

Evaluation of the General Public's Knowledge on Ingredients in Personal Care Products

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Abstract

Objectives: The average person living in North America is exposed to hundreds of chemical ingredients, including those that are harmful to human health, through application of personal care products. The manufacture of personal care products is largely untested and unregulated at a government level; legislation is not as prescriptive as the public would expect it to be. This shifts the responsibility to consumers to use their own discretion when purchasing personal care products. The purpose of this research was to assess the knowledge of the Canadian general public regarding ingredients in personal care products to determine if they have enough knowledge to avoid harmful substances.

Methods: A knowledge assessment survey was conducted to two different groups in Canada. The first group consisted of the general public who did not have a background in toxicology or dermatology, and the second group consisted of Public Health Inspectors in Lower Mainland B.C. The test scores from the knowledge assessment were compared between the two groups to determine if there was a significant difference in the means.

Results: The survey was completed by 39 Public Health Inspectors and 91 members of the general public. The mean score was 3.0256 for the Public Health Inspectors and 1.846 for the general public; the test score was out of 10. Statistical analyses showed that the mean test scores were significantly different and the null hypothesis (H_0 : mean test score of the Public Health Inspectors = mean test score of the general public) was rejected at $\alpha = 0.05$.

Conclusion: The result showed that both groups had low level of knowledge regarding the ingredients in personal care products that are widely used in Canada. Even the chemical ingredients that are known or suspected to be dangerous to human health or have adverse effects on the environment were not recognized. Exposure to potentially hazardous chemicals can be prevented or reduced by setting a legal requirement of a maximum concentration, imposing marketing restrictions or requiring better labelling of hazardous ingredients to improve public awareness of potential risk.

Key words: chemical ingredients, personal care products, cosmetic, toxic, xenobiotics, preservatives

Introduction

In North America, an average person uses up to ten different personal care products including toiletries and cosmetics, which leave them exposed to more than a hundred chemical ingredients every day (Roeder, 2014). Most people enjoy personal care products without a second thought because they assume that the government and regulatory bodies oversee their safety. Unfortunately, the chemical ingredients used are largely untested and unregulated at a government level. In fact, the Food and Drug Administration authorizes the industry to self-police ingredient's safety through its Cosmetic Ingredient Review panel, which has rejected only 11 ingredients as unsafe while the

European Union has banned hundreds of chemicals in cosmetics over last 30 years (EWG Skin Deep, 2015). As long as the industry meets the labelling requirements, such as listing ingredients in descending order of concentration, and giving directions for safe use of products that present avoidable hazards, they are allowed to market their products as organic, natural, or hospital-approved based on their own interpretation of terms, which may easily mislead consumers (Roeder, 2014).

Moreover, Canada's Cosmetic Regulation under the Food and Drug Act (2016) still does not restrict the use of known offenders such as parabens, triclosan and phthalates, which have been identified in numerous science-based

research papers as being carcinogenic and having the ability to disrupt endocrine and reproductive systems in humans. Cosmetic ingredients are designed to penetrate skin, and research studies have found that many common cosmetic ingredients remain in human tissues and fats after they are washed off the surface (EWG Skin Deep, 2015). As Mia Davis, the head of Health and Safety for the personal care product company Beautycounter, said, “The load adds up quickly day after day. And as we swallow, breathe in, and lather up, toxins entering our bodies may have lasting impact” (Roeder, 2014). This is a public health concern because myriad of studies have shown that some of these ingredients were linked to development of breast cancer and abnormalities in endocrine system and reproductive system in newborns.

Section 29 of Canada’s Cosmetic Regulation (2016) explains that the Minister may request a manufacturer to submit evidence to establish the safety of a cosmetic under the normal conditions of use. By contrast, the European Union, in their legislation (2015), explicitly states that manufacturers must ensure that products undergo an expert scientific safety assessment by registering in the Cosmetic Products Notification Portal, which allows the products to be assessed by Competent Authorities and European Poison Centres. The Canadian legislation seems to be more lenient in regulating industries, thereby leaving the public to use their own discretion when purchasing products. The question is, do average consumers have enough knowledge to interpret what the label means and understand the risks associated with each ingredient? Proponents of safe use of personal care products affirm that more intervention at regulating industries should occur at a government level.

Literature Review

Legislation to Regulate Consumer Product Safety

The United States, being one of the largest trading partners, brings in a variety of goods into Canada under the North America Free Trade Agreement. A great range of personal care product are made and exported from the States, and thus, it is important to note how they regulate what types of products are

allowed in the market. The US Food and Drug Administration (2014) responds to the question, “what chemical ingredients are prohibited from use in cosmetics?” that a cosmetic manufacturer may use “almost any raw material as a cosmetic ingredient and market the product without an approval from FDA” with the exception of a few prohibited ingredients. The Canadian legislation does not seem to be more prescriptive regarding what can go in the personal care products. Section 16 of Canada’s Food and Drugs Act (2016) states that “no person shall sell any cosmetic that has in or on it any substance that may cause injury to the health of the user.” This is accompanied by Section 29 [Evidence of Safety of Cosmetics] in the Cosmetic Regulation, which requires a manufacturer to submit evidence to establish the safety of a cosmetic when the minister requests it. In fact, the legislation does not require intervention of government agency to take initiatives to be a gatekeeper of what goes in cosmetic products in the first place. However, Canada continuously monitors and inspects marketed products through Health Canada, which provides a guideline to communicate to manufactures and consumers on consumer product safety.

Health Canada Guidelines

Health Canada describes ways to ensure safety of cosmetic ingredients on their official website. Their prime means of protecting the safety of products is through legislation, followed by mandatory notification, which requires manufacturers to disclose all cosmetic ingredients to Health Canada through a Cosmetic Notification Form. Health Canada conducts continuous monitoring of scientific literature on cosmetic ingredients, including information from the European Union’s Chemicals Management Plan (Health Canada, 2015). However, the number of ingredients prohibited from use was far less in Canada compared to what the EU banned in the last decade.

The Cosmetic Ingredient Hotlist is an administrative tool that Health Canada uses to list ingredients that are intended to be restricted for use in cosmetics in Canada. These ingredients are determined by investigating both the characteristics of the ingredients as well as

the exposure route to consumers on the principle that even ingredients that may be considered hazardous can be regarded as safe at low doses because the exposure is low (Health Canada, 2015). The strength of this website is that it presents a number of chemical ingredients of concern in detail as to what they are, what kind of products contains them and why or why not they are potentially hazardous. However, when the explanations are compared to the Chemical Substances document, another official Government of Canada website, some are in contradiction. For example, Health Canada states that impurities from heavy metals such as lead are allowed in cosmetics as long as the limit is low, but studies from Chemical Substances showed that adverse health effects occur at lower levels of exposure to lead especially for infants and children who may get exposure from caregivers (Chemical Substances, 2015).

Health Canada also ensures consumer safety by requiring mandatory ingredient labelling as prescribed in Cosmetic Regulation. However, the transparency of listing all the ingredients was challenged because industries could hide problematic ingredients by listing them as fragrance on a label (Roeder, 2014).

Carcinogens and Endocrine Disruptors

Endocrine disruptors are compounds that may mimic and interfere with the functions of hormones in the body. They can turn on, shut off or modify signals that hormones carry, which may affect the normal functions of developmental, reproductive, neural or immune systems. People may be exposed to endocrine disruptors through many ways, including cosmetics they use. It is a significant public health concern because the exposure to endocrine disruptors during pregnancy may adversely affect newborns as well. A large body of research has dealt with different types of endocrine disruptors that are commonly used in personal care products and has linked them to reduced fertility and increased incidence of cancer in humans (National Institute of Environmental Sciences, 2010).

Phthalates are endocrine disruptors that can be found in infant care products and cosmetics. A study of the relationship between infant urine phthalate metabolite concentration

and mother's use of dermally applied infant care products such as infant lotion, powder and shampoo found a strong association not only with the use of infant care products, but also with the adult personal care products that parents were using, thus indicating dermal transfer of phthalates (Sathyanarayana et al., 2008). Another research study has found that phthalate exposure through breast milk was associated with abnormal reproductive hormone levels in infants (Main et al., 2006).

The phthalates most commonly used in cosmetics are DEP (Diethyl phthalate) and DBP (Dibutyl phthalate). DBP is prohibited for use in cosmetic products in the European Union; however, Canada and the U.S. concluded that they are safe at the level currently used in cosmetics, and do not restrict their use (Health Canada, 2015). In 2015, the National Biomonitoring Program by CDC reported that adult women have higher levels of urinary metabolites than men for phthalates used in cosmetics, but it was pointed out that the biomonitoring studies are only sufficient to provide public health officials with reference values and that more research on exposure and health effects on human should be conducted (CDC, 2015).

Parabens are another group of chemicals found in a wide range of personal care products that can be absorbed rapidly through intact skin. In fact, because they are alkyl esters, they are able to accumulate in fatty tissues of body and be retained without hydrolysis by esterases (Dabre et al., 2004). It has been suggested that regular application of products that contain parabens may influence breast cancer development because they have been found to mimic hormone estrogen. The first measurement of parabens in human cancer tissues was conducted and published in the United Kingdom Journal of Applied Toxicology in 2004. Health Canada announced that the 2004 British study has proved invalid and concluded that parabens are safe as used in cosmetics. However, another research study conducted in the U.K. in 2008 proved otherwise. They confirmed the presence of parabens in human body tissues by independent measurements in human urine, and the ability of parabens to penetrate human skin without breakdown by

esterases was demonstrated through studies in vivo using healthy human subjects (Dabre et al., 2008). There still remains the need for full risk assessment of breast cancer from personal care products.

Environmental Pollutant

Triclosan is widely used in a variety of products due to its antimicrobial properties. In Canada, approximately 1600 cosmetics and 130 personal care products including cleansers and tooth pastes were reported to contain triclosan in 2011 (CBC News, 2014). The major concern of this chemical is that triclosan has a range of impurities including dioxin, furans, dichlorophenols, mercury and other heavy metals. Dioxin is a known endocrine disruptor and carcinogen for which no safe level of exposure can be established (Thorpe, 2014). However, a review concluded by Health Canada stated that “triclosan is not harmful to human health but can cause harm to the environment when used in significant amounts.” Health Canada recognized triclosan as a substance that should be restricted but not necessarily prohibited, allowing limits up to 0.3% in cosmetic products (Health Canada, 2015). In contrast, the European Scientific Committee on Consumer Safety considered that the use of triclosan at the maximum concentration of 0.3% is unsafe because of the magnitude of exposure is additive (European Commissions, 2015). In fact, another Canadian government agency, Environment Canada expressed their concern for the use of triclosan in cosmetics, which is flushed down the drain and pollutes the environment (Environment Canada, 2013).

Environment Canada proposed that triclosan meets the criterion of ‘CEPA toxic’ and could be added to the Toxic Substance List in Canadian Environmental Protection Act. In 2010, it was confirmed that triclosan, which is highly toxic to receiving waters, was detected in 89.6% of surface water samples in the Great Lakes. This led to the overall risk management of triclosan in wastewater systems by reducing inputs from products and industrial effluents (Environment Canada, 2013). A Canadian Environmental Law Association researcher, Fe de Leon, said that it should not be left to the consumers to try to avoid these products simply

because they may be unaware of the repercussions (CBC News, 2014).

Purpose of the Research Project

The purpose of this research was to assess the knowledge of the general public in British Columbia, Canada on ingredients in personal care products by comparing their knowledge to the knowledge of Public Health Inspectors (PHI) through survey questionnaires.

Methods and Materials

An on-line survey (see appendix) using Google Doc was conducted to systematically gather information from study participants, who fell under two categories. The first group, Public Health Inspectors in B.C., represented health professionals who had training in toxicology of various aspects, including commercial and industrial. The second group consisted of the general public with no particular experience in toxicology. The survey consisted of demographic questions, validation questions, and knowledge assessment questions. The validation questions were used to identify the two different groups and to screen out any of the general public who had professional backgrounds in toxicology and dermatology. The knowledge assessment questions evaluated their understanding of potential toxicity of different ingredients. An invitation to participate was disseminated via various means, including social media and emails. The on-line survey was sent to the president of the BC CIPHI (Canadian Institute of Public Health Inspectors) branch, who then forwarded the email to the public health inspectors in B.C. The general public was reached using Facebook. The link to participate in the survey was posted on Facebook, which was shared amongst the public.

Materials used for this research included on-line survey questionnaires with a consent form using Google Doc (Google docs, 2014), a cover letter, Microsoft Office Excel 2010 (Microsoft Corporation, 2010) for descriptive statistics and SAS software (SAS Institute, 2013) for inferential statistics.

Inclusion and Exclusion Criteria

Any members of the general public were eligible to participate if they were over the age of 19 and were able to understand English at a proficient level. This ensured that language barriers would not skew the results. Also, the age of consent to participate in research in B.C. is 19 years of age (Health Canada, 2014). The participants had to have internet access and have a Facebook account or be a member of BC CIPHI branch in order to be invited to participate in the survey. Those who did not use Facebook but still wanted to participate received an email from the author that directed them to the on-line survey.

Responses from those who had backgrounds in toxicology or dermatology were excluded in the results because this study was designed to assess knowledge of the general public who did not have such professional backgrounds.

Ethical Considerations

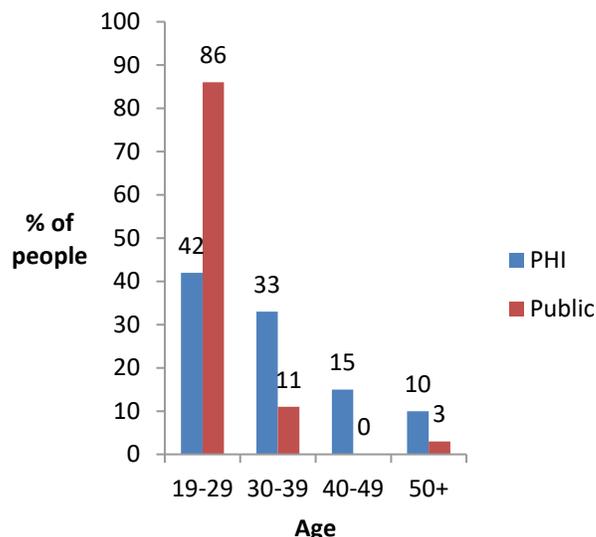
Because the study was conducted on human participants, ethical aspects of beneficence and autonomy had to be carefully considered (Heacock, 2015). The survey was not designed to pose harm or discomfort to participants, and the purpose of the survey was purely for knowledge-building. The cover letter of the survey promised autonomy and confidentiality, and the participants were asked to give the informed consent. Moreover, the participants were allowed to refuse completion of the survey at any point.

Results

Descriptive Statistics

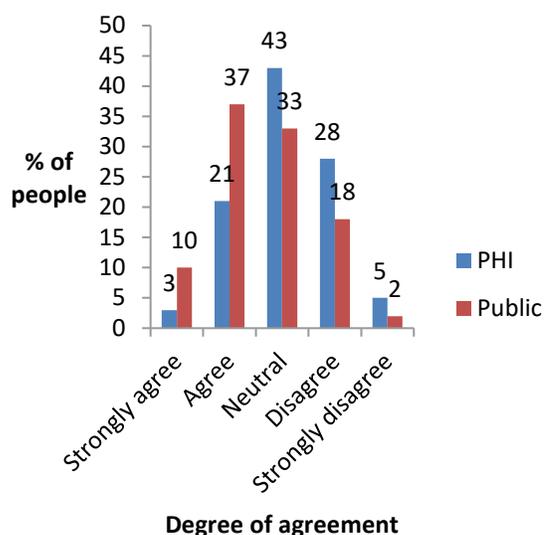
Data was collected from 39 Public Health Inspectors (PHI) and 91 members of the general public. Demographic information was used to generate bar graphs to illustrate the population surveyed (Graph 1). 42% of PHIs surveyed were between 19-29 years of age, 33% were between 30-39, 15% were between 40-49 and 10% were 50 years of age and older. Among the general public, 97% of respondents were under 40 years of age and 3% were over 50.

Graph 1. Demographic information of the participants by age



Graph 2 describes the participants' perception of the efficiency of personal care product labels. 24% of PHIs and 47% of the general public members agreed that the personal care product labelling was useful in understanding the product composition, 43% of PHIs and 33% of the general public members felt neutral, and 33% of PHIs and 20% of the general public members disagreed.

Graph 2. Perception of the efficiency of personal care product labels by the participants



Knowledge test scores were analyzed for mean, median, mode and range for different groups (Table 1). The mean test scores were 3.0256 and 1.8461 for Public Health Inspectors and the general public, respectively, where the total test score was out of 10. Overall, both groups had low scores. Microsoft Office Excel 2010 was used to perform descriptive statistics.

Table 1. Descriptive statistics of the knowledge assessment scores

	Public Health Inspectors	General Public
Mean	3.025	1.846
Median	3	1
Mode	2	1
Standard deviation	2.345	1.563
Range	8	7
Minimum	0	0
Maximum	8	7
Count	39	91

Inferential Statistics

The hypotheses of this study were as follows:

$$H_0: \mu_1 = \mu_2$$

$$H_A: \mu_1 \neq \mu_2$$

The null hypothesis predicted that the mean test score on knowledge assessment by Public Health Inspectors was equal to the mean test score by the general public. The alternate hypothesis predicted that the means were statistically different.

To analyze if the difference in means of test scores in two different groups were statistically significant, two tailed t-test was conducted. The data collected was not normally distributed according to Shapiro-Wilk and Kolmogorov-Smirnov tests (Table 2.1, 2.2), thus a nonparametric test, the Wilcoxon Rank Sum test, was used.

Table 2.1 Tests for Normality for Public Health Inspectors in BC

Tests for Normality				
Test	Statistic		p Value	
Shapiro-Wilk	W	0.910034	Pr < W	0.0043
Kolmogorov-Smirnov	D	0.171029	Pr > D	<0.0100
Cramer-von Mises	W-Sq	0.171067	Pr > W-Sq	0.0124
Anderson-Darling	A-Sq	1.097682	Pr > A-Sq	0.0066

Table 2.2 Tests for Normality for the general public in BC

Tests for Normality				
Test	Statistic		p Value	
Shapiro-Wilk	W	0.874293	Pr < W	<0.0001
Kolmogorov-Smirnov	D	0.255332	Pr > D	<0.0100
Cramer-von Mises	W-Sq	0.823485	Pr > W-Sq	<0.0050
Anderson-Darling	A-Sq	4.404799	Pr > A-Sq	<0.0050

Probability, $p=0.05$, was used as a significance level to evaluate statistical significance. If P value from the Wilcoxon Rank Sum test was less than 0.05, the author would conclude that there was a significant difference between the mean values in two groups and reject the null hypothesis. If P value was greater than 0.05, the author would conclude that there was no significant difference and not reject the null hypothesis at 5% level.

A two-tailed t-test was conducted using SAS Software. The P value was 0.0065 (Table 3). The null hypothesis was rejected at 5% level and there was a statistically significant difference between the mean test score of the

Public Health Inspectors and the mean test score of the general public. The Public Health Inspectors have statistically significantly more knowledge about the ingredients in personal care products than the general public.

Table 3. Inferential Statistics (Wilcoxon two-sample t-test)

Wilcoxon Two-Sample Test	
Statistic	3087.0000
Normal Approximation	
Z	2.7645
One-Sided Pr > Z	0.0029
Two-Sided Pr > Z 	0.0057
t Approximation	
One-Sided Pr > Z	0.0033
Two-Sided Pr > Z 	0.0065
Z includes a continuity correction of 0.5.	

Discussion

According to the Cosmetic Regulations (2016) pursuant to the Food and Drugs Act, all cosmetics sold in Canada must be safe to use and must not pose any health risk. Furthermore, cosmetics must abide by the Consumer Packaging and Labelling Act and any chemicals found in cosmetics may be subject to the Canadian Environmental Protection Act. Since there is legislation to govern various personal care products, consumers believe that industries are well regulated at a government level. However, as described in the literature review, a large proportion of the process involved in making personal care products is left to self-police by industries, and the intervention by the government is minimal compared to that of the European Union. Given too much freedom to the industries, consumers are asked to make an informed choice to avoid possible risks in using daily personal care products.

Health Canada (2009) states that a cosmetic label must contain information that helps consumers to make an informed decision about the products they use and how to safely use the product. The Cosmetic Regulation (2016) and the Consumer Packaging and Labelling Act (2016) require all personal care products sold in Canada to display mandatory ingredient labelling using INCI (International Nomenclature of Cosmetic Ingredients) system; however, at the point of purchase, consumers are rarely alerted by potentially hazardous chemical ingredients. This could be due to the fact that the location of the label or the wording is subtle, or the consumers do not have background knowledge to interpret the risk. The result found in this study showed that although the Public Health Inspectors were more knowledgeable about chemical ingredients in personal care products than the general public, both groups failed to score 50% on the knowledge assessment. A significant number of participants were unable to identify the chemical ingredients that are even banned in some European countries (Commission Regulation, 2014). The reason why certain chemical ingredients are banned in some countries while they are still in use in other countries is because the risk is controversial and requires more long-term studies. The Scientific Committee on Consumer Safety pursuant to Commission Regulation of the European Union adopted an opinion on parabens in December 2010 in response to a unilateral decision by Denmark to ban all parabens and their isoforms in personal care products for children under three years of age based on their potential endocrine activity (Commission Regulation, 2014). Parabens have been found to mimic the hormone estrogen. Studies have shown male animals that ingested or were injected with parabens, especially butylparaben and propylparaben, experienced reproductive system dysfunction (Tavares et al., 2009). However, the Cosmetic Ingredient Review in the US and Health Canada claimed that there is not enough evidence to prove that parabens cause similar problems in humans and further studies are needed to assess how parabens are absorbed when they are applied to the skin. Thus, the Health Canada and the Cosmetic Ingredient Review in the US only recommends the

maximum concentration of parabens rather than making it a legal requirement for manufacturers (FDA, 2007). Not only are the industries not mandated to use the potentially harmful chemical with a limit, but also they are not mandated to provide a special label for such chemical. Any potentially harmful chemicals can be hidden somewhere in the long list of ingredients and may easily be unnoticed.

The majority of the participants from both groups felt 'neutral' about the effectiveness of the ingredient labels in helping them understand what the product was containing and what the risk was. Informed decision should be made not based on mere list of ingredients, but on the label that highlights potentially toxic substances. In spite the unfamiliar chemical names, an average consumer would be better informed if the packaging displayed a special message in a conspicuous manner. As an analogy, the food industry is required to clearly label 'Unpasteurized' or 'Treated by Irradiation' even though the risk of consuming unpasteurized juice or an irradiated potato is controversial (CFIA, 2014). Because the FDA requires that irradiated foods bear the international symbol for irradiation, the Radura symbol, along with the statement "Treated by Irradiation," the consumers can easily be aware of the fact that the food has undergone a special treatment. Likewise, if potentially harmful chemical ingredients are labelled more prominently, consumers would be more aware of the risk when making informed choices. This is especially helpful for chemical ingredients such as lead because the FDA does not set limits for lead content in lipsticks and the highest lead content found in one of the top selling lipsticks contained 7ppm of lead (FDA, 2015). This may not necessarily deter one from purchasing the product while a person providing care to an infant may want to avoid it. More detailed suggestion for the labelling of products will be discussed in Recommendations section of the paper.

Limitations

The survey that measured knowledge level of ingredients in personal care products may not accurately represent the knowledge level of an average Canadian because the

participants were limited to those living in British Columbia and the sample size was only 130 persons which is a small proportion of the BC population. Also, it is important to note that the survey was conducted largely to young demographic; 86% of the general public and 42% of the Public Health Inspectors were of age between 19 and 29. The high proportion of younger general public respondents was due to the fact that the electronic survey questionnaire was distributed through the author's Social Network System and personal email contacts who are a younger demographic. An alternate method that can be used to improve the validity of the study is conducting an in-person survey. The author could conduct the study at a location such as a shopping mall or community centre that may be accessed equally by old and young generations. However, it would be extremely difficult to access EHOs for in-person interviews due to the nature of their work.

Another limitation in the study was that the questions used in the knowledge assessment may have been too technical. One may accurately know the risk of a hair dye but not necessarily know the exact name of the chemical ingredient contained in it. This would undermine the results and contribute to the low mean score. This bias can be minimized by using more general terms and formatting the questions in a manner that the general public can easily relate to.

Recommendations

Personal care products are not subject to pre-market approval by the FDA and there is no limit level for some potentially hazardous ingredients in North America (FDA, 2014). Continued research on the risk of various ingredients in personal care products is recommended as new studies emerge to support the evidence of harmful effects of certain chemical ingredients, such as parabens and their association to breast tumours and reproductive system dysfunction (Dabre and Harvey, 2008). With the exception of a few prohibited ingredients, the FDA allows industries to use any raw materials to make cosmetics and recalls products after they are marketed when an adverse effect is observed (FDA, 2014). This is rather a reactive approach. Public health ought to

be a proactive and preventive intervention. It is recommended that Health Canada mandates industries to submit “the physio-chemical and microbiological specifications of the raw materials and the finished product” and have their finished product assessed for toxicity by an independent third party (Cosmetics Europe).

Additionally, any chemical ingredients that are potentially hazardous should be labelled clearly on the cover that is easy to see for any consumers, and not hidden in the long list of ingredients. The majority of consumers make their decision to purchase a cosmetic based on the advertisement of the product’s effect rather than what is contained in it. Even the advertisements that promote product ingredients only focus on their “good” ingredients that possibly only make up less than 1% of the whole product weight. Moreover, the general public worry less about chemical ingredients in personal care products because they perceive the risk of exposure through skin is small compared to the risk of exposure through ingestion or inhalation. This may be true in non-occupational settings because acute effects are rarely observed. However, it is important to note that the use of personal care products results in direct skin contact, often involving exposure of a large body surface area, and has an accumulative effect from daily use (WHO, 2014). The effect of dermal application of harmful ingredients may be subtle and chronic. This is why more long-term studies must be conducted and followed up. Meanwhile, the risk should not be overlooked and the public must be educated. If the manufacturers were mandated to label potentially harmful ingredient more clearly, for example “This product contains paraben”, the consumers will possibly become more aware and knowledgeable about different chemicals used in personal care products and could make an informed decision. In fact, people understand very little of what the ingredients in cosmetics are. Therefore, if Health Canada does not have conclusive results on the health effects of a product such as parabens, then the product could bear a message such as “Parabens are being studied for their possible adverse health effects.” Such labelling would help to disclose the potentially harmful ingredients without making a hasty conclusion about their ill effects.

Health professionals including the Public Health Inspectors should be educated and at least be aware of the prohibited and restricted ingredients listed on the Cosmetic Ingredient Hotlist of the Health Canada website (2015) since these ingredients not only concern human dermal exposure but are also known to be environmental pollutants as they are washed down the drain. Environment Canada categorized triclosan as potentially toxic to aquatic organisms, bioaccumulative and persistent. In the environment, triclosan reacts to form dioxins, which are known carcinogens (Canosa et al., 2005). Also, the Canadian Medical Association has called for a ban on triclosan-containing products as this chemical contributes to antibiotic-resistant bacteria (Yang, 2009). Therefore, it is important to pay attention to chemical ingredients in personal care products as they are daily washed down the drain and end up in the environment.

Future Research

1. Conduct a similar survey to persons selling cosmetics as they are the ones communicating to the public and should be able to provide accurate information.
2. Analysis of the paraben [or phthalate] content in any personal care products sold in retail stores.

Conclusions

Product ingredients are changed frequently, and there is a lack of research done on long-term effects of individual chemical ingredients. Personal care products are encountered daily and many people apply them without a second thought. Products are perceived to be safe because they are on market, but the national safety regulations and definitions vary depending on the country. Some chemical ingredients used as preservatives or lubricants have been found to be harmful or potentially harmful, yet no stringent limitation exists in North America to safeguard the consumer use. Exposure to potentially hazardous substances in personal care products can be prevented or reduced by setting a legal requirement of a maximum concentration, imposing marketing restrictions or requiring

better labelling of hazardous ingredients to improve public awareness of potential risk.

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Competing Interest

The authors declare that they have no competing interests.

Appendix

Script

Hi, my name is Jessica Ahn and I am studying Environmental Health at BCIT. One of the courses I am taking requires that I conduct a research study, for which I decided to do a survey. My research study focuses on the general public's knowledge on ingredients in personal care products. I have a short questionnaire for you to fill out that should not take you more than 5 minutes. Your participation is voluntary, anonymous and confidential. This will greatly help with my research project and further studies at BCIT. Thank you.

Cover Letter

Description of the study

The following is a short questionnaire that aims to evaluate the general public's knowledge on ingredients, especially those known to be toxic, in various personal care products. For the purpose of this research and in accordance with Canadian Food and Drugs Act, personal care products are defined as products that are used for cleansing, improving or altering the complexion, skin, hair or teeth. This includes, but is not limited to, toiletries, skin care products, hair care products, etc.

The results of this project will be used for my research project in the Environmental Health program at BCIT (British Columbia Institute of Technology). Through your participation, I hope to gain more insight as to health and safety knowledge of the general public, and eventually conclude whether more intervention is required at a government level to restrict personal care product industries.

Voluntary participation

You are under no obligation to participate in this study and your action should be absolutely voluntary. Even if you decide to participate, you may withdraw from the study at any time. You will not be penalized for not participating or for withdrawing.

Confidentiality and anonymity

Your responses will be purely for knowledge-building. Your participation will be anonymous and all information will be kept confidential. The individual responses will only be collected by myself and will not be shared outside my research group which consists of me and my instructor, Helen Heacock. The responses will be shredded at the end of the study to ensure confidentiality.

If you have any questions about this study, please contact:

Jessica Ahn
BCIT Burnaby Campus
3700 Willingdon Avenue
Burnaby, BC V5G 3H2

Electronic on-line survey

Informed Consent

Disclosure Statement: I agree to take part in this study, which has been explained to me as outlined in the cover letter. I understand that any questions that I answer will be anonymous and confidential, and that my identity will not be disclosed at any point. I also understand that my participation is completely voluntary, and I may withdraw from the study at any time. I am 19 years old or over, and am legally able to provide consent.

- Agree
- Do not agree

Survey Questionnaires

Read each question carefully. Please answer all questions honestly and without assistance. I encourage you to select 'Do not know' rather than taking guesses. Only select one answer.

1. What is your gender?

- Female
 - Male
2. What is your age?
- 19-29
 - 30-39
 - 40-49
 - 50+
3. Are you a certified Public Health Inspector (Environmental Health Officer) in Canada?
- Yes
 - No
4. Do you have a background in cosmetic toxicology, aesthetics or dermatology?
- Yes
 - No
5. How often do you check and read the ingredient label on each personal care product before purchase?
- Always
 - Almost always
 - Sometimes
 - Rarely
 - Never
6. Do you feel that reading ingredient labels helps you understand safety and risk of using the personal care products?
- Strongly agree
 - Agree
 - Neutral
 - Disagree
 - Strongly disagree
-
7. What have Parabens, common preservatives in personal care products, been found to do in the body?
- Increase blood pressure
 - Cause premature aging of skin
 - **Mimic hormone estrogen**
 - Disrupt lymphatic system
 - They are safe at any levels
 - Do not know
8. Depending on manufacturing processes, PEG (polyethylene glycols) and SLS (sodium laureth sulphate) ingredients may result in production

of high levels of impurities (1,4 dioxane), which may cause what?

- **Cancer**
 - Resistance to antibiotics
 - Paralysis of limbs
 - Sensitivity to UV radiation
 - Do not know
9. What type of phthalate has been notified as a danger to human health and is not used in Canada, but is still used in other countries as a cosmetic ingredient?
- DEP (diethyl phthalate)
 - DBP (dibutyl phthalate)
 - **DEHP (diethylhexyl phthalate)**
 - Do not know
10. Triclosan is widely used in personal care products due to its antimicrobial properties. What is the major concern of this chemical?
- It disrupts normal flora in the body
 - **It is flushed down the drain and is toxic to aquatic organisms**
 - It can cause severe breakouts
 - It disrupts moisture balance in the body
 - Do not know
11. Formaldehyde is a colorless, pungent chemical that is a potential human carcinogen when it is inhaled. Is formaldehyde found in any personal care products?
- **Yes, Health Canada sets concentration limit that can be used in personal care products**
 - No, it is harmful to human health and is not used in personal care products that we apply to our body
 - Do not know
12. DEA (Diethanolamine) can form harmful nitrosamines that may be linked to cancer. Is DEA permitted to be present in cosmetics sold in Canada?
- Yes, Health Canada sets concentration limit that can be used in personal care products
 - **No, it is harmful to human health and is not used in personal care products that we apply to our body**
 - Do not know

13. When you thoroughly wash off your personal care products, are they completely gone?

- Yes, products only remain on the surface of skin
- **No, products penetrate through skin**
- Do not know

14. BHA (butylated hydroxyanisole) and BHT (butylated hydroxytoluene) are ingredients found in personal care products, usually at a concentration 0.1% or less. Is this safe?

- **Yes, they are safe at low concentrations**
- No, there is no safe limit for these ingredients
- Do not know

15. PPD (Para-phenylenediamine) is a coal tar dye commonly used in hair dyes, colours and tints. What is the main concern of this ingredient?

- It may lead to development of cancer
- It may cause lesions in the areas where the substance is applied
- It may mimic hormones in the body
- **It may cause allergic reactions upon repeat exposure**
- Do not know

16. What type of Siloxane did the government of Canada conclude to be harmful to the environment and its biological diversity?

- **D4**
- D5
- D6
- Do not know

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