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APPLICATION OF MAHALANOBIS DISTANCE AS A MEASURE ON LIFESTYLE OF HEALTH AND SUSTAINABILITY AND ITS COMPONENTS

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Abstract

The Mahalanobis distance method is used in the present investigation to assess the levels of lifestyle of health and sustainability (LOHAS), physical fitness, mental health, emotional health, spiritual health, environmentalism, and social consciousness of two groups of undergraduate students. Differences between student groups for all dependent variables tested at the same time are disregarded. The Mahalanobis Distance (MD) is a useful metric to assess the dynamical character of a set of variables. This study considers three unique dichotomous groups of students. Seven dependent variables-LOHAS, physical fitness, mental health, emotional health, spiritual health, environmentalism, and social consciousness are compared using Mahalanobis Distance to evaluate how dynamically they differ. Results showed that there are no significant differences with respect to stream, residence and gender for the variables under consideration.

Keywords: MD, Physical Fitness, Mental Health, Emotional Health, Spiritual Health, Environmentalism, Social Consciousness, LOHAS.

Introduction

LOHAS (Lifestyle of Health and Sustainability) is defined as a perceptual, attitudinal, and behavioural lifestyle that emphasises personal health and well-being in addition to environmental and social sustainability in the pursuit of balanced prosperity for people in general, the environment, and society (Cheng et al., 2019). In today's world, which is defined by both global connections and technological progress, we are confronted with complex problems that impact people's health, the quality of life, and the long-term survival of our planet. A sustainable lifestyle is a way of living that aims to minimize the harm caused by human actions to the environment, society, and the economy. This idea encourages us to use Earth's resources wisely and in a way that helps both the environment and people's quality of life (Das, et al. 2023). By living in a way that is kind to the environment, city residents can both protect nature and improve their own quality of life (Brown, 2022). Sustainable Practices that help both the planet and people by reducing social inequalities and taking care of the environment (Chen, 2021). Embracing a sustainable lifestyle is like nurturing a garden of eco-conscious choices, where each decision blooms into a brighter, greener future for our planet. A thriving future depends not on the transient popularity of sustainable living but on its essential role in shaping behaviour and psychology to promote widespread adoption of eco-conscious choices (Johnson, 2019).By weaving together, the threads of physical fitness, mental health,

emotional well-being, spiritual fulfilment, environmentalism, and social consciousness, we aspire to create a tapestry of sustainable living that not only enhances our lives but also ensures the well-being of the planet we call home. Overcoming the overuse of environmental resources is not solely an environmental challenge; it is a moral and ethical imperative. It is a reflection of our responsibility to future generations, to the countless species with whom we share this planet, and to the very ecosystems that sustain us.

Review Related to Lifestyle of Health and Sustainability

Arora and Mishra (2020) conducted a study on COVID-19 and importance of environmental sustainability and found that the COVID-19 pandemic has underscored the urgent need for humanity to unite and address the root causes of pandemics by achieving the targets of environmental sustainability, reducing greenhouse gas emissions, curbing unnecessary travel, and protecting ecosystems. Pathak et al. (2018) conducted a study on Cyanobacterial Farming for Environment Friendly Sustainable Agriculture Practices: Innovations and Perspectives and found that Cyanobacterial farming, through large-scale cultivation in systems like raceway ponds and photobioreactors, offers the potential to generate biomass for sustainable bioenergy, food supplements, nutraceuticals, biofertilizers, and aquaculture and poultry feeds, while also contributing to significant atmospheric CO_2 reduction to address global climate change, albeit requiring substantial capital and operational investment. Arora (2018) conducted a study on Biodiversity conservation for sustainable future and found that Environmental Sustainability emphasizes that understanding microbial diversity is crucial, as it can lead to the discovery of novel microbes and genes for various applications while ensuring the conservation of delicate ecosystems worldwide.

Arora (2019) conducted a study on United Nations Sustainable Development Goals 2030 and environmental sustainability: race against time and found that The urgent need for action to address the rapidly deteriorating environmental and climate emergency requires global cooperation, including measures such as removing fossil fuel subsidies, imposing carbon taxes, and labelling products with their carbon footprint, with a specific focus on low-carbon food production, green technologies in energy, transportation, and a profound transformation in human behaviour toward our environment. Arora et al. (2018) conducted a study on Environmental sustainability: challenges and viable solutions and found that the sustainability of the environment is crucial for the survival of mankind, necessitating urgent global action to shift towards green alternatives and implement biological tools and entities like microorganisms and plants to reverse the damage caused by anthropogenic activities. Strid et al. (2023) conducted a study on Expectations on implementation of a health promotion practice using individually targeted lifestyle interventions in primary health care: a qualitative study and found that Health care professionals' commitment to promoting a healthy lifestyle in primary health care settings was evident, but they faced challenges in altering their routine methods, underscoring the need for an implementation strategy to address identified obstacles and facilitating factors.

Meng et al. (2023) conducted a study on Green Household Technology and Its Impacts on Environmental Sustainability in China and found that the importance of policymakers addressing positive and negative shocks to green technology adoption separately, investing in research and development for green technologies, enhancing the role of information and communication technology (ICT) for digitalization and dematerialization of the economy, and raising education levels to promote pro-environmental practices for environmental sustainability. Setyaningrum and Muafi (2022) conducted a study on Green Human Resource Management, Green Supply Chain Management, Green Lifestyle: Their Effect on Business Sustainability Mediated by Digital Skills and found that One of the key findings from this study is that Green Supply Chain Management (GSCM) has a positive and significant effect on Business Sustainability (BS) amid the current COVID-19 pandemic and Indonesia's 4.0 and 5.0 revolutions, while Green Human Resources Management (GHRM) also plays a significant and positive role in influencing BS, but Digital Skill (DS) does not have a direct effect on BS. Prasad and Muthusamy (2023) conducted a study on A Review on Sustainable Product Design, Marketing Strategies and Conscious Consumption of Bamboo

Lifestyle Products and found that Stakeholders in the bamboo industry are embracing conscious consumption, utilizing eco-labels, and adopting transparent practices to meet the growing demand for sustainable bamboo products and cater to the urban user.Machado and Davim (2023) conducted a study on Sustainability in the Modernization of Higher Education: Curricular Transformation and Sustainable Campus - A Literature Review and found that University administrators and managers highlight financial resource scarcity and resistance to change as primary challenges in implementing sustainability at universities, emphasizing the vital roles of faculty leadership and student involvement, as well as innovative learning approaches, in addressing these issues.

Review Related to Mahalanobis Distance

In recent time, Mahalanobis Distance is used in different educational measurement to draw inference. Where inference is drawn for similarity using cluster analysis (Adhikari & Sen, 2023; Sen et al., 2023; Adhikari et al., 2023a; Ansary et al., 2023; Adhikari et al., 2023b; Mohanta et al., 2023; Gorain et al., 2022; Saha, et al., 2021), Mahalanobis Distance is used to compare the difference in achievement analysis (Ahmed et al., 2020; Sen and Pal, 2020; Ahmed et al., 2021; Ahmed et al., 2022a; Ahmed et al., 2022b) as multivariate analysis. Mahalanobis Distance is also used as a measure of multivariate analysis in educational psychology (Mahato and Sen, 2021; Gorain et al., 2021; Mohanta et al., 2023; Sen, Pal, and Adhikari, 2023; Sen et al., 2023; Adhikari, 2023). Present work is dealt with the comparison between Science and Arts, Rural and Urban and Male and Female undergraduate students with respect to LOHAS and its components viz. Physical Fitness, Mental Health, Emotional Health, Spiritual Health, Environmentalism and Social Consciousness by applying Mahalanobis Distance as a measure of Multivariate Analysis.

Objectives of the Study

Objectives of this study is to compare LOHAS, Physical Fitness, Mental Health, Emotional Health, Spiritual Health, Environmentalism, Social Consciousness and taking together as a branch for different group of undergraduate students as follows:

1. To compare the difference between Science and Arts undergraduate students regarding the condition of above-mentioned variables.
2. To compare the difference between Rural and Urban undergraduate students regarding the condition of above-mentioned variables
3. To compare the difference between Male and Female undergraduate students regarding the condition of above-mentioned variables.

Hypotheses of the Study

Following hypothesis may be considered for the present work:

$H_0$1: There is no significant difference between Science and Arts undergraduate students on LOHAS, physical fitness, mental health, emotional health, spiritual health, environmentalism, and social consciousness.

$H_0$2: There is no significant difference between Rural and Urban undergraduate students on LOHAS, physical fitness, mental health, emotional health, spiritual health, environmentalism, and social consciousness.

$H_0$3: There is no significant difference between Male and Female undergraduate students on LOHAS, physical fitness, mental health, emotional health, spiritual health, environmentalism, and social consciousness.

Research Methodology

Method Used: The present study employs the descriptive survey method.

Population of the Study: All undergraduate students of Purulia district of west Bengal, India.

Sample and Sampling of the Study: 151 samples are taken randomly.

Variable of the Study:

- Independent variable: Stream (Science and Arts), Residence (Rural and Urban), and Gender (Male and Female).
- Dependent variable: LOHAS, Physical fitness, Mental health, Emotional health, Spiritual health, Environmentalism and Social consciousness.

Tools of the Study: Lifestyle of health and sustainability scale: construction and validation by Choi and Feinberg (2021).

Statistical Measure: Mahalanobis Distance (MD) has been calculated by equation:

$$MD = \sqrt{(M_1 - M_2)^T \Sigma^{-1} (M_1 - M_2)}$$

Where M_1 and M_2 are column vector and $\sum$ is pooled covariance matrix of two groups of data.

Pooled Covariance Matrix

$$\sum = [n_1 \sum_1 + n_2 \sum_2]/N$$

Where $\sum_1$and $\sum_2$be the covariance Matrices, n_1 and n_2 are the sample sizes for first and second group respectively and $N = n_1 + n_2$.

Results and Discussions

Table 1: Descriptive statistics for different group of students

Science students (N=31)							
Dependent variable	LOHAS	PHYSICAL FITNESS	MENTAL HEALTH	EMOTIONAL HEALTH	SPIRITUAL HEALTH	ENVIRONMENTALISM	SOCIAL CONSCIOUSNESS
Mean	105.94	18.55	11.42	15.13	9.35	39.39	12.10
Arts students (N=120)							
Dependent variable	LOHAS	PHYSICAL FITNESS	MENTAL HEALTH	EMOTIONAL HEALTH	SPIRITUAL HEALTH	ENVIRONMENTALISM	SOCIAL CONSCIOUSNESS
Mean	104.53	17.77	11.30	15.17	10.38	38.38	11.52
Rural students (N=109)							
Dependent variable	LOHAS	PHYSICAL FITNESS	MENTAL HEALTH	EMOTIONAL HEALTH	SPIRITUAL HEALTH	ENVIRONMENTALISM	SOCIAL CONSCIOUSNESS
Mean	103.98	17.94	11.23	15.06	10.06	38.19	11.50
Urban students (N=42)							
Dependent variable	LOHAS	PHYSICAL FITNESS	MENTAL HEALTH	EMOTIONAL HEALTH	SPIRITUAL HEALTH	ENVIRONMENTALISM	SOCIAL CONSCIOUSNESS
Mean	106.98	17.90	11.57	15.43	10.48	39.62	11.98
Male students (N=97)							
Dependent variable	LOHAS	PHYSICAL FITNESS	MENTAL HEALTH	EMOTIONAL HEALTH	SPIRITUAL HEALTH	ENVIRONMENTALISM	SOCIAL CONSCIOUSNESS
Mean	103.92	17.91	11.25	15.18	9.99	38.14	11.45
Female students (N=54)							
Dependent variable	LOHAS	PHYSICAL FITNESS	MENTAL HEALTH	EMOTIONAL HEALTH	SPIRITUAL HEALTH	ENVIRONMENTALISM	SOCIAL CONSCIOUSNESS
Mean	106.43	17.96	11.46	15.15	10.50	39.39	11.96

Means of different dimensions and LOHAS are presented in Table 1. Different dichotomous variables like stream (Science and Arts), residence (Rural and Urban) and gender (Male and Female) are considered for representation of data. Difference in LOHAS, Spiritual Health and Environmentalism are found between Science and Arts students. Difference in LOHAS and Environmentalism are found between Rural and Urban students. Difference in LOHAS and Environmentalism are found between Male and Female students.

Table 2: Pooled Variance-Covariance Matrix for Science and Arts **Students**

	LOHAS	PHYSICAL FITNESS	MENTAL HEALTH	EMOTIONAL HEALTH	SPIRITUAL HEALTH	ENVIRONMENTALISM	SOCIAL CONSCIOUSNESS
LOHAS	247.4222	43.88565	27.21105	32.29897	26.09106	91.63862	26.29669
PHYSICAL FITNESS	43.88565	17.77918	5.123947	4.341285	1.86604	12.02842	2.746987
MENTAL HEALTH	27.21105	5.123947	5.806192	2.412364	2.708364	8.379265	2.780914
EMOTIONAL HEALTH	32.29897	4.341285	2.412364	9.472556	3.543636	9.831576	2.698146
SPIRITUAL HEALTH	26.09106	1.86604	2.708364	3.543636	7.647331	8.270848	2.054841
ENVIRONMENTALISM	91.63862	12.02842	8.379265	9.831576	8.270848	42.57639	10.55133
SOCIAL CONSCIOUSNESS	26.29669	2.746987	2.780914	2.698146	2.054841	10.55133	5.465854

Table 3: Pooled Variance-Covariance Matrix for Rural and Urban Students

	LOHAS	PHYSICAL FITNESS	MENTAL HEALTH	EMOTIONAL HEALTH	SPIRITUAL HEALTH	ENVIRONMENTALISM	SOCIAL CONSCIOUSNESS
LOHAS	246.0689	44.1148	27.03812	32.0867	25.57475	91.11221	26.14191
PHYSICAL FITNESS	44.1148	17.89364	5.14551	4.345232	1.734172	12.16687	2.829815
MENTAL HEALTH	27.03812	5.14551	5.785437	2.388311	2.652616	8.306517	2.759007
EMOTIONAL HEALTH	32.0867	4.345232	2.388311	9.446887	3.523808	9.733232	2.649232
SPIRITUAL HEALTH	25.57475	1.734172	2.652616	3.523808	7.767192	7.98545	1.91151
ENVIRONMENTALISM	91.11221	12.16687	8.306517	9.733232	7.98545	42.40047	10.51938
SOCIAL CONSCIOUSNESS	26.14191	2.829815	2.759007	2.649232	1.91151	10.51938	5.473132

Table 4: Pooled Variance-Covariance Matrix for Male and Female Students

	LOHAS	PHYSICAL FITNESS	MENTAL HEALTH	EMOTIONAL HEALTH	SPIRITUAL HEALTH	ENVIRONMENTALISM	SOCIAL CONSCIOUSNESS
LOHAS	246.4502	44.09547	27.13806	32.31836	25.53105	91.23146	26.1358
PHYSICAL FITNESS	44.09547	17.89891	5.144596	4.351715	1.737119	12.14156	2.821205
MENTAL HEALTH	27.13806	5.144596	5.801689	2.416649	2.660013	8.346702	2.768768
EMOTIONAL HEALTH	32.31836	4.351715	2.416649	9.470523	3.54851	9.843338	2.687623
SPIRITUAL HEALTH	25.53105	1.737119	2.660013	3.54851	7.734411	7.960212	1.890788
ENVIRONMENTALISM	91.23146	12.14156	8.346702	9.843338	7.960212	42.42902	10.51163
SOCIAL CONSCIOUSNESS	26.1358	2.821205	2.768768	2.687623	1.890788	10.51163	5.455788

Table 5: Mahalanobis Distance for seven dependent variables LOHAS, physical fitness, mental health, emotional health, spiritual health, Environmentalism, social consciousness

Independent variables	Science Vs Arts	Rural Vs Urban	Male Vs Female
Mahalanobis Distance	0.6207	0.2704	0.4406

Table 5's Mahalanobis Distance values reveal insignificance in differences. Therefore, no substantial distinction exists in the dynamics of the dichotomous groups, when the seven dependent variables (LOHAS, physical fitness, mental health, emotional health, spiritual health, environmentalism, and social consciousness) are combined. Thus, we accept $H_0$1, $H_0$2, and $H_0$3.

Conclusion

The Mahalanobis Distance values indicate a lack of significant differences, suggesting that the dynamics between the dichotomous groups are quite similar. When we combine the seven dependent variables, namely LOHAS, physical fitness, mental health, emotional health, spiritual health, environmentalism, and social consciousness, no substantial distinctions emerge among the groups. Consequently, we find ample evidence to accept the null hypotheses $H_0$1, $H_0$2, and $H_0$3.In essence, this implies that there is little to no variation in the studied characteristics between the groups, reinforcing the notion of their similarity. Overall, the Mahalanobis Distance analysis underscores the absence of noteworthy differences in the mentioned dependent variables, affirming the acceptance of multiple null hypotheses.

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