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She-Economy Driven Consumption Patterns: Multi-Group Segmentation and Mechanism Analysis with PCA-Kmeans-Structural Equation Modeling

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Abstract: *By the end of 2024, a "collective collapse" of Chinese sanitary napkin brands had exposed the industry's indifference to the real health needs of women during their menstrual periods. This paper focuses on residents aged 16 to 30 in Zhanjiang City, exploring the perceptions and consumption behaviors of Generation Z women towards sanitary products within the context of the "she-economy". Data was collected through questionnaires and analyzed using Principal Component K-Means Clustering and Structural Equation Modeling. The clustering results categorized consumers into three groups: "price-sensitive", "low-frequency practical" and "quality-oriented" with notable age and occupational differences among these groups. The Structural Equation Model indicated that product functionality is the key factor influencing consumers to try new brands, while product design, price, and promotion have significant positive effects on consumers' repurchasing of products from "collapsed" brands, revealing brand loyalty in sanitary napkin consumption. Based on these findings, improving the sanitary napkin industry ecosystem requires the joint establishment of a support system from the perspectives of government, enterprises, and communities to collectively promote the healthy development of the industry and safeguard women's health rights.*

Keywords: *She-economy; Sanitary napkin consumer; Cluster analysis; Structural equation*

1. Introduction

In recent years, with the widespread adoption of gender equality concepts and improvements in women's education, female consumers have gained greater market influence and independent judgment. They increasingly prioritize their rights and health, making the "she-economy" a significant force economic market development.

Globally, menstrual product safety is a widespread concern. The EU's 2007 REACH regulation restricted 218 chemicals in sanitary products, followed by Japan's 2014 Pharmaceutical and Medical Device Act, which mandates full ingredient disclosure and continuous monitoring. In China, the 2024 "Hygienic Requirements for Disposable Sanitary Products" updated standards for materials and production to ensure quality and safety.

China has about 400 million reproductive-age women, yet industry incidents have exposed gaps in regulation, standards, and corporate responsibility. Generation Z, having grown up alongside the "she-economy" holds more informed and health-conscious views on menstruation and is more vocal about their rights. Analyzing Gen Z women's perceptions of sanitary products from a "she-economy" perspective including consumer segmentation and purchase preference analysis, which can reveal key factors influencing their consumption decisions. This provides a basis for corporate product market positioning, and targeted marketing, supporting the healthy development of China's sanitary products.

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2. Literature and policy research

2.1 The current situation of "she-economy" development

The "she-economy" has gained wide attention as a key consumer market driver. Yao and Tan (2005) noted education's growing role in women's labor decisions [1]. Goldin (1995) similarly noted that increased women's education and service sector growth opened new job opportunities, allowing women to benefit from economic progress and advance gender equality [2]. Pang and He (2021) further discovered that widespread higher education access significantly promotes women's independent consciousness. This heightened awareness spurs their pursuit of self-actualization, thereby stimulating consumption capacity and accelerating market expansion [3]. Meng (2023) noted that the decline in female labor participation and the widening gender income gap post-reform require nuanced causal analyses considering different female groups' life courses [4]. Park et al. (2025) noted that women tend to assess their economic conditions more negatively, aligning with the "feminization of poverty", highlighting women's disproportionate economic disadvantages [5].

2.2 Female Menstrual Cognition

Menstruation, long medicalized as pathological in the West, is now viewed by some women as a sacred, empowering experience (Moloney, 2010) [6]. Nevertheless, this shift has not dispelled widespread social dilemmas. Wilbur et al. (2022) demonstrate that, regardless of disability status, menstrual taboos and activity restrictions continue to impose multiple difficulties on women [7]. This phenomenon finds resonance in the Chinese context as well. Li (2024) found that contemporary young Chinese women are highly concerned about the socio-cultural implications behind menstruation [8]. Wang et al. (2025) pointed out that menstrual stigma suppresses women's self-expression and has severe negative impacts on their physical and mental health [9]. As Dong (2024) observed, although menstrual shame has become a topic that can be discussed, it often merely dons a veneer of "respectability" and has not truly been accepted by society at large [10].

2.3 The factors influencing consumer's purchasing decisions from "she-economy" perspective

Under the "she-economy", female consumers' behavioral traits and decision-making mechanisms show distinct features. Jin (2017) noted that they heavily rely on word-of-mouth reviews and prefer convenient, efficient shopping methods [11]. Research by Lu (2023) indicates "marketing strategies", "brand characteristics", and "after-sales service" have emerged as the three core factors influencing their consumption behavior [12]. Moreover, Song and Pei (2006) noted that modern women increasingly seek "autonomous" and " personalized" consumption experiences, driving companies to adjust market positioning and implement more precise and differentiated strategies [13]. In this evolution, internet platforms have been pivotal. Lv (2018) emphasized that the internet breaks spatial-temporal barriers and provides valuable consumer feedback to merchants [14]. This demand-oriented product optimization underscores the importance of valuing online feedback and leveraging online communities for word-of-mouth promotion (Li, 2018) [15].

However, Tripathi (2022) observes that advertising continues to objectify women across most sectors. Therefore, marketing for women's products should highlight female strength and autonomy to reflect their evolving societal and consumer roles [16].

3. Data Sources and Research Methodology

3.1 Data Source

This study surveyed Generation Z consumers aged 16-30 in Zhanjiang City, Guangdong Province, using a three-stage sampling method. Given constraints in resources, three areas were first selected from Zhanjiang through stratified and PPS sampling. From these, eight township-level streets were then selected using the same methods. In the third stage, convenience sampling was used to randomly interview passers-by on these streets. A total of 100 pre-survey questionnaires were collected. For the formal survey, 540 questionnaires were distributed, with 494 valid returns, achieving a 91.6% response rate. The data showed good reliability and validity.

The questionnaire comprises six modules: basic subject information, consumer behavior, product

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cognition and feedback, issue feedback, suggestions, and male consumer attitudes.

(1)The basic information module of the survey subjects mainly investigates the gender, age, occupation, monthly income, or monthly living expenses of the survey subjects.

(2)The consumer behavior module primarily focuses on the sanitary napkin purchasing behavior of female consumers, including purchase frequency, types, prices, channels, and habits.

(3)The consumer product cognition and feedback module mainly investigates the factors influencing female consumers' purchases of sanitary napkins, including their purchasing concerns and priorities.

(4)The product issue feedback module primarily investigates the problems encountered by female consumers when purchasing and using sanitary napkins, including their purchase concerns, whether they experience discomfort during use, and their willingness to purchase or use products with issues.

(5)The suggestion module mainly investigates female consumers' suggestions for the development of sanitary napkins, including improvements to sanitary napkin products, how sanitary napkin merchants can contribute to women's health, and how the sanitary napkin industry can promote the development of the "she-economy".

(6)The male consumers' attitudes module serves as supplementary questions for the survey, investigating male consumers' attitudes toward "menstrual shame", their understanding of women's physical conditions during menstruation, and their knowledge of sanitary napkins.

3.2 Research Methods

3.2.1 K-means Clustering Analysis Based on Principal Component Analysis

Since the questionnaire design incorporates multiple variables that may influence consumers' purchasing behaviors, and there may exist certain correlations among these variables, directly using the original variables for cluster analysis could lead to information redundancy and classification bias. Therefore, this paper first employs principal component analysis (PCA) to reduce the dimensionality of the original variables. For a sample $X_{n\times p}$ containing p variables and n data points, with a correlation matrix $R_{p\times p}$, the p eigenvalues are calculated and sorted in descending order as $\lambda_1, \ldots, \lambda_p$, along with the corresponding p eigenvectors $T_1, \ldots, T_p$. The i-th principal component Yi is then given by:

$$Y_i = XT_i,\ 1 \le i \le p \tag{1}$$

The contribution rate of the k-th principal component is:

$$\varphi_k = \frac{\lambda_k}{\sum_{i=1}^{p} \lambda_i} \tag{2}$$

To provide a reasonable interpretation of the m principal components extracted from the p variables, this paper further calculates the factor loading p of the k-th principal component with respect to the original i-th variable:

$$p\ (Y_k, X_i) = \sqrt{\lambda_k} T_{ki} \tag{3}$$

Based on the factor loadings of principal components on the original variables and the meanings of the original variables, the principal components can be classified into categories such as all-round excellent care product factors, purchase channel factors, and economically suitable product factors. Furthermore, K-means clustering is performed on the original variables with high loadings corresponding to different categories of principal components:

$$\arg_c \min J(C) = \sum_{k=1}^{K} \sum x^{(i)} \in C_k \left\| x^{(i)} - \mu^{(k)} \right\|_2^2 \tag{4}$$

Here, K represents the number of clusters, C_k denotes the sample points in the k-th cluster, $x^{(i)}$ signifies the i-th standardized sample within C_k, and $\mu^{(k)}$ is the centroid of the k-th cluster. In this paper,

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the principal component score matrix is utilized as the input variable for clustering experiments with different K values. Ultimately, through a comprehensive evaluation based on silhouette coefficients and the interpretability of clustering results, the optimal number of clusters is determined to be three. Subsequently, an analysis is conducted on the consumption preferences and behavioral characteristics of sanitary napkin consumers across different clusters.

3.2.2 Structural Equation Modeling

To examine the causal influence paths of various latent variables on consumers' behavioral intentions of "trying new brands" and "continuing to purchase problematic products", this study constructed a structural equation model. This model can simultaneously handle latent variables and their observed indicators, as well as estimate the direct effects among variables. It enables the analysis of relationships between each variable and the strength of their interactions, facilitating the identification of key factors influencing each other. These key factors influence the effectiveness of assistance, allowing for targeted prevention and problem-solving.

4. Empirical Analysis

4.1 Population Difference Analysis of Sanitary Napkin Consumer Behavior Preferences Based on cluster analysis

To identify the structural differences in sanitary napkin purchasing behaviors among women with different characteristics, this paper selects seven questionnaire questions covering five aspects: purchase frequency, functionality, price, purchasing channel preferences, and brand preferences for factor analysis. For questions involving judgments, a "yes" response is recorded as 1, and otherwise as 0; questions concerning attitudes are collected using a Likert scale (1 = highly unimportant; 2 = somewhat unimportant; 3 = moderately important; 4 = very important; 5 = extremely important). Principal component analysis is employed to extract factors, and when eight factors are selected, the cumulative variance contribution rate reaches 74.21%. The data is further processed using the varimax rotation method, and the rotated component matrix is shown in Table 1.

Table 1: Component matrix after rotation

The questionnaire involves variables	*Component 1*	*Component 2*	*Component 3*	*Component 4*	*Component 5*	*Component 6*	*Component 7*	*Component 8*
Leak-proof effect	*0.897*							
Thickness	*0.870*							
absorption function	*0.868*							
Dryness and breathability	*0.866*							
Safety and comfort	*0.863*							
Discount promotion activity	*0.859*							
Shopping environment and after-sales service	*0.859*							
The material of the product	*0.854*							
Brand awareness/advertising promotion/social media influence	*0.836*							
Offline purchase		*0.822*						
Live-streaming sales on social Media platforms		*-0.607*						
Price			*0.817*					
Pure cotton breathable products			*0.590*					
Products of cooling herbs				*0.829*				
High-end products for teenage girls					*0.902*			
Consumption frequency						*0.824*		
Nighttime use function							*0.840*	
Outdoor function								*0.883*

To specifically analyze the eight factors, K-means clustering was applied to corresponding questionnaire items. The results summarized characteristics of each category, analyzed need

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differences across groups, and proposed targeted policy recommendations. Setting clusters to three provided clear outcomes, with final cluster centers shown in Table 2.

Table 2: Final Clustering Centers

Cluster index set	Clustering types		
	Type I: Price-sensitive	Type II:Low-frequency practical type	Type III:Quality-oriented
Age	Aged 18 to 25	Aged 26 to 30	Aged 26 to 30
Occupation	Student	Housewife	Social practitioners
Monthly income or monthly living expenses	1500 to 2500 yuan	3000 to 5000 yuan	5000 to 7000 yuan
Purchase frequency	Purchase only when there is a discount	Semi-annually	Once every month
Usage occasion	For daily and at night use	For daily and at night use	Indoor sports
Price	10 to 20 yuan	10 to 20 yuan	20 to 30 yuan
Purchasing channel	Online shopping or other channels	Online shopping	Live-streaming sales on social media platforms or offline supermarkets
Product type	High-end products for teenage girls Instant ultra-thin products	Other niche products	Common products include high-end products for young girls, ultra-thin and leak-proof products, and pure cotton breathable products

Based on the clustering results, we conduct a feature analysis of consumer groups, examining the characteristics of the three consumer groups across various attributes. This allows us to summarize the group characteristics for each category. Based on these feature descriptions, we classify potential consumers into three distinct categories.

4.1.1 The Price-Sensitive Group

This group primarily consists of students aged 18-25.Their purchasing behavior is driven by promotions. They prefer economical products priced between 10-20 yuan, purchasing through online shopping combined with other channels. They emphasize cost-effectiveness and basic functionality, with moderate brand loyalty.

4.1.2 Low-Frequency Practical Groups

Consumers in this group are often housewives who purchase sanitary napkins every six months. They tend to buy low-priced products ranging from 10-20 yuan online and have a preference for niche products. Their purchasing decisions are rational, emphasizing practicality and long-term stockpiling.

4.1.3 Quality-Oriented Group

This group mainly comprises working professionals aged 26-30 with relatively good incomes. They prefer to purchase mid-to-high-end products priced between 20-30 yuan on a monthly basis, buying through a combination of online and offline channels. They exhibit high brand loyalty. Consumers in this group prioritize product quality and comfort and are significantly influenced by social media.

4.2 Analysis of Influencing Factors on Purchase Behavior Preferences of Sanitary Napkin Consumers Based on Structural Equation Modeling

Based on the characteristics of the questionnaire and the data conditions, this paper classifies the factors influencing the purchasing behavior preferences of sanitary napkin consumers into 16 variables. The path coefficient effects of each manifest variable on the latent variable, as well as the causal path coefficient of each exogenous latent variable on the endogenous latent variable, are shown in Figure 1.

Path Analysis:

H1: Price has a significant positive impact on the continued purchase of "compromised" products.

H2: Price has a significant positive impact on the willingness to try new products.

H3: Functionality has a significant positive impact on the continued purchase of "compromised" products.

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H4: Functionality has a significant positive impact on the willingness to try new products.

H5: Design has a significant positive impact on the continued purchase of "compromised" products.

H6: Design has a significant positive impact on the willingness to try new products.

H7: Promotion has a significant positive impact on the continued purchase of "compromised" products.

H8: Promotion has a significant positive impact on the willingness to try new products.

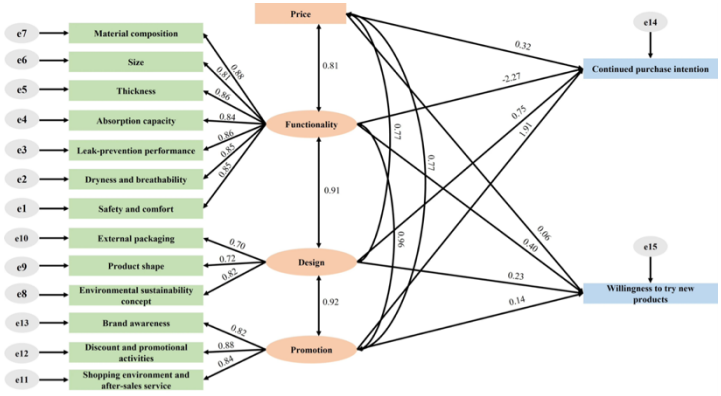

Figure 1: Standardized Structural Equation Model

Product functionality is the key factor influencing new brand trials. Path analysis shows it is the only significant driver, indicating that initial purchases prioritize core efficacy over marketing and packaging.

The factors influencing "continued purchase of problematic products" are complex, with significant brand loyalty evident.Unlike trying new brands, consumers exhibit a more complex decision-making mechanism when faced with products that have already encountered quality or reputation issues, as shown in Table 3.

(1) Product functionality exerts a strong negative influence, indicating that severe functional defects significantly impact consumers' purchase intentions.

(2) However, discounted prices, designs, and promotions strongly encourage continued purchases. This apparent contradiction underscores the market's high brand loyalty and low substitutability. Long-term use builds consumer path dependency and emotional trust. When issues arise, they often see them as incidental and, influenced by discounts and emotional ties, stay loyal to the original brand.

Table 3: Influencing Factors on Consumers' Purchase Behavior Preferences

Path of Influence			Standardized Path Coefficient	Unstandardized Path Coefficient	Standard Deviation	P-value
Continued Purchase	<--	Price	0.323	0.327	0.101	0.001
Trying New Products	<--	Price	0.056	0.062	0.061	0.311
Continued Purchase	<--	Functionality	-2.266	-2.654	0.585	***
Trying New Products	<--	Functionality	0.404	0.512	0.196	0.009
Continued Purchase	<--	Design	0.751	0.994	0.354	0.005
Trying New Products	<--	Design	0.228	0.327	0.212	0.123
Continued Purchase	<--	Promotion	1.914	2.415	0.675	***
Trying New Products	<--	Promotion	0.143	0.196	0.281	0.486

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5. Conclusions and Suggestions

5.1 Conclusions

5.1.1 Distinct Group Differences in Consumer Behavior

K-Means cluster analysis categorizes sanitary napkin consumers into three types: price-sensitive (mainly students aged 18-25 who prioritize promotions and cost-effectiveness), low-frequency practical (primarily homemakers who maintain long-term inventory and focus on utility), and quality-oriented (mostly employed individuals with stable incomes who emphasize quality and comfort).

5.1.2 Product Functionality as a Key Decision Factor

Principal component analysis and LDA models indicate that nearly 80% of consumers consider "product structure and functionality" the primary purchasing factor, followed by price, brand marketing, and design. Semi-structured interviews confirm the general prioritization of product features, making functionality optimization and technological innovation essential for market competitiveness.

5.1.3 High Stickiness and Low Substitutability in Consumption

Over 80% of consumers repurchase brands that meet their needs, demonstrating strong brand loyalty. Nearly half continue purchasing after quality or advertising controversies due to promotions or brand apologies, reflecting high stickiness and low substitutability driven by long-term brand trust.

5.1.4 Evolving Male Perceptions of Menstruation and Sanitary Products

Previously, some men held stigmatized views due to limited gender education. Surveys now show more men oppose "menstrual shame" and accurately identify common symptoms, indicating a scientific understanding of female physiology. Despite progress, continued gender equality education is needed to translate knowledge into genuine social respect.

5.2 Recommendations

5.2.1 From the government's perspective: Strengthen the intensity of industry supervision

Sanitary pads directly contact vaginal skin, allowing chemicals to enter the body. Manufacturers must therefore limit harmful substances, disclose ingredients and test reports, and follow strict quality regulations. Many companies currently only meet minimum standards, and fraud occurs. A Products Safety Background Platform should be established to assign unique codes for full tracking. Unqualified products and firms should be disclosed publicly, with repeat violations progressively penalized.

5.2.2 Enterprise perspective: Emphasize the basic rights of female consumers

First, companies must establish full-process quality systems, adhere strictly to national standards, and strengthen monitoring from materials to finished goods for safety. Secure packaging also ensures safe delivery. Second, firms should build user databases and use real-time data for dynamic recommendation systems enabling personalized promotions. Finally, responding to Gen Z women's rising gender awareness, marketing should focus on product functionality and quality over stereotypes, implement gender equality training in required courses, and collaborate with medical experts via channels like scientific livestreams to build trust.

5.3.3 Community perspective: Building a multi-dimensional health community health system

Through health seminars, regular home visits, and other promotional activities, enhance women's awareness of physiological health and their ability to practice self-care. Additionally, beyond simply disseminating knowledge on a one-to-one or one-to-many basis, it is essential to establish a community support network that provides free health products to economically disadvantaged women, ensuring their menstrual dignity.

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