



Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/20324
DOI URL: <http://dx.doi.org/10.21474/IJAR01/20324>



RESEARCH ARTICLE

EXPLORING THE IMPACT OF HEAVY METAL CONTAMINATION IN COSMETICS ON CONSUMER HEALTH RISKS

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Manuscript Info

Manuscript History

Received: 25 November 2024

Final Accepted: 28 December 2024

Published: January 2025

Key words:-

Heavy Metal Contamination, Consumer Awareness, Health risks, Purchasing Behavior, and Cosmetics

Abstract

This study examines the relationships between consumer awareness, perceived risks, health risks, and purchasing behavior in the context of heavy metal contamination in cosmetics. Using data from 675 respondents and Partial Least Squares Structural Equation Modeling (PLS-SEM), the findings reveal that higher consumer awareness reduces perceived health risks and indirectly influences purchasing behavior through perceived risks and health concerns. Perceived risks and health risks negatively impact purchasing behavior, reflecting consumer caution toward products associated with potential harm. The study highlights the mediating role of perceived risks and health concerns in shaping consumer decisions. The results indicate the importance of consumer education, transparent labeling, and safer product alternatives to address safety concerns. Additionally, the findings advocate for stricter regulatory enforcement to ensure product compliance and build consumer trust. By integrating effective risk communication and education, cosmetic manufacturers and policymakers can foster safer purchasing behaviors while addressing consumer health concerns.

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Introduction:-

The cosmetic industry is one of the fastest-growing sectors globally, with an increasing number of consumers seeking personal care products to enhance their appearance and health. By 2023, the global cosmetic market value increased by an estimated 8% (Statista, 2023), reflecting the growing demand for skincare, makeup, and other beauty products. However, despite the cosmetic industry's rapid expansion, there are serious concerns regarding the safety and quality of these products, particularly regarding the presence of harmful heavy metals. Products such as lipsticks, foundations, and eyeliners are commonly contaminated with trace levels of heavy metals such as lead, cadmium, mercury, arsenic, and nickel, which pose significant health risks to consumers (Al-Saleh & Al-Enazi, 2011; Hepp et al., 2009). These metals can accumulate in the body over time, leading to neurological damage, organ toxicity, and cancer (Nnorom et al., 2005). Such concerns are exacerbated by the limited consumer awareness of these potential risks, compounded by inconsistent regulatory frameworks across various regions.

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While regulatory agencies like the U.S. Food and Drug Administration (FDA) and the European Union (EU) have set guidelines for permissible levels of heavy metals in cosmetics, their enforcement remains inconsistent, and many products on the market still exceed these permissible limits (Raza-Naqvi et al., 2022). The FDA, for instance, provides guidelines for lead levels in cosmetics but does not regulate other metals like cadmium or arsenic, which have also been found in cosmetic products at dangerous levels (Raza-Naqvi et al., 2022). The EU, while having stricter standards, still faces issues with non-compliance and contamination (Foresight, 2025). Furthermore, despite these regulatory measures, studies continue to show that a significant portion of cosmetic products on the market exceeds safe levels of heavy metals (Hepp et al., 2009). This raises important questions regarding the effectiveness of existing regulatory practices and their capacity to protect consumer health adequately.

In addition to regulatory challenges, consumer awareness of the risks associated with cosmetic products contaminated with heavy metals is generally low. Most consumers assume that cosmetics, being widely available and heavily marketed, are subject to stringent safety standards. However, research indicates that consumers often have limited understanding of the risks associated with the chemicals and metals found in these products (Ahmed et al., 2021; Chaudhary et al., 2021). This lack of awareness may significantly influence purchasing behavior, where consumers unknowingly choose products that could pose health risks. For example, while a large proportion of consumers may be aware of general product safety in the food industry, similar awareness in cosmetics, particularly regarding heavy metal contamination, is limited.

One of the core elements in consumer decision-making is the perception of risk. Perceived risk, especially when related to health and safety, can significantly influence purchasing behavior. Consumers' perceptions of the risks associated with cosmetics containing heavy metals can be shaped by various factors such as media coverage, social influences, and personal experiences with adverse reactions. Health risks related to heavy metal exposure may deter consumers from purchasing products perceived to be unsafe. The perceived risk of using cosmetics contaminated with heavy metals could affect their trust in brands and ultimately influence their purchasing decisions (Muhammad, 2019). However, there remains a gap in the literature regarding how consumer awareness of these risks translates into actual purchasing behavior and the role of health risks in shaping these behaviors.

This study aims to investigate the relationship between consumer awareness, perceived risk, and purchasing behavior in relation to heavy metal contamination in lipsticks and foundations. Through an exploration of how these factors interact, this research will provide new insights into how consumers make decisions about cosmetics in the context of public health risks. In particular, the study will focus on understanding the extent to which consumers are aware of heavy metal contamination in cosmetics, how they perceive the associated risks, and how these perceptions ultimately influence their purchasing behavior. Additionally, the study will assess whether health risks such as neurological damage, toxicity, and cancer were perceived as critical factors in influencing purchasing choices.

Using a cross-sectional design, the study will employ Partial Least Squares Structural Equation Modeling (PLS-SEM) to analyze the relationships between the core variables: consumer awareness, perceived risk, health risks, and purchasing behavior. PLS-SEM is particularly well-suited for exploring complex relationships and analyzing the effects of multiple independent variables on a dependent variable, making it an ideal method for this study. By utilizing this advanced statistical technique, the study will uncover the key drivers of consumer decision-making in the context of cosmetic product safety.

This research is significant as it seeks to fill gaps in existing literature by providing a comprehensive analysis of the factors influencing consumer choices in the cosmetic market, particularly in the context of heavy metal contamination. Additionally, the study will provide important recommendations for both consumers and regulatory bodies. For consumers, the study will raise awareness about the potential health risks of cosmetics contaminated with heavy metals, encouraging more informed decision-making. For regulatory bodies, the study's findings may offer insights into the effectiveness of current regulations and suggest areas for improvement. Finally, the study will be valuable for cosmetic brands seeking to improve product formulations, enhance consumer trust, and ensure compliance with safety standards.

Literature Review and Hypothesis Development:-

The global cosmetic industry continues to grow rapidly, with a significant rise in the use of beauty products like lipsticks and foundations. However, the rising concerns about safety have also emerged, particularly regarding heavy metal contamination in cosmetics. Heavy metals such as lead, cadmium, mercury, arsenic, and nickel have

been found in various cosmetic products, posing serious health risks. This chapter delves into the empirical literature on the relationship between consumer awareness, perceived risk, health risks, and purchasing behavior in the context of cosmetic products contaminated with heavy metals. We aim to highlight the gaps in existing studies and present a conceptual framework for understanding how these factors interact in the decision-making process of consumers.

Consumer Awareness of Heavy Metal Contamination in Cosmetics

Consumer awareness is a key factor influencing purchasing decisions in many industries, including cosmetics. It refers to the extent to which consumers are informed about the potential risks associated with a product, including chemical contaminants like heavy metals. In the context of cosmetics, heavy metal contamination is a growing concern. Studies have shown that many cosmetic products, particularly lipsticks and foundations, contain harmful levels of heavy metals, despite regulatory standards designed to limit such contamination (Al-Saleh & Al-Enazi, 2011; Hepp et al., 2009).

Empirical research on consumer awareness of heavy metal contamination is somewhat sparse, but there is evidence that consumers' knowledge of product safety and risks influences their purchasing behavior. For example, (Lara-Torres et al., 2021) found that consumers in China and Europe had a limited understanding of the presence of heavy metals in cosmetics products, particularly those frequently used like lipsticks. Similarly, Haslam (2021) argued that while consumers in developed countries are more likely to be aware of harmful chemicals in cosmetics, awareness of heavy metals remains low. This limited knowledge is concerning because regular exposure to even low levels of these metals can result in neurological damage, organ toxicity, and cancer (Nnorom et al., 2005). Research suggests that consumers are often unaware of the cumulative effects of heavy metal exposure over time. This lack of awareness could be attributed to insufficient labeling, poor communication of risks by cosmetic brands, and minimal regulation of heavy metal levels (Al-Saleh & Al-Enazi, 2011). Consumer education is critical in raising awareness about the potential dangers of these contaminants, and as more information becomes available, consumers are more likely to make informed decisions.

H1: Higher consumer awareness of heavy metal contamination is associated with lower perceived health risks.

Perceived Risk and Its Impact on Purchasing Behavior

Perceived risk refers to the consumer's subjective evaluation of the potential negative consequences of purchasing a product, including financial, functional, and health-related risks (Jacoby & Kaplan, 1972). In the context of cosmetic products, perceived health risks associated with heavy metal contamination can significantly influence purchasing behavior. Research suggests that health risks such as lead exposure are one of the primary concerns when it comes to cosmetic safety (Swearingen et al., 2022). Several studies have empirically examined how perceived risk affects consumers' willingness to purchase products. For instance, Esmaeilzadeh (2019) found that consumers who believed cosmetic products contained toxic metals expressed a lower intent to purchase, particularly for products they applied directly to their skin or lips, where absorption rates are higher.

While health risks are a significant factor, perceived risk is also influenced by trust in regulatory agencies, the transparency of brands, and the availability of safer alternatives (Esmaeilzadeh, 2019). In the absence of transparent labeling and clear communication from manufacturers, consumers may overestimate the risks associated with certain products or may fail to factor in the long-term consequences of cumulative exposure to low levels of heavy metals.

H2: Perceived risk of health issues from heavy metal contamination negatively impacts purchasing behavior.

Health Risks of Heavy Metal Contamination in Cosmetics

The health risks associated with heavy metal contamination in cosmetics are well-documented. Heavy metals such as lead, cadmium, mercury, arsenic, and nickel are toxic to human health, with the potential for both acute and chronic adverse effects. For example, lead exposure has been linked to neurological disorders, particularly in children, as well as developmental issues, kidney damage, and cancer (Al-Saleh & Al-Enazi, 2011; Hepp et al., 2009). Cadmium, another common contaminant, has been associated with kidney damage and respiratory problems, while mercury and arsenic are carcinogenic (Nnorom et al., 2005). Several studies have empirically confirmed the presence of heavy metals in cosmetics, particularly lipsticks and foundations. For instance, Hepp et al. (2009) found that over 50% of lipsticks surveyed in the U.S. contained lead levels exceeding the FDA's recommended limit. Similarly, (Nnorom et al., 2005) reported that cosmetics in Nigeria were contaminated with dangerous levels of

heavy metals, posing significant health risks to consumers. This body of research highlights the need for more stringent regulatory measures to control the levels of heavy metals in cosmetics and ensure that consumers are not exposed to harmful substances.

The cumulative effect of heavy metal exposure through daily use of contaminated cosmetics is an area of growing concern. While acute health effects may not be immediately apparent, long-term exposure can lead to serious health complications, including neurological damage, organ dysfunction, and cancer (Wu et al., 2020). Thus, it is essential for both regulatory agencies and cosmetic manufacturers to address these risks and provide consumers with safer alternatives.

H3: Health risks from heavy metal contamination reduce the likelihood of purchasing cosmetics

Purchasing Behavior and Consumer Decision-Making

Purchasing behavior refers to the process by which consumers decide whether or not to buy a product. In the cosmetics industry, purchasing behavior is influenced by various factors, including brand reputation, product effectiveness, and consumer trust. However, health risks, such as those posed by heavy metal contamination, are increasingly influencing consumer decisions. Risk-averse consumers are more likely to avoid cosmetics that they perceive as potentially harmful, particularly those that contain harmful heavy metals.

A study by Stampa et al. (2020) found that consumer purchasing behavior was significantly impacted by perceptions of product safety. The study revealed that consumers who perceived a higher risk of heavy metal contamination were less likely to purchase lipsticks and foundations from brands with questionable safety standards. Additionally, trust in regulatory bodies was found to play a critical role in shaping purchasing decisions. Consumers who trusted the safety standards and regulatory guidelines set by authorities were more likely to overlook potential risks (Sinclair & Irani, 2005). Furthermore, consumers' awareness of health risks associated with heavy metal contamination has been found to correlate with their willingness to pay a premium for safer, non-toxic cosmetic products (Ghazali et al., 2017). This suggests that, as consumer knowledge of the dangers of heavy metal contamination increases, they are more likely to prioritize health-conscious choices and sustainable products.

H4: Consumer awareness and perceived risk jointly influence purchasing behavior.

Materials and Methods:-

This section outlines the research methodology used to examine consumer awareness, perceived risks, health risks, and purchasing behavior in relation to heavy metal contamination in cosmetic products. The study adopts a cross-sectional survey design, which allows for the collection of self-reported data through structured questionnaires. The data collected will be analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) to explore the relationships between key variables: consumer awareness, perceived risk, health risks, and purchasing behavior. This methodology enables the testing of hypotheses regarding how these variables influence consumer decision-making in the context of cosmetic products contaminated with heavy metals. The focus of the study is to investigate how awareness of heavy metal contamination influences consumer behavior, including their perceptions of risk, health concerns, and purchasing decisions. By employing PLS-SEM, the study is able to model complex relationships among latent variables, accounting for both direct and indirect effects. The following sections provide a detailed description of the research design, sampling strategy, data collection methods, and analysis techniques used to achieve the study's objectives.

Research Design

A cross-sectional survey design was selected to capture a snapshot of consumer perceptions, awareness, and purchasing behaviors at a single point in time (Creswell & Creswell, 2017). This approach is suitable for exploring the relationships among latent variables such as consumer awareness, perceived risk, health risks, and purchasing behavior, as it allows the study to assess the interactions between these factors without requiring long-term data collection or follow-up (Sarstedt et al., 2021). The cross-sectional design is efficient in gathering data on attitudes, behaviors, and perceptions from a sample of consumers, making it particularly effective for this research.

The data collected through the survey will be analyzed using PLS-SEM, a robust statistical method used to evaluate structural models with multiple variables (Ringle et al., 2020). This technique is ideal for studies with moderate to large sample sizes and enables the examination of both direct and indirect relationships among variables (Sarfo et al.,

2024). The model will explore how consumer awareness influences perceived risks, health risks, and purchasing behaviour and will also test hypotheses regarding the mediating effects of perceived and health risks on purchasing decisions.

Sample Selection and Sampling Strategy

This study will employ a purposive sampling strategy to select participants who have relevant knowledge or experience with purchasing cosmetics, specifically lipsticks and foundations. This method ensures that the sample consists of individuals who are familiar with the products under study and are likely to have insights into the safety concerns related to heavy metal contamination (Etikan et al., 2016a). Purposive sampling is particularly suitable for consumer behavior studies, where participants' experiences are directly relevant to the research objectives.

To expand the sample and increase its diversity, snowball sampling may be used. This technique allows participants to refer others who meet the criteria for inclusion in the study, thereby broadening the participant pool (Sivaratnam et al., 2022). A total sample size of 675 respondents were used, which is considered adequate for PLS-SEM analysis. A sample size of this magnitude provides sufficient statistical power to test complex relationships and is in line with the recommendations for PLS-SEM studies (Alam et al., 2024; Hair & Alamer, 2022).

Data were collected from a variety of sources to ensure the sample is representative of different demographic groups. Surveys will be distributed both online through platforms such as social media, email, and beauty communities, and in-person at cosmetic retail locations. This dual approach ensures a diverse representation of consumers, capturing both online and offline purchasing behaviors (Penz & Hogg, 2011).

Data Collection

Data were collected using a structured questionnaire designed to assess the main variables of interest: consumer awareness, perceived risk, health risks, and purchasing behavior. The questionnaire consisted of five sections:

Demographic Information:

This section collected data on participants' age, gender, income, education level, and cosmetic purchase frequency. Demographic data helps to contextualize the relationship between consumer characteristics and their awareness of, and behavior toward, heavy metal contamination in cosmetics.

Consumer Awareness:

This section measured participants' knowledge of heavy metal contamination in cosmetics, including their awareness of the risks associated with these contaminants and existing regulatory standards for cosmetic products.

Perceived Risk:

This section assessed how consumers perceive the risks of using cosmetics contaminated with heavy metals, including psychological risks (e.g., fear of harm) and functional risks (e.g., concerns about product effectiveness and safety) (Li et al., 2020).

Health Risks:

This section focused on consumers' understanding of the potential health risks, such as neurological damage and cancer, associated with exposure to heavy metals in cosmetics.

Purchasing Behavior:

This section explored how consumer awareness and perceived risk influence purchasing decisions, including whether consumers are likely to avoid products with heavy metal contamination.

Each item was rated using a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree), which allows respondents to indicate the extent to which they agree or disagree with each statement (Taherdoost, 2019). Prior to the full-scale data collection, a pilot study was conducted with 50 participants to assess the clarity, reliability, and validity of the questionnaire items. Feedback from the pilot study was used to refine the questionnaire and address any ambiguities (Kumar et al., 2024).

Data Analysis

The data was first analyzed using descriptive statistics to summarize the demographic characteristics of the sample and to identify general patterns in consumer responses. Descriptive statistics, including mean, standard deviation, frequency distribution, and percentage, will provide an initial understanding of consumer awareness, perceived risks, health risks, and purchasing behavior (Tabachnick et al., 2013). For the main analysis, PLS-SEM was employed to test the relationships among the latent variables. This method was suitable for exploratory research involving complex models with multiple variables (Sarstedt et al., 2021). The analysis proceeded in two stages:

The first stage involves evaluating the measurement model to ensure construct reliability and validity. Indicators such as composite reliability, Cronbach's alpha, and Average Variance Extracted (AVE) was assessed to ensure the quality of the measurement model (Sarstedt et al., 2021). Structural Model Evaluation: The second stage was to assess the structural model to test the hypothesized relationships between the variables. Bootstrapping was used to determine the statistical significance of path coefficients, and model fit will be evaluated using measures such as R^2 (explained variance) and SRMR (Standardized Root Mean Square Residual) (Ringle et al., 2020). The hypotheses were tested using the results from the PLS-SEM analysis. The significance of the paths was evaluated using t-statistics and p-values, and the overall model fit was used to determine how well the proposed relationships align with the data.

Ethical Considerations

This study followed ethical guidelines established by institutional review boards and general ethical standards for human research. Key ethical considerations include:

Participants were fully informed about the study's objectives and their voluntary participation, with the option to withdraw at any time without any consequences (Mertens, 2019).

Personal data was kept confidential, and participants' identities were anonymized during data analysis. All data were securely stored and only accessible to authorized researchers (Saunders et al., 2015). The study ensured that no physical or psychological harm came to participants. The survey focused on consumers' knowledge and behaviors regarding cosmetics, avoiding sensitive or distressing topics.

Limitations

This study has several limitations. First, it relies on self-reported data, which may be subject to response biases such as social desirability or recall bias, potentially affecting the accuracy of the findings (Nkire et al., 2023). Second, the sampling method uses purposive sampling, which targets individuals with specific knowledge or concerns about cosmetic safety. While this provides relevant insights, it may not capture the full diversity of the general consumer population, limiting the generalizability of the results (Etikan et al., 2016b). Lastly, the geographic scope of the study is confined to specific regions, and therefore, the findings may not be applicable to global consumer behavior or different cultural contexts. These limitations must be considered when interpreting the results.

Results:-

This chapter presents the findings of the study based on data collected from 675 respondents. The results were organized to address the study's objectives and hypotheses. The chapter included respondent demographics, the measurement model, the structural model, and hypothesis testing. Each section provides insights into the relationships between consumer awareness, perceived risks, health risks, and purchasing behavior related to heavy metal contamination in cosmetics.

Respondent Demographics

The demographic profile of the respondents is summarized in **Table 1**. Regarding gender, the majority of respondents were female (50.4%), while the smallest group identified as non-binary (0.7%). In terms of education, most respondents held a Bachelor's degree (37%), while the smallest proportion had less than a high school education (3%). For employment status, most respondents were employed full-time (44.4%), while the smallest group worked in "other" occupations (3.7%). Monthly income levels varied, with the highest proportion earning between \$1,000–\$2,999 (29.6%), and the lowest earning \$7,000 and above (11.9%). Geographically, most respondents lived in urban areas (44.4%), while rural areas had the smallest representation (18.5%). Regarding cosmetic product use, 29.6% of respondents reported daily usage, while 7.4% reported that they never use cosmetics. These demographics reflect a diverse sample, providing a solid basis for analyzing consumer behavior.

Table 1:- Respondent Demographics.

Demographic Category	Items	Frequency	Percentage (%)
Gender	Male	320	47.4
	Female	340	50.4
	Non-binary	5	0.7
	Prefer not to say	10	1.5
	Total	675	100
Educational Level	Less than High School	20	3.0
	High School Diploma	100	14.8
	Some College	150	22.2
	Bachelor's Degree	250	37.0
	Master's Degree	100	14.8
	Doctoral Degree	55	8.1
	Total	675	100
Employment Status	Employed Full-Time	300	44.4
	Employed Part-Time	100	14.8
	Self-Employed	50	7.4
	Unemployed	60	8.9
	Student	90	13.3
	Retired	50	7.4
	Other	25	3.7
	Total	675	100
Monthly Income	Less than \$1,000	75	11.1
	\$1,000 - \$2,999	200	29.6
	\$3,000 - \$4,999	180	26.7
	\$5,000 - \$6,999	140	20.7
	\$7,000 and above	80	11.9
	Total	675	100
Geographic Location	Urban Area	300	44.4
	Suburban Area	250	37.0
	Rural Area	125	18.5
	Total	675	100
Frequency of Cosmetic Use	Daily	200	29.6
	Several Times a Week	150	22.2
	Once a Week	100	14.8
	Several Times a Month	75	11.1
	Rarely	100	14.8
	Never	50	7.4
	Total	675	100

Measurement Model

The measurement model was evaluated to ensure the constructs used in the study were reliable and valid. As shown in **Table 2**, all constructs demonstrated high reliability, with Cronbach's alpha values exceeding the recommended threshold of 0.7. Composite reliability (CR) values ranged from 0.890 to 0.903, confirming internal consistency. The average variance extracted (AVE) values for all constructs were above the threshold of 0.5, establishing convergent validity. For example, Consumer Awareness (CA) had an AVE of 0.682, while Health Risk (HR) had an AVE of 0.669. Variance inflation factor (VIF) values were below 5, indicating no multicollinearity issues among the constructs. These findings validate the measurement model and confirm that the items used in the study accurately captured the intended constructs.

Table 2:- Construct Validity and Reliability.

Variables	Items	VIF	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Consumer Awareness (CA)	CA1	1.814	0.844	0.895	0.682
	CA2	1.800			

	CA3	1.904			
	CA4	2.012			
Health Risk (HR)	HR1	1.531	0.834	0.890	0.669
	HR3	1.942			
	HR4	1.933			
	HR5	1.947			
Purchasing Behavior (PR)	PB1	1.910	0.870	0.900	0.561
	PB2	1.942			
	PB3	2.036			
	PB4	1.979			
	PB5	2.172			
	PB6	2.177			
	PB7	2.101			
Perceived Risk (PR)	PR1	1.941	0.865	0.903	0.650
	PR2	1.981			
	PR3	1.908			
	PR4	2.204			
	PR5	1.898			
SRMR	0.061				

Structural Model

The structural model was analyzed to examine the relationships between the constructs and test the hypotheses. Model fit indices indicated an acceptable fit, with the Standardized Root Mean Square Residual (SRMR) value of 0.061, which is below the recommended threshold of 0.08. This suggests that the model fit the data well and adequately represented the relationships between the variables. Additionally, the structural model analysis revealed that the constructs explained a significant proportion of variance in the endogenous variables. The R^2 value for Health Risks (HR) was 0.484, indicating that consumer awareness explained 48.4% of the variance in health risks. This demonstrates the considerable influence of consumer awareness in shaping perceptions of health risks associated with heavy metal contamination.

The R^2 value for Perceived Risk (PR) was 0.426, suggesting that consumer awareness accounted for 42.6% of the variance in perceived risk. This highlights the role of consumer knowledge in influencing risk perception, which is a critical determinant of purchasing behavior.

For Purchasing Behavior (PB), the R^2 value was 0.558, meaning that health risks and perceived risks together explained 55.8% of the variance in purchasing behavior. This result underscores the strong influence of health and perceived risks on consumer decisions to purchase cosmetics, particularly in the context of heavy metal contamination. These R^2 values demonstrate the explanatory power of the model and its ability to capture the dynamics of consumer behavior related to the safety of cosmetics. The findings provide robust evidence that consumer awareness, perceived risks, and health risks collectively play significant roles in shaping purchasing behavior.

Hypothesis Testing

The results of the hypothesis testing strongly supported all four hypotheses. For H1, higher consumer awareness was found to significantly reduce perceived health risks ($CA \rightarrow HR = -0.400$, $T = 8.749$, $P = 0.000$), indicating that informed consumers feel more confident in managing potential risks associated with heavy metal contamination. For H2, perceived risks negatively impacted purchasing behavior ($PR \rightarrow PB = -0.404$, $T = 8.783$, $P = 0.000$), showing that consumers who perceive greater risks are less likely to purchase cosmetics. For H3, health risks were found to strongly deter purchasing behavior ($HR \rightarrow PB = -0.500$, $T = 11.364$, $P = 0.000$), highlighting the critical role of health concerns in shaping consumer decisions. Lastly, for H4, consumer awareness indirectly influenced purchasing behavior through both perceived risks and health risks, with significant indirect effects ($CA \rightarrow HR \rightarrow PB = -0.278$, $T = 7.743$, $P = 0.000$; $CA \rightarrow PR \rightarrow PB = -0.264$, $T = 8.297$, $P = 0.000$). Together, these results demonstrate the interconnected relationships between consumer awareness, risk perceptions, and purchasing decisions, emphasizing the importance of addressing health and safety concerns to influence consumer behavior positively.

Discriminant Validity

Discriminant validity was evaluated using the Fornell-Larcker Criterion and the HTMT (Heterotrait-Monotrait) ratio. The Fornell-Larcker Criterion, shown in **Table 3**, confirms discriminant validity as the square root of the AVE for each construct was greater than its correlation with other constructs. For example, the square root of the AVE for Consumer Awareness (0.826) exceeded its correlations with Health Risk (0.600), Purchasing Behavior (0.550), and Perceived Risk (0.580).

Similarly, the HTMT ratios in **Table 4** were all below the threshold of 0.85, further confirming discriminant validity. For instance, the HTMT ratio between Consumer Awareness and Health Risk was 0.750, while the ratio between Perceived Risk and Purchasing Behavior was 0.733. These results indicate that the constructs in the model were distinct and measured unique aspects of consumer behavior. The results emphasize the importance of consumer awareness, perceived risks, and health risks in shaping purchasing decisions in the cosmetics industry. These findings underscore the need for improved risk communication and transparency from manufacturers to address consumer concerns and ensure product safety. By enhancing awareness and addressing health risks, manufacturers can positively influence purchasing behavior while building trust among consumers.

Table 3:- Discriminant Validity Fornell-Larcker Criterion.

Variables	FP	HR	PB	PR
CA	0.826			
HR	0.600	0.840		
PB	0.550	0.620	0.770	
PR	0.580	0.650	0.640	0.820

Table 4:- HTMT (Heterotrait-Monotrait Ratio).

Variables	FP	HR	PB
CA			
HR	0.750		
PB	0.720	0.777	
PR	0.700	0.788	0.733

Table 5:- Hypothesis Testing Results.

Variables	Path	Mean	Standard deviation	T statistics	P values	Decision
CA -> HR	-0.400	-0.400	0.046	8.749	0.000	Supported
CA -> PR	0.652	0.653	0.027	24.28	0.000	Supported
HR -> PB	-0.500	-0.500	0.044	11.364	0.000	Supported
PR -> PB	-0.404	-0.406	0.046	8.783	0.000	Supported
Indirect Effects						
CA -> HR -> PB	-0.278	-0.278	0.036	7.743	0.000	Supported
CA -> PR -> PB	-0.264	-0.264	0.032	8.297	0.000	Supported

Table 6:- Summary of Hypothesis Testing Results.

Hypothesis	Path/Effect	Supported	Interpretation
H1	CA → HR = -0.400	Yes	Higher consumer awareness reduces perceived health risks, indicating informed consumers feel more capable of mitigating risks.
H2	PR → PB = -0.404	Yes	Perceived risk negatively impacts purchasing behavior, showing risk-averse behavior among consumers.
H3	HR → PB = -0.500	Yes	Health risks significantly reduce purchasing behavior, reflecting consumer concern over potential harm.
H4	CA → HR → PB = -0.278, CA → PR →	Yes	Consumer awareness and perceived

PB = -0.264

risk jointly influence purchasing behavior through their indirect effects.

Discussions of Results:-

This section discusses the findings of the study in light of the research objectives, hypotheses, and the existing literature reviewed. The results reveal significant insights into the relationships between consumer awareness, perceived risks, health risks, and purchasing behavior concerning heavy metal contamination in cosmetics. These findings are compared with prior studies, offering a deeper understanding of consumer behavior in this context.

The results demonstrated a significant negative relationship between consumer awareness and perceived health risks ($CA \rightarrow HR = -0.400$, $T = 8.749$, $P = 0.000$). This finding supports the hypothesis that as consumer awareness increases, perceived health risks decrease. It highlights the importance of educating consumers about heavy metal contamination in cosmetics, as informed consumers feel more capable of managing or mitigating potential health risks. This aligns with studies such as (Ward et al., 2024), which emphasized the role of consumer awareness in improving confidence and reducing anxiety about product safety. Similarly, (Joshi et al., 2022) found that awareness campaigns about harmful chemicals in cosmetics significantly improved consumer attitudes toward product safety. However, this finding contrasts with Zhao et al. (2023). The differences may stem from variations in consumer education and access to reliable information, highlighting the need for awareness campaigns to provide not only information but also actionable solutions.

The study also found that perceived risk negatively impacts purchasing behavior ($PR \rightarrow PB = -0.404$, $T = 8.783$, $P = 0.000$). Consumers who perceive higher risks are less likely to purchase cosmetics, indicating a cautious and risk-averse approach. This result aligns with (Sharma, 2021). Similarly, Kumar et al. (2021) found that higher perceived risks reduced brand trust, further discouraging purchasing behavior. These findings underscore the critical role of perceived risk as a determinant of consumer behavior, particularly in contexts involving potential health hazards. However, the degree of impact may vary based on cultural and demographic factors. For instance, Consumers (2019) found that consumers in developing regions, where awareness about product safety is lower, may show less sensitivity to perceived risks compared to consumers in more developed markets.

The findings also revealed a strong negative relationship between health risks and purchasing behavior ($HR \rightarrow PB = -0.500$, $T = 11.364$, $P = 0.000$). This result suggests that consumers are significantly deterred from purchasing cosmetics when they perceive health risks associated with heavy metal contamination. This aligns with prior studies, such as (Nnorom et al., 2005) and (Hepp et al., 2009), which found that health concerns about lead and cadmium contamination reduced consumer willingness to purchase cosmetics. The findings emphasize the importance of addressing health risks in product development and marketing strategies. Consumers are particularly cautious about products applied directly to the skin or lips, as these are perceived to have a higher potential for harm, consistent with findings by Draelos (2011). While these results highlight the importance of mitigating health risks, it is also important to recognize that some consumers may prioritize aesthetic benefits over health concerns, especially in markets with limited safer alternatives, as noted by (Rostamzadeh & Rahimi, 2025).

In addition to the direct effects, the results highlighted the joint influence of consumer awareness and perceived risks on purchasing behavior. The indirect effects for $CA \rightarrow HR \rightarrow PB$ (-0.278 , $T = 7.743$, $P = 0.000$) and $CA \rightarrow PR \rightarrow PB$ (-0.264 , $T = 8.297$, $P = 0.000$) indicate that consumer awareness affects purchasing behavior by shaping perceptions of both health risks and overall risks. Consumers with greater awareness are more likely to evaluate these risks carefully, which subsequently impacts their purchasing decisions. These findings are consistent with studies by (Zhao et al., 2010) and (Chen & Chang, 2013), Chaudhry et al. (2021) and Liu et al. (2021), which highlighted the mediating role of perceived risks in the relationship between consumer awareness and purchasing behaviour. However, while awareness reduces health risks, it may also increase perceived risks, as evidenced by the positive relationship between CA and PR (0.652 , $T = 24.280$, $P = 0.000$). This suggests that awareness campaigns must strike a balance between informing consumers about risks and providing actionable steps to mitigate those risks, fostering trust and confidence in product safety.

When compared with the existing literature, the results align with established theories such as the Health Belief Model, which posits that perceptions of risk and susceptibility influence health-related behaviors (Rosenstock, 1974). The findings also complement studies on consumer decision-making in the context of product safety, demonstrating

the interplay between awareness, risk perception, and purchasing behavior (Yeung & Morris, 2001). Moreover, the study contributes to the literature by showing how consumer awareness and perceived risks interact to shape purchasing decisions, providing a more comprehensive understanding of the mediating role of risk perceptions.

These findings have several implications. From a theoretical perspective, the study validates existing theories on risk perception and consumer behavior while highlighting new pathways through which awareness influences behavior. Practically, the findings emphasize the importance of transparent labeling, consumer education, and effective risk communication in addressing concerns about heavy metal contamination. Manufacturers must focus on building trust by providing clear information about product safety and offering safer alternatives. Finally, the results underscore the need for stricter regulatory enforcement to ensure product compliance with safety standards. Regulatory agencies should collaborate with manufacturers to address consumer concerns and promote safer practices in the cosmetics industry.

The findings provide valuable insights into the relationships between consumer awareness, perceived risks, health risks, and purchasing behavior. The study highlights the critical role of risk perception in shaping consumer decisions and underscores the importance of integrating consumer education, transparent communication, and regulatory enforcement to enhance trust and safety in the cosmetics industry. By addressing these factors, manufacturers and regulators can positively influence purchasing behavior while safeguarding consumer well-being.

Conclusions:-

This study explored the relationships between consumer awareness, perceived risks, health risks, and purchasing behavior in the context of heavy metal contamination in cosmetics. The findings revealed that higher consumer awareness reduces perceived health risks and indirectly influences purchasing behavior through its effects on perceived risks and health concerns. Perceived risks and health risks were shown to significantly deter purchasing behavior, highlighting the critical role of risk perception in consumer decision-making.

The results align with existing literature and emphasize the importance of consumer education, transparent communication, and stringent regulatory enforcement to address safety concerns in the cosmetics industry. By enhancing awareness, mitigating risks, and fostering trust, manufacturers and regulators can positively influence consumer behavior while ensuring safer cosmetic products. These findings contribute to the understanding of consumer decision-making and provide actionable insights for improving product safety and consumer confidence.

Implications of the Study

The findings of this study have significant implications for theory, practice, and policy within the cosmetics industry and beyond. By exploring the relationships between consumer awareness, perceived risks, health risks, and purchasing behavior, the study provides actionable insights into how these factors influence consumer decision-making in the context of heavy metal contamination.

From a theoretical perspective, this study advances the understanding of consumer behavior by validating existing frameworks such as the Health Belief Model and extending them to the domain of product safety and cosmetics. The study highlights the mediating role of perceived risks and health concerns in shaping purchasing behavior, demonstrating how consumer awareness influences decisions indirectly. This offers new insights into the interplay between awareness, risk perception, and behavior, which can be applied to other industries facing safety concerns, such as food and pharmaceuticals.

From a practical perspective, the results underscore the importance of consumer education and effective risk communication. Cosmetic manufacturers must prioritize transparency in their product labeling and safety information to build trust among consumers. Providing clear, accurate, and accessible information about heavy metal contamination and its potential health risks can help alleviate consumer concerns and foster confidence in products. Additionally, manufacturers should consider developing and marketing safer, non-toxic alternatives, as informed consumers are increasingly likely to prioritize safety over brand loyalty or price. Marketing campaigns that emphasize product safety and address consumer concerns directly could significantly influence purchasing behavior positively.

The study also has critical policy implications. The results emphasize the need for stricter regulations and enforcement to ensure that cosmetics meet safety standards and are free from harmful levels of heavy metals.

Regulatory agencies should work closely with manufacturers to establish clear guidelines for acceptable levels of contaminants and to ensure compliance through regular monitoring and testing. Consumer safety must remain a top priority, and transparent regulatory frameworks can play a vital role in fostering trust between consumers, manufacturers, and policymakers. Additionally, global coordination on safety standards could address disparities in product safety regulations across different regions, ensuring consistent consumer protection worldwide.

Finally, this study highlights the importance of addressing both the actual and perceived risks associated with cosmetic products. While consumer awareness plays a critical role in reducing health risks, it can also amplify perceived risks if not managed effectively. Therefore, both manufacturers and regulators must balance education efforts with reassurance, providing actionable steps for mitigating risks without overwhelming consumers with fear or uncertainty. By integrating these strategies, stakeholders can create a safer, more transparent, and consumer-centric cosmetics industry.

Limitations of the Study

This study has a few limitations that should be acknowledged. First, the cross-sectional design captures data at a single point in time, limiting the ability to establish causal relationships or analyze changes over time. A longitudinal approach would provide deeper insights into how consumer awareness and risk perceptions evolve and influence purchasing behaviour. Second, the use of purposive and snowball sampling methods may not fully represent the broader population, reducing the generalizability of findings, especially across different cultural or geographic contexts where awareness and perceptions about heavy metal contamination may vary.

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