5-2014

# Public Health, News Media, and Knowledge Gaps: An investigation into the factors impacting the knowledge gap between West Nile virus and tick borne diseases

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May 2014

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**Abstract**

The knowledge gap hypothesis, developed in 1970 by Tichenor and colleagues, proposed that socioeconomic status, measured by education, was the prominent cause of knowledge gaps. However, since then many studies have found evidence suggesting factors on many scales from macro-level, such as community conflict to micro-level, such as individual interest and life situation, that impact the knowledge gap despite socioeconomic status. Knowledge gaps pertaining to public health are a threat to the health of both communities and individuals. To investigate a potential public health knowledge gap a convenience sample of an upstate New York population was used to investigate the differences between the knowledge of two different vector transmitted diseases, West Nile virus and tick borne diseases, and how the number of media sources may have influenced that knowledge. A survey was created with several sections pertaining to demographics, media source, and knowledge of the diseases. The results show that there is a statistically significant difference between the scores on the tick borne disease section and West Nile virus section with the higher score being on the tick borne section. There is evidence that suggests that demographic factors such as age, education and income, but not the number of sources, influenced the knowledge gap.

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## Acknowledgments

The author wishes to express sincere appreciation to Professors Folta, Ryan, and Whipps for their assistance in planning, preparation, analysis and writing of this research paper. In addition, special thanks to Dr. Diane H. Kiernan for assisting with statistics and making recommendations for analysis. Thanks also to Accent Physical Therapy for distributing surveys. Finally, thank you to everyone who participated in the survey.

## Introduction

In a study looking at implementation gaps, knowledge, and public health; 60% of 9.7 million deaths of children were preventable using effective and affordable interventions (Haines et al., 2004). There is a failure to effectively communicate and translate needed information, to the public and between professionals, in many situations (Haines et al., 2004). Mass education is one of the most important tools in preventative methods (Williams et al., 1980). It gives people the knowledge necessary to take precautions and avoid getting diseases. However, facts can be obscured by a number of factors ranging from lifestyle and history, socioeconomic status, and community interactions. Tichenor *et al.* (1970) described the knowledge gap hypothesis:

> "As the infusion of mass media information into a social system increases, segments of the population with higher socioeconomic status tend to acquire this information at a faster rate than the lower status segments, so that the gap in knowledge between these segments tends to increase rather than decrease."

The authors concluded that education is the driving factor behind knowledge gaps. Although interests influence knowledge gaps, an individual's interests are primarily determined by their education (Tichenor *et al.*, 1970). The authors proposed five factors, in addition to education, that influence knowledge gaps: relevant interpersonal contacts, communication skills, prior knowledge, selective exposure, and the mass media system. Interpersonal contacts in higher socioeconomic status (SES) groups are typically with other high SES individuals (Eveland and Schefele, 2000). Information relayed and perceived in higher SES groups is typically communicated and interpreted at a higher efficiency (Eveland and Schefele, 2000). This feedback loop between high SES groups has a potential to widen knowledge gaps. Communication skills are improved in higher SES groups which results in a widening in knowledge gaps; as higher SES groups can process and retain information at a higher efficiency (Eveland and Schefele, 2000). Higher SES groups also typically have a larger foundation of prior knowledge which enables individuals to make connections and fill in information (Eveland and Schefele, 2000). The ability to make these connections and potentially gain information that is lost to lower SES groups causes a widening in knowledge gaps. Selective exposure causes a “polarization” of knowledge; as individuals pay attention to their own interests and have the ability, especially in today’s media selection, to easily ignore other facets of their interests and results in knowledge gaps widening (Beudoin, 2009; Prior, 2005). Finally, the media system distributing the information can impact knowledge gaps by fragmenting audiences, poor presentation, or by having inaccurate information (Prior, 2005). Knowledge gaps create tension in social systems, obstruct the resolution of social problems and, when concerning public health, can represent a threat to both communities and individuals (Tichenor *et al.*, 1970; Yows *et al.*, 1991). Understanding knowledge gaps allows us to develop methods of communication to narrow them.

Communication skills such as interpretation, information processing, and critical analysis are typically improved in individuals with a higher SES (Eveland and Schefele, 2000). Prior knowledge allows individuals to better fill in information, make associations, and have accurate recall (Eveland and Schefele, 2000). Therefore, they are more likely to understand a higher content of information and possibly relay it more efficiently (Eveland and Schefele, 2000). However, Ettema and Kline (1977) proposed a more conditional relationship between socioeconomic status and knowledge gaps. They say that “persons from different social strata manifest their abilities in different circumstances” (Ettema and Kline, 1977, 187). In other words an individual may be more knowledgeable in an area despite their education and depending more on their interests or motivation. The amount and type of social contacts may vary as well; contacts that include many topics may narrow gaps (Ettema and Kline, 1977).

Knowledge gaps are also associated to an individual's interests and what motivates them to pay attention to particular news media which in turn can be related to SES. Economic and motivational factors are major influences on interests and in turn knowledge gaps (Eveland and Schefele, 2000; Eveland, 2001; Kwak, 1999; Ettema *et al.,* 1983; Horstmann, 1991; Yows *et al.*, 1991). Disagreements in a community, between communities or within households can lead to conflict. Differences in perceptions and interpretations can also lead to conflict in social systems. Conflict, on many levels, can also have a varying impact on individuals' interests and ultimately their knowledge (Donohue *et al.*, 1975). Individuals may be inspired to or discouraged from pursuit of information on a topic; depending on whether the conflict is personal, within their community or between communities (Donohue *et al.,* 1975).

A study investigating knowledge gaps in cardio vascular health found that motivation was a modest factor in obtaining information and that life situations drive motivation rather than socioeconomic status (Ettema *et al.,* 1983). Tick borne diseases and West Nile virus threatens individuals whose lifestyles take them outdoors more than others (Fight the Bite!, 2012). This may be due to occupation or hobbies (Tick-Borne Diseases, 2011). Another study suggests that interest is based on social utility and perceived personal utility (Genova *et al.,* 1979). Another factor that needs to be recognized is the dynamics of individuals. Changes in an individual's activities result in changing perceptions of information utility (Genova *et al.*, 1979). These factors, motivation, lifestyle, and utility, can potentially impact the extent of knowledge gaps.

In reference to the increasingly larger spectrum of media sources; the numbers of media outlets creates audience fragmentation and selective exposure (Prior, 2005). Individuals now have the ability to customize the information they receive; this can have a "polarizing" effect on knowledge. A study looking at political knowledge and content preference found that if media users' preference were not focused on politics then they would ignore those sections and become less knowledgeable (Prior, 2005). Not only does user preference factor into knowledge gaps but media sources tend to target specific groups as well (Beaudoin, 2009). Media sources that identify with media users have a greater influence (Beaudoin, 2009). Viewpoints, opinions, perceptions and ideas are less likely to be challenged; as a person comes across material they disagree with, they will simply dismiss it and seek out material that is associated with their line of thought (Prior, 2005). Media users will only read what they are interested in and isolate everything else (Prior, 2005). This "polarizing" effect could be particularly detrimental, not only politically, to public health.

Social capital is defined by Beaudoin (2009, 611) as "intangible resources that stem from social networks." This is a step towards quantifying knowledge of a community as a measureable resource. Identifying communities that are low in "social capital" is important in narrowing knowledge gaps and testing the efficiency of public communication and interpretation methods (Beaudoin, 2009). The author also defines an identification theory as "a person will adopt a behavior from another person or group to establish or maintain a relationship with the other person or group" (Beaudoin, 2009, 616). As discussed earlier, people are dynamic; in their interests, as well as their life history. They are not static geographically just as they are not static in their interests. When people move from place to place, about their daily lives and also changing the place they live, social networks are disturbed and their access to information changes (Beaudoin, 2009). This can impact interests, conflicts, and media sources and the information they deliver.

Issues with high media coverage and low media coverage will be correlated with differences in knowledge gaps (Eveland and Schefele, 2000). News events with longer durations of media coverage result in a narrowing of knowledge gaps (Genova *et al.*, 1979). This concept of information "saturation" is also suggested to lead to a general understanding of a topic and create a "general equalization of knowledge throughout a system" (Donohue *et al.*, 1975). However, despite media coverage, exposure itself would rely more heavily on socioeconomic factors (Eveland and Schefele, 2000).

Knowledge gaps can be incredibly complex with factors on small scales compounding complexity on rising scale levels; for even though a factor on a small scale may be shrouded on larger scales the effects can carry over. Understanding knowledge particularly those concerning public health issues will assist in developing proper communication methods and ways to asses those methods. Identifying and assessing a knowledge gap concerning West Nile virus and tick borne diseases can help us understand public health knowledge gap dynamics.

**West Nile virus and Tick Borne Disease: What people should know?**

West Nile virus appeared in the US in 1999 and has infected more than 30,000 people (Fight the Bite!, 2012). Tick borne diseases have been reported and researched since the early 1900s (Spach *et al.*, 1993). Lyme disease, discovered in Old Lyme, Connecticut in the 1970s, has had a larger amount of cases as West Nile in a similar time period (Spach *et al.*, 1993). From 1982 to 1992 there were 50,000 cases reported (Spach *et al.*, 1993). Tick borne diseases have only recently been coming into the fore front of media attention due to increasing incidence and rising risk factors such as encroachment into tick habitat (Daszak *et al.*, 2000). Due to the longer amount of time in the news media, people have had more exposure and should therefore be more knowledgeable about tick borne diseases; whereas West Nile virus has been present in the media for a shorter duration resulting in less exposure and less knowledge acquisition. This is an investigation to determine if there is a knowledge gap concerning West Nile virus and tick borne diseases and to determine what factors, SES or saturation/exposure (represented by number of sources used), influenced the knowledge capital in these areas.

## Methods

### Internet News Source Investigation

To determine what kind of pattern actually exists in the news media for tick borne diseases and West Nile virus; video/text reports from ten news sources were looked at. The news sources were Yahoo, CNN, MSNBC, Google, New York Times, Fox, Washington Post, ABC news, USA Today and BBC news. These sources were listed in the top 15 most popular news sites (eBizMBA, 2012). The number of results and date range were recorded for each search on the news sites. Ten articles were then selected, based on relevance and date, and the release date and social media (if available) were recorded. To test for a significant difference in the amount of social "shares" a t-test, assuming unequal variance, was used at $\alpha = 0.05$. It was also noted whether or not the article contained descriptions of symptoms, transmission, treatment, or prevention. To test for a difference in the information content a two sample t-test was used, assuming unequal variances, to determine if there was a significant difference in content from each internet news source at $\alpha = 0.05$.

**Population Sample Analysis**

A survey was created with several sections (Fig. 1 a. and b.). First it asked about demographics including date of birth, sex, education, ethnicity, race, and income. Next, there was a section on tick borne diseases. The first part of this section asked the participant what sources were used to get the information on tick borne diseases. These included newspaper, internet, TV/radio, word of mouth, and other. The second part was seven questions based on common myths of tick borne diseases (Farral, 2012; Torrey, 2012). Lastly there was a section on West Nile virus. Similar to the first part of the tick borne section; there were questions on where they got the information. Then there were eight questions based on common myths of West Nile virus (Five Common Myths about West Nile Virus, 2012).

274 surveys were distributed physically and digitally. A digital form of the survey was made using Obsurvey. This was then distributed over Facebook and emailed across the ESF campus. Some physical copies were distributed at Destiny USA in Syracuse, NY, on the ESF campus, Accent Physical Therapy (East Syracuse, NY), and to some individuals in the Binghamton area. To determine statistical relationships between scores based on sex, age, education, and income; two sample t-tests, assuming unequal variance, were used. t-tests were also used to determine if total knowledge for both diseases were statistically different. All hypotheses were analyzed with $\alpha = 0.05$. Single factor ANOVA analysis was used to determine statistically significant differences between the number of sources used at $\alpha = 0.05$.

ANOVA, single factor, was also used to determine if there was any difference in scores of the age groups, income groups, and education groups. Differences in the number of sources by scores and by the different SES groups were also determined using ANOVA single factor analysis. Significance was determined in all tests at $\alpha = 0.05$.

**Results**

**Internet News Source Investigation**

There were a total of 94 video/text reports on West Nile virus and 62 reports on tick borne diseases that were examined. The mean number of search results was higher for West Nile virus, 14,428 ± 25,199, then for tick borne diseases (1,934 ± 3,337) (Fig. 2). However, at $\alpha = 0.05$ there was not a significant difference ($p = 0.077$) between these mean search results for tick borne diseases and West Nile virus.

The diffusion of news media through social media, Twitter and Facebook, showed that more users shared articles on the West Nile virus than tick borne diseases (Fig. 3). However, the difference in number of "tweets" about West Nile virus and tick borne diseases had no statistical significance ($p = 0.0510$). Also, there was no statistical significance to the difference ($p = 0.468$) of Facebook "shares".

The information content of the internet news sources (Fig. 4 a. and b.) for tick borne diseases and West Nile virus was quite different (Table 1). The mean number of articles containing information on symptoms or transmission was significantly different with p-values of 0.018 and 0.004 respectively. However, there was not a significant different number of articles on West Nile and tick borne diseases which contained information on both symptoms and transmission ($p = 0.289$).

The mean number of West Nile articles containing prevention information outnumbered the mean number of tick borne disease articles containing prevention information (Table 1). There was a significant difference ($p = 0.0009$) in the mean number of articles containing information on prevention of West Nile and tick borne diseases. There was no significant difference between the number of articles containing information both treatment and prevention ($p = 0.111$).

**Sources used by the participants**

Participants were given several choices for where their information came from. These included newspaper, internet, TV/Radio, word of mouth, or other (Fig. 5). The TV/Radio media was almost twice as high in West Nile than tick borne diseases. On the other hand, word of mouth is almost twice as high for tick borne diseases as West Nile.

The specific sources where many of the participants got their information were also compiled. The newspaper source in the tick borne section was mostly the Post Standard and some other miscellaneous papers. Wikipedia, Yahoo, and WebMD are the most frequent internet sources for the tick borne section. WSYR, 9 is the most popular TV/Radio source in the tick borne section. In the word of mouth section information comes from teachers, vets, friends, family, doctors, and coworkers. The National Park Service was the most popular “other” source. In the West Nile section the most popular newspaper source is also the Post Standard. For the internet source, Yahoo was the most popular. WSYR, 9 is, again, the most popular TV/Radio station selection. The most popular sources in the word of mouth category was family, friends, teachers, and coworkers. The only “other” source in the West Nile section was from the NY DEC. This information gives an idea of where people got their information.

**Demographics of the sample**

65% of the 274 participants were female; the distribution is shown in Figure 6. The M/F ratio was 0.548 for the sample population. Figure 7 shows the distribution of age in the sample. 12% of the sample was born on or before 1960 (52 or older). 31% was born between 1960 and 1985 (51-27) and 57% (younger than 27) was born after 1985. Figure 8 shows the distribution of race and ethnicity. 85% of the participants were caucasion and non-hispanic. Race and ethnicity will not be used as a factor in investigating relationships due to there being primarily caucasians. The distribution of income, Figure 9, was skewed slightly to the right. 20% of the participants made less than $10,000 dollars a year. This was the highest bracket value. The remaining categories each comprised about 7% ± 0.02% of the remaining participants. The approximate median household income was $45,000.

**What people know about West Nile virus and tick borne diseases**

The tick borne disease and West Nile sections were scored separately and then a score was given for both sections combined as shown in Fig. 10. Total mean score was 66.6% ± 12.1%. The tick borne section had a mean score of 70.5% ± 15.6%. Participants scored lower on the West Nile section with a mean score of 63.1% ± 16.5%. Using a two-sample t-test, assuming unequal variance, there was a statistically significant difference between the tick borne section and the West Nile section with a p-value of $4.87 \times 10^{-8}$.

Questions 9-15 (Table 2) pertained to subjects of the tick borne disease that included prevention, transmission and treatment. Participants scored the best on transmission questions, moderate on prevention, and scored worst on treatment. Questions 18-25 (Table 2) focused on West Nile virus. Similarly to the tick borne section, participants scored the best on transmission questions, moderate on prevention, and scored worst on treatment.

**Demographics and scores**

Male and female total scores for each section were not significantly different (Fig. 12). The t-test resulted in a p-value of 0.304. There was no statistically significant difference between the male and female scores for both the tick borne section and West Nile section. The tick borne section had a p-value of 0.18 and the West Nile section had a p-value of 0.50. Comparing male tick borne scores and male West Nile scores resulted in a significant difference in grades (p-value = 0.009). For female tick borne and female West Nile there was also a significant difference (p-value = $2.945 \times 10^{-7}$). This suggests that sex is not a significant factor in the difference in the knowledge of tick borne diseases, West Nile virus, or total knowledge of the diseases.

The age of the participants was divided into sections based on being born before or during 1960 (52 or older), between 1961 and into 1985 (27-51), and after 1985 (younger than 27) as shown in Figure 13. West Nile, tick borne and total scores are shown in Table 3. Using an ANOVA single factor test, the mean scores for the tick borne section, West Nile section and total score, for the age groups, were analyzed for statistical significance. The p-value was 0.808 for tick borne diseases. Therefore, there was no significant difference between the tick borne scores, by age group. In contrast, the p-value for the three age groups, West Nile section, was 0.003. Therefore, there was a significant difference between mean scores in the West Nile section for the age groups. For total scores, the p-value was 0.015. Comparing the score of age groups between West Nile and tick borne diseases showed that only the group born before or into 1960 were not significantly different (p-value = 0.159) (Table 4). These results suggest that age plays a role in the knowledge gap of West Nile information. The significant difference of the total score suggests a general knowledge gap based on age.

The degree of education was a significant factor for only one of the disease sections (Figure 14). Scores of the education groups and their distributions are shown in Table 5. An ANOVA, single factor test was used to analyze the degrees of education for statistically significant differences. The tick borne section for each degree of education was statistically different to each other at a p-value of 0.034. However, the degrees of education in the West Nile section were not significantly different at a p-value of 0.241. There were significant differences between the degrees of education based on overall score with a p-value of 0.015. Between the tick borne and West Nile section scores, according to education, those with high school or less were the only group which had no significant difference at a p-value of 0.100 (Table 6). This suggests that education plays a role in the tick borne knowledge and also gives evidence that there is a knowledge gap based on education.

Similar to education and age, only one of the disease sections was significantly different between the income groups. Figure 15 shows an interesting, fluctuating pattern between income groups and mean grade. ANOVA, single factor analysis was used to determine significant differences between the income groups for the disease sections and total score. Table 7 shows the scores in relation to income level and their distribution. The tick borne sections had a p-value of 0.322 at $\alpha = 0.05$ and therefore the tick borne disease section for income groups were not different with any statistical significance. However, the West Nile sections had significantly different mean scores with a p-value of 0.034 at $\alpha = 0.05$. The overall scores had a p-value of 0.027. After comparing income groups between West Nile virus and tick borne diseases; all were significantly different except for the 40-59 and 80-99 thousand groups (Table 8). This suggests that income played a role in West Nile knowledge and also the total scores.

**Number of Sources**

The relationship between the number of sources used by individuals and the mean scores they received is shown in Figures 16 and 17. Table 9 shows the mean grades for the different number of sources used and their distribution. ANOVA single factor analysis showed that, within the tick borne and West Nile groups, there was no statistically significant differences between the numbers of sources used at p-values of 0.079 and 0.823 respectively. There was also no statistically significant difference between total scores in the groups with a p-value of 0.651. Table 10 shows the comparison between tick borne and West Nile sections in relation to number of sources. All the groups were significantly different. These results suggest that number of sources was not a factor in the scores.

Using ANOVA single factor analysis there was no significant difference in number of sources used for sex, age, education, and income (Figs. 18-21). Sex had no significant relation to scores and also had no relation to number of sources used (Fig. 18). Table 11 shows the mean number of sources according to sex and their distribution. There was also no difference between the number of sources used between tick borne and West Nile by sex (Table 11). Age, as suggested by score results, may be a factor in the knowledge gap in West Nile and total knowledge of the two diseases (Fig. 19). There was no statistical difference between the numbers of sources used for West Nile with a p-value of 0.759 (Table 12. a). Therefore age does not have an impact on the number of sources used for West Nile. There was no statistically significant difference between the number of sources used and the total score at a p-value of 0.607. Therefore age does not have any relation with the number of sources used for the total score. Although age showed no significance for the tick borne section the test was also done here. It showed no significance between age and the number of sources for the tick borne section at a p-value of 0.493. There was also no statistically significant difference between number of sources used between the West Nile and tick borne sections by age (Table 12. b). Sex and age had no impact on the number of sources used.

Education was shown to be a factor in the scores of the tick borne section and the total scores (Fig. 20). The ANOVA test showed that the number of sources and education were not significantly related with a p-value of 0.278 and 0.091 for the tick borne section and total scores respectively (Table 13. a). Education was not a significant factor for the West Nile section scores but the test was also done here. It showed no significance between education and number of sources used for the West Nile section at a p-value of 0.452. There was also no difference in the number of sources used between the tick borne and West Nile sections according to education (Table 13. b). Education had no impact on the number of sources used.

Income was shown to be a factor in the West Nile and total scores. There was no significant difference in the numbers of sources used between income groups for West Nile virus, tick borne diseases, or total at p-values of 0.449, 0.337, and 0.378 (Table 14. a). When comparing tick borne and West Nile by income levels; there were no differences in the number of sources used (Table 14. b). Income had no impact on the number of sources used.

**Discussion**

Several facets of knowledge gaps were further exposed in this study. Factors influencing one topic may not hold the same weight when applied to another. Education was a factor in tick borne diseases while age and income were factors in West Nile virus. Information saturation on an individual scale may not be as important as on a community level as the number of sources used by participants had no impact on knowledge.

There was a statistically insignificant difference between the number of search results between West Nile virus and tick borne diseases. A broader range of news companies should be investigated to increase the number of observations and lend more support to any real differences. Supporting a difference in the number of search results would suggest a difference in the amount of information and a possible knowledge deficit. A larger number of results in one disease or the other would also increase the probability that an individual encounters the information and the frequency of those encounters (Donohue *et al.*, 1975; Eveland and Schefele, 2000). This would enable reinforcement of previously learned information and increased knowledge (Donohue *et al.*, 1975; Eveland and Schefele, 2000). Further investigating the specific sources used by participants in a study would give a more accurate association between volume of information and knowledge base.

Investigating what information is being shared over social media networks is a potentially useful method to look for what media formats are getting people's attention. The fact that there was no statistical difference in the number of "tweets" and "shares" for West Nile and tick borne diseases may support the previous findings in this study, no difference in numbers of search results, that there actually is no lack of information pertaining to these public health issues. This also may suggest that even though there may be differences in the amount of information on the news networks; the difference may still leave plenty of sources for both. For example, there may be a news website that retrieves two million articles on West Nile but only half a million on tick borne diseases. Despite this large difference there are still a large number of articles on both subjects allowing adequate immersion in the inquired subject to allow for learning. An in depth analysis of media diffusion using a large number of social networks across varying social mediums and incorporating news source analysis is needed to make definite conclusions on knowledge gaps and how social networks impact them.

Information content of internet resources specifically cannot be used to predict knowledge capital. There was higher information content for West Nile in the internet source investigation but the lower scores occurred on the West Nile section. Figure 5 shows the frequency of the sources used by individuals who took the survey. Internet use ranks second, out of five, for tick borne diseases and fourth for West Nile. To better understand information content and knowledge gaps, the number of articles reviewed should be much higher and should be of higher media type diversity. Each specific media type, such as internet or newspaper, should be dissected into specific media outlets to effectively compare content and knowledge capital. Media content preference was shown to be a large factor in the knowledge of politics (Prior, 2005). Prior (2005, 577) states that SES gaps are eclipsed by preference-based gaps and that “lack of motivation, not lack of skills or resources, poses the main obstacle to a widely informed electorate.” The study results showed that news media increases political knowledge and involvement, however if the media users’ preferences are not focused on politics they will have the ability to tune out that portion of the news and therefore become less knowledgeable (Prior, 2005). A study looking at information content could also include a section on content preference to determine if there is an association between media preference and public health issues.

Overall the number one source used by participants was word of mouth (Fig. 5). This suggests social interest and a possible perception of threat from the disease (Genova *et al.*, 1979). The high numbers of word of mouth sources also suggest a more knowledgeable community because of comfort levels in discussion (Genova *et al.*, 1979). Individuals of higher SES are thought to be able to engage in and understand conversations that would provide useful information (Eveland and Schefele, 2000). Young adults, ages 18-26, have been shown to be the most highly connected age group (Hagittai and Hinnant, 2008). This age group was the primary age of the sample taken due to its distribution across a college campus and across Facebook networks that contained people of primarily that age group. This may have biased the results. There is a pattern, in this study, of individuals with higher education who interacted with doctors and vets having higher scores than those with lower education who interacted with doctors and vets (Fig. 22). However, due to too few participants marking this information there was no statistical significance to this observation. A future study specifically seeking out the knowledge acquisition differential between SES groups should be looked at specifically pertaining to a public health message. The overwhelming amount of research data that health professionals sift through creates a communication barrier from research to practitioner and also from practitioner to patient

(Haines *et al*, 2004). Understanding the factors influencing the communication between health professionals and individuals will help develop better communication methods.

Education has been shown, in several studies, to be a primary factor in knowledge gaps (Tichenor *et al.*, 1970; Donohue, 1975; Genova *et al.*, 1979; Eveland, 2001, Kwak, 1999; Yows *et al.*, 1991). However, education, as well as other factors, was linked to overall knowledge of tick borne diseases and West Nile virus; it was not a determinate factor when focusing on just one of the categories separately. Similarly, Horstmann (1991) concluded that education is not a central factor in knowledge gaps during a political campaign. That conclusion is also consistent in this study as income and age were also significant factors in total knowledge and West Nile virus knowledge. The fact that education was a significant factor for tick borne diseases while age and income were significant factors for West Nile virus suggests a much more dynamic relationship between media and knowledge gaps. Other variables linked to income and age such as life situations, motivation, and interest are most likely factors but further investigation is necessary.

Yows *et al.* (1991) looked at education, perceived threat, and channel selection, focused exposure to health information, knowledge and information holding. This study found that motivation and perceived threat predicted focused exposure to health information. Education and income did not. However, gender and level of education were significant predictors of information holding and erroneous and correct knowledge. The authors concluded that motivational variables strongly predicted focused exposure which then influenced knowledge and in some cases even more in low education groups. Public health information usually advises against habits that are highly desired by individuals of all SES groups but may pertain to more sections than others (Randolf and Viswanath, 2004). Therefore, information regarding these habits may be dismissed as inconsequential or not really pertaining to the individuals. Along with public health messages advising against desired habits, they typically encourage people into actions they do not like or are uncomfortable doing such as exercise, eating healthy, or taking extra precautions (Cohan, 2003; Randolf and Viswanath, 2004). Individuals may be inspired into a behavioral change that only ends up being part time (Randolf and Viswanath, 2004). However, if a real but controllable threat is presented then behavioral changes can be induced effectively (Beck and Frankel, 1981). The point at which a knowledge gap in public health becomes threatening to a community needs to be assessed. Whether or not the gaps in knowledge of tick borne diseases and West Nile virus presents a danger to communities is unknown.

The interaction between the different SES categories cannot be dismissed either. There is a link between income and education; that being that those with higher education typically make more money (Gregorio and Lee, 2003). Education provides individuals with a greater knowledge base and often advanced communication and interpretation skills (Eveland and Schefele, 2000). This allows them to absorb more information and further communicate it at a greater efficiency than individuals of lower education (Eveland and Schefele, 2000). Information saturation is thought to ensure a general understanding of a topic (Donohue *et al.*, 1975). A higher income may allow individuals access to a larger number of sources (saturation) and further immersion and absorption of knowledge; however this study showed that there was no significant link between number of sources and income or number of sources and education. A study further investigating number of sources using a detailed analysis of sources and with a broader sample will further illuminate the inconsistencies in the relationships between knowledge gaps and SES factors.

Donohue *et al.* (1975, 3) proposed that information "saturation" leads to a general understanding of a topic and creates a "general equalization of knowledge throughout a system." The authors explored four issues: the extent of the issue, system conflict and its impact on knowledge gaps, community structure (pluralistic or homogeneous), and patterns of media coverage. Numbers of sources used represents information saturation on an individual scale. Donohue *et al.* looked at large scale, community and inter-community, information saturation. The results from this study suggest that on small scales the amount of information does not lead to an equalization of knowledge but has no effect on knowledge acquisition at all. There may be a type of funnel effect. Wherein, as a community is saturated with information only some individuals receive that information. Individuals may come across the information randomly and therefore only have a small number of sources, but retention, influenced more by education, interest, and life history, still may occur (Tichenor *et al.*, 1970; Eveland and Schefele, 2000; Eveland, 2001; Kwak, 1999; Ettema *et al.*, 1983; Horstmann, 1991; Yows *et al*, 1991). Whereas in individuals interested in a subject will pursue multiple facets of media and engage in interactions that increase that individual's number of sources. However, as stated before, that individual's education, interest, and life history will have a high impact on retention ability and negate the effects of information saturation (Tichenor *et al.*, 1970; Eveland and Schefele, 2000; Eveland, 2001; Kwak, 1999; Ettema *et al.*, 1983; Horstmann, 1991; Yows *et al*, 1991).

Another factor that needs to be recognized is the dynamics of individuals. Changes in an individual's activities result in changing perceptions of information utility (Genova *et al.*, 1979). These factors, motivation, lifestyle, and utility, can potentially impact the extent of knowledge gaps. Identification theory is defined as "a person will adopt a behavior from another person or group to establish or maintain a relationship with the other person or group" (Beaudoin, 2009, 616). People are dynamic; in their interests, as well as their life history. They are not static geographically just as they are not static in their interests. When people move from place to place, about their daily lives and also changing the place they live, social networks are disturbed and their access to information changes (Beaudoin, 2009). This can impact interests, conflicts, and media sources and the information they deliver. However, the mobility of social networks, provided by technology, may lesson disruption caused by displacement and movement by individuals as described by Beaudoin (2009). Tick borne diseases and West Nile virus are very geographically distributed (Fight the Bite!, 2012; Geographic Distribution, 2010). It would be expected that an individual's life style, and therefore perceived utility, impacts their knowledge of these topics rather than geographic location but further investigation is needed.

**Conclusion**

Understanding knowledge gap dynamics allows us to develop the methods necessary to narrow them. Human behavior is too complicated to make assumptions on any level (Fischhoff *et al.*, 1982). There are a number of situational variables from macro factors, such as SES and community conflicts, to micro factors, such as life situations and personal interest. Therefore, based on other studies and this one, depending on media content, user preference, SES, motivation/interest, and the subject (politics, public health, etc.), the knowledge gaps and communication methods to close them will be quite variable.  The communication gap is inevitable, however if appropriate communication strategies are employed it can be avoided (Shingi and Mody, 1976).  To address a knowledge gap, if one is known to exist, all factors at all scales should be considered when planning an educational campaign to narrow the gap.

The findings of this study suggest a knowledge gap in West Nile and tick borne diseases based upon, age, education, and income.  The threat the knowledge gap represents to public health is unknown.  Information saturation through increased number of sources had no effect on the knowledge of tick borne diseases and West Nile virus.  Analysis to determine the most efficient sources should be conducted to establish the best outreach methods for the specific demographic audiences.

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# Appendices

## Figures and Tables

a.)

I am a student from ESF doing a study on the efficiency/ effectiveness of media delivered disease education. Survey responses will not be integrated, analyzed, or reported in any way in which the confidentiality of the survey responses is compromised.

Please complete **FRONT** and **BACK.**

**1.) What is your date of birth?**

Year:

**2.) Sex:**

- ☐ M
- ☐ F

**3.) Education:**

- ☐ Less than High School
- ☐ High School/GED
- ☐ Some College
- ☐ 2 - Year College Degree (Associates)
- ☐ 4 – Year College Degree (BA, BS)
- ☐ Master's Degree
- ☐ Doctoral Degree
- ☐ Professional Degree (MD, JD)

**4.) Ethnicity**

- ☐ Hispanic or Latino
- ☐ Not Hispanic or Latino

**5.) To which racial or ethnic group(s) do you most identify?**

- ☐ African-American (non-Hispanic)
- ☐ Asian/Pacific Islanders
- ☐ Caucasian (non-Hispanic)
- ☐ Native American
- ☐ Other

**6.) What is your income or your total household income?**

| | | | |
|---|---|---|---|
| Less than $10,000 | | $60,000 to $69,999 | |
| $10,000 to $19,999 | | $70,000 to $79,999 | |
| $20,000 to $29,999 | | $80,000 to $89,999 | |
| $30,000 to $39,999 | | $90,000 to $99,999 | |
| $40,000 to $49,999 | | $100,000 to $149,999 | |
| $50,000 to $59,999 | | $150,000 or more | |

**Tick Borne Diseases**

**7.) Have you heard/read about tick borne diseases?**

- ☐ Yes
- ☐ No

**8.) Where did you hear about tick borne disease? Circle all that apply and list the name of the source if applicable.**

Newspaper (digital, Paper):

Internet (health website, wiki):

TV/Radio (what channel?):

Word of mouth (who was it?):

Other (e.g. class, informational poster, kiosk, presentation, science paper):

**9.) Modifying your landscape can help prevent encounters with ticks.**

- ☐ True
- ☐ False

**10.) Lyme disease is the only illness that ticks can transmit to dogs and humans.**

- ☐ True
- ☐ False

**11.) The only way to diagnose Lyme Disease is by the distinctive bullseye rash.**

- ☐ True
- ☐ False

Flip Over

Figure 1 a.) and b.): The survey used to gather the data.

b.)

I am a student from ESF doing a study on the efficiency/ effectiveness of media delivered disease education. Survey responses will not be integrated, analyzed, or reported in any way in which the confidentiality of the survey responses is compromised.

**12.) Testing a tick will predict if you will get a disease.**
- ☐ True
- ☐ False

**13.) Ticks aren't a problem in the winter when it's too cold for them to live outside.**
- ☐ True
- ☐ False

**14.) Where are ticks primarily found?**
- ☐ Wooded and bushy areas with high grass and leaf litter
- ☐ Wetlands, swamps, or bogs
- ☐ Heavily populated urban areas
- ☐ Anywhere

**15.) How do you properly remove a tick?**
- ☐ With your fingers
- ☐ Pull out gently with tweezers
- ☐ Use a source of heat, such as a match or lighter, to make the tick back out
- ☐ Smother the tick with alcohol, nail polish remover, or Vaseline to force it out

**West Nile Virus**

**16.) Have you heard/read about West Nile Virus?**
- ☐ Yes
- ☐ No

**17.) What source? (Please list name of source)**

Newspaper (digital, paper):

Internet (health website, wiki):

TV/Radio (what channel?):

Word of mouth (who was it?):

Other (e.g. class, informational poster, kiosk, presentation, science paper):

**18.) How is West Nile Virus spread? Circle all that apply.**
- ☐ Infected mosquitoes
- ☐ Coming into contact with infected animals or animal waste
- ☐ Contact with infected individuals
- ☐ A surface that an infected individual may have come into contact with

**19.) Is West Nile treatable?**
- ☐ Yes
- ☐ No

**20.) There's not much you can do about West Nile virus.**
- ☐ True
- ☐ False

**21.) Kids are in the most danger of getting sick from West Nile.**
- ☐ True
- ☐ False

**22.) People who are already in poor health are the only ones who need to worry about West Nile.**
- ☐ True
- ☐ False

**23.) Repellents containing DEET are not safe.**
- ☐ True ☐ Sometimes
- ☐ False

**24.) Modifying your landscape can help prevent West Nile infection.**
- ☐ True
- ☐ False

**25.) All mosquitoes carry West Nile.**
- ☐ True
- ☐ False

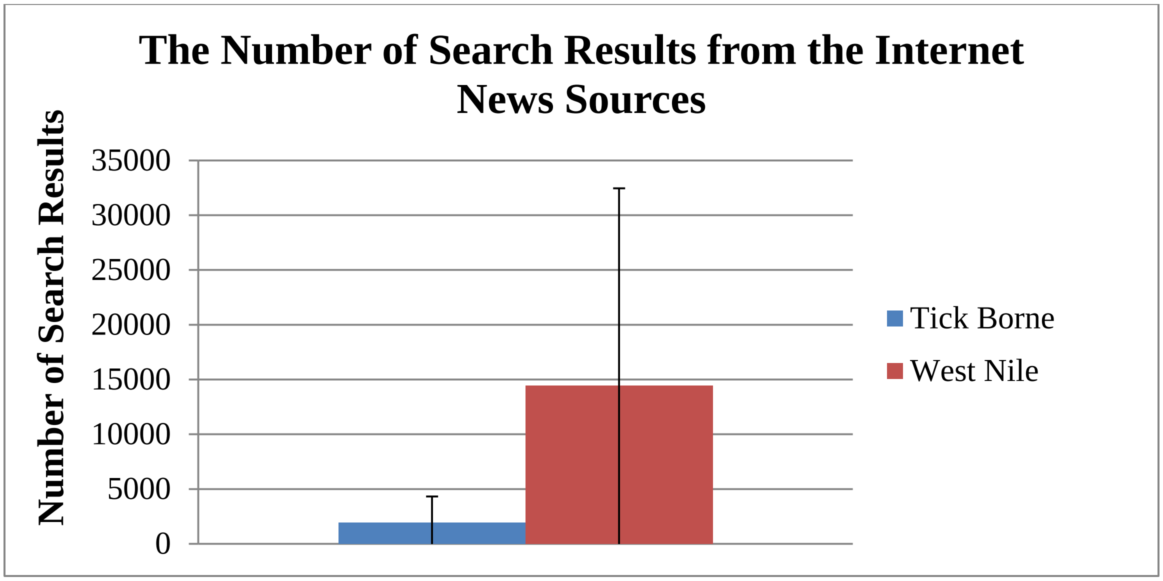



Figure 2: The number of search results for West Nile virus and tick borne diseases from each internet news source. There was no significant difference.  Error bars represent confidence intervals.

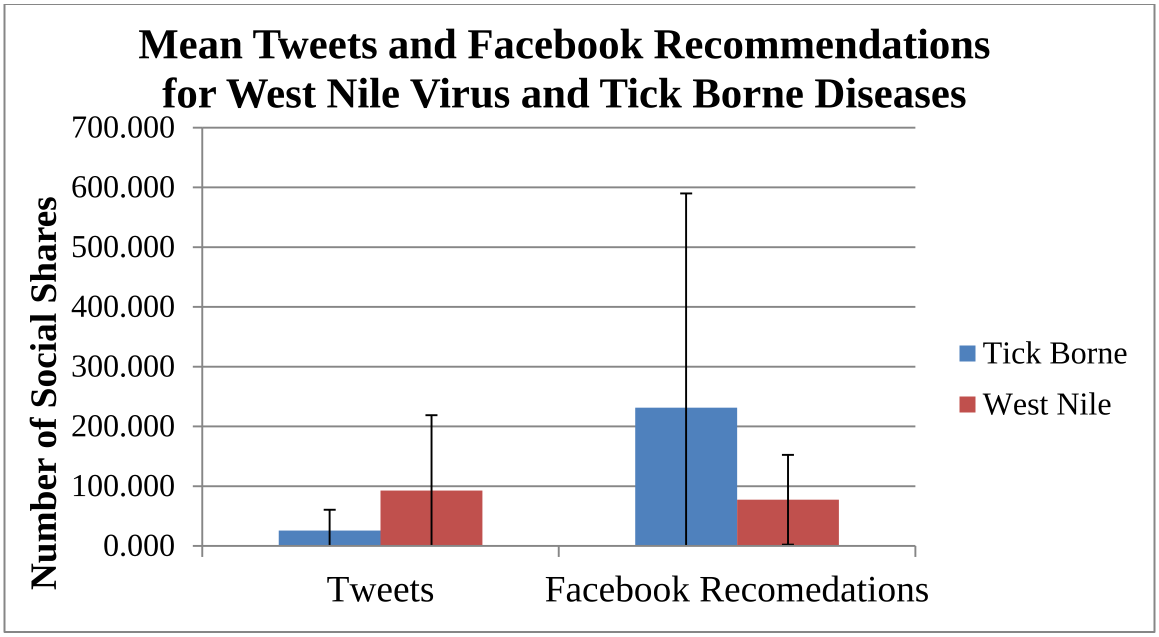
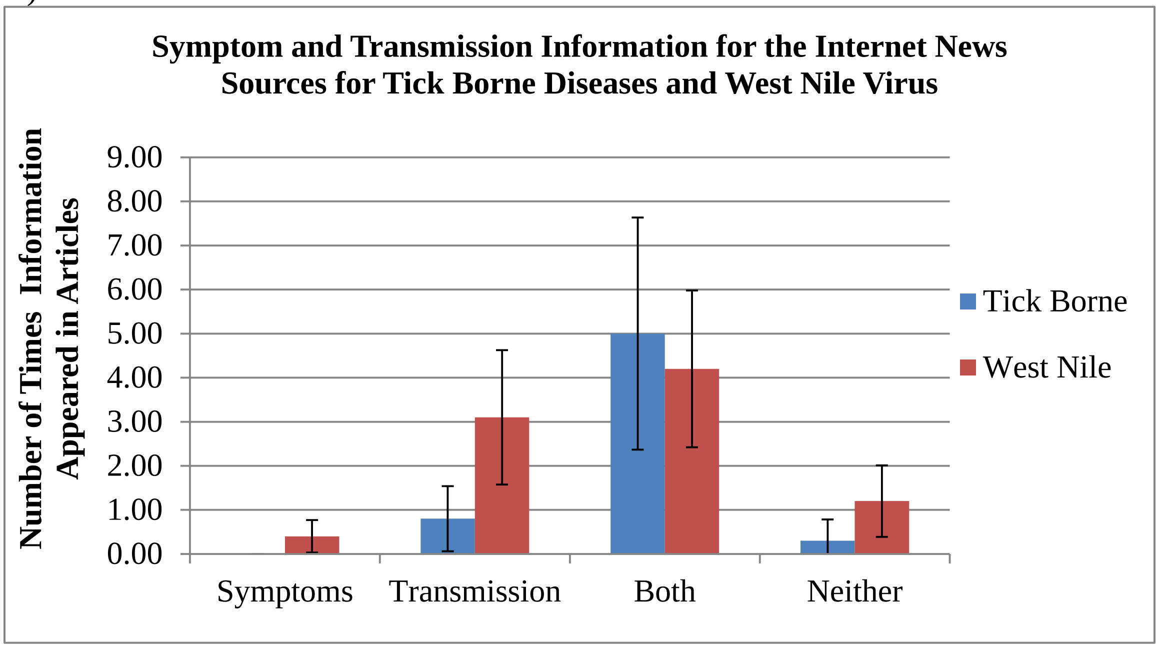



Figure 3: The mean number of tweets and Facebook recommendations from the internet news source for tick borne diseases and West Nile virus. There was no significant difference between the social shares between tick borne diseases and West Nile virus. Error bars represent confidence intervals.

a.)




b.)

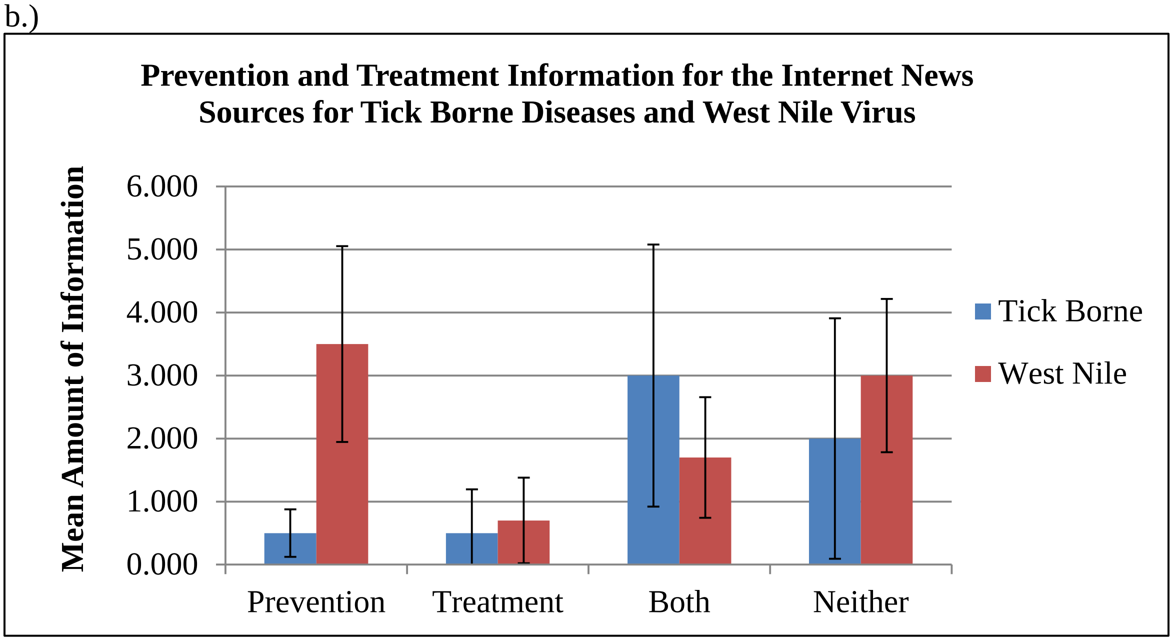



Figure 4: Information content, prevention, treatment, symptoms and transmission, of the internet sources for West Nile (a.) and tick borne diseases (b.). Error bars represent confidence intervals.

Table 1: Information content of the internet sources.

| Tick Borne Diseases | Mean Amount of Information | Standard Deviation | Confidence Level (95.0%) |
|---|---|---|---|
| **Symptoms** | 0.000 | 0.000 | 0.000 |
| **Transmission** | 0.800 | 1.033 | 0.739 |
| **Both** | 5.000 | 3.682 | 2.634 |
| **Neither** | 0.300 | 0.675 | 0.483 |
| **Protection** | 0.500 | 0.527 | 0.377 |
| **Treatment** | 0.500 | 0.972 | 0.695 |
| **Both** | 3.000 | 2.906 | 2.079 |
| **Neither** | 2.000 | 2.667 | 1.908 |

**West Nile Virus**

| | | | |
|---|---|---|---|
| **Symptoms** | 0.400 | 0.516 | 0.369 |
| **Transmission** | 3.100 | 2.132 | 1.525 |
| **Both** | 4.200 | 2.486 | 1.778 |
| **Neither** | 1.200 | 1.135 | 0.812 |
| **Protection** | 3.500 | 2.173 | 1.555 |
| **Treatment** | 0.700 | 0.949 | 0.679 |
| **Both** | 1.700 | 1.337 | 0.957 |
| **Neither** | 3.000 | 1.700 | 1.216 |

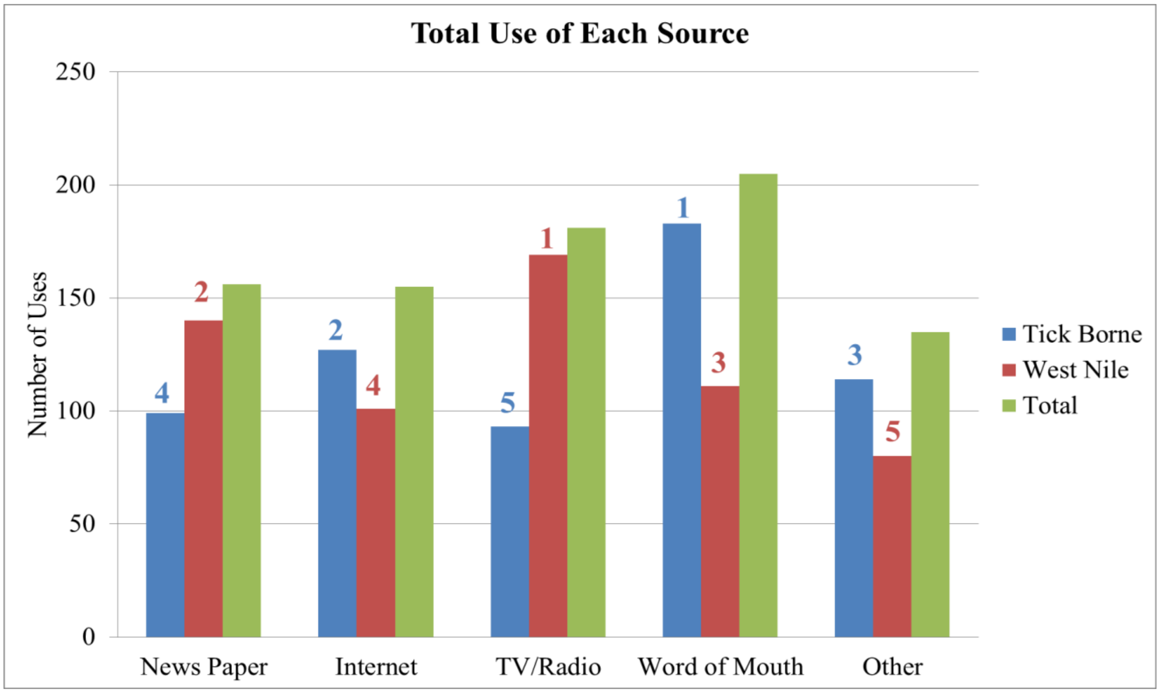



Figure 5: The type of sources used and amount of each category. Word of mouth was the most used for tick borne diseases. TV/Radio was the most used for West Nile.

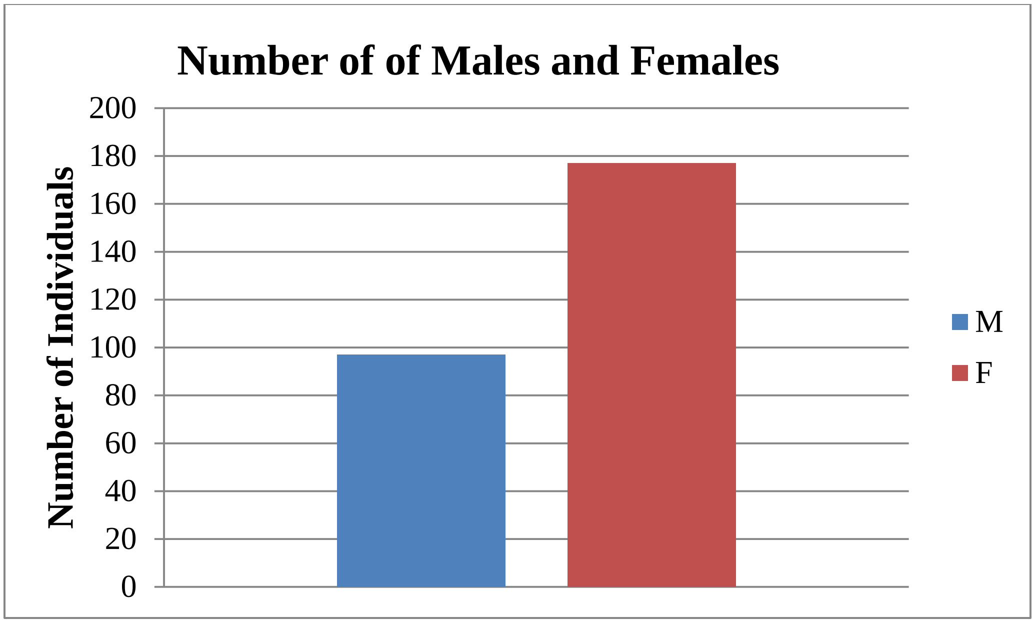



Figure 6: a.) The distribution of males and females of the 274 participants. The sample population had a M/F ratio of 0.548.

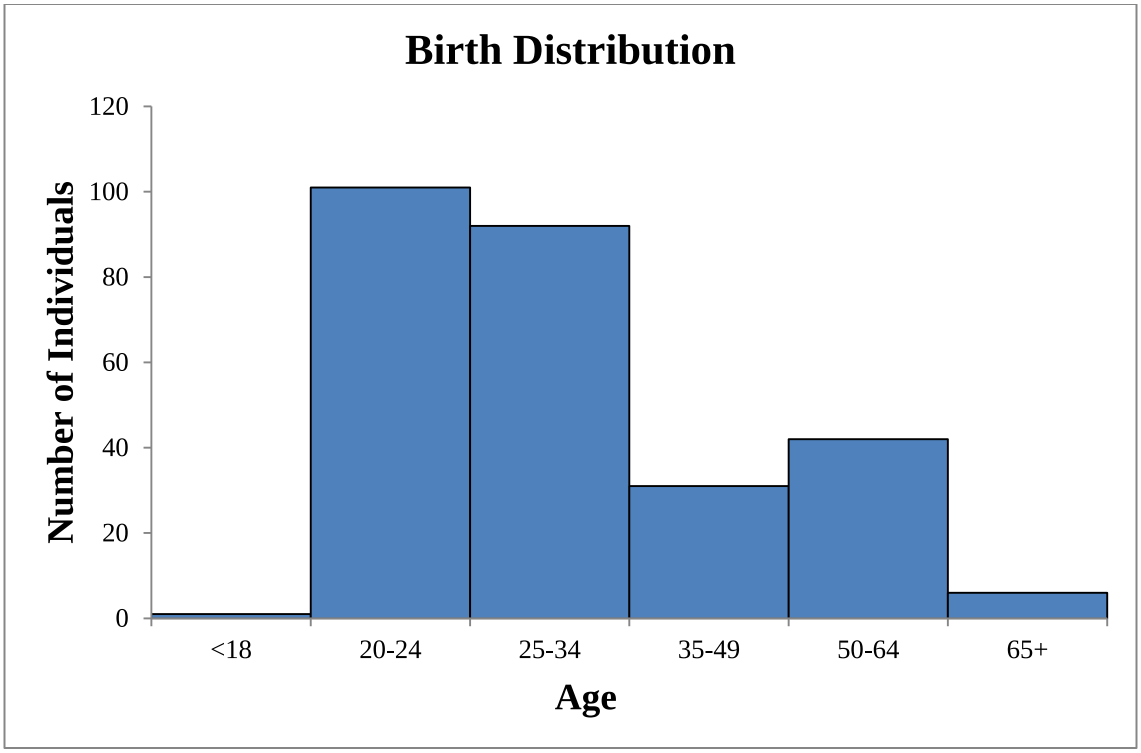



Figure 7: The age distribution of the 274 survey participants. 12% of the sample was born on or before 1960 (52 or older). 31% was born between 1960 and 1985 (27-51) and 57% was born after 1985 (younger than 27).

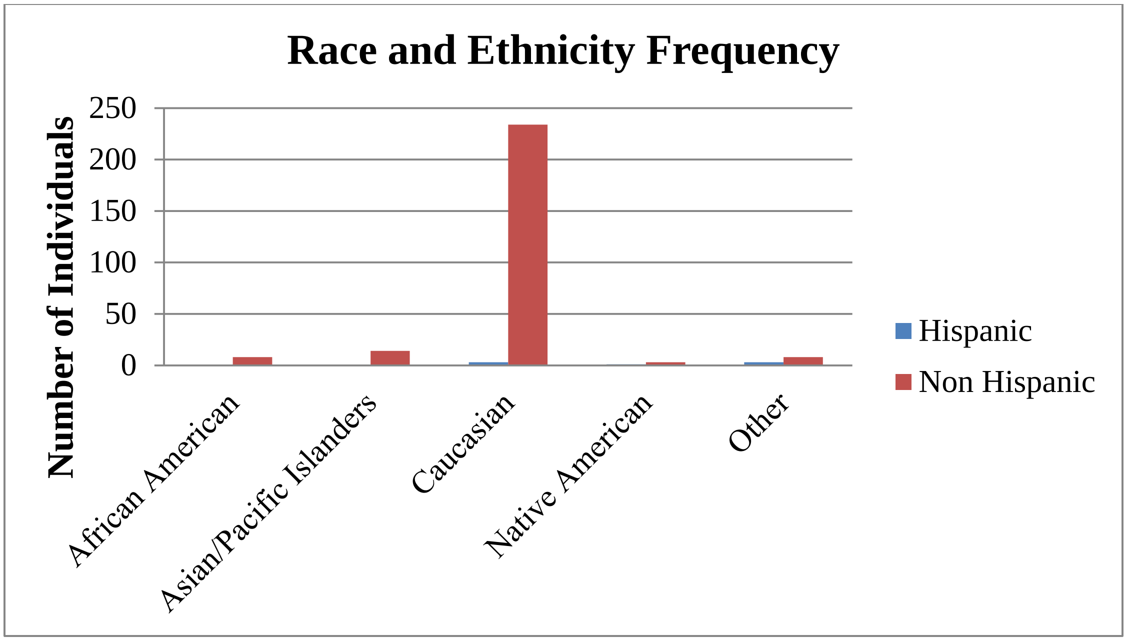



Figure 8: The distribution of race and ethnicity in the 274 participants. 85% of the participants were caucasion and non-hispanic.

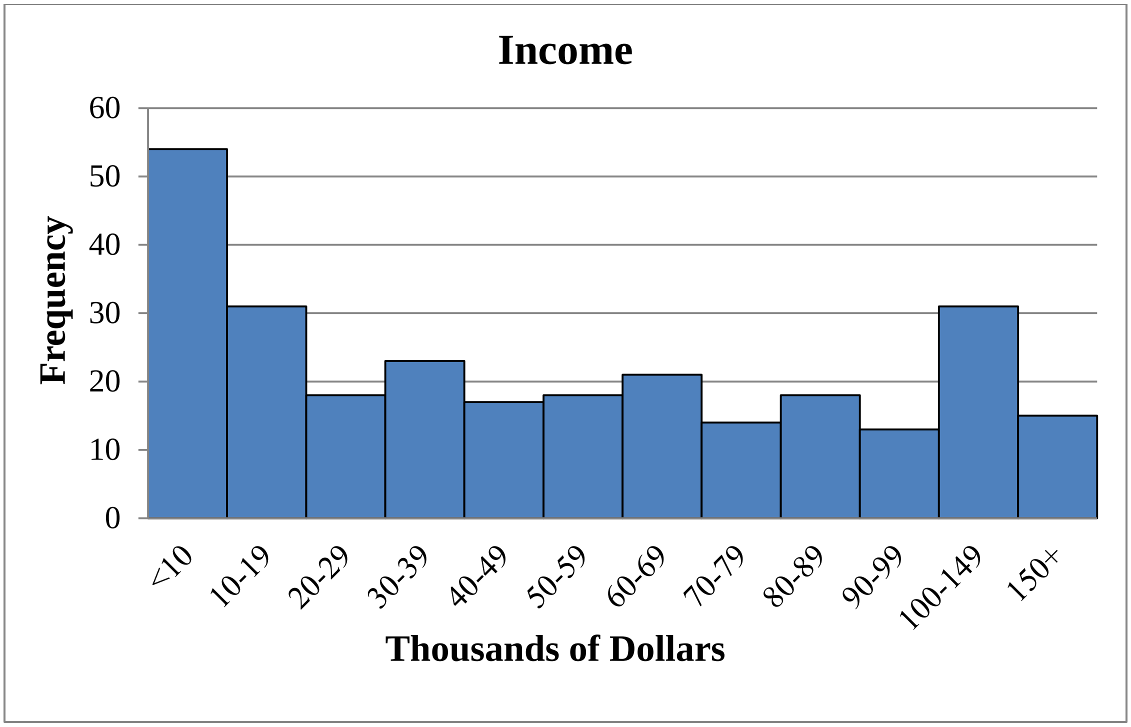



Figure 9: The income distribution of the 274 participants. 20% of the participants made less than $10,000 dollars a year. The remaining categories each comprise about 7% ± 0.02% of the remaining participants.

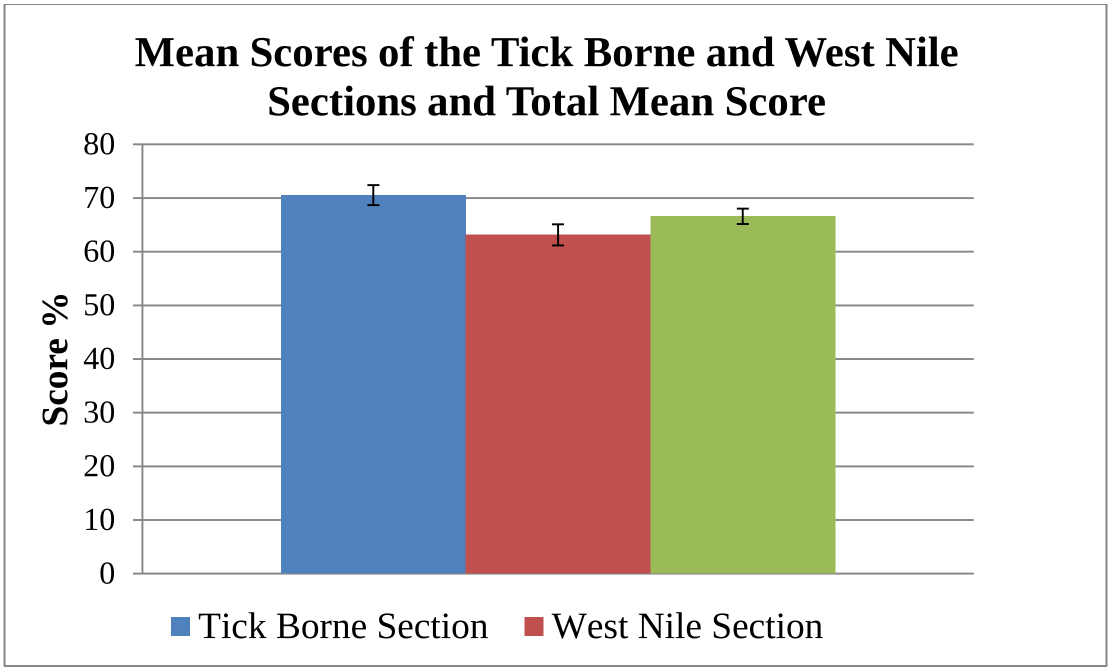



Figure 10: The mean scores of the tick borne section, West Nile section, and the mean overall score. Tick borne diseases have a significantly higher score than West Nile. The bars indicate confidence intervals.

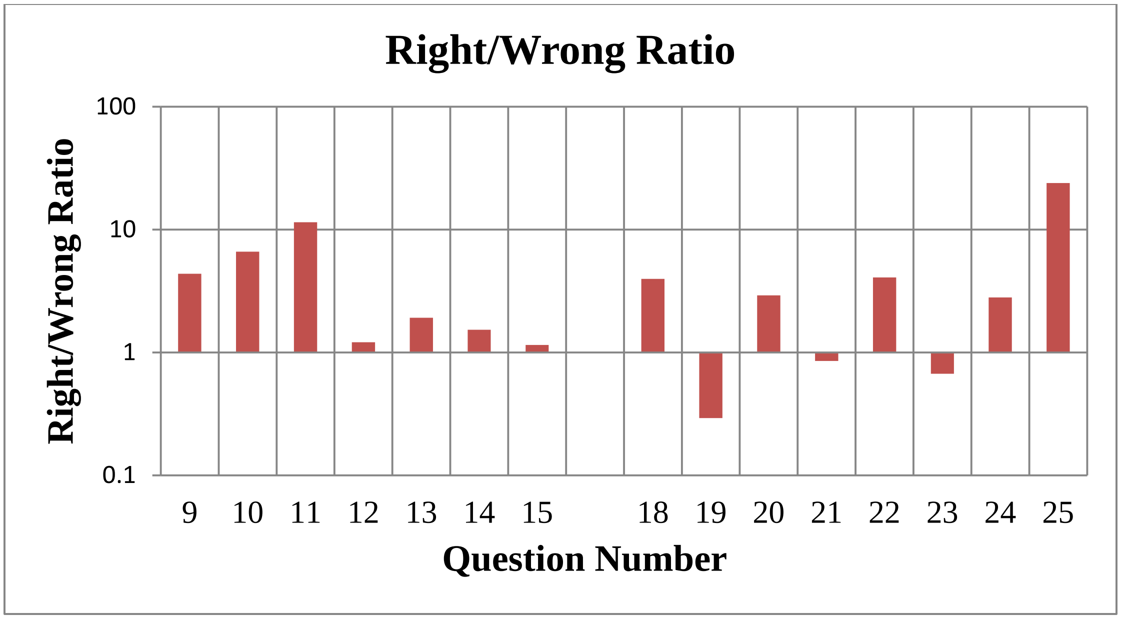



Figure 11: The right/wrong ratio for the tick borne section (9-10) and the West Nile section (18-25).

Table 2: Survey questions and percent correct. Participants scored the best on transmission questions, moderate on prevention, and scored worst on treatment.

| Question | Section | Question Type | % correct |
|---|---|---|---|
| 9.) | Tick Borne Section | Prevention | 81.4 |
| 10.) | | Transmission | 86.9 |
| 11.) | | Treatment | 92.0 |
| 12.) | | Treatment | 54.7 |
| 13.) | | Prevention | 65.7 |
| 14.) | | Prevention | 60.2 |
| 15.) | | Treatment | 53.3 |
| 18.) | West Nile Section | Transmission | 79.6 |
| 19.) | | Treatment | 22.6 |
| 20.) | | Prevention | 74.5 |
| 21.) | | Prevention | 46.0 |
| 22.) | | Prevention | 80.3 |
| 23.) | | Prevention | 40.1 |
| 24.) | | Prevention | 73.7 |
| 25.) | | Transmission | 96.0 |

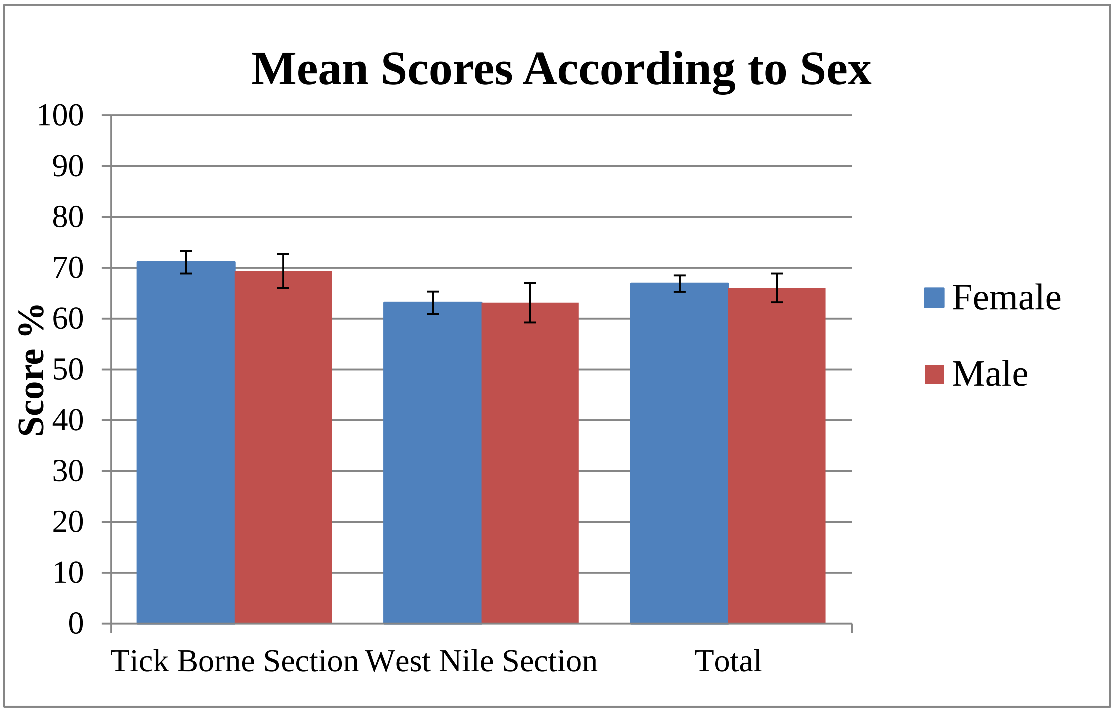



Figure 12: The mean total score and scores of each section according to sex. Error bars represent confidence intervals. Sex was not a factor in any of the scores.

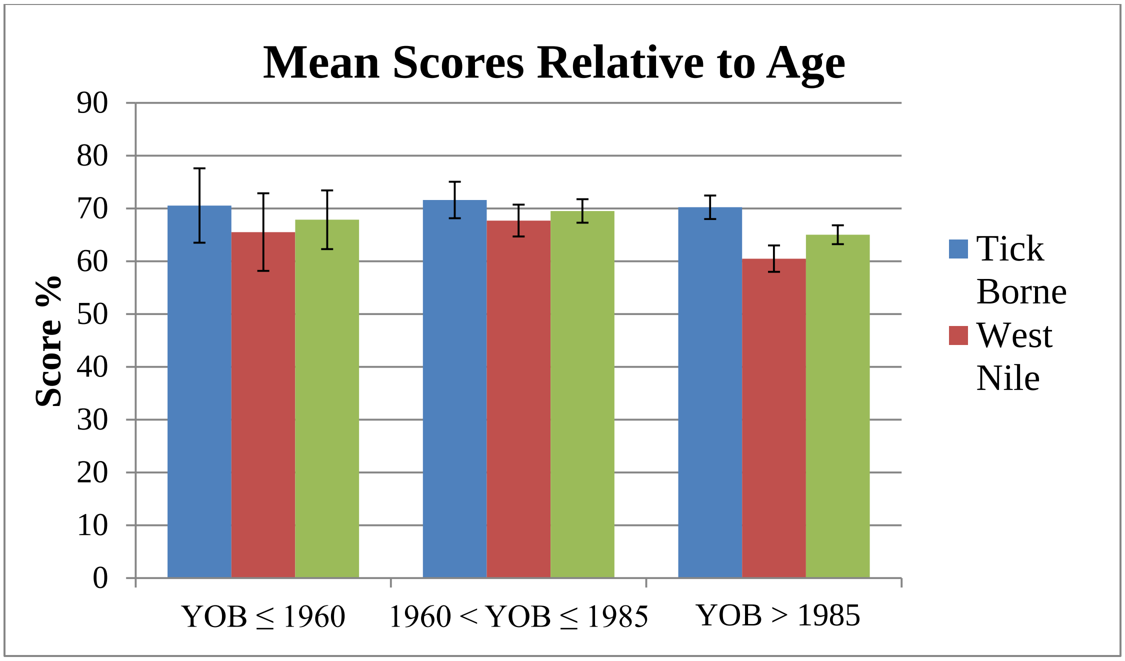



Figure 13: The mean total score and scores for each section relative to age. Age was divided into three sections: born before or in 1960, born between 1961 and into 1985, and born after 1985. The bars indicate confidence intervals.

Table 3: Tick borne, West Nile, and total mean scores and their distribution.

| | Mean | Standard Error | Standard Deviation | Confidence Level(95.0%) | *p-value* |
|---|---|---|---|---|---|
| *Tick Borne Section* | | | | | |
| YOB ≤ 1960 | 70.6 | 3.46 | 19.9 | 7.04 | |
| 1960 < YOB ≤ 1985 | 71.6 | 1.74 | 15.9 | 3.45 | 0.808 |
| YOB > 1985 | 70.2 | 1.12 | 14.0 | 2.22 | |
| *West Nile Section* | | | | | |
| YOB ≤ 1960 | 65.5 | 3.61 | 20.7 | 7.35 | |
| 1960 < YOB ≤ 1985 | 67.7 | 1.52 | 13.9 | 3.01 | 0.003 |
| YOB > 1985 | 60.5 | 1.27 | 15.8 | 2.51 | |
| *Total* | | | | | |
| YOB ≤ 1960 | 67.9 | 2.73 | 15.7 | 5.56 | |
| 1960 < YOB ≤ 1985 | 69.5 | 1.12 | 10.3 | 2.23 | 0.015 |
| YOB > 1985 | 65.0 | 0.91 | 11.3 | 1.79 | |

Table 4: Differences between the mean score in tick borne and West Nile Scores of each age group. Only YOB ≤ 1960 was not significantly different.

| **Age Group** | **Tick** | **West** | |
|---|---|---|---|
| | Mean | | *p-value* |
| YOB ≤ 1960 | 70.6 | 65.5 | 0.159 |
| 1960 < YOB ≤ 1985 | 71.6 | 67.7 | 0.047 |
| YOB > 1985 | 70.2 | 60.5 | 0.000 |

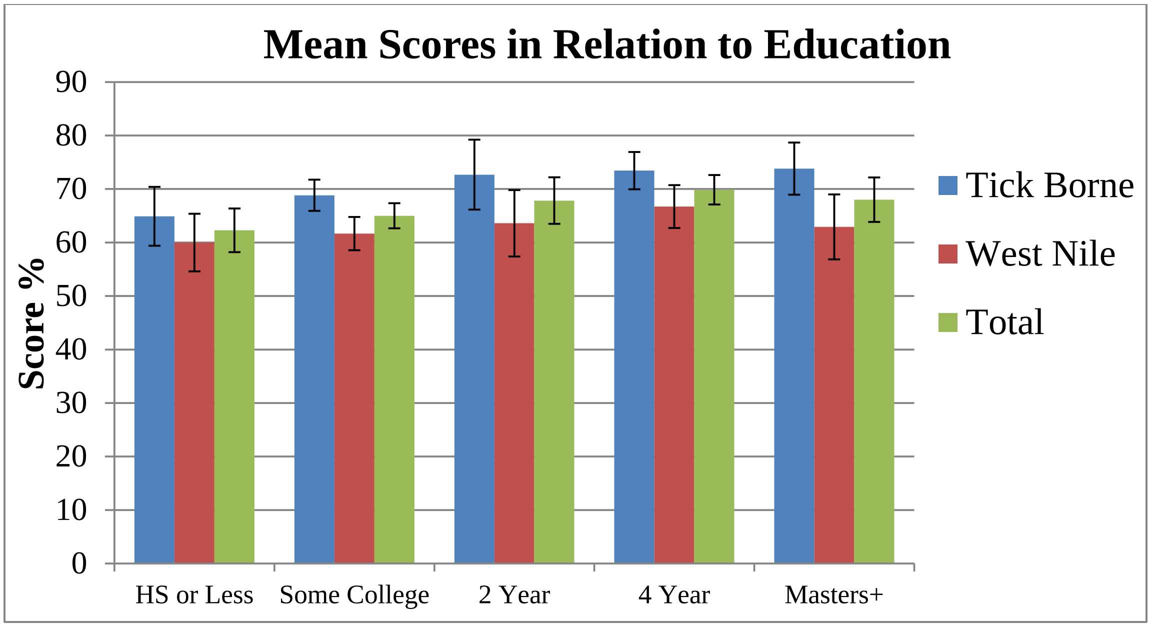



Figure 14: The mean total score and scores on each section relative to degree of education. The bars represent confidence intervals.

Table 5: Mean scores relative to education and their distribution.

| Tick Education Levels | Mean | Standard Error | Standard Deviation | Confidence Level(95.0%) | *P-value within groups* |
|---|---|---|---|---|---|
| *HS or Less* | 64.9 | 2.71 | 16.0 | 5.50 | |
| Some College | 68.8 | 1.47 | 15.0 | 2.92 | |
| 2 Year | 72.7 | 3.21 | 18.7 | 6.54 | 0.034 |
| 4 Year | 73.4 | 1.75 | 14.7 | 3.49 | |
| Masters+ | 73.8 | 2.38 | 13.0 | 4.87 | |
| | | | | | |
| West Education Levels | | | | | |
| *HS or Less* | 60.0 | 2.65 | 15.69 | 5.39 | |
| Some College | 61.7 | 1.57 | 15.99 | 3.11 | |
| 2 Year | 63.6 | 3.05 | 17.78 | 6.20 | 0.241 |
| 4 Year | 66.7 | 2.01 | 16.90 | 4.00 | |
| Masters+ | 62.9 | 2.97 | 16.24 | 6.07 | |
| | | | | | |
| Total Education Levels | | | | | |
| *HS or Less* | 62.3 | 2.01 | 11.88 | 4.08 | |
| Some College | 65.0 | 1.18 | 12.07 | 2.35 | |
| 2 Year | 67.8 | 2.13 | 12.44 | 4.34 | 0.015 |
| 4 Year | 69.9 | 1.38 | 11.65 | 2.76 | |
| Masters+ | 68.0 | 2.03 | 11.13 | 4.16 | |

Table 6: Section mean score comparison for each degree of education. Only high school or less was not significantly different.

| **Degree of Education** | **Tick** | **West** | |
|---|---|---|---|
| | Mean | | p(T<=t) one-tail |
| *HS or Less* | 64.9 | 60.0 | 0.100 |
| Some College | 68.8 | 61.7 | 0.001 |
| 2 Year | 72.7 | 63.6 | 0.022 |
| 4 Year | 73.4 | 66.7 | 0.006 |
| Masters+ | 73.8 | 62.9 | 0.003 |

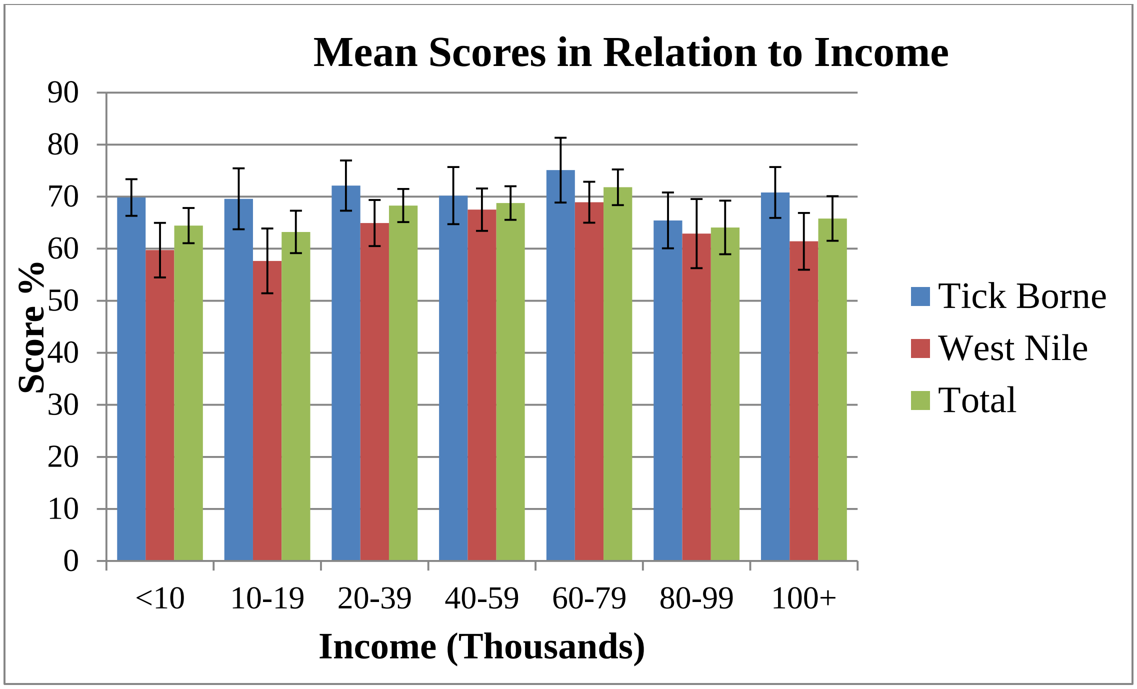



Figure 15: The mean total, tick borne, and West Nile scores relative to income. The bars represent confidence intervals.

Table 7: Mean scores in relation to income level and their distribution.

| Tick Income Levels | Mean | Standard Error | Standard Deviation | Confidence Level(95.0%) | *P-value* |
|---|---|---|---|---|---|
| *<10* | 69.8 | 1.76 | 12.9 | 3.53 | |
| 10-19 | 69.6 | 2.87 | 16.0 | 5.86 | |
| 20-39 | 72.1 | 2.39 | 15.3 | 4.83 | |
| 40-59 | 70.2 | 2.71 | 16.0 | 5.50 | 0.322 |
| 60-79 | 75.1 | 3.06 | 18.1 | 6.22 | |
| 80-99 | 65.4 | 2.63 | 14.6 | 5.37 | |
| 100+ | 70.8 | 2.43 | 16.5 | 4.90 | |
| | | | | | |
| West Nile Income Levels | | | | | |
| *<10* | 59.7 | 2.62 | 19.2 | 5.25 | |
| 10-19 | 57.7 | 3.05 | 17.0 | 6.23 | |
| 20-39 | 64.9 | 2.19 | 14.0 | 4.43 | |
| 40-59 | 67.5 | 2.00 | 11.8 | 4.06 | 0.034 |
| 60-79 | 68.9 | 1.94 | 11.5 | 3.95 | |
| 80-99 | 62.9 | 3.25 | 18.1 | 6.64 | |
| 100+ | 61.4 | 2.71 | 18.4 | 5.47 | |
| | | | | | |
| Total Score Income Levels | | | | | |
| *<10* | 64.4 | 1.69 | 12.4 | 3.39 | |
| 10-19 | 63.2 | 2.00 | 11.1 | 4.09 | |
| 20-39 | 68.3 | 1.58 | 10.1 | 3.18 | |
| 40-59 | 68.8 | 1.59 | 9.40 | 3.23 | 0.027 |
| 60-79 | 71.8 | 1.69 | 10.0 | 3.43 | |
| 80-99 | 64.1 | 2.52 | 14.1 | 5.16 | |
| 100+ | 65.8 | 2.13 | 14.4 | 4.29 | |

Table 8: Tick borne and West Nile score comparison relative to income.  The 40-59 and 80-99 thousand groups were not significantly different.

| **Income (Thousand)** | **Tick** | **West** | |
|---|---|---|---|
| | Mean | | p(T<=t) one-tail |
| *<10* | 69.8 | 59.722 | 0.001 |
| 10-19 | 69.6 | 57.661 | 0.003 |
| 20-39 | 72.1 | 64.939 | 0.015 |
| 40-59 | 70.2 | 67.500 | 0.212 |
| 60-79 | 75.1 | 68.929 | 0.047 |
| 80-99 | 65.4 | 62.903 | 0.274 |
| 100+ | 70.8 | 61.413 | 0.006 |

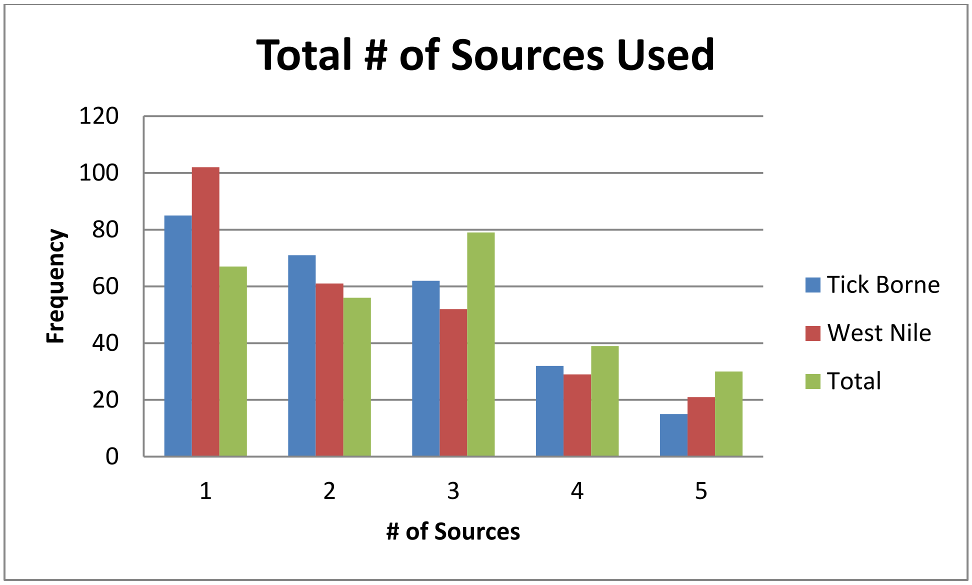



Figure 16: The distribution of the number of sources used in the tick borne and West Nile sections.

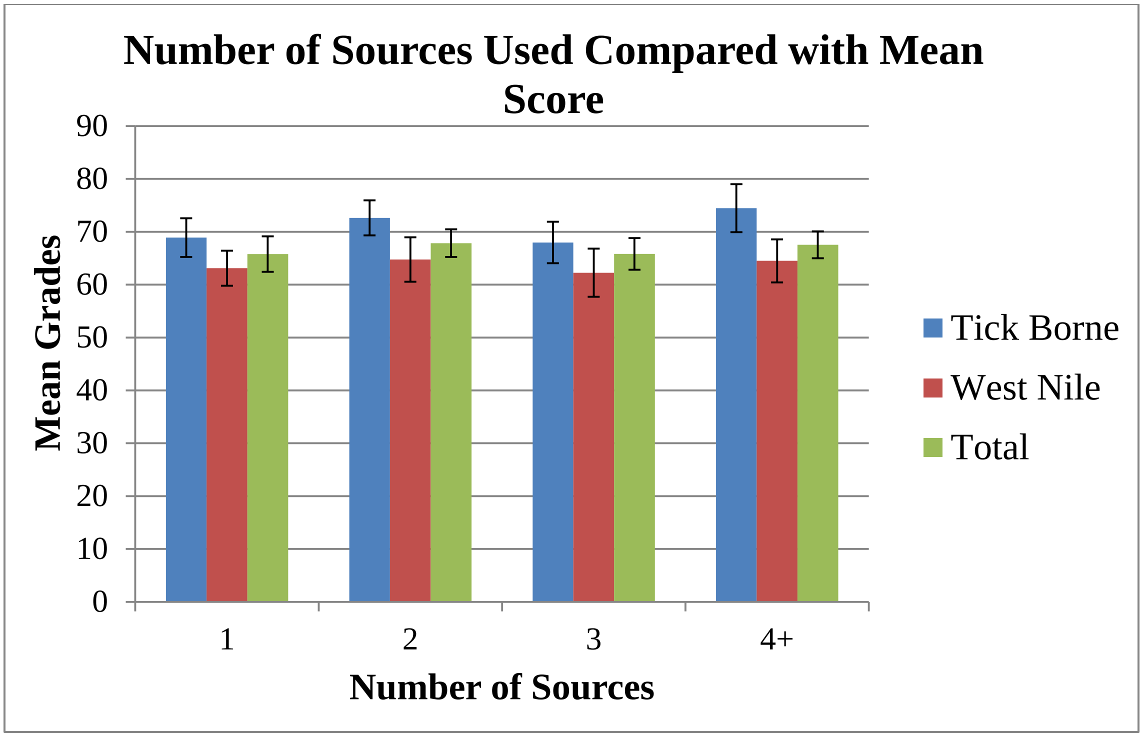



Figure 17: The mean total and section scores relative to number of sources used. The number of sources did not have an effect on the mean grades. Error bars represent confidence intervals.

Table 9: Mean grades for the different number of sources used and their distribution.

| Number of sources | Mean | Standard Error | Standard Deviation | Confidence Level(95.0%) | *P-value* |
|---|---|---|---|---|---|
| West | | | | | |
| *1* | 63.1 | 1.67 | 16.9 | 3.3 | 0.823 |
| *2* | 64.8 | 2.10 | 16.4 | 4.2 | |
| *3* | 62.3 | 2.26 | 16.3 | 4.5 | |
| *4+* | 64.5 | 2.03 | 14.4 | 4.1 | |
| Tick | | | | | |
| *1* | 68.9 | 1.84 | 17.0 | 3.7 | 0.079 |
| *2* | 72.6 | 1.66 | 14.0 | 3.3 | |
| *3* | 68.0 | 1.96 | 15.5 | 3.9 | |
| *4+* | 74.5 | 2.26 | 15.5 | 4.5 | |
| Total | | | | | |
| *1* | 65.8 | 1.68 | 13.8 | 3.4 | 0.651 |
| *2* | 67.9 | 1.31 | 9.8 | 2.6 | |
| *3* | 65.8 | 1.50 | 13.3 | 3.0 | |
| *4+* | 67.5 | 1.28 | 10.6 | 2.5 | |

Table 10: Section score comparison relative to number of sources used. All the groups were significantly different.

| Number of Sources | West Nile | Tick Borne | |
|---|---|---|---|
| | Mean | | p(T<=t) one-tail |
| *1* | 63.1 | 68.9 | 0.010 |
| *2* | 64.8 | 72.6 | 0.002 |
| *3* | 62.3 | 68.0 | 0.030 |
| *4+* | 64.5 | 74.5 | 0.001 |

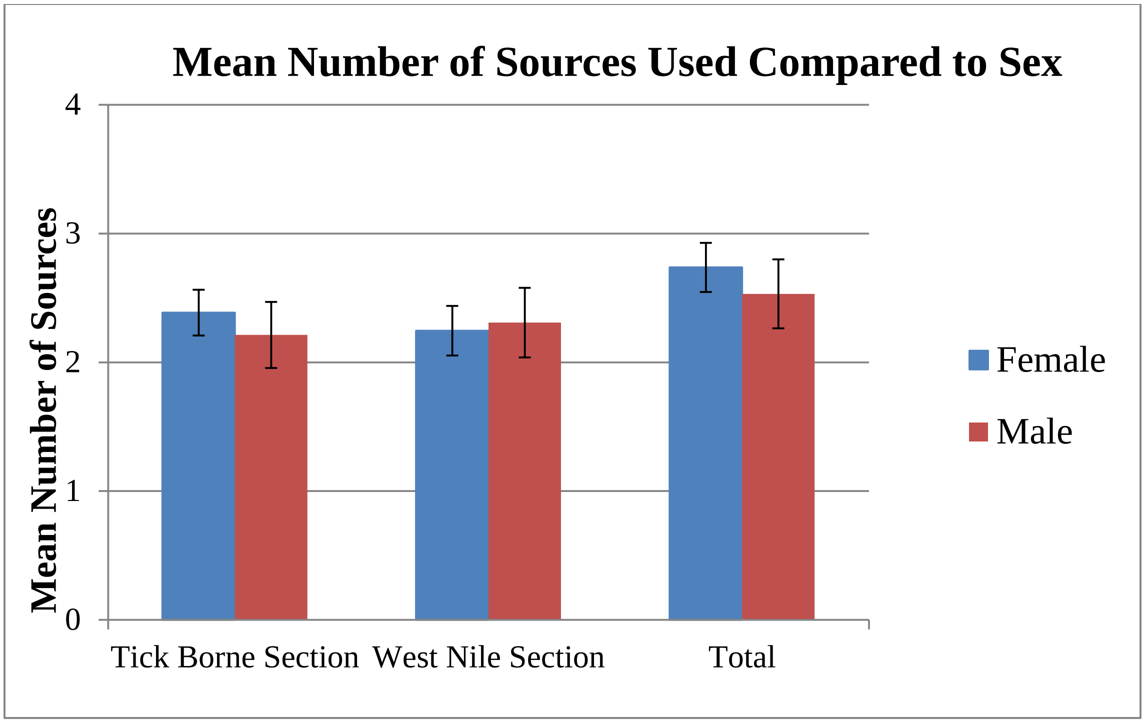



Figure 18: The number of sources used with respect to sex. There was no significant differences is number of sources used based on sex. Error bars represent confidence intervals.

Table 11: The mean number of sources according to sex and their distribution. There was no difference between the number of sources used between tick borne and West Nile by sex.

| Male | Mean | Standard Error | Standard Deviation | Confidence Level (95.0%) | *p-value (M/F)* | *p-value (M/M, F/F)* | |
|---|---|---|---|---|---|---|---|
| Tick | 2.21 | 0.129 | 1.25 | 0.256 | 0.263 | M/M | 0.305 |
| West | 2.31 | 0.136 | 1.32 | 0.270 | 0.705 | F/F | 0.146 |
| Total | 2.53 | 0.135 | 1.32 | 0.268 | 0.211 | | |

| Female | | | | |
|---|---|---|---|---|
| Tick | 2.39 | 0.090 | 1.17 | 0.177 |
| West | 2.25 | 0.098 | 1.28 | 0.193 |
| Total | 2.74 | 0.097 | 1.28 | 0.191 |

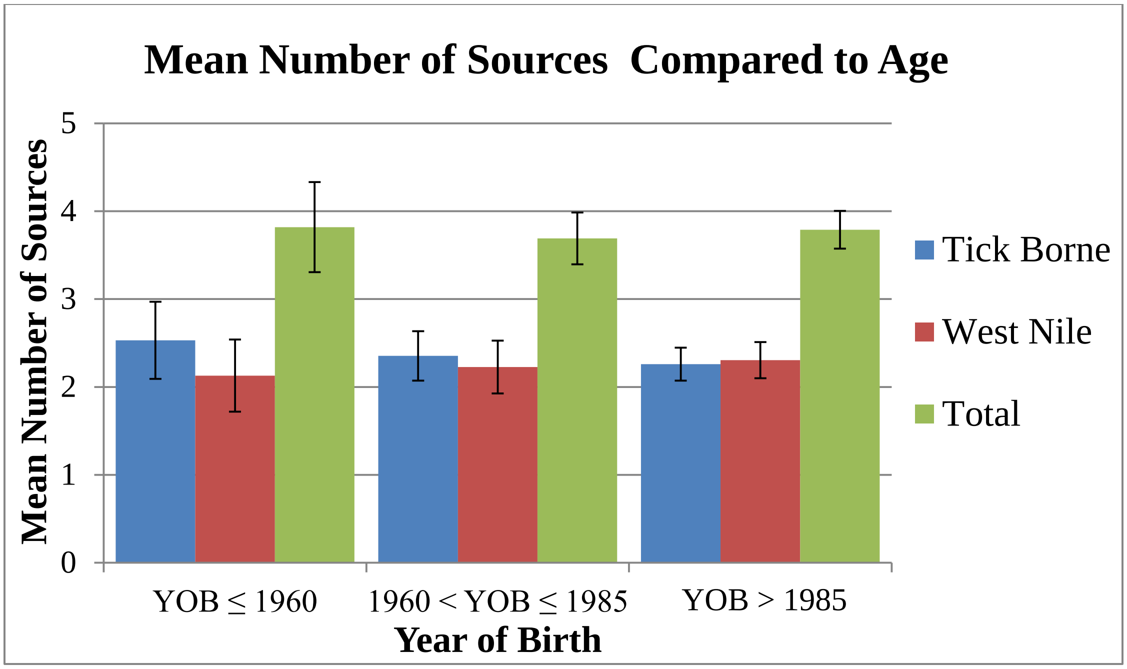



Figure 19: The number of sources used with respect to age.  Error bars represent confidence intervals.

Table 12: a.) Number of sources used according to age. b.) Comparison of mean number of sources used between sections. There was no significant difference between age and number of sources used. There was also no difference in number of sources used between West Nile and tick borne diseases.

a.)

| West | Mean | Standard Error | Standard Deviation | Confidence Level(95.0%) | *P-value between the groups* |
|---|---|---|---|---|---|
| *YOB ≤ 1960* | 2.13 | 0.201 | 1.12 | 0.410 | |
| *1960 < YOB ≤ 1985* | 2.23 | 0.151 | 1.38 | 0.300 | 0.759 |
| *YOB > 1985* | 2.38 | 0.142 | 1.32 | 0.283 | |
| *Tick* | | | | | |
| *YOB ≤ 1960* | 2.53 | 0.215 | 1.22 | 0.439 | |
| *1960 < YOB ≤ 1985* | 2.35 | 0.141 | 1.28 | 0.281 | 0.493 |
| *YOB > 1985* | 2.26 | 0.095 | 1.16 | 0.187 | |
| *Total* | | | | | |
| *YOB ≤ 1960* | 3.94 | 0.229 | 1.29 | 0.466 | |
| *1960 < YOB ≤ 1985* | 3.69 | 0.149 | 1.36 | 0.296 | 0.607 |
| *YOB > 1985* | 3.82 | 0.103 | 1.27 | 0.203 | |

b.)

| Age | West | Tick | |
|---|---|---|---|
| | Mean | | P(T<=t) one-tail |
| *YOB ≤ 1960* | 2.13 | 2.53 | 0.088 |
| *1960 < YOB ≤ 1985* | 2.23 | 2.35 | 0.269 |
| *YOB > 1985* | 2.38 | 2.26 | 0.235 |

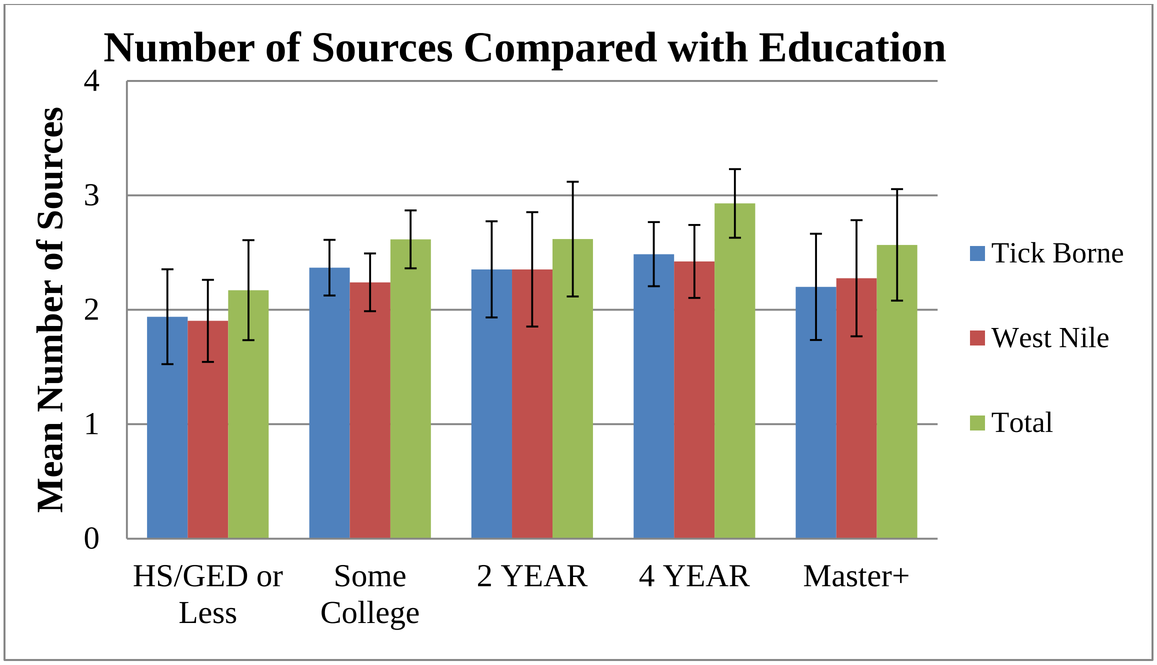



Figure 20: The number of sources used with respect to education. There was no difference in the number of sources used relative to education. Error bars represent confidence intervals.

Table 13: a.) Mean number of sources used according to education. b.) Comparison of mean number of sources between sections. There was no difference in the number of sources used between the tick borne and West Nile sections according to education. Education had no impact on the number of sources used.

a.)

| Tick | Mean | Standard Error | Standard Deviation | Confidence Level(95.0%) | *P-value within Groups* |
|---|---|---|---|---|---|
| *HS or Less* | 1.94 | 0.204 | 1.17 | 0.415 | |
| *Some College* | 2.37 | 0.123 | 1.21 | 0.243 | |
| *2 Year* | 2.35 | 0.206 | 1.20 | 0.420 | 0.278 |
| *4 Year* | 2.49 | 0.141 | 1.18 | 0.280 | |
| *Masters+* | 2.20 | 0.227 | 1.24 | 0.464 | |
| West | | | | | |
| *HS or Less* | 1.90 | 0.176 | 0.978 | 0.359 | |
| *Some College* | 2.24 | 0.127 | 1.27 | 0.252 | |
| *2 Year* | 2.35 | 0.246 | 1.43 | 0.500 | 0.452 |
| *4 Year* | 2.42 | 0.160 | 1.35 | 0.319 | |
| *Masters+* | 2.28 | 0.248 | 1.33 | 0.507 | |
| Total | | | | | |
| *HS or Less* | 2.17 | 0.215 | 1.27 | 0.437 | |
| *Some College* | 2.62 | 0.128 | 1.30 | 0.253 | |
| *2 Year* | 2.62 | 0.246 | 1.44 | 0.501 | 0.091 |
| *4 Year* | 2.93 | 0.151 | 1.27 | 0.300 | |
| *Masters+* | 2.57 | 0.238 | 1.30 | 0.487 | |

b.)

| Degree of Education | Tick | West | |
|---|---|---|---|
| | Mean | | P(T<=t) two-tail |
| HS or Less | 1.94 | 1.90 | 0.447 |
| Some College | 2.37 | 2.24 | 0.236 |
| 2 Year | 2.35 | 2.35 | 0.500 |
| 4 Year | 2.49 | 2.42 | 0.384 |
| Masters+ | 2.20 | 2.28 | 0.411 |

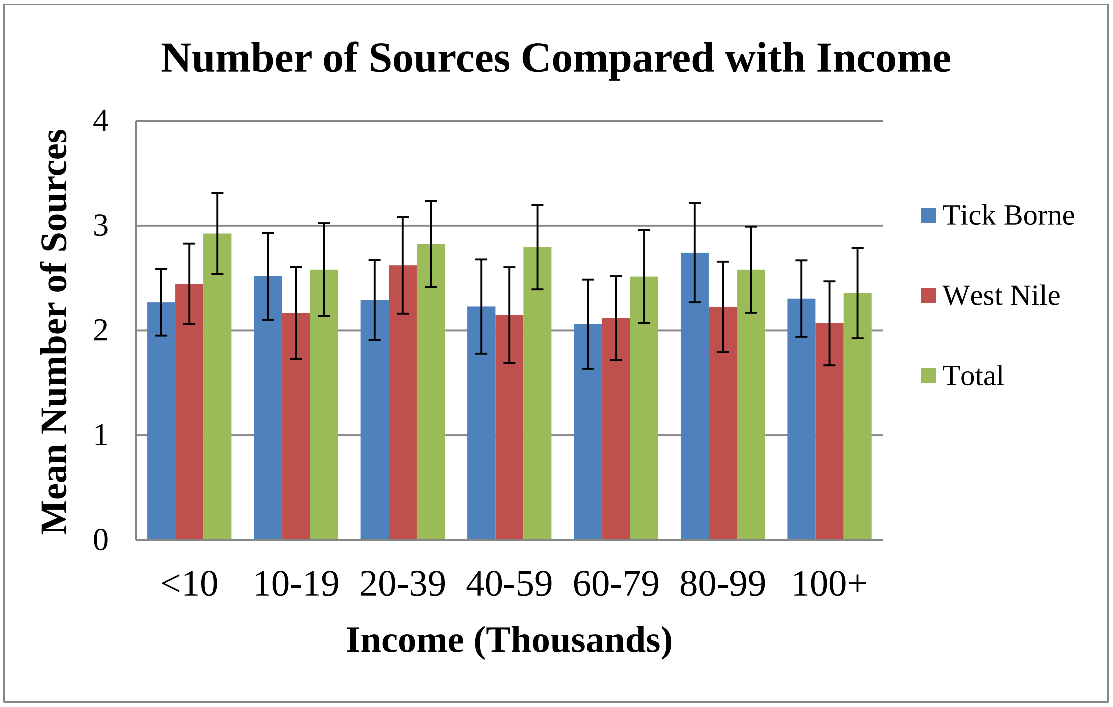



Figure 21: The number of sources used with respect to income. Error bars represent confidence intervals.

Table 14: a.) Mean number of sources used according to income. b.) Comparison of mean number of sources between sections. There was no significant difference in the numbers of sources used between income groups for West Nile virus, tick borne diseases, or total.

a.)

| *Tick* | Mean | Standard Error | Standard Deviation | Confidence Level(95.0%) | *P-value* |
|---|---|---|---|---|---|
| *<10* | 2.27 | 0.158 | 1.14 | 0.317 | |
| *10-19* | 2.52 | 0.202 | 1.09 | 0.414 | |
| *20-39* | 2.29 | 0.188 | 1.16 | 0.381 | |
| *40-59* | 2.23 | 0.221 | 1.31 | 0.449 | 0.377 |
| *60-79* | 2.06 | 0.208 | 1.20 | 0.425 | |
| *80-99* | 2.74 | 0.232 | 1.29 | 0.473 | |
| *100+* | 2.30 | 0.181 | 1.23 | 0.364 | |

| *West* | | | | | |
|---|---|---|---|---|---|
| *<10* | 2.44 | 0.192 | 1.41 | 0.385 | |
| *10-19* | 2.17 | 0.215 | 1.18 | 0.439 | |
| *20-39* | 2.62 | 0.227 | 1.38 | 0.461 | |
| *40-59* | 2.15 | 0.224 | 1.31 | 0.456 | 0.449 |
| *60-79* | 2.12 | 0.197 | 1.15 | 0.401 | |
| *80-99* | 2.23 | 0.211 | 1.18 | 0.431 | |
| *100+* | 2.07 | 0.199 | 1.32 | 0.401 | |

| *Total* | | | | | |
|---|---|---|---|---|---|
| *<10* | 2.93 | 0.192 | 1.41 | 0.385 | |
| *10-19* | 2.58 | 0.216 | 1.20 | 0.442 | |
| *20-39* | 2.83 | 0.202 | 1.28 | 0.409 | |
| *40-59* | 2.79 | 0.197 | 1.15 | 0.401 | 0.378 |
| *60-79* | 2.51 | 0.218 | 1.29 | 0.444 | |
| *80-99* | 2.58 | 0.201 | 1.12 | 0.410 | |
| *100+* | 2.36 | 0.214 | 1.43 | 0.430 | |

b.)

| Income | Tick | West | |
|---|---|---|---|
| | Mean | | P(T<=t) one-tail |
| *<10* | 2.27 | 2.44 | 0.241 |
| *10-19* | 2.52 | 2.17 | 0.120 |
| *20-39* | 2.29 | 2.62 | 0.132 |
| *40-59* | 2.23 | 2.15 | 0.398 |
| *60-79* | 2.06 | 2.12 | 0.421 |
| *80-99* | 2.74 | 2.23 | 0.052 |
| *100+* | 2.30 | 2.07 | 0.191 |

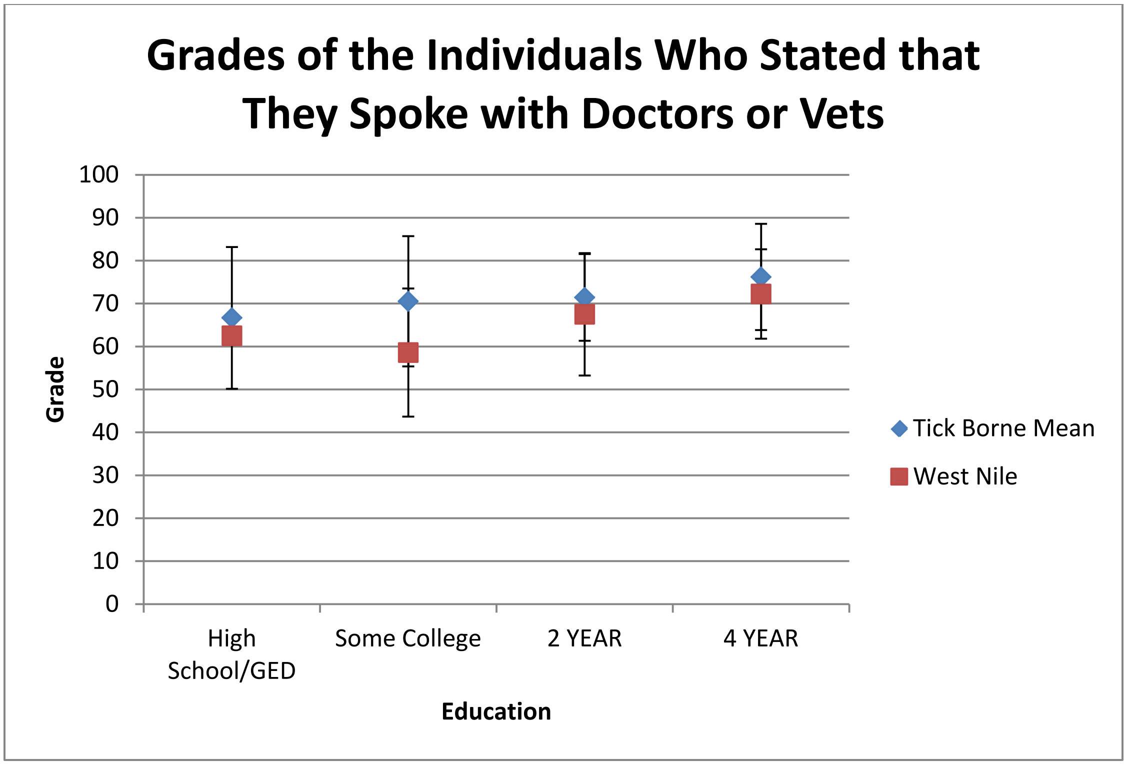



Figure 22: Social interactions and derived information. Social interactions show individuals with higher education are able to derive more information from the experience. This was calculated with no statistical significance at $\alpha = 0.05$. Error bars represent standard deviation.