility is that these are the most well-documented, and therefore well publicized, effects of SHS. When the effects of SHS first were being studied, research was focused on lung cancer and other respiratory problems. As the results became known, they became a focus of public attention. Another reason many of the respondents knew SHS caused respiratory problems is because many people have experienced them from being exposed to SHS. Many non-smokers and even smokers have walked into a smoke-filled room or been next to a person that was smoking and have had to cough, or have had trouble breathing. It is these reactions that cause people to associate cigarette smoke with respiratory conditions.

Eight-five percent of respondents knew that exposure to SHS by a pregnant woman can cause low birth weight. This is most likely because it is well known that women who smoke are at a high risk of having a child with low birth weight. This has become common knowledge through advertisement campaigns stressing the importance of not smoking while pregnant. Many respondents may have correctly assumed that any exposure to smoke by a pregnant woman could lead to a low birth weight, even if the mother is not smoking herself.

Conclusion

In conclusion, these results suggest that there is a need for more education of the effects of second-hand smoke for all of the public, particularly Toledo residents. Only eight respondents of eighty-nine people surveyed scored an 80% or better on the survey. This could indicate that less that 10% of the population of Toledo is sufficiently educated enough to know what exposing oneself to SHS can do. Most of the respondents realized that SHS is associated with respiratory consequences in both adults and children, but do not realize that being exposed to SHS can cause other types of cancer besides lung, as well as SIDS in children and heart disease. Future educational programs and advertisement campaigns should be focused on stressing the other consequences of adult exposure to SHS, or be specifically focused on the harmful effects of exposing a child to SHS. It is also necessary for medical providers to educate his or her patients about the dangers of SHS. It is not enough to only encourage patients not to smoke cigarettes, it is also important to encourage avoidance of cigarette smoke in general. SHS exposure can cause many different types of cancers, heart disease, and has many detrimental effects on children, including increased risk of SIDS and asthma. It is important for the public to know these things in order to decrease their likelihood of occurring in the future.

Limitations

This study was a pilot study and therefore similar studies performed should be in the future in order to compare the results found in this study with those of others. A major limitation of this study is the small sample size. Only 89 people were surveyed, and a larger sample would have possibly yielded statistically significant data. Also, although subjects that responded had varied ethnicities, educational levels, and smoking histories, conducting the survey at several different locations would have assured a larger sample. Unfortunately, Wal-Mart was the only one out of several locations approached that allowed distribution of surveys at their location. Another limitation could be that there was a bias with the survey. The participating subjects knew that they were being questioned about adverse effects of SHS, so perhaps they assumed that every medical condition listed was associated with SHS. Five of the eighteen medical conditions listed on the survey were not associated with SHS exposure, so these were considered "controls". If a respondent had answered "yes" to SHS increasing the risk of all of the listed medical conditions, he or she would have still gotten more than one-third of the questions right. Perhaps this could have been avoided by adding more "control" questions.

Applicability to the Physician Assistant Profession

A Physician Assistant will always have patients in his or her practice that smoke cigarettes. Not only is it important to educate those patients that their smoking hurts them, but also the people that they are around. It is also imperative to let non-smoking patients know what SHS exposure can do, especially those patients that are married to smokers. Although many of those surveyed were aware of some of the effects of exposure to SHS, they may not realize that this pertains to their smoking or to their exposure to SHS. Therefore it is necessary to warn people what the effects of exposure to SHS can do in order to protect themselves, their children,

and those around them.

References

American Cancer Society (2002). *Cancer facts and figures.*

American Cancer Society (2004). *National Center for Health Statistics, Center for Disease Control and Prevention.*

American Heart Association, 2004. Retrieved from http://www.aha.org/smokingstats on May 12, 2005.

Barnoya, J., Glantz, S. (2005). Cardiovascular effects of second hand smoke. *Circulation, 111*,2684-2698.

Blair, P. (1996). Smoking and the sudden infant death syndrome: results from the 1993-95 case-control study for confidential inquiry into stillbirths and deaths in infancy. *British Medical Journal*, 313.

Bosch, F., Castellsague, X., Munoz, N., deSanjose, S., Ghaffari, A., Gonzalez, S., Gili, M. (1996). Male sexual behavior and HPV; Key risk factors for cervical cancer in Spain. *Journal of the National Cancer Institute, 88,*1060-1067.

Brownson, R., Alavanja, M., Hock, E., Loy, T. (1992). Passive smoking and lung cancer in non-smoking women. *American Journal of Public Health, 82,* 1525-1530.

Cadrenas, V., Thun, M., Austin, H., Lally, C., Clark, W., Greenberg, R., Heath, C.(1997). Environmental tobacco smoke and lung cancer mortality in the American Cancer Society's Cancer prevention Study II. *Cancer Causes and Control, 8,*57-64.

Center for Disease Control (1997). State specific prevalence of smoking among adults, children, and adolescent's exposure to environmental tobacco smoke in the United States, 1996. *JAMA, 278,* 2056-2057.

Center for Disease Control (2002). State smoking prevalence of cigarette smoking among adults; policies and attitudes about second hand smoke: United States, 2000, retrieved from http://www.cleanlung.com/eduaction/features/ets_attitudes2000.html.

Center for Disease Control, 2005. Retrieved from http://www.cdc.gov/nccdphp/aag/aag_osh.htm on August 18, 2005.

Centers for Disease Control and Prevention, National Center for Health Statistics. *Early Release of Selected Estimates Based on Data form January-March 2003 National health Interview Survey.* Retrieved from http://www.cdc.gov/nchs/data.nhis/earlyrelease/200309_08.pdf on October 3, 2005.

Chen, Y., Su, H., Leon, Y., Houseman, A., Christiani, D. (2005) Interaction between

environmental tobacco smoke and arsenic methylation ability on the risk of bladder cancer. *Cancer Causes and Control, 16*,75-81.

Coker, A., Rosenberg, A., McCann, M., Hulka, B. (1992). Active and passive cigarette smoke exposure and cervical intraepithelial neoplasia. *Cancer Epidemiology, Biomarkers and Prevention, 1*,349-346.

DiFranza, J., Lew, R. (1996). Morbidity and mortality associated with the use of tobacco products by other people. *Pediatrics, 96*,560-8.

Dwyer, J. (1997). Exposure to environmental tobacco smoke and coronary risk. *Circulation, 96(5),* 1367-1369.

emedicine (2005). Retrieved from emedicine.com/articles/15405-1.asp on November, 11,2005.

emedicine (2005). Retrieved from emedicine.com/ent/topic254.htm on November 11, 2005.

emedicine (2005). Retrieved for emedicine.com/med/topic324.htm on November 9, 2005.

Fontham, E. *Environmental tobacco smoke and lung cancer in non-smoking women*. JAMA, 1994; 271(22), 1752-9.

Fukada, K., Shibata, H (1991). Exposure-response relationships between woodworking, smoking, and passive smoking, and squamous cell neoplasms of the maxillary sinus. *Cancer Causes and Control, 1*,165-168.

Garfinkel, L.(1981). *T*ime trends on lung cancer mortality among nonsmokers and a note on passive smoking. *JNCI, 6,* 1061-6

Glantz, S. & Parmley, W. (1991). Passive smoking and heart disease: Epidemiology, physiology, and biochemistry. *Circulation, 83*,1-12.

He, J., Vupputuri, S., Allen, K. et al. (1999). Passive smoking and the risk of coronary heart disease: a metaanalysis of epidemiologic studies. *New England Journal of Medicine, 340*,920-926.

Heart attacks decline after a smoking ban (2005), November 11). *Wall Street Journal,* p. D11.

Hirayama, T. (1981) Nonsmoking wives of heavy smokers have a higher risk of lung cancer, a study from Japan. *British Medical Journal, 282*,182-3.

Hirayama, T. (1984). Passive smoking and lung cancer, nasal sinus cancer, brain tumor and ischemic heart disease. *Proceeding of the Fifth World Conference on Smoking and*

Health, 1,137-141.

International Agency for Research on Cancer (1992). Tobacco Smoking. Lyon, France: I IARC. *Evaluating Carcinogen Risk Chemical Manual, 38,* 314.

Johnson, C., Hu, J., Yang, M. (2000). Passive and active smoking and breast cancer risk in Canada, 1996-1997. *Cancer Causes and Control, 11(3),*211-221.

Kawachi, I., Colditz, G., Spiezer, F., Manson, J., Stampfer, M., Willet, W. (1997). A prospective study of passive smoking and coronary heart disease. *Circulation, 95,*2375-2379.

Ko, Y., Lee, C., Chang, M., Huang, C., Chang, Y., Lin, H., Wang, H., Chang, P. (1997). Risk factors for primary lung cancer among non-smoking women in Taiwan. *International Journal of Epidemiology, 26,* 24-31.

Lash, T. & Aschengrau, A. Active and passive cigarette smoking ad the occurrence of breast cancer. *American Journal of Epidemiology, 149,*5-12.

Li, C., Unger, J., Schuster, D., Rohrbach, L., Howard-Pitney, B., Norman, G. (2002). Youths' Exposure to environmental tobacco smoke; Associations with health beliefs and s ocial pressure. *Addictive Behaviors*, 28, 39-53.

Liu, O., Sasco, A., Riboli, E., Xu, M. Indoor air pollution and lung cancer in Guanghxu, Peoples' Republic of China. *American Journal of Epidemiology*, 1993; 137(2), 145-154.

Martin, T. & Bracken, M. (1986). Passive smoking and birth weight. *Lancet, 1,* 37-38.

Morabia, M., Berstein, A., Heritier, S., Khatchatrian, N. (1996). Relation of breast cancer with passive and active smoking to tobacco smoke. *American Journal of Epidemiology, 143,*918-928.

Munoz, N., Castellsague, X., Munoz, N., deSanjose, S., Ghaffari, A., Gonzalez, S., Shah, K. (1996). The difficulty in elucidating the male role of cervical cancer in Colombia, a high risk area. *Journal of the National Cancer Institute, 88,*1068-1075.

Muscat, J. & Wynder, E. (1995). Esposure to environmental tobacco smoke and the risk of heart attack. *International Journal of Epidemiology, 24(4),* 715-719.

National Center for Chronic Disease Prevention and Health Promotion, 2004. Retrieved from http://www.cdc.gov/tobacco/issue.htm on August 25, 2005.

National Institute of Health, 2004. Retrieved from http://cis.nci.nih.gov/fsct/3_9.htm.

Office for National Statistics (2003). Smoking related behavior and attitudes, 2002. *The Stationery Office: London.*

Overpeck, M & Moss, A. (1991). Children's exposure to environmental cigarette smoking before and after birth. Advance data and vital health statistics of the National Center for Health Statistics #202. Hyattsville, MD: US Department of Health and Human Services.

Pershagen, G. (1994). Passive smoking and lung cancer. *Epidemiology of Lung Cancer, 74,*109-130.

Physicians for a Smoke Free Canada, 2005. *Cigarette smoke and kids' health.* Retrieved from http://www.smoke-fee.ca/second-hand-smoke/health_kids.htm on August 4, 2005.

Pirkle, J., Flegal, K., Bernert, J. (1996). Exposure of the US population to environmental tobacco smoke: the Third National health and Nutrition Examination Survey, 1988 to 1991. *JAMA, 275,*1233-1240.

Rickert, W., Walker, R., Brown, K., Cameron, R. (2002). Environmental tobacco smoke in the home: Attitudes, beliefs and actions of smokers and non-smokers. *Environmental Health Perspective, 243,*189-203.

Rubin, H., Krasilnikoff, P., Leventhal, J., Weite, B., Derget, A. (1986). Effect of passive smoking on birth weight. *Lancet, 2,* 415-417.

Sandler, D., Everson, R., Wilcox, A., Browder, J. (1985). Passive smoking and cancer in adults. *American Journal of Epidemiology, 121,*37-48.

Sargent, R., Shepard, R., Glantz, S. (2004). Reduced incidence of admissions for myocardial infarction associated with smoking ban, before and after study. *BMJ, 328,*977-980.

Siegel, M. (1993). Involuntary smoking in the restaurant workplace: a review of employee exposure and health effects. *JAMA, 270,*490-493.

Shopland, D., Eyre, H., Pechacek, T. Smoking attributable cancer mortality in 1991: Is lung cancer now the leading cause of death among smokers in the United States? *Journal of the National Cancer Institute, 83,* 1142-1148.

Slattery, M., Robinson, R., Schurman, K., French., T., Abbott, T., Overall, J., Gardner, J. (1989). Cigarette smoking and exposure to passive smoke are risk factors for cervical cancer. *JAMA, 261,* 1593-1598.

Stockwell, H., Goldman, A., Lyman, G., Noss, A., Armstong, A., Pinkman, C., Candelora, E., Brusa, M. (1992). Environmental tobacco smoke and cancer risk in non-smoking women. *Journal of the National Cancer Institute, 84,* 1417-1422.

Survey on Smoking in Canada, 1994. *Statistics Canada.*

Tannenbaum, R., Ross, R., Yu, M. (2003). Nonsmoking-related arylamine exposure and bladder cancer risk. *Cancer Epidemiology Biomarkers, 12(6),*503-507.

Thun, M., Henley, J., Apicella, L. (1999). Epidemiologic studies of fatal and nonfatal cardiovascular disease and ETS form spousal smoking. *Environmental Health Perspective, 107,*841-846.

Trichopoulos, D. Kalandidi, A., Sparros, L. (1981). Lung Cancer and Passive Smoking. *International Journal of Cancer, 27,*1-4.

United States Environmental Protection Agency, (1992). Respiratory health effects of passive smoking: Lung cancer and other disorders; *EPA*/600/6-90/006 F.

United States Surgeon General (1983). The health consequences of smoking: Cardiovascular disease. A report of the Surgeon General. *DHHS,* 84-5024.

Ventura, S., Mosher, W., Curtin, S., Abma, J., Henshaw, S. (2000). Trends in pregnancy and pregnancy rates by outcome: Estimates for the United States, 1976-96. *National Center for Health Statistics,* 21(56).

Vezner, T. and Shockman, L. (2004, August 19). Study looks at smoking ban's effects on health Bowling Green focus of research, *Toledo Blade*, p. C6.

Wells, A. (1992). Breast cancer, active and passive cigarette smoking. *American Journal of Epidemiology, 135,*719-712.

Witschi, H., Pinkerton, K., Coggins, C., Penn, A., Gori, G. (1995). Environmental tobacco smoke: Environmental facts and societal issues. *Fundamental and Applied Toxicology, 24,*3-12.

World Health Organization (1999). International Consultation on environmental tobacco smoke and child health. *Tobacco Free Initiative.*

Zheng, W., McLaughlin, J., Chow, W., Chien, H., Blot, W. (1993). Risk factors for cancers of the nasal sinus cavity and paranasal sinuses among white men in the United States. *American Journal of Epidemiology, 138,*965-972.

Appendix A: Cover Letter and Survey

Assessing the Public's Knowledge of the Effects of Second Hand Smoke

Dear Wal-Mart Shopper:

The purpose of this questionnaire is to obtain your knowledge about the effects of second hand smoke.

The questionnaire has tow sections: demographic information and knowledge of the effects of second hand smoke. Your answers will be used as part of a research paper for a physician assistant student at the Medical University of Ohio. Participation in this survey is completely voluntary and you the right to discontinue this survey at any time and to leave the questions blank. Please answer questions to the best of your knowledge, but if you are unsure of the correct answer, please circle "don't know" for that specific question. Once the question is complete, please place it in the marked box. The survey will take approximately five minute or less to complete.

In order to maintain your confidentiality, all questionnaires have no specific identifiers to you. If you are under 18 years of age please do not complete this questionnaire. If you have any questions, ask the person who handed you the survey. By returning this questionnaire, you are implying your consent to participate in this study. There will be mo monetary or gift compensation for your participation in this study.

Your participation in this survey is greatly appreciated.

Christopher Bork, Ph.D.
Dean, College of Health Sciences Program

Emily Voorhees
Student, Physician Assistant Studies

COLLEGE OF HEALTH SCIENCES
Office of the Dean, 3015 Arlington Avenue, Toledo, Ohio 43614-5803
Phone:419.383.6301 Fax: 419.383.5880 E-Mail:cbork@meduohio.edu

Principal Investigator: Christopher Bork, PhD.
Co-investigator: Emily Voorhees, PA-S

Secondhand Smoke Knowledge Survey

For the following, please circle the answer that applies to you best:

1. What is your gender? male female

2. Are you a: current smoker non-smoker past smoker?

3. How old are you? ____

4. Your highest education level completed: less than 8th grade didn't complete high school completed high school some college completed college graduate school

5. Do you have any children? Yes No

6. What is your ethnicity? Caucasian (white) African American Asian Hispanic Other

Please circle the correct answer.

Does second hand smoke exposure increase the risk of a non-smoking person to develop

lung cancer	yes	no	don't know
breast cancer	yes	no	don't know
cervical cancer	yes	no	don't know
nasal sinus cavity cancer	yes	no	don't know
bladder cancer	yes	no	don't know
glaucoma	yes	no	don't know
urinary tract infections	yes	no	don't know
asthma	yes	no	don't know
heart disease	yes	no	don't know

Does second hand smoke exposure increase a child's risk of developing

asthma	yes	no	don't know
SIDS (Sudden Infant Death Syndrome)	yes	no	don't know
ear infections	yes	no	don't know
deafness	yes	no	don't know
pneumonia	yes	no	don't know
croup	yes	no	don't know

Does a pregnant woman who is exposed to secondhand smoke increase her risk of having a child born with low birth weight?

yes no don’t know

Thank you for you participation in this survey. Please put your completed survey into the marked box.

Appendix B
Tables and Figures

Demographic Information

Table 1: Gender

	Frequency	Percent
Male	37	41.6
Female	52	58.4
Total	89	100

Table 2: Smoking History

	Frequency	Percent
Current Smoker	20	22.5
Non-Smoker	49	55.1
Former Smoker	20	22.5
Total	89	100

Table 3: Education Level

	Frequency	Percent
Did not complete high school	8	9
High school graduate	20	22.5
Some college	31	34.8
Completed college	16	18
Graduate school	14	15.7
Total	89	100

Table 4: Does the subject have children?

	Frequency	Percent
Yes	72	80.9

No	17	19.1
Total	89	100

Table 5: Ethnicity

	Frequency	Percent
Caucasian	59	66.3
African American	19	21.3
Hispanic	7	7.9
Other	4	4.5
Total	89	100

Table 6: Age

	Minimum	Maximum	Mean
Age in years	18	74	40

Item by Item Analysis of Answers

Table 7: Questions pertaining to the effects of SHS on adults

Medical Condition	Percent that Answered Correctly	Percent that Answered Incorrectly	Percent that Didn't Know
Lung Cancer	92.1	4.5	3.4
Breast Cancer	34.8	24.7	40.4
Cervical Cancer	32.6	23.6	43.8
Nasal Sinus Cavity Cancer	65.2	10.1	24.7
Bladder Cancer	27.0	24.7	48.3
Diabetes	33.7	21.3	44.9
Alzheimer's Disease	34.8	22.5	42.7
Asthma	83.1	5.6	11.2
Heart Disease	73.0	6.7	20.2
Arthritis	40.4	10.1	49.4

Table 8: Questions pertaining to the effects of SHS on children

Medical Condition	Percent that Answered Correctly	Percent that Answered Incorrectly	Percent that Didn't know
Asthma	88.8	1.1	10.1
SIDS	49.4	18.0	36.0
Ear Infections	44.9	19.1	36.0
Deafness	33.7	16.9	49.4
Pneumonia	68.5	6.7	24.7
Urinary Tract Infections	38.2	10.1	51.7
Croup	51.7	12.4	36.0
Low Birth Weight	85.3	3.4	11.2

Abstract

Exposure to cigarette smoke, whether it is by smoking a cigarette or by being exposed to second-hand smoke (SHS), is considered a serious risk to human health. It is becoming increasingly obvious that SHS can cause many of the same medical problems as actively smoking a cigarette. Therefore it is important to know what the public knows about these adverse effects of SHS, in order to better inform them. Objective: to determine what the general public knows about the effects of SHS. Method: a questionnaire regarding the effects of SHS was completed by 89 subjects. Results: only 8 respondents of 89 surveyed answered at least 80% of the questions correctly. In general the respondents knew SHS was associated with respiratory problems, but not other medical problems. Conclusion: these findings suggest the public needs more education about the effects of SHS, especially non-respiratory effects and the effect of SHS on children.