PERCEPTIONS OF INDIAN CONSUMERS TOWARDS PHARMACEUTICALS IN THE ENVIRONMENT

A Thesis

Presented to the Faculty of the Graduate School

of Cornell University

In Partial Fulfillment of the Requirements for the Degree of

Master of Science

by

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August 2018

ABSTRACT

The increase in access to and use of medication worldwide has led to ubiquitous and persistence presence of pharmaceuticals in the natural environment. Major risks from environmental contamination due to drugs include death of organisms, habitat loss, mutation, and rise of antigen-resistant microbes. India has suffered enormous regional ecological damage from pharmaceutical contamination. Green chemistry approaches and environmentally-friendly pharmaceuticals exist, but they currently do not enjoy popular support from the pharmaceutical industry or consumers.

By conducting a public survey in Indore, India, this research attempts to understand whether consumers would support environmentally-friendly pharmaceuticals. The survey measures environmental concern, self-estimated knowledge, risk perception, and consumer intention. Statistical analyses indicate that environmental concern, self-estimated knowledge, and risk perception are each positively correlated with consumer intention. Results show that most people demonstrate environmentally-friendly consumer intention; and environmental concern was found to be its strongest indicator of consumer intention.

Keywords: environmental pollution; pharmaceuticals in the environment; sustainable pharmaceuticals; Indian pharmaceutical industry; Indian consumers

BIOGRAPHICAL SKETCH

Sukruti Gupta grew up in Indore, Madhya Pradesh, a city in Central India. Born to surgeon parents, she developed a keen interest in helping the community and the environment at a young age. She chose to study Architecture at the undergraduate level from School of Planning and Architecture, Bhopal, from which she graduated with honors at the top of her class in 2016. Her conviction to use spatial design as a tool to improve quality of life and the environment encouraged her to seek higher education in the specialized field. She moved to the United States in August 2016 to pursue a Master's degree in Human -Environment Relations (Sustainable Design Studies) from Design and Environmental Analysis at Cornell University.

She believes that her graduate education in research and design would strengthen her skills as an architectural designer. Upon her graduation, she will move to New York City to live with her husband, where she hopes to continue creating sustainable and desirable spaces. In addition to design, Sukruti finds joy in reading books, cooking, travelling, and spending time with friends and family.

ACKNOWLEDGMENTS

This research has been possible only with the encouragement and help from many wonderful individuals. With immense gratitude and admiration, I thank my advisor Dr. Nancy Wells, for her continuous guidance and support throughout the research and beyond. I also thank my minor committee member, Prof. George Frantz, for his feedback and enthusiasm. In addition, I extend my gratitude to Dr. Michelle Cox of English Language Support Office for her guidance with the writing process, and Françoise Vermeylen of Cornell Statistical Consulting Unit for statistical consultation and suggestions. I would also like to thank the generous management and staff of *New Look Optics and Pharmacy, Indore* and *Rohit Eye Hospital, Indore* for their cooperation with data collection for this thesis.

I also want to acknowledge my friends at Cornell University, and all the graduate students in Design and Environmental Analysis for their constant support and encouragement. Finally, and most importantly, I want to thank my family for being my pillar of strength through the research process, especially my mother Dr. Surbhi Gupta, my father Dr. Rakesh Gupta, and my dear husband Deepam.

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CHAPTER 1

INTRODUCTION

Environmental degradation resulting from pharmaceutical pollution is an important concern, especially in a developing country like India. The following text discusses the state of pharmaceutical industry in the world and in India. Projections about the growth of the industry are described. These projections implicate the establishment of more manufacturing units and, subsequently, greater ingress of pharmaceutical drugs in the natural and built environment.

Rise of pharmaceuticals

The steady increase in availability and accessibility of medication throughout the world is a great achievement in recent history of healthcare. The global pharmaceutical industry is growing continuously, with regular new advancements both in currently available drugs and in research and development (R&D) for new drugs. The production value of the global pharmaceutical industry has increased from USD 651.4 billion in 2006, to USD 870.1 billion in 2010, and USD 996.9 in 2014 (International Federation of Pharmaceutical Manufacturers & Associations, 2017). India plays an important role in the multi-billion-dollar industry, both as a production region and as a consumer market. The country's pharmaceutical industry is ranked 3rd in terms of volume, and 13th in terms of value (FICCI, 2017). India is also a major exporter of pharmaceutical drugs, supplying about 10% of the total global production and exporting pharmaceuticals to regions comprising United States, European Union, and sub-Saharan Africa (U.S. International Trade Commission, 2018).

The Annual Report (2016-17) of Department of Pharmaceuticals, India, mentions plans to increase manufacturing of active pharmaceutical ingredients (APIs) or bulk drugs within India

to strengthen self-reliance. This would help to maintain competitiveness of Indian industries and ensure low-cost healthcare. According to the report, the Government of India is also promoting clusters of pharmaceutical manufacturing units through introduction of programs like "Cluster Development Program for Pharma Sector" (CDP-PS) and in the future, creation of bulk drug and API parks (Department of Pharmaceuticals, 2017; FICCI, 2017). Currently, the majority of pharmaceutical manufacturing clusters are located in the Indian states of Telangana, Andhra Pradesh, Gujarat, Punjab and Haryana, as shown in Figure 1. The Hyderabad and Vishakhapatnam clusters in states of Telangana and Andhra Pradesh are known for their bulk drug and active pharmaceutical ingredients manufacturing units, while more specialized formulations like birth control pills are generally produced near the Ahmedabad cluster in Gujarat (Global Business Reports, 2017). The country plans to invest $27.3 million to establish ten new pharmaceutical clusters in the near future, projected to reduce cost of medication by up to 25% (Lane, 2015). These industrial clusters are expected to receive subsidized land and utilities, with shared infrastructure like effluent treatment plants, discharge pipelines, and quality assurance checks (FICCI, 2017). It is thus evident that production and consumption of pharmaceuticals will continue to rise in near future, and India is expected to become a progressively important manufacturing center for the global industry.

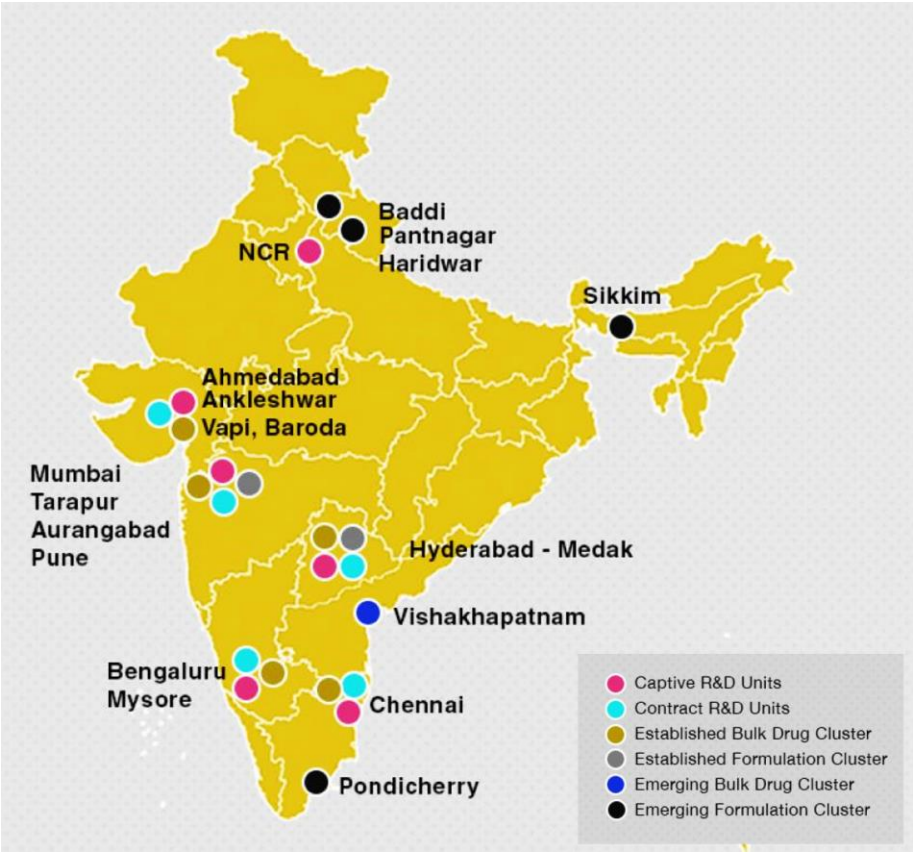

Figure 1: Map of India showing major pharmaceutical clusters (Invest India, 2018)

Pharmaceuticals in the environment

The high volume and geographically widespread use of pharmaceuticals has led to the introduction and persistent presence of medicines and drugs in the natural environment (Daughton & Ternes, 1999; Fent, Weston & Caminada, 2006; Kümmerer, 2008). There is a complex network of processes and pathways that release pharmaceuticals, chemicals and active drugs into the natural and human-made external environment. A review article of publications that quantitatively analyzed pharmaceuticals in water in the U.S. states that pharmaceuticals have been detected drinking water, surface water, groundwater, wastewater, and municipal biosolid waste (Deo & Halden, 2013). Figure 2 and 3 depict the pathways of introduction of

pharmaceuticals into natural and built water streams. In addition to water systems, these contaminants are also absorbed into soil and found in bodies of plants and animals (Daughton, 2016; Deo & Halden, 2013; Kümmerer, 2010).

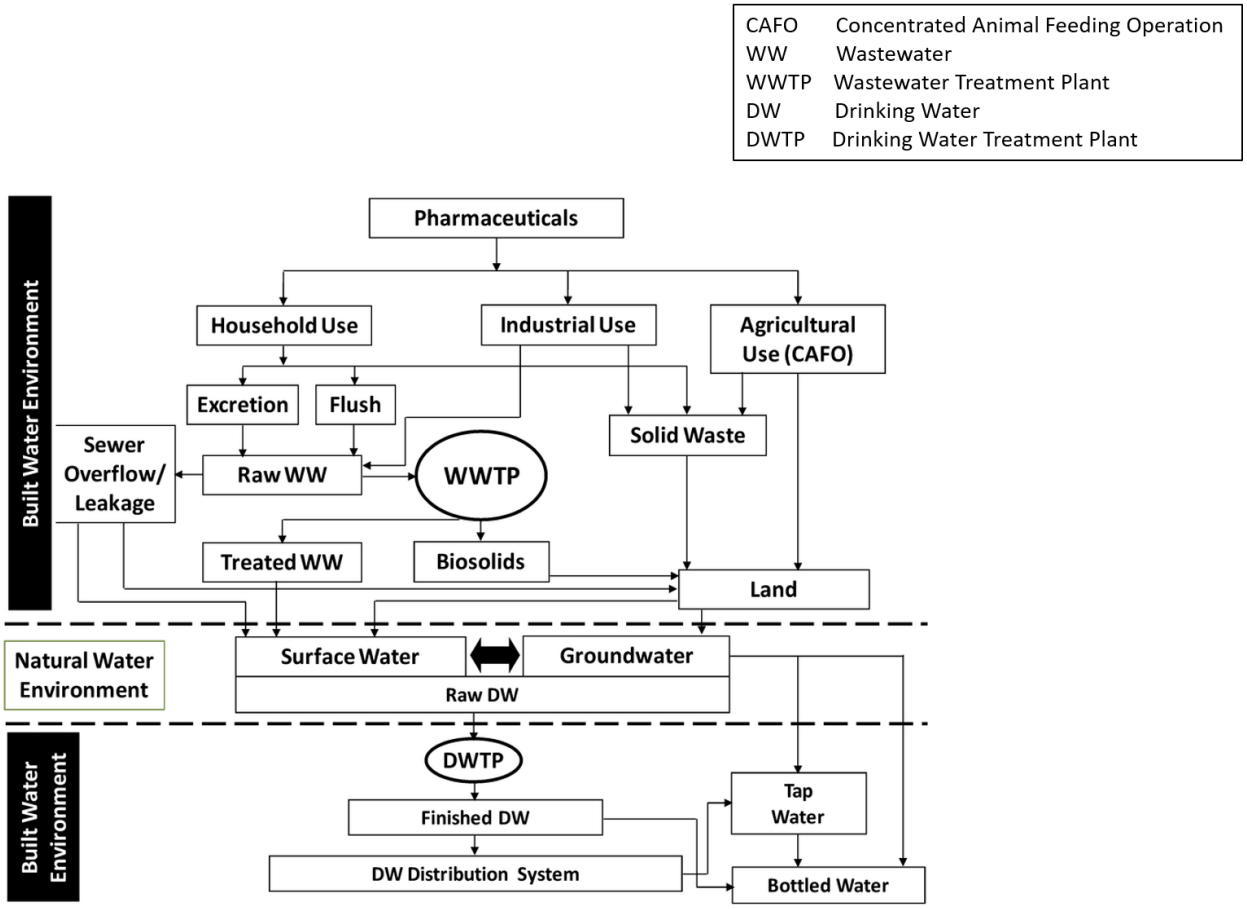

Figure 2: Pathways of introduction of pharmaceuticals into natural and built environment (Deo & Halden, 2013)

The pathways through which pharmaceuticals enter the environment are described in the following paragraphs, along with information about the damage they could cause to human beings and other living organisms. In subsequent sections, strategies for control and remediation of pharmaceutical pollution, their merits and their demerits are briefly discussed. The most

effective long-term solution presented here is the widespread use of sustainable or environmentally-friendly pharmaceuticals.

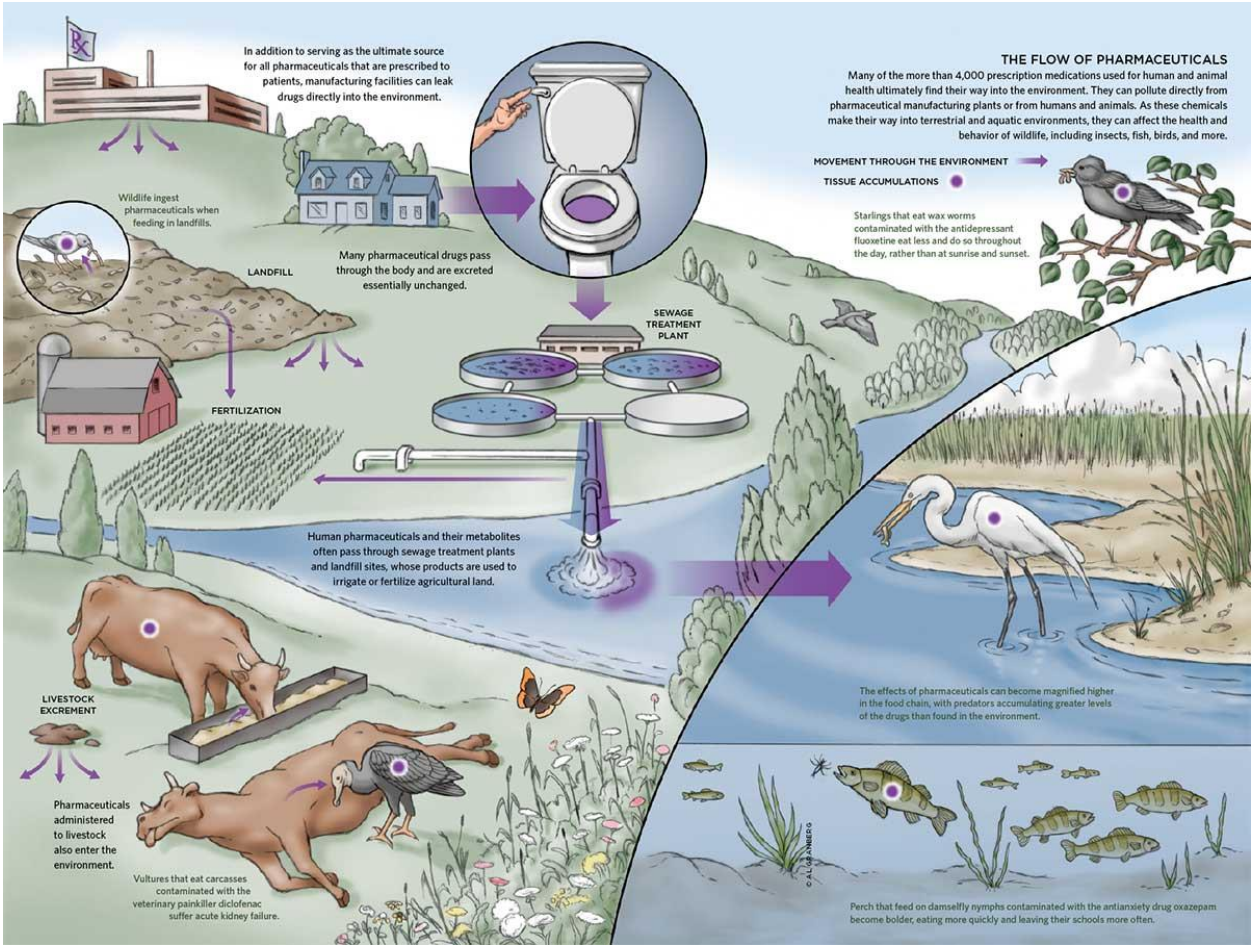

Figure 3: The flow of pharmaceuticals (Granberg, 2015)

Daughton (2016) classifies the introductory pathways of pharmaceuticals (see Figures 2 and 3) into the environment into two categories: upstream, and downstream. The upstream pathway of pharmaceutical contamination is often short, and releases concentrated active drugs into the external environment – these include the many kinds of large-scale negligent storage and disposal practices like waste elimination from manufacturing industries, or hospitals. The downstream pathway, in contrast, releases lower concentration of active drugs into the

environment through ways of diluted discharge from personal excretion, washing, flushing of unwanted medicine, landfill leaching, or wastewater discharge. Even though these bioactive chemicals travel in waste streams and eventually get diluted, the continual inflow from aforementioned sources creates a persistent presence of active pharmaceutical chemicals in trace quantities in the ambient environment (Daughton, 2016).

The ecological life cycle of pharmaceuticals has also been studied over the years. As the animal or human body only absorbs a fraction of the pharmaceutical drug ingested, a large and therefore unabsorbed amount of the drug is excreted. Farre, Perez, Kantiani & Barcelo (2008) studied the ecotoxicological effect of 42 common pharmaceuticals, and found that on average, about 50% of the prescribed drug was not metabolized, and 70% of the parent pharmaceutical compound was excreted by the patient. In many cases, the individual low concentrations of active pharmaceutical compounds in the environment interact with each other and/or with other chemicals like chlorine to create compounds or mixtures, often called “drug cocktails”, that are potentially more toxic than the parent compounds (Farre et al., 2008; Sirés & Brillas, 2012). Once into the external natural environment, the active pharmaceutical drugs and chemical compounds could undergo transformation in presence of microbes, sunlight, and other chemicals, causing metabolites to disintegrate or give rise to new toxic and persistent byproducts that further complicate the assessment of risk from combined ambient exposure to these contaminants (Daughton, 2016; Kümmerer, 2007; Löffler, Römbke, Meller & Ternes, 2005). The concentration and toxicity of a particular pharmaceutical in the environment can become difficult to quantify due to continuous uptake by soil and organisms, bio-concentration, and transformation (Daughton, 2003). Despite multiple studies spanning time and distance, the full

ecological implications of pharmaceuticals in the environment is not fully known or understood (Fent et al., 2006).

The first studies in the wide field of environmental contamination by pharmaceuticals were published in the late 1940s. These studies specifically explored increase in microbial resistance due to antibiotics in the environment (Barber, 1947; Miller, 1948). Later studies explored other pathways, contaminants, concentrations, environmental effects, and implications – these included topics like ecosystem impacts of veterinary drugs (Coats et al., 1976), steroid pollution in wastewater streams (Tabak et al., 1981), pharmaceuticals in water supply (Raloff, 1998), uptake by plants and bio-concentration (Crowdy and Jones, 1956), along with risk assessment and environmental assessments of pharmaceutical pollutants (Bloom and Matheson, 1993). Many studies, across geographical regions, contemporaneously found the presence of pharmaceutical and personal care products in water and in bodies of organisms. An overview of the available transdisciplinary literature indicates that the studies come from diverse but overlapping fields of chemistry, chemical engineering, pharmacology, healthcare, veterinary medicine, water resources research, environmental studies, environmental health, toxicology, behavioral sciences and other such fields, comprising journal articles, conference papers, books, government reports, and industry guidelines. This thesis explores the concerns surrounding pharmaceutical contamination through social and behavioral science, specifically within the field of human-environment relations.

Ecological damage due to pharmaceuticals

There is mounting evidence to indicate the presence of pharmaceutical chemicals across the globe and ecological disturbance thus caused. Sub-therapeutic quantities of pharmaceuticals and their by-products in the environment can cause stress and serious damage to non-target

organisms. Other long-term environmental stressors that interact with active pharmaceuticals include heavy metals, persistent organic pollutants (POPs), trace chemicals, detergents, pesticides, personal care products and make-up, micro-pollutants, and endocrine disruptors.

The presence of pharmaceuticals and related active chemicals in the environment have been conclusively proven to be responsible for ecological damage in multiple instances. One of the earliest studied consequence of pharmaceuticals in the environment was the emergence of antibiotic resistant bacteria. Many broad-spectrum antibiotics have been gendered ineffective due to strengthening antimicrobial resistance, or AMR (Ventola, 2015). This has implications for the field of medicine, as previously effective drugs become useless, and new alternatives are slow to transition from R&D labs to availability in the healthcare sector. The significant relationship between AMR and public health at a global level is well-recognized. The Centre of Disease Control and Prevention (CDC, 2013) recognized the present situation as 'post-antibiotic era', and World Health Organization reported that AMR is risking humankind's ability to treat even the most common infections. The UK Government's independent review on AMR estimates that 10 million lives per year and 10 trillion USD worth of economic output would be at risk due to drug-resistant infections by 2050 (*Tackling Drug-Resistant Infections Globally*, 2016).

Similarly, overuse of veterinary drugs, especially in industrialized farming in the U.S. has been found to discharge unsafe quantities of pharmaceuticals into the surroundings. Animals reared on large farms for food in industrialized feedlots, also called Concentrated Animal Feeding Operations or CAFOs, are often treated regularly with antibiotics to prevent disease outbreaks, and growth hormones for early maturation (CDC, 2013). The subsequent entry and presence of pharmaceuticals from veterinary uses have been verified to cause drug-resistance in micro-organisms. The resistant micro-organisms are then transmitted to humans through

fertilizer, meat, groundwater, or surface water and can limit immunity in human beings (Michael, Dominey-Howes & Labbate, 2014).

Steroid hormones meant for human consumption have also been detected in hazardous concentrations in the environment. Steroid estrogens, in particular, have been known to cause causing feminization of male fish, development of intersex characteristics, decreased fertility, and developmental abnormalities because of endocrine disruption in various species of fish and snails (Jobling et al., 2004; Silva, Otero & Esteves, 2012).

World Health Organization's report on pharmaceuticals on drinking water (WHO, 2012) mentions that though the presence of trace quantities of pharmaceuticals in drinking water might not directly risk human health, it is a cause of concern for water safety management as it might cause indirect microbial and chemical hazards. According to the report, pharmaceuticals enter drinking water sources from groundwater, landfill leaching, and surface runoff, as most water treatment facilities do not have adequate infrastructure to filter out trace concentrations of pharmaceuticals. The report consists of data from the UK, US, and Australia.

The uptake and bioconcentration of pharmaceuticals in soil and various plants has also been studied. Pharmaceuticals enter soil through groundwater, insufficiently treated sewage and manure, and are subsequently taken up by plants. Their effect on plants is seen as inhibition in branching, depressed growth, and bioaccumulation of chemicals, and reduction in crop yields (Jjemba, 2002).

Ecological damage in India due to pharmaceuticals

The entire Indian subcontinent, including India, Pakistan and Bangladesh, has seen loss of biodiversity due to pharmaceutical poisoning of scavenger animals like vultures. In 1990s, declining vulture populations spurred studies that found that diclofenac, a non-steroidal anti-

inflammatory drug was ingested by vultures that ate carcasses of treated animals caused renal failure, leading to eradication of the species in cities like New Delhi (Green et al., 2004; Oaks et al., 2004; Schultz et al, 2004). In India, pharmaceutical pollution is conspicuous in news reports about large-scale loss of biodiversity in lakes near urban or industrial areas. Medhi and Sewal (2012) estimate the contamination in India to be almost 150 times the level of those found in developing countries. The length of polluted waterways in India reportedly doubled in the five-year period from 2009-2014 (Vashishtha, 2015). API and bulk drug manufacturing in India is concentrated in a few locations in the country (see Figure 1), including the cities of Hyderabad, Telangana and Vishakhapatnam, Andhra Pradesh. The industrial areas in and around these two cities in southern India have borne the worst environmental damage due to pharmaceuticals among all other clusters in the country. Waterways along the periphery of Hyderabad, including Iska Vagu stream shown in Figure 4 and the Musi river, are heavily polluted with pharmaceutical effluents. In one of the many sporadic instances of acute pharmaceutical discharge, toxic leakage of a pharmaceutical solvent into Gandigudem lake in the district of Hyderabad in October 2017 caused the death of 2.3 million fish, as seen in Figure 5, in the lake (Sangareddy, 2017). Dead or dying animals like fish and amphibians are a common sight, along with viscous white and brown foam, a classic indication of polluted water. Some waterbodies show change in the color of water to red or green due to toxins or heavy metal compounds (Ecostorm, 2016).

Figure 4: Polluted Iska Vagu stream, near Hyderabad, India (Kumar, 2008)

Figure 5: Dead fish in Gandigudem Lake, Hyderabad, India (Nitin B., 2017)

The extent of ecological damage in Hyderabad due to drug manufacturing prompted the Ministry of Environment and Forests (MoEF) to ban the expansion of industries in the area in 2010 and in 2013. As early as 2004, Greenpeace reported the adverse effect of ambient drugs and chemicals on people, animals, crops, and the land around these industrial clusters (Ecostorm, 2016). Recent studies by Ecostorm (2016) have found superbugs and drug-resistant bacteria in Musi river near suburban Hyderabad.

The communities residing in areas near drug manufacturing clusters have suffered long-term damage. The same streams that carry effluent discharge from industries are the main source of drinking water for many villages and settlements downstream. In these communities, children have been reported to have congenital defects to due overexposure to toxic effluents. Adults and children alike have developed chronic ailments that do not respond to conventional treatment (Ecostorm, 2016). The Center for Disease Dynamics, Economics and Policy, Washington report that an estimated 58,000 newborn babies died in 2013 in India as a result of drug-resistant infections (CDDEP, 2015). The residual effects of exposure remain in place, even though manufacturing units are now required by law to treat and purify all wastewater before its release into the surroundings. The expected growth of pharmaceutical industry in India and the extent of degradation that has already been caused necessitates that all future growth of the industry is managed in a way that gradually restores the environment by eliminating pollutants while preventing any further degradation.

Managing pharmaceutical pollution

It is imperative to control the quantities and types of pharmaceuticals allowed to enter the natural environment and remove the existing compounds to put a check to environmental contamination due to pharmaceutical pollution. Even after a pharmaceutical compound's ill-effects have come to light, it often takes a long time to systematically remove the active chemical stressor or pharmaceutical from the environment. Polychlorinated biphenyls (PCBs), now recognized as persistent pollutants, were known to be associated with severe health problems since 1899. However, they were only banned in the European Union after about 100 years, in 1999, despite recurring reports of their neurotoxicity and carcinogenic impacts (Kümmerer, 2007).

Kümmerer (2007) classifies approaches to manage environmental chemical stressors in three broad categories (see Figure 6). The first category, called "Technical approach" is a short to medium-term management strategy that works by treating emissions or effluents, also referred to as "end of the pipe technology." The strategy is effective for managing short and concentrated emanations as it focuses on major upstream pathways of contamination introduction, but it requires the presence of relevant infrastructure. It also fails for trace quantities of pollutants, downstream pathways and non-point sources. Industrial treatment of effluents and wastewater treatment are some examples of the technical approach.

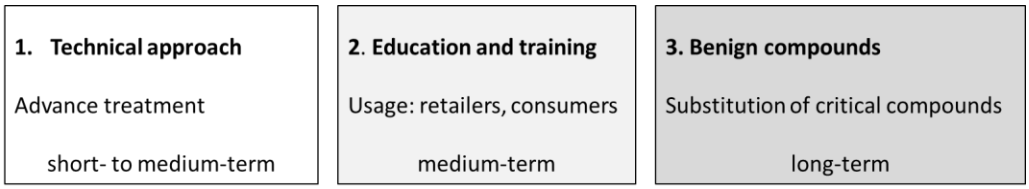

Figure 6: Approaches to manage pharmaceutical pollution (Kümmerer, 2007)

The second management strategy, "Education and training", aims to address the issue by training the stakeholders about risks of pharmaceutical pollution and how to alleviate them. These stakeholders include medical practitioners, hospital staff, pharmacists, and the patients or other end users. The strategy includes drug take-back programs, modification of prescription doses, containment at source, responsible use and care, and managing illicit drugs. Drug take-back programs are operational in many countries including most countries in the European Union, New Zealand, and Canada, wherein people can deposit unused or leftover medication to a pharmacy, hospital or collection center. Such practices are aimed at reducing improper drug disposal such as flushing or throwing in trash by the consumer (Kümmerer, 2010, Chapter 11). Several ideas have been put forward that explore environmental stewardship by reconsidering

current practices of pharmaceutical prescription. Daughton and Ruhoy (2013) recommend selecting "the lowest effective dose" of medication possible, to prevent drug overuse and wastage. They also recommend personalized dosage according to the needs of each individual patient to avoid over-prescription of drugs, and leftover medication due to patient non-compliance. The use of Precautionary Principle or PP, as recommended by European Commission to regulate risk from chemicals including pharmaceuticals can also supplement this management category. Rogers (2003, p. 374) defines PP in two ways: weak PP, which posits that "lack of full certainty is not a justification for preventing an action that might be harmful"; and strong PP, which advices to "take no action unless you are certain that it will do no harm." This evidence-based policy intervention, as currently used to regulate hazardous chemicals in Europe, is open to interpretation. The burden to provide evidence regarding risks possessed by a pharmaceutical rests with the primary producer or manufacturer of the pharmaceutical, while the burden to interpret evidence rests on the regulatory body (Larsen, 2004; Rogers, 2003). Recently, the precautionary principle has been applied to justify withdrawal of several pharmaceutical drugs in EU and worldwide (Onakpoya, Heneghan & Aronson, 2016), but the risks cited to justify these withdrawals were regarding human health, including drug-attributed deaths. The withdrawal justifications did not include either direct risks to the environment, or impacts on human health due to environmental damage. Rogers (2003) also observed that the successful application of PP depends upon educating both evidence-providers and regulators on quantitative assessment of health and ecological hazards from pharmaceuticals. In the future, more stringent use of the precautionary principle can be expected to eliminate the potential environmental risks from new pharmaceutical drugs and chemicals by conducting extensive risk assessments and environmental or health impact reviews, provided that the social benefits of pharmaceuticals do

not outweigh environmental considerations (Larsen, 2004). In sum, while the second strategy is more comprehensive in preventing the entry of pharmaceuticals in the environment, it does not account for all pathways, and needs to be widely accepted to be effective. The adoption of practices mentioned above are also not popular, especially in developing countries. Importantly, the second management strategy does not address the source of contamination – the pharmaceutical compound itself (Kümmerer, 2004; Kümmerer 2007; Daughton 2003).

The third strategy advocates the redesign of pharmaceuticals as environmentally-benign compounds. A long-term strategy, it calls for the eventual substitution of all potentially toxic pharmaceuticals with environmentally-friendly alternatives. It is noteworthy that some policies and strategies address only upstream pathways, while some address only downstream pathways. When adopted widely, efficient or eco-friendly drugs would reduce or eliminate the need for stringent waste disposal, saving time, money, and physical resources. Their use would also alleviate the harm that is caused by informal or non-point source of pharmaceutical contamination like household excretion and washing (Ruhoy and Daughton, 2008). There are very few strategies that comprehensively deal with both pathways while focusing on the cause of pollution itself, among which, the best and often the most cited is the green chemistry approach.

Environmentally-friendly pharmaceuticals

The idea of using green chemistry to develop environmentally-benign pharmaceuticals was first proposed in the field of chemistry around 2000 (Anastas and Warner 1998, Clark and Smith 2005, Clark 2006) as a method to address issues and concerns stemming from the presence of pharmaceuticals in the environment. Green pharmaceuticals, or benign-by-design drugs are pharmaceuticals that, by the virtue of their chemical make-up, either have an efficient manufacturing process, are target-specific, have harmless residues, or are bio-degradable

(Cordell, 2009; Daughton, 2003; Kümmerer, 2010). In this approach, the full life cycle of a pharmaceutical is carefully studied, from its inception to large scale manufacturing, treatment capability, and its behavior or fate after being emitted into the environment (Kümmerer, 2010). This holistic approach of studying raw materials used, synthesis, manufacturing, use and after-use life of a drug is also known as "cradle-to-cradle stewardship" (Daughton, 2003; Kümmerer, 2010). Cradle-to-cradle stewardship as a design and manufacturing approach has been used in a wide variety of disciplines ranging from manufacturing and product design to urban planning (McDonough & Braungart, 2010), aiming at regeneration of the environment rather than reduction of environmental degradation. Recent literature uses a variety of phrases to discuss the field of green chemistry, some among them being "sustainable pharmacy", "benign-by-nature", "ecopharmacostewardship", and "sustainable health products" (Kümmerer, 2010). Countries like the United States (the U.S. Presidential Green Chemistry Challenge Award instituted in 1995), Japan, Italy, the UK, and Australia have adopted green chemistry awards to encourage industry and academic action in the field (Anastas and Kirchhoff, 2002).

Taylor (2010) specifies pharmacological objectives that, when achieved, would result in sustainable improvements in drug design. These objectives consist of complete oral absorption of drug to alleviate emission from patients, drug metabolization that would result in inert residues, effective drugs to reduce overall drug use, target-specific or disease receptor specific drugs that do not impact healthy receptors, and elimination of side or non-therapeutic effects of a drug (p. 110). An overhaul of industrial manufacturing and R&D is also leading to more environmentally-friendly pharmaceuticals in the market. Many drug synthesis processes have undergone major improvements in efficiency, and big pharmaceutical manufacturers are collaborating to further these sustainable synthesis routes (Crow, 2008). Biopharmaceuticals, or

biologically derived pharmaceuticals, are gaining momentum against synthetically synthesized chemicals – leading to a much less toxic manufacturing chain. Industries are shifting to less toxic solvents for bulk drug manufacturing than conventional solvents (Taylor, 2010). Pharmaceutical manufacturing companies are also rethinking the basic composition of drug molecules, redesigning to avoid certain non-biodegradable chemical bonds like the carbon-fluorine bond (Lubick, 2008).

Despite the widely accepted and endorsed benefits of green chemistry, the approach still faces some critical challenges. By extension, these challenges also apply to the adoption of environmentally-friendly pharmaceuticals. Anastas and Kirchhoff (2002) classify these challenges into three groups: research challenges, implementation challenges, and education challenges. Research challenges include development of solvents, methodologies, processes, surfaces, materials, and energy sources that do not cause harm to humans and the environment. Implementation challenges involve overcoming the barriers of codes and regulations, provision of tax incentives and long-term research programs, and patent extensions for process optimization. Education challenges include the systemic recognition of green chemistry, updating textbooks, labs, and coursework to include green chemistry, and educating legislators and all stakeholders involved (Anastas & Kirchhoff, 2002, p. 691).

Green chemistry in India is still in the nascent stage. The country saw the establishment of a chapter of Green Chemistry Institute in New Delhi in 2003 and sanctioned the proposal for establishment of a Center for Green Technology in 2004 (Yadav, 2006). Ecopharmacology is also recognized as an emerging field in India. Gupta and Mahajan (2015) compiled a series of manufacturing processes optimized to reduced environmental damage, consisting of manufacturing for various solvents and synthetic chemicals used in production of

pharmaceuticals. In the pharmaceutical industry, sustainable methodologies are available for the production of various antibiotics and different drugs used to lower cholesterol, control diabetes, control central nervous system disorders, regulate cardiovascular system, treat depression, and complement anti-cancer treatment or chemotherapy (Gupta & Mahajan, 2005). The Bureau of Indian Standards, in 2006, adopted industry standards and guidelines for chemicals and pharmaceuticals with respect to their environmental life-cycle assessment (IS/ISO 14040:2006), but the country has not seen extensive reporting on sustainability in the pharmaceutical industry. By 2013, only 2 of the 9 Big Pharma companies in India had released reports of their sustainability initiatives (Chaturvedi, Sharma, Dangayach & Sarkar, 2017).

Green manufacturing and supply chain in India

The challenges to widespread adoption of environmentally-friendly pharmaceuticals include demand from consumers, so it is discussed in the following text how consumer support can result in incentives for adoption of this long-term sustainable strategy against pharmaceutical pollution. Finally, the theoretical framework and rationale behind this research study are reported, along with research questions and hypotheses examined in the study.

As the sustainable pharmaceutical industry in India is in its initial stages, the studies about advanced green manufacturing and supply chains in more established industries can provide useful knowledge applicable to the pharmaceutical industry. Several studies have explored motivations for large manufacturers and traders to engage in environmentally-friendly supply chains and manufacturing across prominent industries like auto components, cold storage and refrigeration, electricals and electronic manufacturing, mining, and construction. Principal among these are studies on Indian industries and markets done by Bag (2016), Mathiyazhagan & Haq (2013), and Muduli, Govindand, Barve & Geng (2013). The studies found that the most

important factors that incentivizing large companies to engage in green practices include government regulations, local laws, tax incentives, and land subsidies. In addition, Mathiyazhagan & Haq (2013) find that a significant motivating factor in India is the demand from the consumers and stakeholders, especially for large companies and suppliers, as it creates a bottom-up pressure. Sustained profit margins and long-term feasibility, along with image of the company through Corporate Social Responsibility (CSR), are also crucial significant factors for promoting eco-friendly manufacturing and supply (p. 830).

Rationale for the thesis

One of the crucial challenges to adoption of environmentally-friendly pharmaceuticals, according to the literature discussed above, are educational challenges that include substantiating stakeholder awareness and involvement, and demand from consumers, especially in India. It is therefore imperative to study existing consumer perceptions to establish point of actions and best strategies to encourage change in behavior and consumer action. In recent past, a growing number of campaigns have successfully effected change in consumer behavior by focusing on education about environmental problems and environmentally-friendly alternatives. Even international policymakers have invested in social marketing campaigns to promote pro-environmental consumer behavior, often accompanied by financial incentives to the industries to gain leverage (European Commission, 2008; Kollmuss & Agyeman, 2002; Whitmarsh & O'Neill, 2010).

A close review of literature reveals that certain specific factors influence public perception and individual behavior regarding environmental pollution. Individual behavior that positively affects the environment is often called ecological behavior or environmentally-friendly behavior in these texts. Studies have expounded on certain measurable qualities or traits of an

individual that cumulatively determine the likelihood of an individual to engage in ecological behavior. Various types of ecological behaviors have been studied in diverse settings, including shopping for organic food, willingness to purchase renewable energy, disposal of medication, etc. in countries from the European Union and the US, UK, Canada, New Zealand, China, Japan, Singapore, and Kuwait (Bang, Ellinger, Hadjimarcou & Traichal, 2000; Götz & Keil, 2007; Grunert 1993). Most of these studies focus on individual behavior at the level of consumer, and not holistically on the entire life cycle or supply chain.

In the field of pharmaceuticals in the environment (PiE), well-known studies about consumer behavior are those regarding popularity of and compliance with drug take-back programs (Abahussain & Ball, 2007; Daughton, 2003, Götz & Keil, 2007). To the best of the author's knowledge, no study has analyzed consumer perceptions regarding pharmaceutical pollution, especially in the Indian context. This research thesis thus fills a crucial gap in the field by analyzing perceptions of consumers towards environmentally-friendly pharmaceuticals in a country that is facing severe environmental degradation due to active chemical drugs. It is expected that this research would provide a nuanced understanding of consumer perceptions in India, which could then encourage manufacturers to invest in, and market eco-friendly pharmaceuticals. It will also help to raise awareness about the issue of pharmaceutical contamination and identify areas of intervention for public policy campaigners, especially for imminent India-specific issues like industrial effluent discharge, and antimicrobial resistance.

Theoretical framework

In the field of environmental psychology, most discussions around environmental attitudes and ecological behavior are grounded in the theory of reasoned action (Ajzen & Fishbein, 1980) and the theory of planned behavior (Ajzen, 1985). The theory of reasoned action

by Ajzen & Fishbein (1980) posits that a particular behavior is immediately preceded by an intention to perform that particular behavior. In most studies that have measured ‘ecological behavior intention’ and ‘ecological behavior’, the two variables are strongly, or at least moderately correlated (Kaiser, Wolfing & Fuhrer, 1999), however, the strength of this correlation varies greatly across the behaviors studied. Some ecological behaviors are strongly associated with environmental attitudes, environmental knowledge, environmental values, or ecological behavioral intention, while others are not; specific ecological behaviors such as recycling or use of public transport, are more strongly associated with environmental attitudes, while general behaviors such as taking care of the environment or participating in environmental activities, are moderately associated (Kaiser et al., 1999).

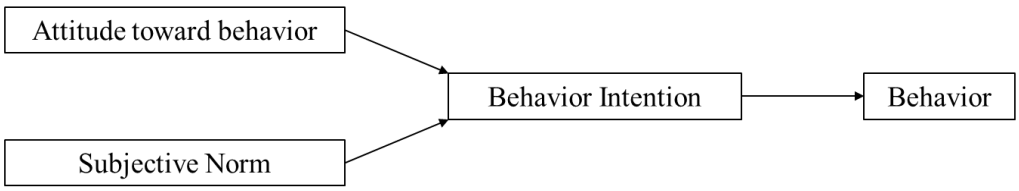

Figure 7: Theory of reasoned action - intention precedes behavior (Ajzen & Fishbein, 1980)

Kaiser and colleagues (1999) also suggest three concepts as the skeleton of the theory of planned behavior: environmental knowledge, environmental values, and ecological behavioral intention. In addition, these authors state that the relationship between general attitudes and general behavior should remain consistent regardless of ideological differences among people. Environmental knowledge encompasses factual knowledge about the environment, and the knowledge about what and how something can be done. Environmental values are social and moral values regarding the environment. Ecological behavior includes actions that contribute to

environmental preservation or conservation. Ecological behavior intention immediately precedes ecological behavior and is a function of the environmental attitude towards performing an act and subjective norms or the expectations of others (Kaiser et al., 1999).

Research variables

By applying the theory of reasoned action (Ajzen and Fishbein, 1980) and its interpretation for studying environmentally-friendly behavior (Kaiser et el., 1999) to this research study, it becomes evident that consumer perceptions toward pharmaceutical in the environment can be examined through the study of environmental knowledge, values, and intention. Environmental knowledge can be interpreted in the context of this study as knowledge of the issue of pharmaceutical pollution, and the risks associated with it. Environmental values can be interpreted as environmental concern. The study of ecological behavior takes more time and resources than available for this research; thus, ecological behavior intention is studied. While ecological behavior intention is not a true indicator of ecological behavior, the two are expected to be associated according to the theory of planned behavior and theory of reasoned action (Ajzen & Fishbein, 1980; Ajzen, 1985), with intention being the immediate predecessor of the behavior or action. Details about each measurable variable are discussed in the following paragraphs. All variables measured for the purpose of this study are presented in Figure 8.

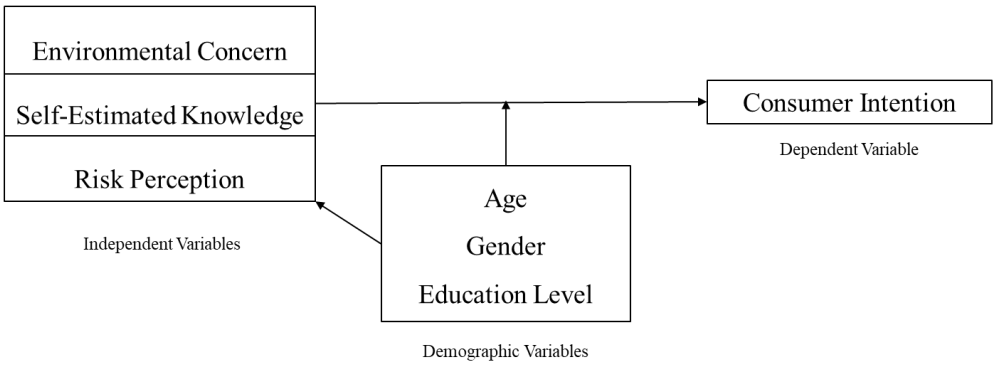

Figure 8: Research Design

Environmental concern: Yeung (2004) defines environmental concern as "an affective attribute that can represent a person's worries, likes and dislikes about the environment" (Yeung, 2004, p. 101). Similar to a person's attitude towards the environment, it can cover either general or some particular aspects of the environment (Kaiser et el., 1999) and encompasses people's tendencies to live and act in an environmentally responsible way (Yeung, 2004). Environmental concern has been used to study pro-environmental behavior. For example, Mobley, Vagias, and DeWard (2010) measured environmental concern in their study to predict environmentally-responsible behavior in US residents. Lee (2008, 2014) used the attribute to predict sustainable consumption among young people in Hong Kong, and Yeung (2004) used it to evaluate the effect of teaching approaches on students' environmental attitudes. In this research study, environmental concern is measured to understand the extent of a consumer's interest in issues related to environment.

Self-estimated or Subjective Knowledge: According to Vandermoere (2008), subjective or self-estimated knowledge refers to an individual's perception about their personal knowledge of a specific issue. The measure is used in risk perception studies to examine the "familiarity

effect" (Slovic, 1987), which states that the level of familiarity with a particular risk may affect people's perceptions of it. Both objective and subjective knowledge contribute to people's opinions. Self-estimated knowledge has been measured in studies that examine perceptions of residents exposed to soil pollution (Vandermoere, 2008), and perceptions regarding genetically modified foods (Durant & Legge, 2005). In this study, self-estimated knowledge is measured to get a nuanced understanding of consumers' perceptions about the issue of pharmaceutical pollution.

Risk Perception: The field of risk analysis uses risk perception measures to study people's opinions about a particular threat. Risk perception involves various attributes like newness or familiarity of risk, severity of consequences, and social trust (Slovik, 1987). Perception of risk is also related to the acceptance of a new concept by the public, like gene technology (Sparks, Shepherd & Frewer, 1994) and e-commerce (Pavlou, 2003). In the study, risk perception is used to determine the acceptance of the risk from existing pharmaceutical pollution among Indian citizens.

Consumer Intention: The inclination of a consumer to engage in a particular behavior is called consumer intention. Consumer intention is also used to predict pro-environmental behavior or stewardship by a consumer (Hensen, Keeling, Ruyter & Wetzel, 2016). The concept of consumer intention has been used to study marketing effects on pro-environmental behavior (Kollmuss & Agyeman, 2002; Whitmarsh & O'Neill, 2010) and environmentally-friendly alternatives to conventional products (Steg & Vlek, 2009). A comprehensive term for long-term environmentally-friendly consumer intention, consumer stewardship is defined (Hensen et al., 2016, p. 390) as "an individual's willingness to take personal responsibility for, and balance one's own short-term interests with long-term collective interests of the environment, society and

future generations, even if this requires personal sacrifices in consumption decision." In this study, environmentally-friendly consumer intention is used to ascertain the willingness of Indian consumers to buy green pharmaceuticals, since studies indicate that intention directly leads to action (Kaiser et al., 1999).

Research Questions and Hypotheses

The following research questions will be explored through this thesis.

Research Question 1(a): What are the levels of environmental concern, awareness about pharmaceutical pollution, perceived risk of pharmaceutical pollution, and environmentally-friendly consumer intention among Indian consumers? **(b)** Do the levels of environmental concern, awareness about pharmaceutical pollution, perceived risk, and consumer intention vary with age, education level, or gender (see Figure 9)?

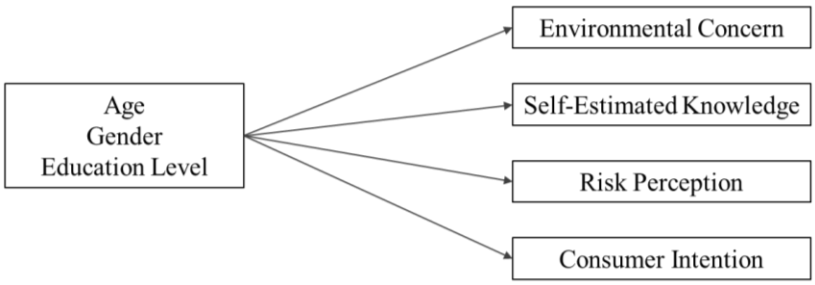

Figure 9: Research Question 1(b)

The levels of environmental concern, awareness about pharmaceutical pollution, perceived risk of pharmaceutical pollution, and environmentally-friendly consumer intention among Indian consumers will be assessed. It is hypothesized that citizens do not have much information about the subject of pharmaceutical pollution, nor consider it an important environmental threat. On average, younger people (ages 44 years and younger), and citizens with

higher education levels (bachelor's degree/diploma and above) are expected to have higher levels of environmental concern, awareness about pharmaceutical pollution, perceived risk, and environmentally-friendly consumer intention than older citizens and citizens with lower levels of education.

Research Question 2 (a): Are environmental concern, awareness about pharmaceutical pollution, and perceived risk each individually associated with the dependent variable, environmentally-friendly consumer intention (see Figure 10)? **(b)** Do age, education and/or gender moderate the associations between the independent variables (environmental concern, self-estimated knowledge, risk perception) and the dependent variable (consumer intention) (see Figure 11)?

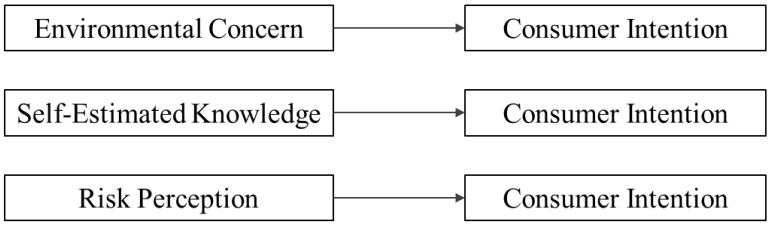

Figure 10: Research Question 2(a)

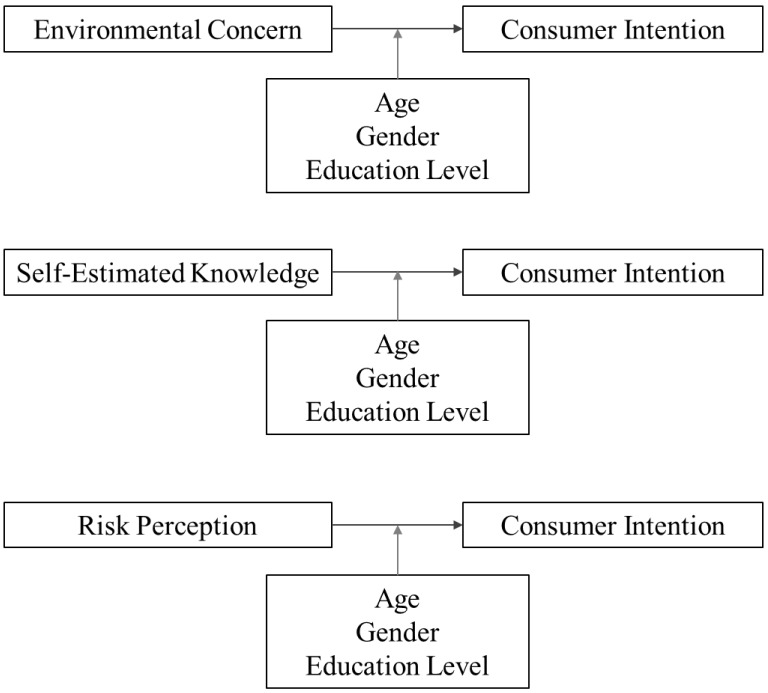

Figure 11: Research Question 2(b)

The independent variables, environmental concern and awareness about pharmaceutical pollution, are expected to be positively correlated with scores on Consumer Environmental Stewardship (CENS) scale. Risk perception is also expected to be positively associated with consumer intention. Second, on average, younger citizens (ages 44 years and younger), and citizens with higher education levels (bachelor's degree/diploma and above) are expected to have higher consumer intention scores than older citizens and citizens with lower levels of education. Third, the associations of each independent variable with the dependent variable are expected to be moderated by demographics of age and/or education level. Specifically, it is hypothesized that the positive effect of each independent variable on consumer intention will be stronger for younger citizens (ages 44 years and younger), and for citizens with higher education levels (bachelor's degree/diploma and above) than for older or less educated participants.

Research Question 3: Which among the three independent variables — environmental concern, awareness, and perceived risk — are the most salient correlates of environment-friendly consumer intention (see Figure 12)?

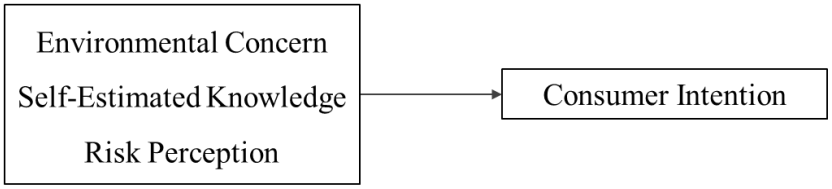

Figure 12: Research Question 3

It is hypothesized that environmental concern will be most strongly correlated with environment-friendly consumer intention. Most studies that have evaluated the relation between environmental concern and pro-environmental behavior or consumer intention find a strong or moderate correlation between environmental concern and behavior/intention (Kaiser, 1999; Lee, 2014; Mobley, Vagias, & DeWard, 2010). This study is expected to be consistent with the results that environmental concern is the strongest predictor of consumer intention after controlling for age, gender, and education level.

CHAPTER 2

METHOD

Research Design

This non-experimental research study (one group post-test only, or case study) is aimed at understanding adult Indian consumers' perceptions regarding medication and the environmental contamination resulting from pharmaceutical pollution. The purpose of this study was to evaluate the level of environmental concern among the population. The study tested whether people showing high levels of environmental concern and perceived risk from pollution also showed stronger intention to engage in environment-friendly consumer practices. Quantitative data were collected in the field using survey questionnaire from people visiting a pharmacy in Indore, India.

Site Selection and Description

Indore is situated in the state of Madhya Pradesh in India. The city is an important business hub for central India and over 76 pharmaceutical companies have a management or regional office located in the city. Pithampur, one of the biggest industrial areas of Asia, is located about 30 km (18.6 miles) from Indore. Pithampur is home to at least 16 different drug manufacturing units, which provide pharmaceuticals and active pharmaceutical ingredients for supply throughout central and western India.

Indore has recently seen a surge in awareness against pollution due to municipal initiatives promoting ideas like "Clean Indore, Green Indore". Indore has also been voted as the cleanest city in India for two consecutive years, according to the annual citizen's poll conducted by the Swachh Bharat Campaign (Annual Report, 2017, Swachh Bharat Abhiyan).

The site selected for this study was a pharmacy, *New Look Optics and Pharmacy*, situated on the premises of Rohit Eye Hospital, Indore. The setting for data collection was chosen to be a pharmacy as people visiting a pharmacy are likely to consume medication and often are faced with choices regarding consumer decisions. *New Look Optics and Pharmacy* is in geographic proximity to neighborhoods of varying income levels to maximize demographic variation.

Participants

A semi-random sampling procedure was used for this study. Adults visiting the pharmacy were first asked orally if they have a few minutes to take a survey, and then asked for their consent. All adults in the age range of 18 to 85 years visiting the research site were asked to participate in the study. The sample was expected to be representative of the population living in Indore, as the pharmacy is visited by people from diverse social and economic backgrounds.

As shown in Table 1, the most common age group represented in the study was 18 to 24 years, with 24% of respondent belonging to this category. Forty-seven percent of the respondents were male, and 53% female. The most represented education level was Secondary (Grade 6 to 10), with 23% of the participants belonging to this category.

Table 1

Demographic information of participants

Demographic Variable	Number	Percentage (%)
Gender		
Male	65	47%
Female	72	53%
Age		
18-24	33	24%
25-34	23	17%
35-44	30	22%
45-54	26	19%
55-64	16	12%
65-74	8	6%
75-84	1	1%
>85	0	0%
Education Level		
No schooling	15	11%
Primary (Grade 1 to 5)	10	7%
Secondary (Grade 6-10)	31	23%
Post-secondary (Grade 11-12)	23	17%
Tertiary (Bachelor's degree or diploma)	30	22%
Post-graduate (Master's or above)	25	19%

Demographic information of the participants of this study was compared to the demographics of the city of Indore, and of India. As shown in Table 2, the sample demographics were comparable with those of the population of the city and the country, especially according to age groups and gender.

Table 2

Comparison of demographic information

Demographic Variable	Study (2018)	Indore (Urban)	India
Age			
18-24	24%	10%	19%
25-34	17%	18%	15%
35-44	22%	14%	13%
45-54	19%	10%	9%
55-64	12%	6%	6%
65-74	6%	3%	4%
>75	1%	2%	2%
Gender			
Male	47%	52%	51%
Female	53%	48%	49%
Literacy Rate	N/A	85%	73%

Note. Data Source: Census of India, 2011

Data collection procedure

Data were collected from February 22 to March 9, 2018. A total of 141 responses were collected in this period. Participants were told that the research assistant would like to ask a few questions regarding medicines and environmental pollution. Upon obtaining consent, participants were asked to take a 15-minute survey. A research assistant administered the survey in the local language at the pharmacy counter by reading the questions aloud, to which the participant either responded orally or indicated their response on a printed scale scorecard. Each survey response took about 10 minutes, and participants were compensated with eye checkup coupons worth INR 300 ($4.60) for their participation.

The entire data collection process was conducted in the local language, Hindi, to ensure comfort of all participants and maintain language uniformity. The survey was translated in Hindi

and the original survey was compared with a back-translated English version to check meaning loss in translation (see Appendix A for English and Hindi versions of the questionnaire). The study was granted exemption from review by the Cornell University Institutional Review Board (see Appendix B).

Constructs and Measures

The study included four independent variables (consumption of pharmaceuticals, environmental concern, awareness about pharmaceutical pollution, and perceived risk of pharmaceutical pollution) and one dependent variable (environment-friendly consumer intention), in addition to recording demographic information about each participant. All measures were self-reported on a Likert or Likert-type scale and have been provided in Appendix A for reference. Likert scales are interval scales that provide 1-5 or 1-7 response options related to agreement and disagreement with a series of statements.

1. **Consumption of Pharmaceuticals** was measured to recognize the most commonly consumed over-the-counter (OTC) pharmaceutical drugs by the surveyed population. The 11-item scale from Sihvo, Klaukka, Martikainen, & Hemminki (2000) categorized non-prescription drugs into 10 categories according to the 1993 Anatomic-Therapeutic Classification (ATC). The measure was modified to include common Indian name brands of drugs as examples for each category of medication. The measure was introduced by the research assistant with the following instruction: “Please tell me what medicines you have consumed during the last two days. Do you consume these medicines daily or weekly (used regularly), or do you use them occasionally (as needed)?” Participants were asked to indicate categories of medicines consumed in two days preceding the survey (Vitamins/Mineral Supplements, NSAIDs, Analgesics, Antibiotic, Antianemia Preparations, Antacids, Antihistamines, Cough and Cold Preparations, Topical

Products for Muscular Pain, Laxatives or alternatively, none). They were also asked to indicate if they consumed the pharmaceuticals as and when required (Used Occasionally), or if they consumed them daily or weekly (Used Regularly).

2. Environmental Concern was measured using the Environmental Concern Scale (Lee, 2014) adapted to reflect Indian context.[1] The original scale was developed to examine sustainable consumption among the young educated population of Hong Kong. The original 13-item scale had strong internal consistency with a Cronbach Alpha value of $\alpha = 0.94$. One item was removed due to possible translation error in the original measure.[1] The modified scale consisted of 12 items measured on a 7-point Likert Scale ranging from 'strongly disagree' to 'strongly agree' and included statements like "I am worried about the worsening of the quality of India's environment", and "I think it is very important to advocate environmental protection to Indian citizens." The modified scale for this study had a high Cronbach Alpha value ($\alpha = 0.94$).

3. Awareness about Pharmaceutical Pollution was measured with a self-reported Subjective/Self-estimated Knowledge Scale modified from Vandermoere (2008). The scale consisted of 4 items measured on a 5-point scale ranging from 'not at all' to 'very much', and "less informed" to "better informed." The original scale was developed to assess subjective knowledge of Belgian people about chemical contamination of their residential land parcels due to former industrial activities. It was adapted to the context of the current study.[2] The scale included questions such as: "To what extent do you feel informed about the problem of

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[1] In all items, 'Hong Kong' was replaced by 'India'. For example, "I am worried about the worsening of the quality of Hong Kong's environment." was changed to "I am worried about the worsening of the quality of India's environment." The item "I often think about how the pollution problem in Hong Kong" was the 12th item in the original measure but was removed from the modified measure.

[2] All four items on the original scale were modified to reflect the context of current study. For example, "To what extent do you feel informed about the previous industrial activities on the site?" was replaced by "To what extent do you feel informed about the problem of pharmaceutical pollution in India?"

pharmaceutical pollution?" and "To what extent do you feel informed about the pharmaceutical pollution in India in comparison with other residents?" The 4-item scale was reported to have moderate internal consistency ($\alpha = 0.797$) (Vandermoere, 2008), and face validity was established by consultation with experts. Cronbach Alpha for the scale was found to be high ($\alpha = 0.92$) for the current sample.

4. Perceived Risk of Pharmaceutical Pollution was measured with a Risk Perception Measure modified from Huang et al. (2013), developed to assess risk acceptance of chemical industry in Jiangsu Province, China. The measure was adapted to the context of the current study by changing "chemical" pollution to "pharmaceutical" pollution for all items, one item was further modified to clarify the context, and the number of items were reduced from 9 to 8 to omit an item which was not relevant to the study[3]. The modified measure consisted of 8 items, each measured on 5-point scales. It included questions like "Will the effects of the risk of pharmaceutical pollution occur immediately, or will they take place in the future?" measured on a 5-point scale ranging from 'will occur immediately' to 'will occur far in the future'. The scale was found to have a high Cronbach Alpha ($\alpha = 0.83$) for the current study.

5. Environment-Friendly Consumer Intention or the intention of a person to engage in sustainable consumer behavior was measured using the Consumer Environmental Stewardship (CENS), developed by Hensen, Keeling, Ruyter, & Wetzels (2016) to examine individual responsibility towards the environment (p. 390). Construct validity of the scale was assessed using confirmatory factor analysis, which was supported by demonstration of both convergent

[3] The original item of "How many people are subjected to the risk of chemical pollution?" was modified to "How many people are subjected to the risk of pharmaceutical pollution throughout all of India?" The item, "How acceptable is the risk of chemical industries to which you are subjected?" was removed as it was not relevant to the study.

and discriminant validity with previously established scales. The scale was adapted to the Indian context by making minor changes to the language. It consisted of 10 items measured on 7-point Likert scale ranging from ‘strongly disagree’ to ‘strongly agree’. This measure included questions such as “I feel a personal sense of responsibility for the environment,” and “In my service to society I should balance short-term personal goals with long-term environmental goals”. The measure was found to have high Cronbach Alpha in both the source of the measure ($\alpha = 0.93$) (Hensen et al., 2016) and for the current sample ($\alpha = 0.91$).

Analytic Plan

All paper survey responses were input using Qualtrics, the online survey software, to get data in digital form. The statistical software Minitab 17 was used to perform all statistical tests. For all statistical tests, the confidence interval used as significance threshold was 95% ($p < 0.05$, two-sided confidence intervals, Adjusted or Type III sum of squares). The aggregate score for each variable was obtained using weighted averages of the items on the scale. The weight for each item was calculated using unrotated factor loadings from Confirmatory Factor Analysis for each variable. The aggregate scores thus acquired were used for all subsequent statistical analyses.

Research Question 1) For Part (a), descriptive statistics were calculated and reported to ascertain levels of environmental concern, awareness about pharmaceutical pollution, perceived risk of pharmaceutical pollution, and environmentally-friendly consumer intention among Indian consumers (see RQ 1 (a)). The central tendencies thus obtained were used to evaluate the first set of hypotheses for this research question. For part (b), to examine age, education, and gender differences in environmental concern, awareness about pharmaceutical pollution, perceived risk, and consumer intention (see RQ 1 (b)), each demographic variable was dichotomized (Gender:

Male/Female; Age: Young/Old; Education Level: High/Low). Group-wise descriptive statistics were calculated, and significant differences were observed using ANOVA. Analysis of Variance or ANOVA[4] is a statistical technique used to test whether there is a difference between the means of several samples. The significance of difference in mean score values was assessed using Tukey's pairwise comparison, which compares all possible pairs of means and is used for unequal sample sizes.

Research Question 2) For part (a) of this research question, general linear models were used to examine the main effect of each independent variable individually with the dependent variable, consumer intention (see RQ 2 (a)). General Linear Model[Error! Bookmark not defined.] is an extension of regression and correlational analysis and is commonly used in social science research where there is one dependent variable, and the independent variables are either categorical or covariates. For part (b) of the question, to analyze moderator/interaction effects of demographics on each IV-DV relation (see RQ 2 (b)), general linear models with stepwise backward elimination were used. Each association of independent variable with the dependent variable, i.e. environmental concern with consumer intentions; self-estimated knowledge with consumer intention; and risk perception with consumer intention, were analyzed for interaction effects of age, education level, and gender. All demographics were input in the models, and significant interactions were obtained through stepwise backward elimination. The significance level used for elimination of terms was $\alpha = 0.05$.

Research Question 3) A general linear model with standardized regression coefficients was tested with all three independent variables as covariates and consumer intention as the

[4] As explained by Françoise Vermeylen, Director and Statistician at Cornell Statistical Consulting Unit.

dependent variable, to analyze the cumulative associations among the variables (see RQ 3). The independent variable having the greatest effect on consumer intention score would be the one with the highest value of the standardized coefficient (SE β) in the model. For this analysis, continuous predictors of environmental concern, self-estimated knowledge, and risk perception were standardized by subtraction of the mean followed by division by standard deviation.

CHAPTER 3

RESULTS

Results obtained from statistical analyses of survey data are presented here, organized according to the research questions of this study. Before presenting the findings with respect to each of the three research questions, the weighted averages used to obtain aggregate scores for all variables are reported in Table 3, and information about consumption of pharmaceuticals is reported in Table 4. To examine RQ 1, descriptive statistics for the aggregate scores of the sample population on environmental concern, self-estimated knowledge, perceived risk, and consumer intention are presented. Next, to examine RQ 2, statistical models showing the associations of each independent variable (environmental concern, self-estimated knowledge, and risk perception) with the dependent variable (consumer intention) are reported, followed by examination of interaction effects of demographic variables (age, education level, and gender). Finally, to examine RQ 3, a model showing the cumulative relationship of all three independent variables with the dependent variable is reported.

Table 3

Item-wise factor loadings used to calculate aggregate scores for each variable

Questions	Scale	Factor Loading
Environmental Concern, α = 0.94		
I am worried about the worsening of the quality of India's environment.	1 to 7	0.85
I am worried that our pollution problem is getting worse.	1 to 7	0.70
I cherish our earth very much.	1 to 7	0.82
I fully support environmental protection.	1 to 7	0.90
It's very important to advocate green living in India.	1 to 7	0.88
Environmental protection is one of my major concerns.	1 to 7	0.85
I fully support to have more environmental activities organized in India.	1 to 7	0.89
I regard myself having a responsibility to protect the environment.	1 to 7	0.87
I am emotionally involved in environmental protection issues in India.	1 to 7	0.85
I think about how the environmental quality in India can be improved.	1 to 7	0.76
I think it is very important to advocate environmental protection to Indian citizens.	1 to 7	0.91
I totally agree with the statement that "environmental protection starts with me."	1 to 7	0.84
Self-Estimated Knowledge, α = 0.92		
To what extent do you feel informed about the problem of pharmaceutical pollution?	1 to 5	0.89
To what extent do you feel informed about the problem compared with other residents?	1 to 5	0.88
To what extent do you feel informed about pharmaceutical pollution in India?	1 to 5	0.92
To what extent do you feel informed about the pharmaceutical pollution in India compared with other residents?	1 to 5	0.91
Risk Perception, α = 0.83		
Is the risk of pharmaceutical pollution new and unfamiliar, or is it old and familiar?	1 to 5	0.59
How much knowledge do you have of the risk of pharmaceutical pollution?	1 to 5	0.67
How beneficial to local economic development is the pharmaceutical industry?	1 to 5	0.6
Will the effects of the risk of pharmaceutical pollution occur immediately, or will they take place in the future?	1 to 5	0.55
How many people are subjected to the risk of pharmaceutical pollution throughout all of India?	1 to 5	0.76
When the risk of pharmaceutical pollution appears, how fatal will the consequences be?	1 to 5	0.79
To what degree can the risk be avoided by the exposed population?	1 to 5	0.81
To what degree do you trust in the government or related policy makers' risk management abilities?	1 to 5	0.74
Consumer Intentions, α = 0.91		
I feel a personal sense of responsibility for the environment.	1 to 7	0.82
I feel accountable for the environmental impact of my purchases.	1 to 7	0.81
I think it is inappropriate, for me as a single person, to buy products without considering the environmental impact of them.	1 to 7	0.9
When searching for a product I should seek a balance between its costs and its impact on the environment.	1 to 7	0.92
I am willing to make personal sacrifices for the good of the environment.	1 to 7	0.86
I carry responsibility for the environmental impact of my purchases on society.	1 to 7	0.91
I need to help maintaining a green environment for society.	1 to 7	0.75
In my service to society I should balance short-term personal goals with long-term environmental goals.	1 to 7	0.89
I feel responsible for the environmental impact of my purchases on future generations.	1 to 7	0.92
I need to help maintain a green environment for future generations.	1 to 7	0.82

Consumption of Pharmaceuticals

The participants of the study indicated their consumption of over-the-counter pharmaceuticals, classified in ten categories (Table 4). The most common occasionally consumed medicines were analgesics, with 40% of the surveyed population indicating that they had consumed analgesics during the two days preceding the survey. Of medicines that were indicated to be used regularly, topical products for muscular pain were most common, their use being indicated by 6.5% of the surveyed participants. In total, 71.7% of the respondents indicated that they had used some OTC medication in the two days preceding the survey. Only 28.3% of the respondents indicated that they had not consumed any pharmaceuticals in the two days preceding the survey.

Table 4

Consumption of Pharmaceuticals

Medicine	Used Occasionally	Used Regularly
Vitamins + Mineral Supplements	27%	5.0%
NSAIDs	32%	0.7%
Analgesics	40%	0.1%
Antibiotics	24%	0.2%
Antianemia Preparations	13%	0.0%
Antacids	18%	0.2%
Antihistamines	16%	0.7%
Cough and Cold Preparations	27%	1.4%
Topical Products for Muscular Pain	19%	6.5%
Laxatives	14%	0.7%
None		28.3%

RQ 1(a): *What are the levels of environmental concern, self-estimated knowledge, perceived risk of pharmaceutical pollution, and environmentally-friendly consumer intention among Indian consumers?*

The following text reports the central tendencies and ranges of aggregate scores for all variables; environmental concern, awareness about pharmaceutical pollution, perceived risk of pharmaceutical pollution, and environmentally-friendly consumer intention. The detailed descriptive statistics are reported in Table 5.

Table 5

Aggregate scores of participants for all variables (n = 137)

	Environmental Concern	Self-Estimated Knowledge	Risk Perception	Consumer Intention
Mean (SD)	5.66 (1.23)	2.89 (1.30)	3.44 (0.90)	5.50 (1.25)
1st Quartile	5.49	1.75	2.86	5.49
Median	6.00	3.00	3.59	6.00
3rd Quartile	6.32	4.00	4.11	6.13
Range	3.19 - 7.00	0.29 - 5.00	1.64 - 4.85	2.99 - 7.00

Environmental Concern: It was hypothesized that the participants would have low- to middle-range scores on Environmental Concern, but the results from survey population did not support this hypothesis. On average, participants showed high environmental concern (on a scale of 1 to 7; 1 = low environmental concern; 7 = high environmental concern), with a mean score of 5.66 with standard deviation of 1.23. The median score of the surveyed population was 6, which indicates that half of the sample population scored 6 or higher on the scale. Only a quarter of the sample population had a score lower than 5.49 (first quartile).

Self-estimated Knowledge: As hypothesized, the participants demonstrated low self-estimated or subjective knowledge on the topic of pharmaceutical pollution in general and in

India. On average, the scores on the scale (scale of 1 to 5; 1 = low self-estimated knowledge, 5 = high self-estimated knowledge) were low-range, with mean score of 2.89 and standard deviation of 1.30. The median score was 3, indicating that half the surveyed population had self-estimated/subjective knowledge scores above 3 while the other half had scores below 3.

Risk Perception: It was hypothesized that the respondents' perception of risk from pharmaceutical pollution would be low as they are not well-informed about its threats. However, the survey results indicate mid-range scores for risk perception. According to the given dataset, the mean score on Risk Perception scale (scale of 1 to 5; 1 = low perceived risk; 5= high perceived risk) was 3.44 and standard deviation was 0.90. The median score was 3.59, and based on the first and third quartile scores, half of the surveyed population had mid-range scores between 2.86 and 4.11.

Consumer Intention: The surveyed population had high-range scores for environment-friendly consumer intention, with a mean of 5.50 (on a scale of 1 to 7; 1 = low environmental concern; 7 = high environmental concern), with a standard deviation of 1.25. The median score was 6, implying that half of the people surveyed had a score of 6 or above on the scale. Only a quarter (25%) of the respondents had scores less than 5.49.

RQ 1(b): *Do the levels of environmental concern, awareness about pharmaceutical pollution, perceived risk, and consumer intention vary by age, education level, or gender (see Figure 13)?*

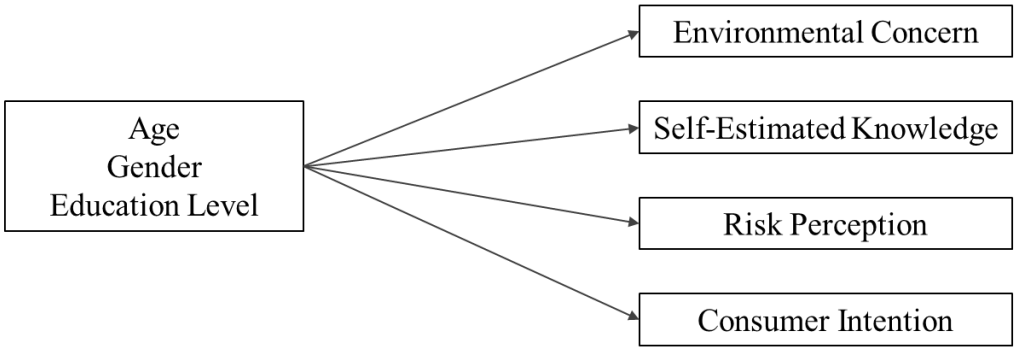

Figure 13: Research Question 1(b)

The mean levels of environmental concern, self-estimated knowledge, perceived risk, and consumer intention vary by age (young-old), education level (high-low), and gender (female-male). Some of these variations are statistically significant. The following paragraphs report the correlations between demographic variables and all variables: environmental concern, self-estimated knowledge, perceived risk, and consumer intention, as obtained by general linear model analysis of each variable with demographic categories (Figure 13). Table 6 reports the statistical values obtained from the correlational analyses.

Table 6

Correlations between aggregate scores of variables, and demographics

Variable	n	M	SD	F	p
Environmental Concern					
Age				5.90	0.016*
Young (≤ 44 years)	86	5.87	0.97		
Old (≥ 45 years)	51	5.29	1.52		
Education Level				3.47	0.065
Low (Grade 12 or lower)	82	5.46	1.30		
High (Bachelor's degree/diploma or higher)	55	5.95	1.06		
Gender				0.51	0.475
Male	65	5.66	1.18		
Female	72	5.66	1.29		
Self-Estimated Knowledge					
Age				2.32	0.130
Young (≤ 44 years)	86	3.06	1.31		
Old (≥ 45 years)	51	2.60	1.24		
Education Level				8.91	0.003*
Low (Grade 12 or lower)	82	2.60	1.35		
High (Bachelor's degree/diploma or higher)	55	3.32	1.10		
Gender				0.36	0.551
Male	65	2.89	1.30		
Female	72	2.88	1.31		
Risk Perception					
Age				3.22	0.075
Young (≤ 44 years)	86	3.55	0.88		
Old (≥ 45 years)	51	3.25	0.91		
Education Level				5.04	0.026*
Low (Grade 12 or lower)	82	3.28	0.99		
High (Bachelor's degree/diploma or higher)	55	3.67	0.69		
Gender				3.33	0.070
Male	65	3.34	0.83		
Female	72	3.53	0.96		
Consumer Intentions					
Age				5.03	0.027*
Young (≤ 44 years)	86	5.71	0.99		
Old (≥ 45 years)	51	5.14	1.55		
Education Level				6.85	0.010*
Low (Grade 12 or lower)	82	5.24	1.40		
High (Bachelor's degree/diploma or higher)	55	5.88	0.88		
Gender				0.82	0.366
Male	65	5.48	1.22		
Female	72	5.51	1.29		

Note. *$p < 0.05$, **$p < 0.001$

Environmental Concern: There is an effect of education level on environmental concern. As hypothesized, younger people (ages 44 and below) have a significantly ($p = 0.016$) higher score (M = 5.87) for environmental concern than older people (ages 45 and above) (M = 5.29). The effect of education level on environmental concern however, is not significant at 95% confidence interval but is significant at 90% confidence interval ($p = 0.065 < 0.1$). People with less education (Grade 12 or lower) have lower scores for environmental concern (M = 5.46) than people with higher education level (Bachelor's degree/diploma) (M = 5.95). In the surveyed sample of population, environmental concern does not vary with gender.

Self-estimated Knowledge: The results indicate that self-estimated/subjective knowledge of pharmaceutical pollution varies significantly ($p = 0.003$) by education level. People with higher education levels have significantly higher scores (M = 3.32) than those with less education (M = 2.60). Contrary to other parts of hypothesis, levels of self-estimated knowledge do not differ significantly by age or gender.

Risk Perception: Similar to self-estimated/subjective knowledge, the levels of perceived risk scores vary significantly ($p = 0.026$) by education level. On average, people with higher education levels perceive pharmaceutical pollution as a significantly greater risk (M = 3.67) than people with lower education levels (M = 3.28). It is noteworthy that the effect of age ($p = 0.075$) and gender ($p = 0.070$) on risk perception however, are not significant at 95% confidence interval but are significant at 90% confidence interval ($p < 0.100$). Younger people (ages 44 and below) have higher score (M = 3.55) for risk perception than older people (ages 45 and above) (M = 3.25). Women (M = 3.53) have higher mean scores on risk perception scale than men (M = 3.34).

Consumer Intention: The mean scores for consumer intention vary significantly by age and education level. On average, younger people (M = 5.71) have significantly (*p = 0.027*) higher environmentally-friendly consumer intentions than older people (M = 5.14). Also, people with higher education level (M=5.88) have a significantly (*p = 0.010*) higher score on consumer intention scale than people with lower education level (M = 5.24).

Taken together, on average, people with higher education level have higher environmental concern, subjective knowledge, risk perception, and environmentally-friendly consumer intention than people with lower education level; younger people have higher environmental concern, risk perception and consumer intention scores than older people; and women have higher risk perception scores than men, according to the survey data.

RQ 2(a): *Are environmental concern, awareness about pharmaceutical pollution, and perceived risk each individually associated with the dependent variable, environmentally-friendly consumer intention (see Figure 14)?*

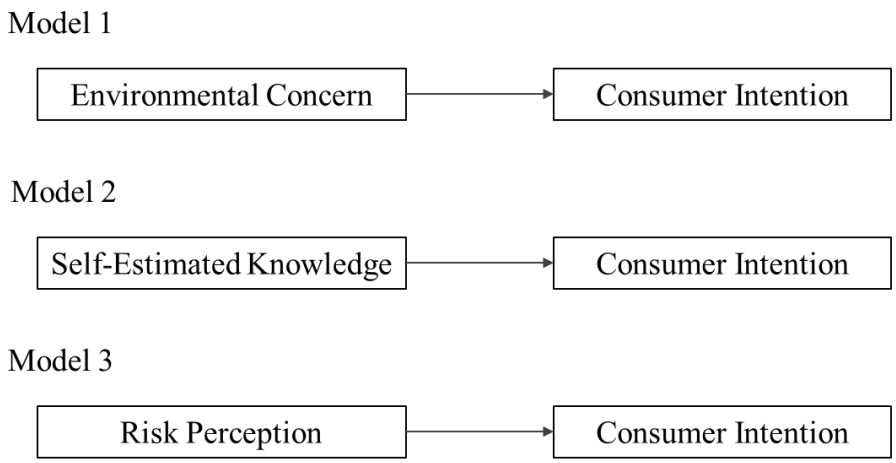

Figure 14: Research Question 2(a)

To examine RQ 2(a), the individual associations of each pair of independent variable and dependent variable (each IV-DV pair), i.e. environmental concern with consumer intentions; self-estimated knowledge with consumer intention; and risk perception with consumer intention, are each analyzed using general linear model (Figure 14). The results from individual analysis of each independent variable with the dependent variable are given in Table 7.

Table 7

Associations from General Linear Model analysis of each independent variable with dependent variable, consumer intention

	R^2 (adj.)	*df*	β	SE β	F	*P*
Model 1. Environmental Concern – Consumer Intention	63.79%	1	0.81	0.05	238.81	0.000**
Model 2. Self-estimated Knowledge – Consumer Intention	14.51%	1	0.38	0.08	23.92	0.000**
Model 3. Risk Perception – Consumer Intention	47.00%	1	0.96	0.09	120.71	0.000**

Note. *p < 0.05, **p < 0.001

Model 1: Environmental Concern – Consumer Intention: Environmental concern had a significant positive association with consumer intentions, such that higher environmental concern indicated more environment-friendly consumer intentions. According to the data, environmental concern scores explained 63.79% of variance in consumer intention scores. An increase in 1 point on environmental concern was associated, on average, with an increase in 0.81 points on consumer intentions scale.

Model 2: Self Estimated Knowledge – Consumer Intention: Self-estimated knowledge, by itself, was also significantly (p = 0.000) positively associated with Consumer Intentions. However, it only explained 14.51% (R^2 *adj*.) of the variance in Consumer Intentions, and a 1-

point increase in score of self-estimated knowledge only resulted in a 0.37-point increase in consumer intentions.

Model 3: Risk Perception – Consumer Intention: A significant (p = 0.000) positive association was found between risk perception and consumer intentions. Risk perception alone explained 47% (R^2 *adj*.) of the variance in consumer intentions scores. A rise of 1 point in risk perception score was associated with 0.96 point rise in consumer intention score.

RQ 2(b): *Do age, education and/or gender moderate (i.e., have interaction effect on) the individual associations between the independent variable (environmental concern, self-estimated knowledge, risk perception) and the dependent variable (consumer intention) (see Figure 15)?*

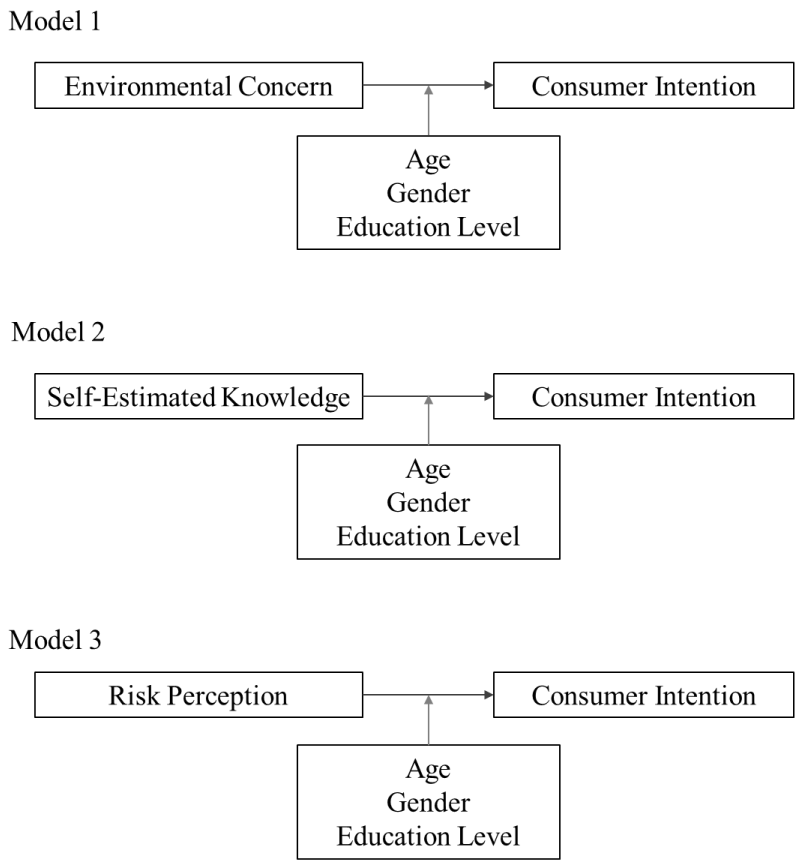

Figure 15: Research Question 2(b)

The interaction effects of demographic variables (age, education level, and gender) on the associations of each independent variable with the dependent variable, i.e. environmental concern with consumer intentions; self-estimated knowledge with consumer intention; and risk perception with consumer intention, are each analyzed using a general linear model with stepwise backward elimination (Figure 15). The process of backward elimination for each model thus examined, resulted in the following significant interaction effects of demographic variables on each IV-DV pair presented in Table 8.

Table 8

General Linear Model analyses to test for interaction effects on associations between the independent variables and consumer intention

Models	R^2	R^2 (adj.)	*df*	*B*	SE β	F	*p*
Model 1	67.14%	66.39%					
Environmental Concern			1	0.73	0.06	169.80	0.000**
Education Level			1	1.08	0.33	10.66	0.001*
Environmental Concern*Education Level			1	-0.16	0.06	8.66	0.004*
Model 2							
No significant interactions were found							
Model 3	51.84%	50.75%					
Risk Perception			1	0.77	0.10	58.41	0.000**
Education Level			1	1.20	0.37	10.65	0.001*
Risk Perception*Education Level			1	-0.30	0.10	8.54	0.004*

Note. Education level encoded as -1 (low education), +1 (high education)
*p < 0.05, **p < 0.001

Model 1: Interaction of Demographic Variables with Environmental Concern to Affect Consumer Intention: Of the three demographic variables, only education level was found to significantly interact (*p = 0.004)* with environmental concern to affect consumer intention (Table 8). There was a positive effect of environmental concern on consumer intention scores for both

levels of education. However, the positive correlation was more pronounced for people with lower levels of education than for people with higher education level, as can be seen from the difference in slopes of the fitted line plots in Figure 16. This pronounced positive correlation is visible as a steeper slope of the fitted line plot between environmental concern and consumer intention for people with low education level. Thus, it can be observed that education level moderates the relationship between environmental concern and consumer intention.

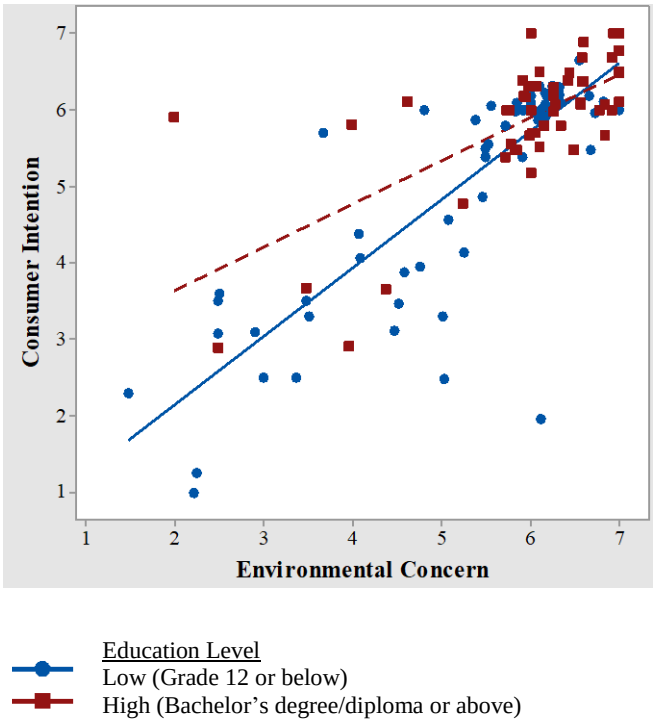

Figure 16: Interaction of Education Level with Environmental Concern to affect Consumer Intention

Model 2: Interaction of Demographic variables with Self Estimated Knowledge to Affect Consumer Intention: None of the demographic by self-estimated knowledge interactions were significant in their effects on consumer intention.

Model 3: Interaction of Demographic variables with Risk Perception on DV, Consumer Intention: Similar to interaction effects between environmental concern and consumer intention,

only education level was found to moderate (*p = 0.004)* the association between risk perception with consumer intention (Table 8). There was a positive relationship of risk perception and consumer intention scores for both levels of education. However, the positive correlation was more pronounced for people with lower levels of education than for people with higher education level, as can be seen from the difference in slopes of the fitted line plots in Figure 17. This pronounced positive correlation is visible as a steeper slope of the fitted line plot between risk perception and consumer intention for people with low education level. Thus, it can also be observed that education level moderates the relationship between risk perception and consumer intention.

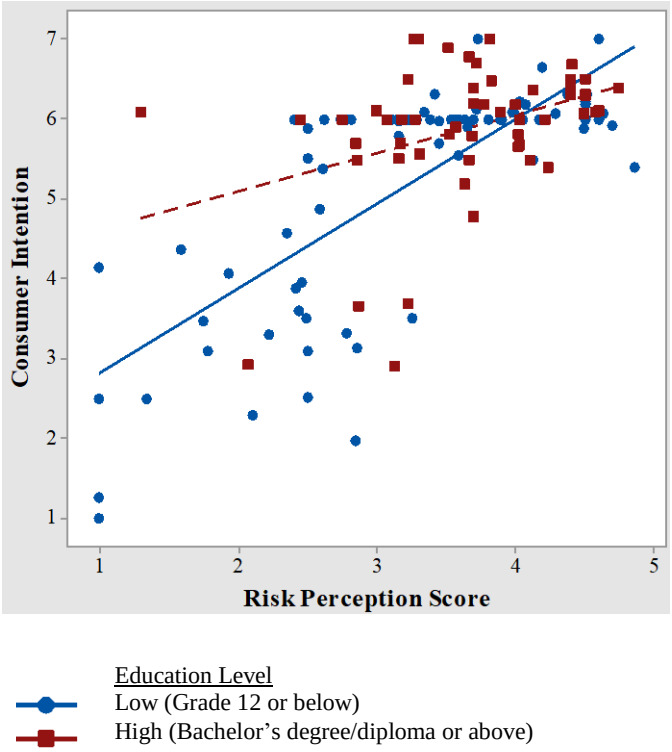

Figure 17: Interaction of Education Level with Risk Perception to affect Consumer Intention

In summary, as hypothesized, education level was observed to moderate associations between IV-DV pairs of environmental concern–consumer intention, and risk perception–

consumer intention. Contrary to the hypotheses, age had no significant moderator (interaction) effects on IV-DV pairs, and the self-estimated knowledge-consumer intention relation was not significantly moderated by any demographic variable.

RQ 3: *Which among the three independent variables of environmental concern, awareness, and perceived risk, are the most salient indicators of environment-friendly consumer intentions (see Figure 18)?*

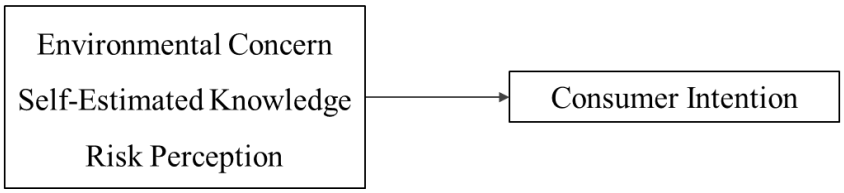

Figure 18: Research Question 3

Consumer intention is associated with all three independent variables: environmental concern, self-estimated knowledge, and risk perception. The general linear model using standardized coefficients that regressed all three independent variables with the dependent variable consumer intentions (Figure 18), explained 71.19% (R^2 *adj*.) of variance in consumer intention. From this model, it was indicated that environmental concern had the highest standardized regression coefficient among the three IVs ($\beta = 0.75$). Detailed values of all standardized coefficients from this model are given in Table 9. The standardized coefficients for self-estimated knowledge ($\beta = -0.04$) and risk perception ($\beta = 0.45$) are lower than that of environmental concern.

Table 9

General Linear Model analysis of independent variables with dependent variable, consumer intention

Model	R^2	R^2 (adj.)	*Df*	*β*	SE *β*	T	*p*
	71.83%	71.19%					
Environmental Concern			1	0.75	0.07	10.60	0.000**
Self-estimated Knowledge			1	-0.04	0.07	-0.54	0.588
Risk Perception			1	0.45	0.87	5.17	0.000**

Note. *p < 0.05, **p < 0.001
Continuous Predictor Standardization: subtract the mean, then divide by standard deviation

It can be thus said that the most salient correlate of consumer intention score is environmental concern, as it has significant p-value and the highest standardized coefficient (*β)* in the model. Therefore, as hypothesized, environmental concern is most strongly associated with consumer intention among all three independent variables.

CHAPTER 4

DISCUSSION

The following sections discuss the findings of this research study, their interpretations, and their implications. In addition, the strengths and limitations of the study are discussed, along with possible directions that can be taken by future research.

Summary of findings

This study was conducted with the primary objective to understand perspectives of pharmaceutical consumers in India regarding environmental degradation caused by pharmaceutical contamination. Results from the survey suggest that people are concerned about the environment and are willing to make eco-friendly consumer choices. Survey results also indicate that although people are not extremely familiar with the phenomenon of pharmaceutical pollution, they do perceive it as an important risk (from RQ 1(a)). Young people have significantly higher scores on environmental concern and consumer intention than older survey participants; and people with higher levels of education have significantly higher scores on self-estimated knowledge, risk perception, and consumer intention than people with lower levels of education (from RQ 1(b)). Results indicate the people demonstrate positive associations between environmental concern and consumer intention, self-estimated knowledge and consumer intention, and risk perception and consumer intention (from RQ 2(a)). Moderator analyses indicated that people with high education level also show a significantly stronger correlation between environmental concern and consumer intention, and risk perception and consumer intention, than people with low education level (from RQ 2(b)). In addition, evidence indicates that people who are more concerned about the environment, have more knowledge about

pharmaceutical pollution, and consider it a greater risk, are overall more willing to engage in eco-friendly consumerism. Results also suggest that environmental concern is the strongest indicator of environmentally-friendly consumer intention among survey participants (from RQ 3).

Relationship between environmental concern and pro-environmental behavior, attitudes, or behavior intention: In recent studies, environmental concern has been observed to be a strong indicator of environmentally responsible behavior, attitudes, or behavior intention (Lee 2008, 2014; Mobley et al., 2010; Yeung, 2004). These studies found significant positive correlations between environmental concern and environmentally responsible behavior (Mobley et al., 2010); attitudes towards the natural environment (Yeung, 2004); and behavior intentions for sustainable consumption (Lee, 2008, 2014). Likewise, in this study, environmental concern was also found to be the strongest indicator of environmentally-friendly consumer intention, a sign of potential pro-environmental behavior. For this study, environmental concern is defined as an affective attribute of an individual to care for the environment, including emotional involvement with the environment. Several studies have illustrated the defining role of emotional involvement in pro-environmental behavior (Bang et al., 2000; Grunert, 1993). The current study also includes items that examine emotional concern (see Appendix A1) as part of the environmental concern measure. However, the strong correlation between environmental concern and behavior, attitudes, or behavior intention is seen only in recent studies. In multiple studies conducted during the 1990s, the relationship between environmental concern and ecological behavior (pro-environmental behavior) was found to be mostly either moderate or weak (Kaiser et al., 1999). These earlier studies defined environmental concern as “attitude towards the environment, comprising knowledge, values, and intention” (Kaiser et al., 1999) –

while excluding emotional concern from the measures. The substantial difference in the report of correlation between environmental concern and ecological behavior among new and old research studies can therefore, in the author's opinion, be attributed to the change in the definition of environmental concern over the years.

Associations between environmental knowledge and behavior or behavior intention: According to the knowledge deficit model, the gap between a non-expert individual's (or layperson's) perception of a hazard and the actual risk posed by the hazard is a consequence of the person's lack of knowledge (Slovic, 1987). In addition, it has been found that when an individual's knowledge about an issue is inadequate, the person is more likely to trust an expert (Giddens, 1990). However, in the current study, it was observed that although individuals did not have much knowledge about the subject of pharmaceutical pollution, they still considered it a hazard. Vandermoere (2008) studied residents' subjective and objective knowledge with respect to soil contamination and found that the increase in knowledge resulted in increased hazard perception and awareness, which was linked closely to residents' willingness to act. Similarly, this thesis has illustrated that increase in subjective knowledge is correlated with in an increase in individual's willingness to engage in environmentally-responsible consumerism.

Risk perception studies: Risk perception studies are important because governments, policymakers, and industrialists need to account for public opinion when implementing decisions that directly affect people and their environment (Huang et al., 2013). A single quantitative measure of perceived risk from a hazard was developed by Slovic (1987) that included attributes of familiarity, severity, benefits, etc. Studies have observed a significant relationship between risk perception and behavior, such that perceived risk is positively correlated with the willingness to take pro-environmental action (Gifford & Nilsson, 2014; Stern, Dietz, Kalof &

Guagnano, 1995). Reflecting the findings in previous literature, the current study also demonstrates a significant positive relationship between perceived risk and environmentally-friendly consumer intention.

Relationship between behavior intention and the actual behavior: Both the theory of reasoned action (Ajzen & Fishbein, 1980), and the theory of planned behavior (Ajzen, 1985), conclude that a behavior is immediately preceded by the intention to perform that behavior, i.e., an action is preceded by the intention to act. This theory has been used in many studies regarding ecological behavior (Hensen et al., 2016; Kaiser et al., 1999; Steg & Vlek, 2009; Vermeir & Verbeke, 2006) as it is logistically easier to measure self-reported behavior intention than to measure actual behavior. A meta-analysis (Schwenk & Möser, 2008) of 11 studies that measured environmental behavior intention and actual environmental behavior found that there was a substantial correlation between intention and behavior. The authors, however, also acknowledged the possible influence of confounding situational factors. For the current research study, it can thus be inferred that there is a fair likelihood of translation of consumer intention to actual consumer action or behavior.

Strengths

This study has several strengths. First, the survey questionnaire was composed of valid and reliable measures. All measures have high internal consistency (with Cronbach alpha values from 0.79 to 0.94) and were validated in previous literature in different settings. The sample for this study, although not completely randomly selected, is expected to be fairly representative of the population of the city of Indore, India. The setting of the study, a pharmacy, was chosen as its customers came from a variety of age, gender and educational level. The study also uses Likert, or Likert-type scales for all the constructs. Likert scales are considered one of the best ways to

study people's perceptions and can be used to conduct a variety of statistical tests as they are interval scales.

Second, the conclusions drawn in the study are based on General Linear Model rather than basic regression to overcome assumptions regarding normal distribution, homogeneity of variance, and the distinction between continuous factors and covariates. Tests for non-collinearity of variables was conducted early in the study, and pilot tests were conducted to test statistical assumptions. Suitable models and procedures were suggested by professional statistics consultants throughout the course of this research.

Third, the study filled various gaps in the existing body of literature. The study is the first of its kind, to the best of author's knowledge, to test the variables together in context of pharmaceutical pollution, especially in India. Though there are studies researching pro-environmental behavior regarding drug take-back programs, perception studies about willingness to consume sustainable pharmaceuticals have not been conducted. The current literature on pharmaceutical pollution in India mostly consists chemical concentration analyses, and case studies and reports of the affected population. Very little information is available on the wider public perception about the issue. The study is extremely relevant to the current time, as the country is planning to expand its pharmaceutical industry while extensively being polluted by the industry at the same time. The study explores interactions and influencing variables that affect decision-making, in order to identify the most useful points of intervention. Understanding these relationships contributes to filling the gap in literature on pro-environmental behavior as it relates to pharmaceutical drug consumption.

Limitations

The limitations of this study are organized by the four types of validity in the following text. Despite the limitations mentioned in this section, the study demonstrates promising results that are expected to promote future research on Indian consumers' perceptions regarding environmental pollution due to pharmaceutical contamination.

Internal validity: This study was designed as a non-experimental study, and thus it cannot conclude a causal relationship between the independent variables and the dependent variables. The study can only conclude associations or correlational relationships between the IVs and the DV. Since there is no direct manipulation of the levels of independent variables, the direction of dependence can also be questioned. Also, apparent correlational relationships can be driven by confounding variables like social or personal factors.

Furthermore, an alternative explanation for higher-than-expected scores of the surveyed population on knowledge and environmental concern is the prevalence of cleanliness campaigns in Indore city. As a part of Swachh Bharat Abhiyan (Clean India Mission), the city has many active citizen engagement and awareness initiatives, which might have resulted in higher scores on subjective knowledge and environmental concern than expected by the author.

External validity: The conclusions of this study may not be generalized to all Indian people regarding pharmaceutical pollution. Since the sample was derived from a single city, it may also not be considered to represent views of citizens of another city in India. Also, as the sample size of this study was relatively small (n = 137), it cannot be extended to represent the perceptions of all citizens of Indore. The effect of setting of the study should be acknowledged. Due to the subject of the study, it is possible that the results were influenced by the pharmacy setting in which data collection occurred. The results obtained in this study may or may not be

replicated if the same study is conducted in a different setting, for example, a mall. Similarly, it is possible that the results are not replicated if a different sample of the population is surveyed.

Construct validity: An important possible limitation of this study is that all measures were translated from English to Hindi (see Appendix A for both versions). The possible loss of meaning in translation could have led to unintentional inaccuracy, or misunderstandings and misinterpretations regarding true meaning of questions, even though attempts were made to minimize this by using back-translation and the presence of a research assistant who administered the survey. For all constructs, reliability was measured using Cronbach alpha, but data was not available regarding test-retest reliability for calculation of Pearson product-moment correlation coefficient. Additionally, all measure used self-report, causing a methodological overlap, causing shared method variance leading to mono-method bias which threatens construct validity.

Experimenter effect could be a limitation of this study because conducting surveys is not a very common form of data collection in India. Specifically, as the survey was administered by a research assistant, the presence of experimenter might have encouraged people to answer in more socially-acceptable ways, confirming to subjective norms. Experimenter effect could have been further compounded by the fact that the research assistant was an employee of the pharmacy and dressed in staff uniform. Evaluation apprehension could have also influenced the participants' responses, causing them to provide socially desirable or politically correct answers. Question framing is a potential drawback of this study – many items in the scales used affirmative language that could lead to agreement bias.

Statistical validity: The small sample size of the study has implications for statistical validity. The sample size was inadequate to perform higher order statistical analyses, including

tests for three-way interaction effects. In addition, the data was collected at the level of an individual, so conclusions cannot be drawn at the community, city, state, or country level.

Implications and potential applications

The study collects preliminary evidence that indicate the possibility of strong consumer support in the transition to environmentally-friendly drugs, especially in a developing country. If replicated across the country, the findings of this study would provide enough consumer support to encourage the production and marketing of sustainable pharmaceuticals in India.

A nuanced understanding of people's environmental concern, knowledge, and risk perceptions is also achieved through this study, and can be leveraged to raise awareness and gather popular support for action against pharmaceutical pollution in the country. Approaches for minimizing pharmaceuticals in the environment need public awareness and support for their successful implementation. Perception studies like this research help to ascertain the disposition of stakeholders. This research provides quantitative information about behavior change among consumers and potential barriers to implementation of planned strategies. A good understanding of stakeholder disposition would help activists and policymakers to gather support for their activities. Perception studies can also be combined with existing data on regional chemical contamination, presenting a complete picture of the issue in conformance with the cause-and-effect bidirectionality in human-environment relations. Such comprehensive reports could then be used to develop policies, agendas, and guidelines for the upcoming pharmaceutical industries.

Findings of this study can be shared with policymakers, pharmaceutical manufacturers and researchers, environmentalists, citizen's collectives, and other social science researchers. The study can also be shared with medical practitioners, hospital staff, pharmacists, and the patients or other end users of pharmaceutical products. Finally, this study can be shared with the

general population and community at large to raise awareness about pharmaceuticals in the environment.

Future research

The fields of pharmaceuticals in the environment (PiE) and sustainable pharmaceuticals are still considered "emerging" fields (Kümmerer, 2004, Chapter 33), hence, there are many suggested directions for future research. In the context of this research thesis, future studies can be conducted that administer the same questionnaire in a different setting, at a different location, or to a bigger and more randomized sample. Such replication studies would help to determine the internal validity of conclusions drawn in the study.

Additionally, the study can be strengthened by measuring potential confounding variables like socio-economic status, education level, age, profession, place attachment, background of environmental education, development in a region, and quality of life. Gifford & Nilsson (2014) give a list of 18 social and personal factors that influence ecological concern and behavior, including childhood experience, personality and self-construal, sense of control, values, political and world views, goals, felt responsibility, cognitive biases, religion, urban–rural differences, social class, proximity to problematic environmental sites. Future research can aim to measure the influencing factors and their moderating or mediating effects on environment concern and behavior. Different stakeholders including doctors, pharmaceutical manufacturers and distributors, pharmacists, experts, chemistry researchers, environmentalists, policymakers, urban planners and developers, infrastructure engineers, and people suffering from ailments or living in close proximity to areas that suffer ecological damage due to pharmaceuticals can be selectively included in the study to understand various critical perspectives.

Future studies can change the design of the research. Multiple measures can be used to measure the same constructs to strengthen construct validity. Experimental designs can be developed, with objective knowledge about pharmaceutical pollution as the predictor independent variable. New scales and measures can be developed that are specific to the issue of pharmaceuticals in the environment, instead of general environmental scales. All scales used in this study can potentially be modified such that pharmaceutical pollution or eco-friendly pharmaceuticals are directly implicated in the questions. Future research can also diversify the techniques used for data collection. This study uses survey questionnaires, but other objective measurements like interviews and behavioral observation studies can also be conducted within the same framework. Other quantitative survey models like Knowledge, Attitude and Practice (KAP) models can be used in similar settings in the context of pharmaceutical contamination.

Future research can also be a combination of perception studies, chemical analysis studies, and sustainable pharmaceutical alternatives. For example, in a given geographic area, chemical analyses can be conducted to test for the presence of specific pharmaceutical compounds in water and soil. Information about people's perceptions of the issue and sustainable alternatives of pharmaceuticals identified in the environment can be compiled together with the chemical analyses. This compilation can then be used by the relevant policy-making body to take well-informed and holistic decisions to address environmental contamination, targeted at the most prevalent or toxic pharmaceuticals.

Conclusion

This study examined the effect of environmental concern, self-estimated knowledge, and risk perception about pharmaceutical pollution on consumer intention to purchase environmentally-friendly pharmaceuticals in Indore, India. Since these are personal covariates, the demographic variable of education level had a significant impact on some of these relationships. Results suggest that people are concerned about environmental pollution, considering it a major risk, and support environmentally-friendly consumer behavior. Findings from this study can help advance our understanding of people's perceptions about environmental degradation and ecopharmacology in developing countries like India that are emerging as strong competitors in the global pharmaceutical market. The inferences from this study can be used by industrial manufacturers, conservationists, activists, and policymakers to take respective relevant actions to develop holistic long-term solutions that address pharmaceutical pollution in India.

REFERENCES

Abahussain, E. A., & Ball, D. E. (2007). Disposal of Unwanted Medicines from Households in Kuwait. *Pharmacy World & Science*, *29*(4), 368-373.

Ajzen, I. (1985). From Intentions to Actions: A Theory of Planned Behavior. In *Action Control* (pp. 11-39). Berlin, Germany: Springer.

Ajzen, I., & Fishbein, M. (1980). Understanding Attitudes and Predicting Social Behavior. Englewood Cliffs, NJ: Prentice-Hall.

Anastas, P. T., & Kirchhoff, M. M. (2002). Origins, Current Status, And Future Challenges of Green Chemistry. *Accounts of Chemical Research*, *35*(9), 686-694.

Anastas, P. T., & Warner, J. C. (1998). *Green Chemistry: Theory and Practice*. New York, NY: Oxford University Press.

Ministry of Drinking Water and Sanitation. (2017). *2016-17 Annual Report.* Retrieved from https://mdws.gov.in/sites/default/files/LOCAL_REF_275_1489985804118.pdf

Arkaravichien, W., Ruchipiyarak, T., Thawinwan, W., & Benjawilaikul, S. (2014). A Threat to the Environment from Practice of Drug Disposal in Thailand. *EnvironmentAsia*, *7*(1), 13-18.

Bag, S. (2016). Green Strategy, Supplier Relationship Building and Supply Chain Performance: Total Interpretive Structural Modelling Approach. *International Journal of Procurement Management*, *9*(4), 398-426.

Bang, H. K., Ellinger, A. E., Hadjimarcou, J., & Traichal, P. A. (2000). Consumer Concern, Knowledge, Belief, and Attitude Toward Renewable Energy: An Application of the Reasoned Action Theory. *Psychology & Marketing*, *17*(6), 449-468.

Barber, M. (1947). Staphylococcal Infection Due to Penicillin-Resistant Strains. *British Medical Journal*, *2*(4534), 863-865.

Binder, C. R., Hinkel, J., Bots, P. W., & Pahl-Wostl, C. (2013). Comparison Of Frameworks For Analyzing Social-Ecological Systems. *Ecology and Society*, *18*(4). doi: 10.5751/ES-05551-180426

Bloom, R. A., & Matheson III, J. C. (1993). Environmental Assessment of Avermectins By The US Food And Drug Administration. *Veterinary Parasitology*, *48*(1-4), 281-294.

Boxall, A. B., Rudd, M. A., Brooks, B. W., Caldwell, D. J., Choi, K., Hickmann, S., ... & Ankley, G. T. (2012). Pharmaceuticals and Personal Care Products in The Environment: What Are The Big Questions? *Environmental Health Perspectives*, *120*(9), 1221-1229.

The Center for Disease Dynamics, Economics & Policy. (2015, September 15). *The State of the World's Antibiotics, 2015.* Retrieved from https://www.cddep.org/publications/state_worlds_antibiotics_2015/

Centers for Disease Control and Prevention (CDC). (2014). *Antibiotic resistance threats in the United States, 2013*. Retrieved from https://www.cdc.gov/drugresistance/threat-report-2013/index.html

Chaturvedi, U., Sharma, M., Dangayach, G. S., & Sarkar, P. (2017). Evolution And Adoption Of Sustainable Practices In The Pharmaceutical Industry: An Overview With An Indian Perspective. *Journal of Cleaner Production*, *168*, 1358-1369. doi: 10.1016/j.jclepro.2017.08.184

Clark, J. H. (2006). Green Chemistry: Today (And Tomorrow). *Green Chemistry*, *8*(1), 17-21. doi:10.1039/b516637n

Clark, J. H., & Smith, P. (2005). Basic Principles of Green Chemistry. *Innovations in Pharmaceutical Technology*, *16*, 94-97.

Coats, J. R., Metcalf, R. L., Lu, P. Y., Brown, D. D., Williams, J. F., & Hansen, L. G. (1976). Model Ecosystem Evaluation of The Environmental Impacts of The Veterinary Drugs Phenothiazine, Sulfamethazine, Clopidol, And Diethylstilbestrol. *Environmental Health Perspectives*, *18*, 167-179.

Cordell, G. A. (2009). Sustainable Drugs and Global Health Care. *Quimica Nova*, *32*(5), 1356-1364.

Costanzo, S. D., Murby, J., & Bates, J. (2005). Ecosystem Response to Antibiotics Entering the Aquatic Environment. *Marine Pollution Bulletin*, *51*(1-4), 218-223.

Crow, J.M. (2008, July 9). Pharma goes green to cut costs. *Chemistry World*. Retrieved from https://www.chemistryworld.com/news/pharma-goes-green-to-cut-costs/3003155.article

Crowdy, S. H., & Jones, D. R. (1956). The Translocation of Sulphonamides in Higher Plants: I. Uptake and Translocation in Broad Beans. *Journal of Experimental Botany*, *7*(3), 335-346.

Daughton, C. G. (2003). Cradle-To-Cradle Stewardship of Drugs for Minimizing Their Environmental Disposition While Promoting Human Health. I. Rationale for and Avenues Toward a Green Pharmacy. *Environmental Health Perspectives*, *111*(5), 757-774.

Daughton, C. G. (2016). Pharmaceuticals and the Environment (PiE): Evolution and Impact of the Published Literature Revealed by Bibliometric Analysis. *Science of the Total Environment*, *562*, 391-426.

Daughton, C. G., & Ruhoy, I. S. (2008). The Afterlife of Drugs and the Role of Pharmecovigilance. *Drug Safety*, *31*(12), 1069-1082.

Daughton, C. G., & Ruhoy, I. S. (2013). Lower-Dose Prescribing: Minimizing "Side Effects" of Pharmaceuticals on Society and the Environment. *Science of the Total Environment*, *443*, 324-337.

Daughton, C. G., & Ternes, T. A. (1999). Pharmaceuticals and Personal Care Products in the Environment: Agents of Subtle Change? *Environmental Health Perspectives*, *107*(6), 907-938.

Deo, R. P., & Halden, R. U. (2013). Pharmaceuticals in the Built and Natural Water Environment of the United States. *Water*, *5*(3), 1346-1365.

Department of Pharmaceuticals. (2017). *Annual Report 2016-17*. Retrieved from http://pharmaceuticals.gov.in/sites/default/files/Chemical%20Pharma%20-2016-17%20English%20Final%20%20for%20mail%20%282%29.pdf

Durant, R. F., & Legge Jr, J. S. (2005). Public Opinion, Risk Perceptions, and Genetically Modified Food Regulatory Policy: Reassessing the Calculus of Dissent Among European Citizens. *European Union Politics*, *6*(2), 181-200.

Ecostorm and Changing Markets. (2016). *Impacts of Pharmaceutical Pollution on Communities and Environment in India*. Retrieved from https://www.nordea.com/Images/35-107206/impacts%201-20.pdf

Fent, K., Weston, A. A., & Caminada, D. (2006). Ecotoxicology of Human Pharmaceuticals. *Aquatic Toxicology*, *76*(2), 122-159.

Federation of Indian Chambers of Commerce and Industry. (2017). *Trends & Opportunities for Indian Pharma*. Retrieved from http://ficci.in/spdocument/22944/india-pharma-2018-ficci.pdf

Frewer, L. J., Shepherd, R., & Sparks, P. (1994). The Interrelationship Between Perceived Knowledge, Control and Risk Associated with a Range of Food-Related Hazards Targeted at the Individual, Other People and Society. *Journal of Food Safety*, *14*(1), 19-40.

Global Business Reports. (2017). *India Pharmaceuticals 2017*. Retrieved from https://www.gbreports.com/publication/india-pharmaceuticals-2017

Giddens, A. (1990). *The Consequences of Modernity*. Stanford, CA: Stanford University Press.

Gifford, R., & Nilsson, A. (2014). Personal and Social Factors That Influence Pro-Environmental Concern and Behavior: A Review. *International Journal of Psychology*, *49*(3), 141-157.

Götz, K., & Keil, F. (2007). Drug Disposal in Private Households: Does the Disposal of Pharmaceuticals via Domestic Sanitary Devices Contribute to Water Contamination. *Z Umweltchem Ökotox*, *18*, 180-188.

Granberg, A. (2015). The flow of pharmaceuticals. Retrieved from https://cdn.the-scientist.com/assets/articleNo/35077/iImg/11636/f599af62-7426-4710-8bd2-3f19e2117d09-feature1-infograph.jpg

Green, R. E., Newton, I. A. N., Shultz, S., Cunningham, A. A., Gilbert, M., Pain, D. J., & Prakash, V. (2004). Diclofenac Poisoning as a Cause of Vulture Population Declines across the Indian Subcontinent. *Journal of Applied Ecology*, *41*(5), 793-800.

Grunert, S. C. (1993). Everybody Seems Concerned About the Environment: But is This Concern Reflected in (Danish) Consumers' Food Choice? *European Advances in Consumer Research*, *1*, 428-433.

Gupta, P., & Mahajan, A. (2015). Green Chemistry Approaches as Sustainable Alternatives to Conventional Strategies in the Pharmaceutical Industry. *RSC Advances*, *5*(34), 26686-26705.

Hensen, N., Keeling, D. I., de Ruyter, K., & Wetzels, M. (2016). Me, Myself, and Future Generations: The Role of Affinity and Effectiveness in the Creation of Consumer Environmental Stewardship (CENS). *Psychology & Marketing*, *33*(5), 389-406.

Huang, L., Ban, J., Sun, K., Han, Y., Yuan, Z., & Bi, J. (2013). The Influence of Public Perception on Risk Acceptance of the Chemical Industry and the Assistance for Risk Communication. *Safety Science*, *51*(1), 232-240.

International Federation of Pharmaceutical Manufacturers & Associations. (2017). *Facts and Figures 2017.* Retrieved from https://www.ifpma.org/wp-content/uploads/2017/02/IFPMA-Facts-And-Figures-2017.pdf

Jjemba, P. K. (2002). The Potential Impact of Veterinary and Human Therapeutic Agents in Manure and Biosolids on Plants Grown on Arable Land: A Review. *Agriculture, Ecosystems & Environment*, *93*(1-3), 267-278.

Jobling, S., Casey, D., Rodgers-Gray, T., Oehlmann, J., Schulte-Oehlmann, U., Pawlowski, S., ... & Tyler, C. R. (2003). Comparative Responses of Molluscs and Fish to Environmental Estrogens and an Estrogenic Effluent. *Aquatic Toxicology*, *65*(2), 205-220. doi:10.1016/j.aquatox.2004.01.002

Jobling, S., Williams, R., Johnson, A., Taylor, A., Gross-Sorokin, M., Nolan, M., ... & Brighty, G. (2006). Predicted Exposures to Steroid Estrogens in UK Rivers Correlate with Widespread Sexual Disruption in Wild Fish Populations. *Environmental Health Perspectives*, *114*(1), 32-39.

Kaiser, F. G., Wölfing, S., & Fuhrer, U. (1999). Environmental Attitude and Ecological Behavior. *Journal of Environmental Psychology*, *19*(1), 1-19.

Kollmuss, A., & Agyeman, J. (2002). Mind the Gap: Why Do People Act Environmentally and What are the Barriers to Pro-Environmental Behavior? *Environmental Education Research*, *8*(3), 239-260.

Kumar, M. A. (2008). Polluted Iska Vagu stream, near Hyderabad, India. Retrieved from http://www.apimages.com/metadata/Index/PharmaWater-India/86c6e33bb3134401a8d11277e4e22550/18/0

Kümmerer, K. (2004). *Pharmaceuticals in the Environment*. Berlin, Germany: Springer.

Kümmerer, K. (2004). Resistance in the environment. *Journal of Antimicrobial Chemotherapy*, *54*(2), 311-320.

Kümmerer, K. (2007). Sustainable from the Very Beginning: Rational Design of Molecules by Life Cycle Engineering as an Important Approach for Green Pharmacy and Green Chemistry. *Green Chemistry*, *9*(8), 899-907.

Kümmerer, K. (Ed.). (2008). *Pharmaceuticals in the environment: sources, fate, effects and risks*. Berlin, Germany: Springer.

Kümmerer, K., & Hempel, M. (Eds.). (2010). *Green and Sustainable Pharmacy.* Berlin, Germany: Springer. doi:10.1007/978-3-642-05199-9

La Farre, M., Pérez, S., Kantiani, L., & Barceló, D. (2008). Fate and Toxicity of Emerging Pollutants, Their Metabolites and Transformation Products in the Aquatic Environment. *Trends in Analytical Chemistry*, *27*(11), 991-1007.

Lane, E.J. (2015, March 23). India plans pharma manufacturing clusters to ease costs. *Fierce Pharma.* Retrieved from https://www.fiercepharma.com/manufacturing/india-plans-pharma-manufacturing-clusters-to-ease-costs

Larsen, T. A., Lienert, J., Joss, A., & Siegrist, H. (2004). How to Avoid Pharmaceuticals in the Aquatic Environment. *Journal of Biotechnology*, *113*(1-3), 295-304.

Lee, K. (2008). Opportunities for Green Marketing: Young Consumers. *Marketing Intelligence & Planning*, *26*(6), 573-586.

Lee, K. (2014). Predictors of Sustainable Consumption Among Young Educated Consumers in Hong Kong. *Journal of International Consumer Marketing*, *26*(3), 217-238.

Löffler, D., Römbke, J., Meller, M., & Ternes, T. A. (2005). Environmental Fate of Pharmaceuticals in Water/Sediment Systems. *Environmental Science & Technology*, *39*(14), 5209-5218.

Lubick, N. (2008). Opening the "Green Pharmacy." *Environmental Science & Technology*, *42*(23), 8620–8621. doi:10.1021/es802555w

Mathiyazhagan, K., & Haq, A. N. (2013). Analysis of the Influential Pressures for Green Supply Chain Management Adoption—An Indian Perspective Using Interpretive Structural Modeling. *The International Journal of Advanced Manufacturing Technology*, *68*(1-4), 817-833.

McDonough, W., & Braungart, M. (2010). *Cradle to Cradle: Remaking the Way We Make Things*. New York, NY: North Point Press.

Medhi, B., & Sewal, R. K. (2012). Ecopharmacovigilance: An Issue Urgently to be Addressed. *Indian Journal of Pharmacology*, *44*(5), 547-549.

Michael, C. A., Dominey-Howes, D., & Labbate, M. (2014). The Antimicrobial Resistance Crisis: Causes, Consequences, And Management. *Frontiers in Public Health*, *2*(145), 1-8. doi: 10.3389/fpubh.2014.00145

Miller, C.P. (1948). Bacterial Resistance to Antibiotics. *Annals of Internal Medicine*, *29*(5), 765–774.

Mobley, C., Vagias, W. M., & DeWard, S. L. (2010). Exploring Additional Determinants of Environmentally Responsible Behavior: The Influence of Environmental Literature and Environmental Attitudes. *Environment and Behavior*, *42*(4), 420-447.

Mohr, L. A., & Webb, D. J. (2005). The Effects of Corporate Social Responsibility and Price on Consumer Responses. *Journal of Consumer Affairs*, *39*(1), 121-147.

Muduli, K., Govindan, K., Barve, A., & Geng, Y. (2013). Barriers to Green Supply Chain Management in Indian Mining Industries: A Graph Theoretic Approach. *Journal of Cleaner Production*, *47*, 335-344.

Nitin B., (2017). Dead fish in Gandigudem Lake, Hyderabad, India. Retrieved from https://www.thenewsminute.com/article/dark-side-hyderabads-pharma-boom-23-lakh-fish-killed-one-lake-69547

Oaks, J. L., Gilbert, M., Virani, M. Z., Watson, R. T., Meteyer, C. U., Rideout, B. A., ... & Mahmood, S. (2004). Diclofenac Residues as the Cause of Vulture Population Decline in Pakistan. *Nature*, *427*(6975), 630-633.

Onakpoya, I. J., Heneghan, C. J., & Aronson, J. K. (2016). Worldwide Withdrawal of Medicinal Products Because of Adverse Drug Reactions: A Systematic Review and Analysis. *Critical Reviews in Toxicology*, 46(6), 477–489. doi:10.3109/10408444.2016.1149452

Pavlou, P. A. (2003). Consumer Acceptance of Electronic Commerce: Integrating Trust and Risk with the Technology Acceptance Model. *International Journal of Electronic Commerce*, *7*(3), 101-134.

Raloff, J. (1998). Drugged Waters: Does It Matter That Pharmaceuticals are Turning Up in Water Supplies? *Science News*, *153*(12), 187-189.

The Review on Antimicrobial Resistance. (2016). *Tackling Drug-Resistant Infections Globally*. Retrieved from https://amr-review.org/sites/default/files/160518_Final%20paper_with%20cover.pdf

Rogers, M. D. (2003). Risk Analysis Under Uncertainty, the Precautionary Principle, and the New EU Chemicals Strategy. *Regulatory Toxicology and Pharmacology*, *37*(3), 370-381.

Ruhoy, I. S., & Daughton, C. G. (2008). Beyond the Medicine Cabinet: An Analysis of Where and Why Medications Accumulate. *Environment International*, *34*(8), 1157-1169.

Sangareddy. (2017, October 7). Large-scale fish kill at Gandi Cheruvu due to pollutants. *The Hindu.* Retrieved from https://www.thehindu.com/news/national/telangana/large-scale-fish-kill-at-gandi-cheruvu-due-to-pollutants/article19817573.ece

Schwenk, G., & Möser, G. (2009). Intention and Behavior: A Bayesian Meta-Analysis With Focus on the Ajzen–Fishbein Model in the Field of Environmental Behavior. *Quality & Quantity*, *43*(5), 743-755.

Shultz, S., Baral, H. S., Charman, S., Cunningham, A. A., Das, D., Ghalsasi, G. R., ... & Pain, D. J. (2004). Diclofenac Poisoning is Widespread in Declining Vulture Populations Across the Indian Subcontinent. *Proceedings of the Royal Society of London: Biological Sciences*, *271*(6), S458-S460.

Sihvo, S., Klaukka, T., Martikainen, J., & Hemminki, E. (2000). Frequency of Daily Over-The-Counter Drug Use and Potential Clinically Significant Over-The-Counter-Prescription Drug Interactions in the Finnish Adult Population. *European Journal of Clinical Pharmacology*, *56*(6-7), 495-499.

Silva, C. P., Otero, M., & Esteves, V. (2012). Processes for the Elimination of Estrogenic Steroid Hormones From Water: A Review. *Environmental Pollution*, *165*, 38-58.

Sirés, I., & Brillas, E. (2012). Remediation of Water Pollution Caused by Pharmaceutical Residues Based on Electrochemical Separation and Degradation Technologies: A Review. *Environment International*, *40*, 212-229.

Slovic, P. (1987). Perception of Risk. *Science*, *236*(4799), 280-285.

Steg, L., & Vlek, C. (2009). Encouraging Pro-Environmental Behavior: An Integrative Review and Research Agenda. *Journal of Environmental Psychology*, *29*(3), 309-317.

Stern, P. C., Kalof, L., Dietz, T., & Guagnano, G. A. (1995). Values, Beliefs, And Pro-environmental Action: Attitude Formation Toward Emergent Attitude Objects. *Journal of Applied Social Psychology*, *25*(18), 1611-1636.

Tabak, H. H., Quave, S. A., Mashni, C. I., & Barth, E. F. (1981). Biodegradability Studies with Organic Priority Pollutant Compounds. *Water Pollution Control Federation*, *53*(10), 1503-1518.

Taylor, D. (2010). Ecopharmacostewardship – A Pharmaceutical Industry Perspective. In Kümmerer, K., & Hempel, M. (Eds.). (2010). *Green and Sustainable Pharmacy* (pp. 105-126). Berlin, Germany: Springer. doi:10.1007/978-3-642-05199-9

Tewathia, N. (2014). Foreign Direct Investment in Indian Pharmaceutical Industry: An Assessment. *International Journal of Social Science and Humanities Research. 2*(3), 20-26.

U.S. International Trade Commission. (2018). *India's Forward Momentum in Pharmaceuticals.* Retrieved from https://usitc.gov/publications/332/executive_briefings/india_ebot-final.pdf

Vandermoere, F. (2008). Hazard Perception, Risk Perception, and the Need for Decontamination by Residents Exposed to Soil Pollution: The Role of Sustainability and the Limits of Expert Knowledge. *Risk Analysis: An International Journal*, *28*(2), 387-398.

Vashishtha, A. (2015, April 3). They're raising a stink: Polluted rivers in the country have doubled over past five years. *Daily Mail UK.* Retrieved from http://www.dailymail.co.uk/indiahome/indianews/article-3024936/Pollution-India-Polluted-rivers-country-doubled-past-five-years.html

Ventola, C. L. (2015). The Antibiotic Resistance Crisis: Part 1: Causes and Threats. *Pharmacy and Therapeutics*, *40*(4), 277-283.

Ventola, C. L. (2015). The Antibiotic Resistance Crisis: Part 2: Management Strategies and New Agents. *Pharmacy and Therapeutics*, *40*(5), 344-352.

Vermeir, I., & Verbeke, W. (2006). Sustainable Food Consumption: Exploring the Consumer "Attitude–Behavioral Intention" Gap. *Journal of Agricultural and Environmental Ethics*, *19*(2), 169-194.

World Health Organization. (2012). *Pharmaceuticals in Drinking Water*. Retrieved from http://www.who.int/water_sanitation_health/publications/2012/pharmaceuticals/en/

Whitmarsh, L., & O'Neill, S. (2010). Green Identity, Green Living? The Role of Pro-Environmental Self-Identity in Determining Consistency Across Diverse Pro-Environmental Behaviors. *Journal of Environmental Psychology*, *30*(3), 305-314.

Yadav, G. D. (2006). Green Chemistry in India. *Clean Technologies and Environmental Policy*, *8*(4), 219-223.

Yeung, S. P. M. (2004). Teaching Approaches in Geography and Students' Environmental Attitudes. *Environmentalist*, *24*(2), 101-117.

APPENDIX A1: SURVEY QUESTIONNAIRE (ENGLISH)

Perceptions of Indian Consumers towards Pharmaceuticals in the Environment

Survey Response #_____

Part A: Consumption of Pharmaceuticals

Please tell me what medicines have you consumed during the last two days. Do you consume these medicines daily or weekly (used regularly), or do you use them occasionally (as needed)?

1. Medicines consumed during the 2 days preceding the survey (select all that apply)

Medicine	Used Continuously	Used Occasionally
Vitamins + Mineral Supplements (e.g., Vit C, Becosule, Supradyn)	☐	☐
Nsaids (e.g., Ibuprofen, Naproxen)	☐	☐
Analgesics (e.g., Paracetamol, Contramol)	☐	☐
Antibiotic (e.g., Cefuroxime, Linezolid)	☐	☐
Antianemia Preparations (e.g., Folvite, Fefol)	☐	☐
Antacids (e.g., Pantocid, Famocid)	☐	☐
Antihistamines (e.g., Levocetirizine, Chlorpheniramine Maleate)	☐	☐
Cough and Cold Preparations (e.g., Corex, Benadryl)	☐	☐
Topical Products for Muscular Pain (e.g., Moov, Ice Gel)	☐	☐
Laxatives (E.G., Smooth, Chromaffin)	☐	☐
None	☐	

Part B: Environmental Concern

Hand "Parts B + E" answer card to respondent.

Now I will read some statements about protection of nature and environment. After each statement, please indicate how much you agree or disagree with the statement. Please refer to the card marked "Part B + E"; the response options are "strongly disagree" "disagree" "slightly disagree" "neutral" "slightly agree" "agree" and "strongly agree." There are no right or wrong answers, please indicate your own opinion.

2. Environmental Concern Scale

	Strongly Disagree (1)	Disagree (2)	Slightly Disagree (3)	Neutral (4)	Slightly Agree (5)	Agree (6)	Strongly Agree (7)
I am worried about the worsening of the quality of India's environment.	☐	☐	☐	☐	☐	☐	☐
I am worried that our pollution problem is getting worse.	☐	☐	☐	☐	☐	☐	☐
I cherish our earth very much.	☐	☐	☐	☐	☐	☐	☐
I fully support environmental protection.	☐	☐	☐	☐	☐	☐	☐
It's very important to advocate green living in India.	☐	☐	☐	☐	☐	☐	☐
Environmental protection is one of my major concerns.	☐	☐	☐	☐	☐	☐	☐
I fully support to have more environmental activities organized in India.	☐	☐	☐	☐	☐	☐	☐
I regard myself having a responsibility to protect the environment.	☐	☐	☐	☐	☐	☐	☐
I am emotionally involved in environmental protection issues in India.	☐	☐	☐	☐	☐	☐	☐
I think about how the environmental quality in India can be improved.	☐	☐	☐	☐	☐	☐	☐
I think it is very important to advocate environmental protection to Indian citizens.	☐	☐	☐	☐	☐	☐	☐
I totally agree with the statement that "environmental protection starts with me."	☐	☐	☐	☐	☐	☐	☐

So now I would like to tell you something. The medicines that we consume dissolve in water as they go through our bodies, and end up going into rivers and ponds. Due to the presence of medicines in water and soil, other animals come into contact with them. Some chemicals making up these medicines are harmful to these organisms, and to the environment.

Part C: Awareness about Pharmaceutical Pollution (Self-estimated Knowledge about Pharmaceutical Pollution)

Now I will read some questions about your knowledge regarding pharmaceutical pollution. After each question, please look carefully at the scale given below and tell me your answer. There are no right or wrong answers, please indicate your own opinion.

3. To what extent do you feel informed about the problem of pharmaceutical pollution? (check one box)

Not at all (1)	(2)	(3)	(4)	Very much (5)
☐	☐	☐	☐	☐

4. To what extent do you feel informed about the problem in comparison with other residents? (check one box)

Less informed (1)	(2)	(3)	(4)	Better informed (5)
☐	☐	☐	☐	☐

5. To what extent do you feel informed about pharmaceutical pollution in India? (check one box)

Not at all (1)	(2)	(3)	(4)	Very much (5)
☐	☐	☐	☐	☐

6. To what extent do you feel informed about the pharmaceutical pollution in India in comparison with other residents? (check one box)

Less informed (1)	(2)	(3)	(4)	Better informed (5)
☐	☐	☐	☐	☐

Part D: Perceived Risk from pharmaceutical pollution

Now I will read some statements regarding your knowledge about pharmaceutical pollution. After each statement, please look carefully at the scale given below and tell me your answer. There are no right or wrong answers, please indicate your own opinion.

7. Is the risk of pharmaceutical pollution new and unfamiliar, or is it old and familiar?

Unfamiliar (1)	(2)	(3)	(4)	Familiar (5)
☐	☐	☐	☐	☐

8. How much knowledge do you have of the risk of pharmaceutical pollution?

No knowledge (1)	(2)	(3)	(4)	High level of knowledge (5)
☐	☐	☐	☐	☐

9. How beneficial to local economic development is the pharmaceutical industry?

Not beneficial (1)	(2)	(3)	(4)	Highly beneficial (5)
☐	☐	☐	☐	☐

10. Will the effects of the risk of pharmaceutical pollution occur immediately, or will they take place in the future?

Will occur immediately (1)	(2)	(3)	(4)	Will occur far in the future (5)
☐	☐	☐	☐	☐

11. How many people are subjected to the risk of pharmaceutical pollution throughout all of India?

Very few (1)	(2)	(3)	(4)	Quite a few (5)
☐	☐	☐	☐	☐

12. When the risk of pharmaceutical pollution appears, how fatal will the consequences be?

Non-fatal (1)	(2)	(3)	(4)	Very fatal (5)
☐	☐	☐	☐	☐

13. To what degree can the risk be avoided by the exposed population?

Not at all (1)	(2)	(3)	(4)	Completely (5)
☐	☐	☐	☐	☐

14. To what degree do you trust in the government or related policy makers' risk management abilities?

Do not trust at all (1)	(2)	(3)	(4)	Completely trust (5)
☐	☐	☐	☐	☐

Part E: Consumer Intentions

Respondent should look at the "Parts B + E" answer card again.

Great. We're almost done. Now I'd like to know about your purchasing trends. I will read statements about purchasing products. After each statement, please look at the card (labelled "Parts B + E") and tell me how much you agree or disagree with the statement. The response options are: "strongly disagree" "disagree" "slightly disagree" "neutral" "slightly agree" "agree" and "strongly agree." There are no right or wrong answers, please indicate your own opinion.

15. Consumer Intentions (Select one option for each statement)

	Strongly Disagree (1)	Disagree (2)	Slightly Disagree (3)	Neutral (4)	Slightly Agree (5)	Agree (6)	Strongly Agree (7)
I feel a personal sense of responsibility for the environment.	☐	☐	☐	☐	☐	☐	☐
I feel accountable for the environmental impact of my purchases.	☐	☐	☐	☐	☐	☐	☐
I think it is appropriate, for me as a single person, to buy products only after considering their environmental impact.	☐	☐	☐	☐	☐	☐	☐
When searching for a product i should seek a balance between its costs and its impact on the environment.	☐	☐	☐	☐	☐	☐	☐
I am willing to make personal sacrifices for the good of the environment.	☐	☐	☐	☐	☐	☐	☐
I carry responsibility for the environmental impact of my purchases on society.	☐	☐	☐	☐	☐	☐	☐
I need to help maintaining a green environment for society.	☐	☐	☐	☐	☐	☐	☐
In my service to society I should balance short-term personal goals with long-term environmental goals.	☐	☐	☐	☐	☐	☐	☐
I feel responsible for the environmental impact of my purchases on future generations.	☐	☐	☐	☐	☐	☐	☐
I need to help maintain a green environment for future generations.	☐	☐	☐	☐	☐	☐	☐

Part F: Demographic Data

Now I have just three final questions about you.

16. What is your age (in years)?

☐ 18-24	☐ 35-44	☐ 55-64	☐ 75-84
☐ 25-34	☐ 45-54	☐ 65-74	☐ >85

17. Educational Level

☐ No schooling	☐ Post-secondary
☐ Primary	☐ Tertiary
☐ Secondary	☐ Post-graduate

18. Gender

☐ Female

☐ Male

APPENDIX A2: SURVEY QUESTIONNAIRE (HINDI TRANSLATED)

पर्यावरण में दवाओं के प्रति भारतीय उपभोक्ताओं की धारणाएं

सर्वे उत्तर #_____

भाग अ: दवाइयों का उपयोग

कृपया मुझे बताएं कि पिछले दो दिनों में आपने कौन से दवाओं का सेवन किया है। क्या आप इन दवाइयों का दैनिक या साप्ताहिक (नियमित रूप से) उपभोग करते हैं, या आप उन्हें कभी-कभी इस्तेमाल करते हैं (आवश्यकतानुसार)?

1. सर्वेक्षण के 2 दिन पहले के दौरान इस्तेमाल किए जाने वाले दवाइयां (जो सभी लागू होते हैं उन्हें चुनें)

दवाइयां	नियमित सेवन	आवश्यकतानुसार सेवन
विटामिन या मिनरल सप्लीमेंट (जैसे विटामिन सी, बीकोसुल, सुप्राडीन)	☐	☐
NSAID (जैसे आइबूप्रोफेन, नेप्रोक्सेन)	☐	☐
एनालजेसिक (जैसे पेरासिटामोल, कॉन्ट्रामॉल)	☐	☐
एंटीबायोटिक (जैसे सैफुरोक्साइम, लीनेज़ोलिड)	☐	☐
एंटी-एनीमिया दवाएं (जैसे फोल्वाइट, फीफोल)	☐	☐
एंटासिड (जैसे पेंटोसिड, फेमोसिड)	☐	☐
एन्टीहिस्टामिन (जैसे लेवोसेट्रिज़िन, क्लोरफेनिरमिन मेलिएट)	☐	☐
सर्दी-खाँसी की दवाई (जैसे कोरेक्स, बेनाड्रील)	☐	☐
दर्द के लिए क्रीम (जैसे मूव, आइस जेल)	☐	☐
जुलाब (जैसे स्मूथ, क्रोमाफिन)	☐	☐
इनमे से कोई नहीं	☐	

भाग ब: पर्यावरण पर विचार

व्यक्ति को "भाग ब और ई" नामक कार्ड दें।

अब मैं प्रकृति और पर्यावरण के संरक्षण के बारे में कुछ वाक्य पढ़ूंगा/ पढ़ूंगी। हर वाक्य के बाद कृपया बताएं कि आप कथन से कितना सहमत या असहमत हैं। कृपया यह "भाग ब और ई" नामक कार्ड देखें, आपके जवाब अत्यधिक असहमत, असहमत, कुछ कुछ असहमत, न सहमत न असहमत, कुछ कुछ सहमत, सहमत, अत्यधिक सहमत में से कोई से भी हो सकते हैं। कोई भी जवाब सही या गलत नहीं है, कृपया आपकी स्वयं की राय बताइये।

	अत्यधिक असहमत (1)	असहमत (2)	कुछ कुछ असहमत (3)	न सहमत न असहमत (4)	कुछ कुछ सहमत (5)	सहमत (6)	अत्यधिक सहमत (7)
मैं भारत का पर्यावरण बिगड़ने के बारे में चिंतित हूं।	☐	☐	☐	☐	☐	☐	☐
मुझे चिंता है कि हमारे प्रदूषण की समस्या बदतर हो रही है।	☐	☐	☐	☐	☐	☐	☐
मैं इस धरती को बहुत ज्यादा पसंद करता/ करती हूं।	☐	☐	☐	☐	☐	☐	☐
मैं पूरी तरह से पर्यावरण संरक्षण का समर्थन करता/ करती हूं।	☐	☐	☐	☐	☐	☐	☐
भारत में पर्यावरण के अनुकूल जीवनशैली को बढ़ावा देना बहुत ज़रूरी है।	☐	☐	☐	☐	☐	☐	☐
पर्यावरण संरक्षण मेरे प्रमुख विचारों में से एक है।	☐	☐	☐	☐	☐	☐	☐
मैं भारत में और ज़्यादा पर्यावरणीय गतिविधियों का आयोजन करने का पूरी तरह से समर्थन करता/ करती हूं।	☐	☐	☐	☐	☐	☐	☐
मैं खुद को पर्यावरण की रक्षा के लिए जिम्मेदार समझता / समझती हूँ।	☐	☐	☐	☐	☐	☐	☐
मैं भारत में पर्यावरण संरक्षण के मुद्दों में भावनात्मक रूप से सम्मिलित हूं।	☐	☐	☐	☐	☐	☐	☐
मैं सोचता रहता/ सोचती रहती हूँ कि भारत के पर्यावरण में सुधार कैसे किया जाये ।	☐	☐	☐	☐	☐	☐	☐
मुझे लगता है कि भारतीय नागरिकों को पर्यावरण संरक्षण के बारे में बताना बहुत महत्वपूर्ण है।	☐	☐	☐	☐	☐	☐	☐
मैं पूरी तरह से सहमत हूँ कि "पर्यावरण संरक्षण मुझसे शुरू होता है।"	☐	☐	☐	☐	☐	☐	☐

तो अब मैं आपको कुछ बताना चाहूंगा/चाहूंगी। हम जो दवाइयां खाते हैं, वे हमारे शरीर में से होती हुई, पानी में घुल कर , नदियों और तालाबों तक चली जाती हैं। पानी और मिट्टी में दवाइयों के मिल जाने से दुसरे जीव-जंतु इनके संपर्क में आ जाते हैं। दवाइयों में होने वाले केमिकल इन जीव-जंतुओं के लिए, और पर्यावरण के लिए हानिकारक होते हैं।

भाग स: दवाइयों द्वारा प्रदूषण के बारे में जागरुकता

अब मैं दवाइयों द्वारा प्रदूषण के बारे में आपके ज्ञान के बारे में कुछ प्रष्न पढ़ूंगा/ पढ़ूंगी। कृपया हर प्रष्न के बाद नीचे दिए गए स्केल को देखिये और मुझे अपना जवाब बताइये। कोई भी जवाब सही या गलत नहीं है, कृपया आपकी स्वयं की राय बताइये।

19. दवाइयों द्वारा प्रदूषण की समस्या के बारे में आप कितनी जानकारी रखते हैं? (कृपया एक ही जवाब दें)

बिलकुल भी नहीं (1)	(2)	(3)	(4)	बहुत ज़्यादा (5)
☐	☐	☐	☐	☐

20. दूसरे नागरिकों की अपेक्षा, आप दवाइयों द्वारा प्रदूषण की समस्या के बारे में स्वयं को कितना जागरुक समझते हैं? (कृपया एक ही जवाब दें)

कम जागरुक (1)	(2)	(3)	(4)	ज़्यादा जागरुक (5)
☐	☐	☐	☐	☐

21. भारत में दवाइयों द्वारा प्रदूषण की समस्या के बारे में आप कितनी जानकारी रखते हैं? (कृपया एक ही जवाब दें)

बिलकुल भी नहीं (1)	(2)	(3)	(4)	बहुत ज़्यादा (5)
☐	☐	☐	☐	☐

22. दूसरे नागरिकों की अपेक्षा, आप भारत में दवाइयों द्वारा प्रदूषण की समस्या के बारे में स्वयं को कितना जागरुक समझते हैं? (कृपया एक ही जवाब दें)

कम जागरुक (1)	(2)	(3)	(4)	ज़्यादा जागरुक (5)
☐	☐	☐	☐	☐

भाग द: दवाइयों द्वारा प्रदूषण से जोखिम की आशंका

अब मैं दवाइयों द्वारा प्रदूषण के बारे में आपकी जानकारी से सम्बंधित कुछ प्रष्न पढ़ूंगा/ पढ़ूंगी। कृपया हर प्रष्न के बाद नीचे दिए गए स्केल को देखिये और मुझे अपना जवाब बताईये। कोई भी जवाब सही या गलत नहीं है, कृपया आपकी स्वयं की राय बताइये।

23. क्या दवाइयों द्वारा प्रदूषण का जोखिम नया एवं अपरिचित है, या पुराना एवं परिचित है?

अपरिचित (1)	(2)	(3)	(4)	परिचित (5)
☐	☐	☐	☐	☐

24. आपको दवाइयों द्वारा प्रदूषण से होने वाले जोखिम का कितना ज्ञान है?

न के बराबर ज्ञान (1)	(2)	(3)	(4)	बहुत ज़्यादा ज्ञान (5)
☐	☐	☐	☐	☐

25. स्थानीय आर्थिक विकास के लिए दवा उद्योग कितना फायदेमंद है?

न के बराबर फायदेमंद (1)	(2)	(3)	(4)	बेहद फायदेमंद (5)
☐	☐	☐	☐	☐

26. क्या दवाइयों द्वारा प्रदूषण से जोखिम का प्रभाव जल्दी ही होगा या भविष्य में होगा?

जल्दी ही होगा (1)	(2)	(3)	(4)	भविष्य में होगा (5)
☐	☐	☐	☐	☐

27. आपके अनुसार भारत में कितने लोग दवाइयों द्वारा प्रदुषण से प्रभावित हैं?

बहुत कम (1)	(2)	(3)	(4)	बहुत ज़्यादा (5)
☐	☐	☐	☐	☐

28. दवाइयों द्वारा प्रदूषण से खतरा कितना जानलेवा हो सकता है?

बिलकुल भी जानलेवा नहीं (1)	(2)	(3)	(4)	बहुत ज़्यादा जानलेवा (5)
☐	☐	☐	☐	☐

29. प्रदूषण से संपर्क में रहने वाले लोगों को किस हद तक जोखिम से बचाया जा सकता है?

बिलकुल भी नहीं (1)	(2)	(3)	(4)	पूर्ण रूप से (5)
☐	☐	☐	☐	☐

30. आप किस हद तक सरकार की जोखिम प्रबंधन क्षमता पर भरोसा रखते हैं?

बिलकुल भरोसा नहीं (1)	(2)	(3)	(4)	पूर्ण रूप से भरोसा है (5)
☐	☐	☐	☐	☐

भाग ई: उपभोक्ता उद्देश्य

व्यक्ति को "भाग ब और ई" नामक कार्ड दोबारा दिखाएं ।

चलिए, बहुत बढ़िया। बस कुछ और सवाल बचते हैं। अब मैं शॉपिंग करते वक़्त आपकी राय जानना चाहता/चाहती हूं। अब मैं कुछ वाक्य पढ़ूंगा/ पढ़ूंगी। हर वाक्य के बाद कृपया बताएं कि आप कथन से कितना सहमत या असहमत हैं। कृपया यह "भाग ब और ई" नामक कार्ड देखें, आपके जवाब अत्यधिक असहमत, असहमत, कुछ कुछ असहमत, न सहमत न असहमत, कुछ कुछ सहमत, सहमत, अत्यधिक सहमत में से कोई से भी हो सकते हैं। कोई भी जवाब सही या गलत नहीं है, कृपया आपकी स्वयं की राय बताइये।

31.

	अत्यधिक असहमत (1)	असहमत (2)	कुछ कुछ असहमत (3)	न सहमत न असहमत (4)	कुछ कुछ सहमत (5)	सहमत (6)	अत्यधिक सहमत (7)
मेरे लिए पर्यावरण संरक्षण एक व्यक्तिगत जिम्मेदारी है।	☐	☐	☐	☐	☐	☐	☐
मैं अपने द्वारा खरीदी वस्तुओं के पर्यावरण पर प्रभाव के बारे में अपने आप को जिम्मेदार समझता/समझती हूँ।	☐	☐	☐	☐	☐	☐	☐
व्यक्तिगत तौर पर, यह उचित है कि मैं उत्पादों के पर्यावरणीय प्रभाव पर विचार करने पर ही उन्हें खरीदूं।	☐	☐	☐	☐	☐	☐	☐
खरीददारी करते समय मुझे सामान की कीमत, और पर्यावरण पर उसके प्रभाव के बीच संतुलन बैठाने की कोशिश करना चाहिए।	☐	☐	☐	☐	☐	☐	☐
मैं पर्यावरण संरक्षण के लिए व्यक्तिगत त्याग करने के लिए तैयार हूं।	☐	☐	☐	☐	☐	☐	☐
मैं समाज पर अपनी खरीददारी के पर्यावरणीय प्रभाव की ज़िम्मेदारी रखता/रखती हूँ।	☐	☐	☐	☐	☐	☐	☐
मुझे समाज के लिए एक अच्छा वातावरण बनाए रखने में मदद करना चाहिए।	☐	☐	☐	☐	☐	☐	☐
समाज के प्रति सेवा में मुझे अपने दीर्घकालिक पर्यावरणीय लक्ष्यों और अल्पकालीन व्यक्तिगत लक्ष्यों के बीच संतुलन रखना चाहिए I	☐	☐	☐	☐	☐	☐	☐
भविष्य की पीढ़ियों पर मेरी खरीददारी के पर्यावरणीय प्रभाव के लिए मैं जिम्मेदार हूं।	☐	☐	☐	☐	☐	☐	☐
मुझे भविष्य की पीढ़ियों के लिए हरा-भरा वातावरण बनाने में मदद करना चाहिए।	☐	☐	☐	☐	☐	☐	☐

भाग फ: सामान्य जानकारी

अब मेरे पास सिर्फ तीन अंतिम प्रष्न हैं।

32. आपकी आयु (वर्षों में) क्या है?
    - ☐ 18-24
    - ☐ 25-34
    - ☐ 35-44
    - ☐ 45-54
    - ☐ 55-64
    - ☐ 65-74
    - ☐ 75-84
    - ☐ >85

33. शैक्षणिक स्तर
    - ☐ कोई स्कूली शिक्षा नहीं
    - ☐ प्राथमिक
    - ☐ माध्यमिक
    - ☐ उच्च माध्यमिक
    - ☐ स्नातक
    - ☐ स्नातकोत्तर

34. लिंग
    - ☐ स्त्री
    - ☐ पुरुष

APPENDIX B: IRB EXEMPTION CERTIFICATE

Cornell University
Office of
Research Integrity and Assurance

East Hill Office Building, Suite 320
395 Pine Tree Road
Ithaca, NY 14850
p. 607-254-5162
f. 607-255-0758
www.irb.cornell.edu

Institutional Review Board for Human Participants

Notice of Exemption

To:	Sukruti Gupta
From:	Amita Verma, Director, ORIA
Protocol ID#:	1802007754
Protocol Title:	"Perceptions of Indian Consumers towards Pharmaceuticals in the Environment" (Perceptions of Indian Consumers towards Environmental Contamination due to Pharmaceutical Pollution)
Approval Date:	February 16, 2018
Expiration Date:	None

Your protocol has been granted exemption from IRB review according to Cornell IRB policy and under paragraph(s) 2 of the Department of Health and Human Services Code of Federal Regulations 45CFR 46.101(b).

• Paragraph 2 allows to be exempted from IRB review research activities in which the only involvement of human subjects will be in the following category: Surveys/Interviews/Standardized Educational Tests/Observation of Public BehaviorResearch involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior if:i) information obtained is recorded in such a manner that human subjects cannot be identified, directly or through identifiers linked to the subjects; orii) any disclosure of the human subjects' responses outside the research would not reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability or reputation.

Please note the following:

- Investigators are responsible for ensuring that the welfare of research subjects is protected and that methods used and information provided to gain participant consent are appropriate to the activity. Please familiarize yourself with and conduct the research in accordance with the ethical standards of the Belmont Report (https://www.hhs.gov/ohrp/regulations-and-policy/belmont-report/index.html).
- Investigators are responsible for notifying the IRB office of change or amendments to the protocol and acquiring approval or concurrence **BEFORE** their implementation.
- Progress reports, requests for personnel or other administrative changes, or requests for continuation of approval are not required for the study. However, upon conclusion of the study, please submit a Project Closure form: http://www.irb.cornell.edu/forms.