Knowledge of Hand Sanitizer and Alcohol Content Among the General Public

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Abstract

Background
The purpose of this research was to determine, via an on-line survey, whether the general public in Canada, is aware of why certain ingredients, such as alcohol content is important to prevent transmission of disease-causing pathogens. The literature demonstrates the importance of hand sanitizers, the efficacy between different types of sand sanitizers, ingredient lists, and the public's knowledge regarding the effectiveness of hand sanitizers.

Methods
The standard methods of this study were an online survey using SurveyMonkey. The survey was distributed online by email and across some social media platforms such as Facebook, Reddit, and Instagram. The survey consisted of 18 questions in three parts: demographic information, ingredient knowledge, and hand sanitizer knowledge. The aim of the survey was to determine the level of the public's knowledge on hand sanitizer regarding alcohol content and product ingredients.

Results
There were 174 respondents who completed the survey, 10 of whom were excluded from the data as per exclusion and inclusion criteria, therefore, the number of analyzable respondents was 164 (N=164). Questions were asked in four areas; (i) knowledge of the correct range of alcohol required for an alcohol-based hand sanitizer (ABHS), (ii) frequency of checking alcohol content in ABHS (iii) whether ABHS ingredient list is checked, (iv) level of understanding of alcohol effectiveness of ABHS. Overall, knowledge regarding the importance of alcohol in ABHS was fair: 63% of respondents knew the correct range of alcohol required in hand sanitizers, 59% almost always checked alcohol content of ABHS, 38% almost always check ABHS ingredients list, and 50% of respondents felt they had a strong understanding of the alcohol effectiveness in ABHS. In order to determine if specific groups were more or less knowledgeable, analyses were conducted using different demographic variables. No statistically significant results emerged: frequency of checking alcohol content in hand sanitizer by age group ($P = 0.4738$), knowledge of correct alcohol content required to kill pathogens and level of education ($P = 0.7686$), understanding alcohol effectiveness and occupation ($P = 0.6657$), and checking ingredients on hand sanitizer labels and gender ($P = 0.4957$).

Conclusions
This small survey study (N=164) showed that Canadians, regardless of gender, age, education, and occupation, were fairly knowledgeable about the appropriate alcohol content required for hand sanitizers as well as reading hand sanitizer ingredients more often than not. However, none of the analyzed hypotheses showed statistically significant associations. As such, initiatives in health promotion and education about hand sanitizers must continue but should not be tailored to specific groups.

Keywords: hand sanitizer, alcohol content, knowledge, efficacy

Introduction

This research project focused on recalls regarding hand sanitizers, and whether the general public in Canada is aware of the reasons that would lead to such recalls. Previously published research on product recalls can provide valuable information, recommendations, and methodology that can be adapted when creating studies of hand sanitizer knowledge, and, particularly, of the ingredients found in hand sanitizers. With the ongoing Coronavirus (COVID-19) pandemic, public health practices have received a great deal of attention, leading to the increased demand for hand sanitizers. Hence, with mass production and consumption of hand sanitizers, recalls can be highly expected. This study's relevance to public health is significant due to the use of hand sanitizers in preventing the transmission and spread of infectious diseases. The following literature demonstrates the importance of hand sanitizers, the efficacy between different types of sand sanitizers, ingredient lists, and the public's knowledge regarding the effectiveness of hand sanitizers.

Literature Review

Hand Hygiene and Public Health Significance

"Hygiene is associated with disease prevention and health promotion" (Babeluk et al, 2014). Since physical contact between people and objects is a major vehicle for the transmission of disease, hand hygiene is a key component in disease prevention (Babeluk et al, 2014). Although the Centres for Disease Control, (CDC) recommends washing hands with soap and water, using a hand sanitizer with at least 60% alcohol can prevent illness and the spread of illness (CDC, 2020). As mentioned in the study by Leung (Leung, 2016), alcohol-based hand sanitizers can quickly reduce the number of microbes on hands but do not eliminate all types of microorganisms (CDC, 2020). Sanitizers with 60-95% alcohol are more effective at killing germs than those with a lower alcohol concentration (CDC, 2020).

During the 20th century, development of vaccines and antimicrobial therapy lead to a negligence of hygiene (Bloomfield et al, 2007). Although single factors such as hands may be a sufficient cause of disease transmission, the

spread of infection involves several "component causes", which together determine the risk (Bloomfield et al, 2007). The role of the hands relative to other surfaces can be observed by mapping the routes of transmission. For gastrointestinal illnesses, respiratory illnesses, and skin infections, the hands are the most important route of transmission as they come into direct contact with the portal of entry (mouse, nose, and eyes), and therefore, are the last line of defense (Bloomfield et al, 2007). To break the chain of transmission, an intervention such as hand washing, or the use of hand sanitizers can be implemented. Hand hygiene must be used in conjunction with the proper use of hand sanitizers and the proper method of hand washing (CDC, 2020). A problem arises when manufacturers mislabel hand sanitizers' alcohol content resulting in the lack of efficacy, hence, the lack of hand hygiene, and, ultimately, to the transmission of communicable diseases. Many studies have addressed hand hygiene; one, by Sandora, showed that use of alcohol-based hand sanitizer in the home reduced the transmission of GI illnesses (Sandora, 2005). Another study stated that improved hand hygiene practices using hand washing and alcohol-based hand sanitizer, resulted in reduced upper respiratory illnesses and absenteeism in university students (White, 2003). Hand hygiene has become a major public health topic since the COVID 19 Pandemic began in March 2020. As such, assessing public knowledge of hand sanitizers, their ingredients and potential for recall is an important and timely area of public health research.

The Efficacy of Hand Sanitizers

The efficacy of alcohol-based hand-sanitizers is very significant in the hand hygiene aspect. It was found that there was a decrease in hand sanitizer effectiveness after repeated use (Christie, 2014). How much hand sanitizer should be used for each application for it to decrease the effectiveness, or is there a certain type of hand sanitizer that loses its effectiveness more quickly than another type of sand sanitizer? These questions were examined in a study conducted to compare the effectiveness of different types of hand sanitizers where gel hand sanitizer was found to be more effective when compared foam hand sanitizers (Leung, 2016).

Similarly, a study evaluated the effectiveness of hand sanitizers by comparing alcohol-based and non-alcohol-based hand sanitizers (Song, 2016). It has been reported that non-alcoholic hand sanitizers are potentially less effective in blocking the transmission of Covid-19 disease (Gao, 2020). The function of alcohol in hand sanitizer is to dry out the virus, therefore, destroying it. Non-alcoholic hand sanitizers may not be effective in killing the virus, but the mechanical function of rubbing will remove it (Gao, 2020). Though Leung used E. coli against the gel and foam hand sanitizers, the author acknowledged that hand sanitizers may not be effective against all pathogens (Leung, 2016). Perhaps, further research can examine the effectiveness of different types of hand sanitizers; gel, liquid, or foam and alcohol-based or non-alcohol-based hand sanitizers on different types of microorganisms or pathogens. A study conducted in 2008 discussed the efficacy of disinfectants and hand sanitizers against Avian Respiratory Viruses (Patnayak, 2008), which is relevant to the COVID-19 pandemic. The study was conducted using hand sanitizer against Avian influenza virus (AIV), avian metapneumovirus (aMPV), and Newcastle disease viruses (NDV). The three different hand sanitizers (gel, liquid, foam) were found to be effective against the viruses it was tested for; NDV and aMPV (Patnayak, 2008). Regarding Influenzas, the efficacy of foam, gel, and wipes were tested against the H1N1 virus on hands (Larson, 2012). The study found that all three types of deliveries produced significantly reduced viral counts on hands (Larson, 2012). This study fills the gaps mentioned in the above studies regarding the use of different types of hand sanitizers on different types of pathogens.

Public Knowledge

Regarding the efficacy of hand sanitizers, the question arises; Is the public aware of the effectiveness of alcohol-based hand sanitizers? A survey showed that the majority of the general public are aware of the efficacy of alcohol-based hand sanitizers, although, in one small survey study, individuals older than the age of 40, as compared to those under 40, had less knowledge on the matter (Lu, 2014). To build on Lu's study, a similar one could be done but grouped by age categories. For example, surveys conducted for

the following age groups: <20, 20-39, 40-60, >60. With the current COVID-19 pandemic and the publicity of hand sanitizers, the level of knowledge within those age groups may have changed. It is important for the public to be aware of the ingredients in hand sanitizers as some chemicals used can pose as a health risk. For example, one Dollarama store recalled a hand sanitizer brand which contained methanol. Methanol is not authorized for use in Canada according to Health Canada because it can cause severe adverse reactions or death when ingested. Since the product is fraudulent, Health Canada states that the product may not be effective at killing bacteria and viruses (CBC, 2020). Methanol is an unlisted ingredient on a hand sanitizer label (Chan, 2018). These products are then recalled and removed from the market.

Hand sanitizers have become a vast commodity for not only North Americans, but the whole world. Cosmetic or personal service products including hand sanitizers use a variety of chemical ingredients. Alcohol-based hand sanitizer products contain ethyl alcohol (ethanol), isopropyl alcohol, n-propanol, or a combination of them all (Lu, 2014). Results from Ahn's survey on knowledge of the ingredients in personal care products indicated a low level of knowledge (Ahn, 2016). Concerning the focus of this project, a study can be conducted regarding the general public's knowledge regarding the ingredients used in hand sanitizers that are widely used. As mentioned above, the difference in time and situation may cause results to differ. Also, the general public may not be aware of the alcohol content in hand sanitizers if they do not recognize the ingredients. Labelling is a significant aspect regarding recalls of products, including hand sanitizers. Not only should consumers look for and recognize ingredients that are listed but should also be aware of ingredients that should NOT be in the product (Gao, 2020). The two unauthorized substances found in hand sanitizers in Canada are methanol and ethyl acetate. These substances can lead to health problems after using the hand sanitizing product. After frequent use, ethyl acetate is likely to cause dry skin causing irritation and methanol can cause dermatitis, eye irritation,

upper respiratory system irritation, and headaches (Health Canada, 2020).

Legislation and Recalls

During the COVID-19 pandemic, "many manufacturers distributed toxic or defective products", resulting in recalls for those certain hand sanitizer products (Blount, 2020). Under the Food and Drug Act, it is illegal to label, sell, or advertise a product in a falsely or deceptively (Health Canada, 2020). Recalls of these products may lead to new legislation to be created to regulate the ingredients used in hand sanitizer.

Several hand sanitizer products have been recalled since June 6, 2020, due to being unauthorized for use in Canada. Industrial-grade ethanol is being used in certain hand sanitizer products and contains impurities that are not found in the ethanol approved for use in manufacturing hand sanitizers such as food-grade or pharmaceutical-grade ethanol. Since industrial-grade ethanol has not been approved for use in hand sanitizers in Canada, it has not been reviewed for the safety or efficacy (Health Canada, 2020). It is suggested that these products are not to be used (Health Canada, 2020).

Technical-grade ethanol contains a higher concentration of acetaldehyde than food-grade or pharmaceutical-grade ethanol (Health Canada, 2020). Health Canada has approved the temporary use of technical-grade ethanol in alcohol-based hand sanitizers, manufacturers must include risk statements on their products labels informing the consumer of any risks that may arise upon use of hand sanitizers using technical-grade ethanol (Health Canada, 2020). Products that are recalled frequently contain ingredients that are not authorized for use or the labels are missing risk statements (Health Canada, 2020).

Purpose of the Research Project

The purpose of this research was to determine, via an on-line survey, the general public's knowledge of ABHS ingredients, in particular, alcohol. The study also assessed whether there were associations between age, gender, educational attainment and occupation with knowledge of ABHSs.

Materials

The materials used for this study included a laptop computer which was used to conduct an online survey and statistical analyses. The online survey was created using SurveyMonkey (SurveyMonkey, 2021) and the statistical analyses were done using a statistical software called NCSS (NCSS, 2021). Data was also analyzed using Microsoft Excel. There was a prize draw for participants to win $100 if they wished to enter.

Methods

The standard method forthis study was an online survey using SurveyMonkey, a platform where online surveys can be designed (SurveyMonkey, 2020). The survey was distributed online by email and across some social media platforms such as Facebook, Reddit, and Instagram. Personal Instagram and Facebook accounts were not used to reduce bias. A link was provided for the participants to be directed to the survey. The survey consisted of three parts: demographic information, recall knowledge, and hand sanitizer knowledge. The aim of the survey was to determine the level of the public's knowledge on hand sanitizer regarding alcohol content and product ingredients. The survey consisted of 18 questions. Closed-ended, Dichotomous, multichotomous nominal, and multichotomous ordinal data was collected for ease of statistical analysis (Heacock, 2020).

Inclusion and Exclusion Criteria

The participant must reside in Canada. Reponses from participants from outside of Canada were excluded from the data analysis for this study. This exclusion was determined at the beginning of the survey questionnaire. Friends, family and classmates were also excluded from the data.

Ethical Considerations

Any survey involving humans requires ethical approval from the Research and Ethics Board (REB). The purpose of a REB is to protect all human subjects participating (Connelly, 2014). A cover letter (Appendix A) and consent form (Appendix B) were presented outlining the ethical considerations of this study. The cover letter provides a brief description of the purpose of the study and confidentiality which refers the consent form. The consent form describes purpose and nature of the research, risks and benefits to the participants, confidentiality, and consent. A participant must give consent prior to the survey questions. All responses from participants were kept confidential and anonymous.

Results

Descriptive Statistics

There were 174 respondents who completed the survey, 10 of whom were excluded from the data as per exclusion and inclusion criteria, therefore, the number of analyzable respondents was 164.

Table 1: Descriptive results.

Question by Variable	Response Category	Group	%
Knowledge of the correct range of alcohol required for an alcohol-based hand sanitizer (ABHS) by *education*	60 – 95% (=correct)	BSc or higher Less than BSc	66% 34%
Frequency of checking alcohol content in ABHS by *age group*	Always/Almost always check	40+ years < 40 years	45% 55%
Whether ABHS ingredient list is checked by *gender*	Always/Almost always check	Female Male	74% 26%
Level of understanding of alcohol effectiveness of ABHS by *occupation*	Very strong understanding	Business, trades, art Healthcare Other	40% 38% 22%

Based on the results presented in the table above, it appears that younger, more educated females, particularly those working in business, the trades arts or healthcare, are more knowledgeable about the importance of alcohol in ABHSs and to check hand sanitizer ingredients.

Inferential Statistics

Chi Square tests were performed to analyse the 4 questions by the demographic categories listed in Table 1

The following table contains a summary of all hypotheses tested, what test was used, what the result was (P-value), and the conclusion.

Table 1: Summary of all null and alternative hypothesis, tests used, result, and conclusion

H_o and H_a	**Test Used**	**Result**	**Conclusion**
H_o: There is no association between the frequency of checking alcohol content in hand sanitizer and age. H_a: There is an association between the frequency of checking alcohol content in hand sanitizer and age.	Chi-square test	P-value = 0.4738	Do not reject H_o. Conclude that there is no association between the frequency of checking alcohol content in hand sanitizer and age.
H_o: There is no association between the knowledge of correct range of alcohol content in hand sanitizer and level of education. H_a: There is an association between the knowledge of correct range of alcohol content in hand sanitizer and level of education.	Chi-square test	P-value = 0.7686	Do not reject H_o. Conclude that there is no association between the knowledge of correct range of alcohol content in hand sanitizer and level of education.
H_o: There is no association between checking ingredients of hand sanitizer and gender. H_a: There is an association between checking ingredients of hand sanitizer and	Chi-square test	P-value = 0.4957	Do not reject H_o. Conclude that there is no association between checking ingredients of hand sanitizer and gender.

gender.			
H_o: There is no association between the understanding of effectiveness alcohol content in hand sanitizer and occupation. H_a: There is no association between the understanding of effectiveness alcohol content in hand sanitizer and occupation.	Chi-square test	P-value = 0.6657	Do not reject H_o. Conclude that there is no association between the understanding of effectiveness alcohol content in hand sanitizer and occupation.

There were no significant associations found between any hypotheses tested. For example, one question in the survey asked, "Do you check the alcohol content (%) of the hand sanitizer you are purchasing?" The answer options given were the following: always, almost always, sometimes, almost never, and never. When doing analysis, categories were grouped together to increase the number of responses in each cell. This was observed with age group data, which was also grouped together. Analyses using both original and collapsed data were not statistically significant. When analyzing the chi-square test, the p-value for the original data was 0.6574 and 0.4738 for collapsed data, therefore the null hypothesis is not rejected (P-value > 0.05). It is concluded that there is no association between the frequency of checking alcohol content in hand sanitizer and age.

Although descriptive statistics in Figure 7 show that females appear to be more frequently check ingredients on the hand sanitizer bottle, the chi-square test showed no significant association between the genders. The sample not being large enough can contribute to this outcome. The results suggested neither alpha nor beta errors as the findings were highly not significant.

Discussion

Alcohol Content Knowledge

No significant associations were found between the knowledge of alcohol content regarding hand sanitizer efficacy and occupation. A previous study showed that the majority of the general public are aware of the efficacy of alcohol-based

hand sanitizers compared between two different age groups (Lu, 2014). This study also looked at two different age groups regarding knowledge on alcohol content in hand sanitizer. It was shown that those in the field of healthcare, science and technology had a very strong understanding of alcohol content efficacy in hand sanitizers (Figure 4). In a way, this study agrees with previous research where one group has more understanding than the other. One methodological limitation was that it is not known how if the participant answered the question truthfully. A participant may answer "yes, I understand", when they do not understand. When assessing validity, answer options were observed. The answer option "I do not understand" was relatively low compared to very strong/very little understanding. The results may be extrapolated to fields of occupation such as business, trades, or education due to the lower level of knowledge in these groups.

Checking Ingredients

There were no significant association between gender and the frequency of checking ingredients on hand sanitizer bottles. Ahn's survey on survey on knowledge of the ingredients in personal care products indicated a low level of knowledge among the general population compared to those in the public health field (Ahn, 2016). This study was focused on the frequency of checking the ingredients on hand sanitizer bottles specifically such as alcohol content or other contents. A sex-specfic analysis of nutrition labels and health was conducted which revealed that men were less likely to use nutrition labels than females (Su et al, 2015). Although, for this study, there was no significant association between males and females, Figure 3 shows that females are more likely to check ingredients on hand sanitizers than males. A limitation of this method was that more than half of the survey participants were female. Therefore, leading to a potentially skewed result. Referring to Figure 3, the results can be extrapolated to males due to the low response for checking ingredients on hand sanitizer labels.

Limitations

A major limitation for this study was due to the COVID-19 pandemic. There was limited access to facilities and resources for survey distribution. There was also a lack of participation in the survey as family, friends, and classmates were excluded from responding to avoid bias according the BCIT Research and Ethics Board. With respect to methodology, this study could have been improved by finding creative ways to distribute the survey in different forms, aside from the ones mentioned under the methods section. For example, the use of a QR Code may have been sufficient as it can be posted in random locations where potential participants work, rest, or learn. Another limitation regarding an online self-administered survey is fraud, where survey questions are not answered truthfully. This can happen when the questionnaire is difficult to understand, or the participant does not want to answer truthfully in fear of seeming unknowledgeable. Respondents may also have asked their friends, family, or colleagues to help out with the answers or they may have looked up the correct answers online. Another limitation was the amount of time provided to distribute the survey, which was just less than 3 weeks resulting in the reduced number of responses.

Knowledge Translation

Results of this study show that age, gender, education, and occupation are not associated with variables such as frequency of checking ingredients and alcohol content of hand sanitizer, knowledge of correct alcohol content required for sanitizer to be sufficient, and the level of understanding of alcohol efficacy against pathogens. Therefore, health promotion and educational materials do not need to be targeted to any specific group. This suggests that the general public, regardless of age, gender, occupation, and education must be encouraged to know the importance of alcohol content in hand sanitizers against pathogens. For example, a general campaign that educates on hand sanitizers and what ingredients are in it, the importance of alcohol content, and what to look for when buying sanitizer.

Future Research

Some future research ideas are as follows:

- A study assessing the physical effectiveness of hand sanitizers consisting of different levels of alcohol concentrations against COVID-19
- A survey on public awareness of alcohol content in hand sanitizers before and after the COVID-19 pandemic. A survey would be utilized to question the respondents how much their hand sanitizer knowledge changed before and after the pandemic.

Conclusions

This small survey study (N=164) showed that Canadians, regardless of gender, age, education, and occupation, were fairly knowledgeable about the appropriate alcohol content required for hand sanitizers as well as reading hand sanitizer ingredients more often than not. Although the descriptive data have shown patterns between gender, age, and occupation with variables relating to hand sanitizer knowledge, none of the analyzed hypotheses showed statistically significant associations. Educational efforts on hand sanitizers should continue but are not required to target specific groups. The study should be included in understanding of alcohol-based hand sanitizers campaign as a supporting document.

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Competing Interest

The author declares that they have no competing interests.

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