Consumers’ Perceptions on Nanotechnology Enabled Cosmetic Products in Conception of Physical Wellness

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Abstract

Applications of Nanotechnology has widened in diverse fields such as, agrifood processing, food packaging, cosmetics and many more. In this paper we defined a research model constitutes consumers’ willingness to pay for NCPs (Nanotechnology enabled cosmetics products) in fulfillment of physical wellness which is studied from observed variables perceive risk, trust and perceived benefit for the past literature. A total of 139 consumer sample data was taken to conduct the study. It is observed through hierarchical regression that perceived risk is more associated with cosmetics products enabled with nanotechnology and perceived benefit is also a significant predictor i.e., at a benefit forthcoming consumers are comprised to pay for NCPs and followed by trust component in predicting the behavior. It is also observed that consumer’s education qualification (control variable) was having a significant positive association on the behavioral aspect willing to pay for nanotechnology enabled products. Inclusion of a variable educational qualification as control variable the explained variance of the model has increased.

Keywords : Nanotechnology, wellness, cosmetic products, perceived benefit, perceived risk, trust.

I. Introduction

Nanotechnology refers to nanomaterials, systems and that in need or in the range of 1-100 m (nm). Nanometers (\textit{f}) were 1/100000000 millimeters (mm). The material properties of this new scale lead to new applications in various fields such as
medicine, involving the production of energy, environmental biology arts. They are not sure that the negative health problems, health and environment can interact with humans as nanomaterials. Since nanotechnology, nanomaterials and improved large number of new products that depend on a change in the properties of the characteristics is that where the size of the body can be reduced. Nanoparticles lead to volume ratio at the surface.

II. Indian Cosmetic Industry

The main drivers of the cosmetic industry in India are the increase in disposable income, the globalization that has an impact on lifestyles, the evolution of retail landscapes, the routes of cosmetics, the increase in consumption, penetration of the distribution network, the acceptance of natural products. The size of India's cosmetics market is expected to reach $20 billion by 2025, compared to the current $6.5 billion, with a CAGR (compound annual growth) of 16.72% over a five-year period. This growth will increase by 25% in the next five years. It is expected that the global cosmetics market will obtain USD 450 billion by 2025, with a CAGR of 4.3%. India will be one of the largest cosmetics markets for the consumer by 2025, with a 5% market share in the global beauty cake [I,XI].

III. Nanotechnology in Cosmetics

With growing concerns for beauty among both men and women, the cosmetics sector is expanding extraordinarily. The usage of cosmetics increased rapidly, resulting in superior production, import, export, distribution, and sale of cosmetics. The cosmetic industry continues to search for new techniques of developing products that make our skin look smoother, healthier, and at the same time younger. The cosmetic world has been frequently perceived as the land of luxury, in which science failed to play any portion. This is, nevertheless, not justified since several aspects of development of cosmetic products necessitate significant input [XII,II]. The cosmetic products are at this moment considered no less than pharmaceutical products in terms of ingredient selection, quality control, efforts, and side effects. Nanotechnology has intensifying arrived in the cosmetic field, and is considered the “hottest technology” existing. The cosmetic industry’s willingness to use unique nanoparticles in its products while adverse health effects persist so poorly understood has created concern amongst the scientific community [III,XIII]. Nano technology enabled cosmetics products (NCPs) have been on the market for 30 years. More than 250 product lines have been brought onto the world market, potentially exposing two billion people. These products are present in all formulations that contain creams, powders, lotions and aerosols. These include contact with the entire body, especially with the skin and mucous membranes; involuntary exposure to other tissues, such as the respiratory tract and gastrointestinal tract, can be achieved.
Because of their size, PCNs have a higher volume-surface ratio, which is likely to increase their responsiveness to most materials, which raises consumer safety concerns. Consumers are attracted to the new properties and functions of products that are compatible with nanotechnology [IV, XV].

IV. Review of Literature
IV.i Perceived Risk, Trust & Perceived Benefit
The widespread use of nanomaterials in technological and consumer applications has increased the potential for inadvertent exposure of human skin. From the available literature, it is reasonable to conclude that the penetration of ZnO and TiO2 nanoparticles under normal conditions of use in healthy skins suggests a minimal risk to health [IX, V]. Therefore, it can be understood in previous studies that the observed risk factor would affect the preference for NCPs.
Trust is a positive behavioral intention, that is, a psychological state with the ability to accept the risk involved (XX,XIX). Therefore, previous studies have shown that confidence in the nanotechnology factor would influence the preference for NCPs.
As nanotechnology introduces new properties into materials, this potential could bring significant benefits [VI, XVII]. From previous studies it can be understood that the observed benefit factor would have an effect on preferences for NCPs.

IV.ii Wellness Concept
Wellness is a multidimensional concept and has been defined as a fundamental option for taking into account the quality of life. Start with a conscious decision of the nature of a healthy lifestyle. [I, XVIII] developed the six-dimensional well-being model. Dimensions include: social, work, spiritual, physical, intellectual and emotional. From this point of view stated by [VII, XI], and what we can deduce from it, it is to achieve physical well-being, it is through the use of cosmetics with nanotechnology.

IV.iii Willingness to Pay for NCPs
It is the intent that created the payment for manufacturing consumer products for their products and services. In the study reported that, that there is a willingness to pay (WTP) for food products and the derivation of assumptions for the operation of a trusted laboratory that most. The CAP for food and the display of new properties increases with confidence, even if the new information technologies and make it known. To come back to consumers, buy books on consumer behavior because it is made up of the possibility and curiosity of consumers to buy a product or use a service. The results of several studies show that the habit is deeply related to the preference for the brand, the product or the service [IX,X]. For example, if the recovery is considered, the purchase price is consistent with consumer behavior,
based on their own habits. Similarly, the preference for NCPs to achieve physical health. Therefore, applications of nanotechnology in agribusiness, food packaging, pharmaceuticals, paints and mechanical devices, while its commercial and social effects, which has been extensively studied. In this help us to ask questions, R1; they knew, to lead the women to want to solve the nanoparticle in the NCP is in no danger, no? R2; Confidence nanomaterials / nanotechnologies paid for PNC? R3; Knowing the benefit nanomaterials / Nanotechnology treatments lead to the acceptance of the NCPs? And finally the control variables such as sex, age and education level have any effect on the dependent variable plan that is willing to accept the NCPs.

IV.iv. Research Objectives

1. To determine the effect of perceived risk associated with nanotechnology on willing to pay for NCPs
2. To determine the effect of trust associated with nanotechnology on willing to pay for NCPs
3. To determine the effect of perceived benefit associated with nanotechnology on willing to pay for NCPs.
4. Finally, to determine the effect of control variables (age, gender and educational qualification) on the consumers’ willingness for NCPs

IV. Hypothesis Formulation

Perceived risk in association with introduction of technology replaced with conventional product therefore this construct would have an either adverse effect on health so it eventually leads to willingness to pay for NCPs [XIX; XVIII]. Trust is the construct proposed in the model with previous studies in the field of nanotechnology applications stating that trust as a major component to pay for NCPs and the other aspect in construct with risk, consumers would also seek for benefit when risk is to be accepted. So, perceived benefit would lead to willingness to pay for NCPs. These constructs lead to an willingness to pay for NCPs which eventually lead to individual wellness in terms of beauty. The hypothesized proposed is represented in figure 1 and the arguments presented above leads to the research hypotheses.

H1: Perceived risk would have a significant effect on consumers’ willingness to pay for NCPs for wellness
H2: Trust on nanotechnology would have a significant effect on consumers’ willingness to pay for NCPs for wellness
H3: Perceived benefit associated with nanotechnology would have a significant effect on consumers’ willingness to pay for NCPs for wellness.
V. Method

Participants’ demographic characteristics: Convenience samples were drawn from Vijayawada urban area via mall intercept method. Before, distributing the questionnaire they were questioned about their awareness of nanotechnology and its applications in cosmetic products. Only those who have had such an awareness of the subject area are considered as valid to be sampled inclusion. Totally 160 participants were considered for the study, out of which 21 responses are discarded by incomplete and ambiguous responses, finally a 139 responses are considered for further data analysis. Among a total of 139 survey participants, most of the respondents are under the age of 26-40 years (42.4 %), 27.3% are between 41-55 years age category and the rest of them are 16.5%, below 25 years and 13.7% by age above or equal to 56 years. With regard to gender, 64.7% are male and the rest of them are female. With regard to monthly income which is a vital demographic factor for purchase potential, about 37.4 % earn 26,000-40,000 per month, 25.2% earn more than 55,000 , 22.3% earn 41,000-55,000 and the rest 15.1% earn 10,000-25,000 Rs. Per month. With regard to the qualification of the respondents, about 61% are graduates, 31.8% are undergraduate holders and the rest 7.8% are post graduates.

V.i. Scale Design

The constructs of the proposed research model i.e., Trust, is been adopted from study made on implications of nanotechnology food products. The concept of trust was also studied widely in the literature[XI, VII, XIII]. The rough draft of the questionnaire was examined by field experts for face validity and some of the items are removed as suggested by the field experts. The final questionnaire contains the following items. The items of the trust construct are made according to the study as: ‘how much do you trust the NCPs based on the information on it’, and ‘how much do you trust the NCPs manufacturing company or wellness service provider?’ on a seven point scale.
The second construct, perceived benefit is adopted from the studies made with respect to application of nanotechnology in food and food packaging [XIX, VII]. The adopted items are revised as to this study as, ‘how beneficial do you consider the NCPs’. Semantic differential scaling is used to identify the intensity, evaluation criterion and potency of the construct on willingness to pay for NCPs (Intensity: 1= very low to 7=very high, and potency: 1=Very strong to 7= very week). The other vital construct of the model perceived risk is adopted for the study made to assess the perception of public on nanotechnology [VII]. The items of the construct are, ‘feelings related to the application of NCPs’ on a seven point scale (1-very positive to 7= very negative), ‘worries related to the application of NCPs on a seven point scale (1= not worried at all to 7= very worried), and the other item as, ‘adverse health effects due to contact with NCPs’ on a seven point scale (1= not at all effect to 7= very adverse effect). The focused construct Willingness to pay NCPs was adopted for the study made by and the scale was revised according to the present study as ‘Nanotechnology offers enhanced features which is effective for my wellness’ and ‘Compare to non-NCPs, NCPs work efficiently for my wellness’ on a seven point scale (1= Strongly agree to 7= Strongly disagree).

VI. Results Analysis

Item-construct loadings, construct reliability and correlations: To determine item-construct loadings, a factor analysis was conducted using SPSS. The results of principle component analysis are shown in Table 1. All loadings were larger than 0.6, demonstrating an adequate convergent and discriminant validity. The reliability scores of the hypothesized constructs are above 0.6, it defines construct reliability[X, XIV]. To derive the factors, exploratory factor analysis with varimax rotation was used. It extracted four factors with total variance explained is 71.368, the KMO measure revealed with sample adequacy 0.612 and bartlett’s test is significant at p-value <0.000.

Hierarchal regression technique was used to compute regression coefficients and coefficient of determination (R²) and demographic variables as Age, gender and educational qualification are used as control variables on the dependent variable willingness to pay for NCPs. In the first step of the regression analysis the major constructs as, trust, perceived risk and perceived benefit are analyzed and in the second step demographic variables are used as control variables and change in the determinant is observed (∆R²).
From the hierarchal regression analysis (Figure 2), the construct perceived risk is significant with $\beta=0.50$, the other construct trust is significant with $\beta=0.17$ and the construct perceived benefit is significant with $\beta=0.40$ to the dependent variable willingness to pay for NCPs at $p<0.000$ and the total explained by the model is 91 percent ($R^2=0.916$). The effect of control variables was observed as follows: gender and age does not have a significant association with dependent variable so, that it can be determined that age and gender of the respondents does not have effect on the model and education qualification is significant with willingness to pay for NCPs, it signifies the educational qualification of the respondents will have an effect on deciding or making a decision for using NCPs.

** Correlation is significant at the 0.01 level (2-tailed).

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APPENDIX-1.4

VII. Discussion

The constructs of the proposed model trust, perceived risk and perceived benefit are important predictors of willingness to pay for NCPs. Hence, the hypotheses H1, is been proved that the perceived risk has a positive significant relation (β=0.50, P<0.01) with willingness to pay for NCPs. The hypothesis H2, is also proved with positive significant relation (β=0.17, p<0.01) and finally hypothesis H3, perceive benefit has significant positive relation with willingness to pay for NCPs. This can analyzed from the result that the respondents have exhibited more risk with nanotechnology in cosmetic product when compared to benefit derived from nanotechnology enabled cosmetic products and the trust when compared with risk and benefit, consumers having low trust, with high risk with compromised with benefits associated with nanotechnology in cosmetic products for wellness. The regression results are represented in table 2, that in the absence of control variables the explained variance is 91 percent, but inclusion of education which having a significant association in explaining willingness for NCPs the model explained variance has increased to 95 percent and significant at P<0.10.

VII.i. Business Implications and Conclusion

A joint report by NSDC with KPMG on sector skill gap study [XV] elucidates, the Indian wellness industry is growing at Compounded Annual Growth Rate (CAGR) of 18.6 percent, were the global wellness industry is growing at a CAGR of 15 per cent which is more than the world average and the countries china, brazil, the US, India and Indonesia are growth markets. The customers are willing to pay a premium for wellness ‘experience’ were, spending for wellness is no longer considered a luxury and are more aware of holistic approaches and setting aside quality time to acquire wellbeing because wellness is an active pursuit of activities, lifestyle and choices that lead to a state of holistic health. (Global wellness economy monitor, 2017).

| Independent Variable | Unstandardized Coefficients (B) | Std. Error | Standardized Coefficient(β) | t- value |
|----------------------|---------------------------------|------------|-----------------------------|----------|
| Perceived Risk       | 0.39                            | 0.032      | 0.50                        | 12.32**  |
| Trust                | 0.17                            | 0.029      | 0.17                        | 5.96**   |
| Perceived Benefit    | 0.41                            | 0.044      | 0.40                        | 9.37**   |
| Gender (Control Variable) | -0.09                        | 0.06       | -0.039                      | -1.5     |
| Age(Control Variable) | 0.064                           | 0.032      | 0.044                       | 2.00     |

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Table 2. Regression Analysis with Willingness to pay for NCPs as dependent variable

| Variable | Coefficient | Standard Error | t-value | p-value |
|----------|-------------|----------------|---------|---------|
| Education (Control Variable) | -0.078 | 0.045 | 0.043 | -1.72* |

Note: N= 139, R²=91% and ΔR²= 95%.

*P< 0.10

**P< 0.01

When such an opportunity for growth of wellness industry, technology such as nanotechnology would accelerate the effectiveness and efficiency of the cosmetics products and it is always cautious that from consumers point of view that either it is a beneficial or risk for consumption and trust projected by brands as a major consideration for the firms in manufacturing such nanomaterial based products. For this understanding, this paper would add value either to make such a decision for introducing nanotechnology enabled products.

References

I. Hettler, B. (n.d.). Defining wellness: The six dimensional model of wellness. The National Wellness Institute. Retrieved from http://www.nationalwellness.org/index.php?id=391&id_tier=381

II. Hymavathi, C.H., Koneru, K.(2019). Investors perception towards Indian commodity market: An empirical analysis with reference to Amaravathi region of Andhra Pradesh. International Journal of Innovative Technology and Exploring Engineering. 8(7), pp. 1708-1714.

III. KishanVarma, M.S., Koneru, K., Yedukondalu, D.(2019). Effect of worksite wellness interventions towards occupational stress. International Journal of Recent Technology and Engineering. 8(1), pp. 2874-2879.

IV. Hymavathi, C., Koneru, K. (2019). Role of perceived risk in mutual funds selection behavior: An analysis among the selected mutual fund investors. International Journal of Engineering and Advanced Technology. 8(4), pp. 1913-1920.
V. Hymavathi, C.H., Koneru, K.(2018). Investors' awareness towards commodities market with reference to GUNTUR city, Andhra Pradesh. International Journal of Engineering and Technology(UAE). 7(2), pp. 1104-1106.

VI. Indian cosmetics Industry report (ICIR) 2017. A short perspective document on the cosmetics retail sector. http://redseer.com/wp-content/uploads/2017/10/118-Cosmetics-Industry-Report_Final_July2017.pdf. Accessed on May 30th, 2018.

VII. John Besley (2010). Current research on public perceptions of nanotechnology. Emerging Health Threats Journal, 3:1, 7098, DOI: 10.3402/ehtj.v3i0.7098

VIII. Kim, A.J., Ko, E. (2012). Do social media marketing activities enhance customer equity? An empirical study of luxury fashion brand. J. Bus. Res. 65 (10) 1480–1486.

IX. Lisa A. DeLouise (2012). Applications of Nanotechnology in Dermatology, Journal of Investigative Dermatology (2012) 132, 964–975

X. Nunnally, J.C.(1978). Psychometric Theory, 2nd ed., McGraw-Hill, New York, NY.

XI. NSDC & KPMG, (2017). “Human Resources and Skill Requirements in Beauty and Wellness Sector”. Retrieved from http://www.nsda.gov.in/skill%20gap%20report/sector%20skill%20gap%20report /Beauty_and_Wellness.pdf, Vol. 4. Accessed on march 10, 2018.

XII. Priyanka Singh & Arun Nanda (2012). Nanotechnology in cosmetics: a boon or bane?, Toxicological & Environmental Chemistry, 94:8, 1467-1479, DOI: 10.1080/02772248.2012.723482

XIII. Pastrana, H., Avila, A. & Tsai, C.S.J. Nanoethics (2018). Nanomaterials in Cosmetic Products: the Challenges with regard to Current Legal Frameworks and Consumer Exposure. Springer Netherlands, 1871-4757, DOI https://doi.org/10.1007/s11569-018-0317-x

XIV. Roosen, Jutta & Bieberstein, Andrea & Blanche, Sandrine & Goddard, Ellen & Marette, Stephan & Vandermeure, Frédéric. (2015). Trust and willingness to pay for nanotechnology food. Food Policy. 52. 10.1016/j.foodpol.2014.12.004.

XV. Siegrist, M. (2000). The influence of trust and perceptions of risks and benefits on the acceptance of gene technology. Risk Analysis, 20, 195–203.

XVI. Sivakoti Reddy, M. (2019). Impact of RSVQUAL on customer satisfaction: A comparative analysis between traditional and multi-channel retailing. International Journal of Recent Technology and Engineering. 8(1), pp. 2917-2920.

XVII. Sivakoti Reddy, M., Venkateswarlu, N.(2019). Customer relationship management practices and their impact over customer purchase decisions: A study on the selected private sector banks housing finance schemes. International Journal of Innovative Technology and Exploring Engineering. 8(7), pp. 1720-1728.
XVIII. Sivakoti Reddy, M., Murali Krishna, S.M. (2019). Influential role of retail service quality in food and grocery retailing: A comparative study between traditional and multi-channel retailing. International Journal of Management and Business Research. 9(2), pp. 68-73.

XIX. Sivakoti Reddy, M., Naga Bhaskar, M., Nagabhushan, A. (2016). Saga of silicon plate: An empirical analysis on the impact of socio economic factors of farmers on inception of solar plants. International Journal of Control Theory and Applications. 9(29), pp. 257-266.

XX. Suhasini, T., Koneru, K. (2019). Employee engagement through HRD practices on employee satisfaction and employee loyalty: An empirical evidence from Indian IT industry. International Journal of Engineering and Advanced Technology. 8(4), pp. 1788-1794.

XXI. Suhasini, T. Koneru, K. (2018). A study on employee engagement driving factors and their impact over employee satisfaction - An empirical evidence from Indian it industry. International Journal of Mechanical Engineering and Technology. 9(4), pp. 725-732.