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Research Article

Reliability Assessment of Himalayan Trekking Indicators Through Cronbach's Alpha

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ABSTRACT

Tourism significantly impacts global economies, outpacing overall economic growth with a notable 3.5% increase in 2019, contributing USD 9.2 trillion to the worldwide GDP. Adventure tourism, a rapidly expanding sector, offers exciting experiences and minimal infrastructure needs, making it suitable for ecologically sensitive regions. With its diverse natural resources, particularly in the Himalayan range, India is well-positioned to develop this sector. Trekking, a key adventure tourism activity, requires careful planning and understanding of trail difficulties, which are often inconsistently assessed. This paper aims to quantify trekking trail quality through specific attributes—spatial, climatic, regional connectivity, and perception-based—and tests this reliability using Cronbach's Alpha. A questionnaire formed on a 9-point Likert scale was distributed to two groups, one containing trekkers (RG1) and the other having experts (RG2). Results indicated high internal consistency after iterative refinement of the indicators. RG2's streamlined model, with higher initial consistency and fewer iterations needed to achieve reliability, is recommended for the assessment due to its balanced and comprehensive approach. This research underscores the importance of reliable trail assessment methodologies to enhance trekking experiences and promote sustainable adventure tourism in India.

Keywords: Adventure tourism, ecologically sensitive regions, infrastructure, suitability of trekking, reliability of indicators, Cronbach's Alpha

INTRODUCTION

Tourism is a significant contributor to global economies, with a growth rate surpassing that of the overall global economy. The World Travel & Tourism Council (WTTC) reported a 3.5% growth in travel and tourism globally in 2019, outpacing the global economic growth of 2.5%. This sector contributed USD 9.2 trillion to the global GDP, accounting for 10.4% (World Bank Group, 2020). Tourism is a pivotal source of employment and economic stimulus, directly employing 119 million and supporting 313 million individuals globally (World Bank Group, 2020). India, recognizing its potential, launched the "Incredible India" campaign in 2002, focusing on adventure tourism and overall sectoral growth (Draft National Tourism Policy 2022 12 Th July 2022 Ministry of Tourism Government of India.; National_tourism_Policy_2002.; Tourism Policy 1982). This study explicitly aims to determine the key attributes necessary for assessing trekking trail quality and difficulty levels, using a structured evaluation method. Cronbach's Alpha is used to test the reliability of selected indicators and compare the perspectives of trekking enthusiasts and experts to develop a standardized assessment approach. Tourism is booming today, covering many service and hospitality sectors and offering thrilling experiences in beautiful natural settings. It is now one of the fastest-growing industries globally. Adventure tourism, a branch of this industry, is attracting many travellers. Destinations that cater to adventure seekers and appeal to those looking for leisure and relaxation are particularly popular. Adventure tourism blends elements of eco, sport, and nature-based travel. Although it is not new as a commercial activity, it is gaining fresh momentum. Today, adventure tourism is more popular, especially among sophisticated travellers who seek experiences beyond just relaxing at a destination. While travel costs remain steady, tourists now look for added experiences in their itineraries to enrich their journeys.
India's diverse natural resources offer vast potential for tailored tourism products, particularly in its extensive Himalayan range. The region's varied topography, encompassing lakes, cliffs, rivers, and forests, presents opportunities for unique mountain-based tourism experiences. However, development in these ecologically

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sensitive areas necessitates a cautious approach to mitigate long-term environmental and cultural impacts (K., K., A., & A., 2014). With approximately 21% of its land area comprising mountains, India aims to leverage its geographical diversity to pioneer the tourism industry, exemplified by initiatives like "Incredible India." The Indian Himalayan Region (IHR) holds promise as a premier adventure tourism destination, with trekking and camping being popular activities (Neilsen, 2016).

Trekking and hiking involve foot travel in nature but differ in intensity and duration. Trekking is multi-day, physically demanding, and impacts fragile environments, while hiking is typically a day-long, less intense activity (*AMALPI Trek: A Geocultural Trail from Maloja to St. Gotthard to Increase the Awareness of Natural Hazard in Mountain Settings*, 2023; Bongaardt, Røseth, & Baklien, 2016; Lone, 2022; Paweł Różycki & Dryglas, 2014). Therefore, adventure tourism offers a way to generate revenue and local employment with minimal anthropogenic impact. It serves as a model where the tourism industry and nature can coexist and complement each other. The adventure tourism service network relies heavily on local connections, thereby promoting and strengthening local employment and partnerships. Unlike mainstream tourism, which emphasizes luxury and lavishness, the infrastructure and facilities required for adventure tourism are minimal and do not necessitate extensive construction. Consequently, developing adventure tourism trails in ecologically fragile areas is feasible. However, some infrastructural and facility-related challenges may arise. It has been observed that in the post-pandemic scenario, tourists have reiterated their choices for a destination and prefer visiting off-beat locations and experiencing new tourism products (Gössling, Scott, & Hall, 2021; Noorashid & Chin, 2021; ONU, 2019; Smith, Velasquez, Norman, & Pickering, 2023; The World Bank Group, 2020). Here is a bar chart representing the growth of the global adventure tourism industry. It shows the industry's value in 2018 at $586.3 billion and its projected value in 2026 at $1.3 trillion. India's adventure tourism, rich with natural diversity, is developing. The Ministry of Tourism's initiative to open new peaks offers potential but faces policy, infrastructure, and safety challenges, needing robust regulation and investment.

Another major issue is that not all trekkers are at the same level in terms of trekking experience and physical capabilities. India is on a shift from mainstream tourism to alternative tourism. From the era of operator-conducted mainstream tours to popularizing off-beat locations, India is not at a stage for hardcore adventure trekkers. Rather, the major potential of the market lies in experiential tourism, where tourist-turned-trekkers would like to experience treks and stay in a tent. Most of them are first-time trekkers (85.7%) or know little about the difficulties and obstacles they will face on a trekking trip (Chopda, Bedekar, Shyam, & Sancheti, 2022; Maoz & Bekerman, 2009). A study assessing trekkers' first aid knowledge found that 40.5% encountered medical incidents during their trips, suggesting that many trekkers in India may be inexperienced or inadequately prepared (Maoz & Bekerman, 2009).

Trekking routes are categorized into difficulty levels, like Easy, Easy-moderate, Difficult, etc. Numerous websites and resources declare the difficulty level of a trekking route to be at some level; however, this data does not corroborate (Calbimonte, Martin, Calvaresi, & Cotting, 2021; P Różycki & Dryglas, 2014). This implies that the difficulty assessment of a trail is not transparent and uniform. This creates ambiguity among the trekkers and makes the decision-making process difficult. Moreover, the methodology for assessing the difficulty is not transparent and is mostly based on experiential and qualitative. Without quantitative descriptions and details on the grading system, it is hard for inexperienced trekkers to understand and plan their trekking activities effectively. Hence, this method intends to assess the quality of a trail and its suitability for various users' skill sets needs to be assessed. To quantify the quality of the trekking trail, some attributes, sub-attributes, and indicators relevant to trekking are taken. These Attributes can be broadly classified into four major types: Spatial, Climatic, Regional Connectivity, and Perception-based. In this paper, the reliability of these attributes and sub-attributes are being tested–using a method based on Cronbach's Alpha for the assessment methodology.

This study explores the need for a reliable method to assess trekking trails in India, a country with vast potential for adventure tourism due to its diverse natural landscapes. With the increasing popularity of trekking, especially among first-time trekkers, there is a pressing need for a standardized, quantitative system to evaluate trail difficulty. The study aims to develop a methodology using Cronbach's Alpha to assess the reliability of various attributes and indicators, ensuring that trekking routes are accurately graded, thereby improving safety and enhancing the trekking experience for all users.

LITERATURE STUDY

2.1 Brief literature on trekking

Trekking tourism in the Himalayan region has significantly impacted the structure of forest ecosystems (Boonyasurat, 2023). The growth of trekking activities in high-elevation areas has led to environmental impacts such as the emergence of non-native plants, issues with rubbish disposal, and improper waste disposal (Paudel, Li, & Kim, 2022). Additionally, trekkers' activities have extensively affected the conservation of vegetation along the trekking trails (Haunolder et al., 2022). These impacts highlight the need for sustainable practices in trekking tourism to minimise ecological damage. Studying trekkers' attitudes, intentions, and behaviour towards the environment is crucial to promoting pro-environmental behaviours (Apollo & Andreychouk, 2022). Adequate pre-travel examination, consultation, and personal preparation are essential to ensure the health and safety of trekkers (Suneel Kumar, Valeri, Shekhar, Sageena, & Mandić, 2023). Sustainable mountain tourism development requires a cooperative approach among stakeholders, including local communities, governments, and tourism authorities, to address environmental concerns and promote responsible trekking practices. But it is very difficult for a trekker to choose an appropriate trekking trail according to their level of expertise- be it a beginner or intermediate trekker or an expert trekker. The levels of challenges and difficulties are not known to a trekker before starting the trek. Moreover, the trekker is completely unaware of the changes in various seasons' difficulties and problems. The study attributes are chosen to fill this gap.

2.2 Selection of Attributes, Sub-attributes and Indicators

The literature content on this specific research area is scarce. When searched with the prime keyword "trekking," the database shows 107. When analysed categorically, these results show that the top three categories are Public Environmental Occupational Health, Biochemistry and Molecular Biology, and Sports Sciences. Some relevant literature was selected from the Geography, Environmental Studies, and other Geoscience Multidisciplinary studies. Hence, three sources were used parallelly to select the attributes and sub-attributes: literature study, operator and enthusiastic survey, and expert opinion.

2.2.1 Spatial Attributes

The Spatial Attributes of a trekking trail include various elements crucial for planning and assessment. Altitude covers acclimatization, detailing the process and duration needed for trekkers to adjust to higher altitudes and acrophobia, considering the impact of fear of heights. The Natural Drinking Water Source at the Campsite includes the time required to fetch water, the importance of the water source's perenniality for reliability, and the quality of water, ensuring it is safe to drink. Geographic Obstacles are examined by measuring the width and flow rate of rivers or streams and the depth of cliffs, identifying potential challenges. Land and Ground Cover involve the types of vegetation along the trail, ground conditions such as rocks or dirt, and noting wildlife crossings and habitation areas. The Gradient of the Trail includes details about the slope's steepness, climb rate for altitude gain, descent rate for altitude loss, and the aspect ratio, all crucial for understanding the trail's difficulty.

2.2.2 Climatic Attributes

This includes snow cover for each section of the trail, describing the presence and extent of snow, relative humidity for each section, measuring the moisture content in the air, average annual rainfall of the region, providing an overview of rainfall patterns, peak rainfall during monsoon, highlighting the intensity of monsoon rains, solar radiation intensity, indicating the strength of sunlight, average daytime temperature, giving an average of daytime temperatures, average night-time temperature, giving an average of nighttime temperatures, and impact of wind speed at campsites, assessing how wind conditions affect camping.

2.2.3 Connectivity Attributes

This attribute evaluates the availability of tourist-oriented bus services in proximity to the start and end points of a trekking trail, the number of buses running on this route each day, the proximity of railway stations to the start and end points, the number of trains running on the same route each day, and the distance of taxi stands from the start and end points of the trek, measuring ease of access to transportation services.

2.2.4 Perception Attributes

This includes total trek distance, the overall length of the trek, other tourist destinations in proximity, highlighting nearby attractions, number of exit points in a trekking trail, identifying points where trekkers can exit if necessary, total trek time, the estimated total duration to complete the trek, trek distance per day, the average distance covered each day, altitude gain per day, the average altitude gain each day, and uniqueness of the route, assessing how distinctive and special the trekking route is compared to others.

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2.3 Need for Reliability Tests

Testing the reliability of a questionnaire is crucial to ensure the accuracy and consistency of the data collected, ultimately enhancing the validity of the research findings. Reliability, as discussed in various research papers (Arundel, 2023; Giordano, Piras, Boschini, & Falasconi, 2018; Santhosh Kumar, 2021; Solans-Domènech, MV Pons, Adam, Grau, & Aymerich, 2019), refers to the ability of a questionnaire to produce consistent results when administered multiple times or by different researchers. By testing reliability, researchers can assess if the questionnaire consistently measures what it is intended to measure, minimizing errors and increasing the trustworthiness of the data. This process is essential in research areas such as impact assessment, food waste quantification, and soft skills training evaluation, where precise and dependable data are paramount for drawing accurate conclusions and making informed decisions.

2.4 Majorly used reliability tests

Split-half reliability is a method used to estimate the inter-item reliability of measures obtained from repeatedly administered items. It is commonly used in psychological and educational research to assess the internal consistency of a scale or test. Several papers in the provided abstracts discuss split-half reliability in different contexts. For example, (Armed, Ahmed Anjum, Batool, Ur Rasheed, & Pakistan, 2018) compare the maximal split-half coefficient with other internal consistency estimates and highlight its potential to overestimate or underestimate reliability. (Thompson, Green, & Yang, 2010) introduces a software tool called RELEX that randomly assembles test halves to estimate split-half reliability. (Steinke & Kopp, 2020) presents an iterative method for dichotomizing a test into parallel halves to ensure maximum split-half reliability. (Nath Chakrabartty, 2013) calculates split-half reliability estimates for facial imagery questionnaires.

The concept of test-retest reliability is crucial for assessing the stability of measurement instruments over time (Assessing survey response stability A Complementary Quality Assurance Protocol for Survey Studies in the Social Sciences, 2022; Ujlaky et al., 2021). Test-retest reliability involves administering the same test to the same group of participants on two separate occasions and correlating the scores obtained to evaluate consistency and reproducibility (Stahl et al., 2022). This method is essential in various fields, including social sciences and clinical practice, to ensure that the measurements are accurate, consistent, and error-free (CEYLAN, DEMİR, & ELRİ, 2021; Manterola Delgado et al., 2018). By examining the correlation between scores from repeated measurements, researchers can determine the instrument's reliability and the degree of stability in the participants' responses over time.

Inter-rater reliability assesses the consistency of measurements among different raters or observers, which is crucial in fields like psychology, sociology, and education, where subjective judgments are prevalent. Various indices exist to measure inter-rater reliability, with experts disagreeing on the most appropriate ones (Babu & Kohli, 2023; Zhao, Feng, Ao, & Liu, 2022). Factors like rating category, distribution skew, and task difficulty can impact the accuracy of reliability indices, with some indices underestimating or overestimating reliability levels (Martinková, Bartoš, & Brabec, 2022). Additionally, contextual variables such as gender, major, or raters' experience can influence inter-rater reliability, highlighting the importance of identifying and addressing such sources of heterogeneity to enhance measurement accuracy (Leventhal & Gregg, 2022). Studies have shown that through proper training and strategy development, high levels of inter-rater reliability can be achieved, as demonstrated in scenarios like training new driver rehabilitation specialists to identify driving errors accurately (Jeghers, Monahan, Wersal, & Classen, 2022).

Parallel Forms Reliability is known as the repeated measures correlation (rmcorr), which assesses the common within-individual association for paired measures across multiple occasions for multiple individuals (Clayson, Baldwin, & Larson, 2021). This statistical method is particularly useful for examining the consistency between two different, but equivalent versions of a test administered to the same group of participants without violating the assumption of independence of observations (Bureš, Cabal, Čech, Mls, & Ponce, 2020). Unlike traditional simple regression/correlation methods that may produce biased results due to violations of independence or differing patterns between participants and within participants, rmcorr estimates the common regression slope shared among individuals, providing greater statistical power without the need for averaging or aggregation of data (Shieh, 2021). The rmcorr technique is well-suited for analysing paired repeated measures data and is supported by the development of the R package (rmcorr) for accessible implementation in research studies (Tohka, Pollick, Pajula, Kauppi, & Virtanen, 2018).

Kuder-Richardson Formula: Similar to Cronbach's alpha, the Kuder-Richardson formula assesses the internal consistency of dichotomous (yes/no) items in a scale or questionnaire (Nilsson, Garvin, Festin, Wenemark, & Kristenson, 2020). Cronbach's alpha and Kuder-Richardson Formula 20 (KR-20) are internal consistency reliability measures, but their application and assumptions differ. Cronbach's alpha is used for polytomous items, whereas KR-20 is designed explicitly for dichotomous items (A Uyanah & U. I, 2023). KR-20 assumes equal item difficulty, which can lead to underestimation if items have varying difficulties. In contrast, Cronbach's alpha does not make this assumption. Both measures are recognized as valid internal consistency estimates, but the choice between them depends on the type of items and the research context (Soto & Charter, 2010).

The Guttman Split-Half Coefficient is an alternative to the Spearman-Brown formula for estimating the reliability of split-half measures. Unlike the Spearman-Brown formula, Guttman's method does not assume equal reliability or variance between the two halves (tau-equivalence) ("Reliability Analysis | Statistical Software for Excel," 2023). This makes it more suitable when items are ordered hierarchically. Guttman's lambda 4 is the most used measure of this type(Zaiontz Charles, 2022).

The coefficient of stability measures the consistency of scores obtained from two different administrations of the same test to the same group of participants (McCrae, Kurtz, Yamagata, & Terracciano, 2011). This metric is particularly useful in longitudinal studies where the same test is administered over multiple time points, allowing researchers to assess the test's reliability and validity (Levin, 1993).

These are some of the tools that provide various options for assessing the reliability of their measurement instruments, each with its own strengths and limitations depending on the nature of the data and the research context. Choosing the most appropriate reliability measure depends on factors such as the type of data collected, the structure of the measurement instrument, and the research objectives.

2.5 Cronbach's Alpha

Cronbach's alpha is another statistical measure used to assess the internal consistency or reliability of a set of scale items or questionnaire items intended to measure a single construct or variable. It is widely employed in research to ensure that the items within a scale or questionnaire consistently measure the same underlying concept. Cronbach's alpha values range from 0 to 1, with higher values indicating greater internal consistency among the items.

One of the primary reasons for using Cronbach's alpha is to determine the extent to which the items in a scale or questionnaire measure the intended construct reliably. A high Cronbach's alpha value suggests that the items are strongly correlated with each other, indicating that they are all measuring the same underlying construct effectively. This ensures that the scale or questionnaire is reliable and valid for measuring the intended variable. In a study by Nunnally and Bernstein (1994), the authors emphasize the importance of internal consistency reliability in psychometric measurement (Nunnally, 1994). The paper discusses Cronbach's alpha as a key method for assessing reliability and suggests that researchers should strive for alpha values above 0.70 to ensure the reliability of their measurement instruments. Cronbach's alpha value of 0.859 > 0.7 thresholds shows high internal consistency in data. The use of Alpha is done to ensure reliability in survey responses for accurate conclusions and valid inferences (Srikanth, Kanimozhee, & Ramireddy, 2023). Typically, a scale would require enough items to achieve a Cronbach's alpha value greater than 0.7. The number of items in a scale impacts the reliability coefficient estimation. Increasing the number of items can enhance the scale's reliability (Vaske, Beaman, & Sponarski, 2016). For instance, a 4-item scale with an alpha of 0.80 can see its reliability increase to 0.86 with 6 items and 0.91 with 10 items, assuming a constant average correlation among the items (Fashina, Omar, Sheikh, & Fakunle, 2021). Therefore, the number of iterations needed to obtain an alpha value above 0.7 would depend on the initial alpha value and the number of items in the scale, with a general trend requiring more items to reach higher reliability levels (Eys, Carron, Bray, & Brawley, 2007).

Using Cronbach's Alpha, it can be determined if the survey questions are internally consistent and reliable in capturing the factors influencing mode choice behaviour, providing confidence in the study's findings and conclusions (Abdullah, Ali, Bilal Aslam, Ashraf Javid, & Arif Hussain, 2022). Additionally, Cronbach's alpha can be used to assess the need for item deletion or refinement within a scale or questionnaire. If the alpha value is low, it may indicate that some items are not contributing effectively to measuring the underlying construct and may need to be revised or removed. This process helps improve the reliability and validity of the measurement instrument. Cronbach's alpha assesses the internal consistency reliability of scale or questionnaire items, ensuring that they effectively measure the intended construct. It provides a quantitative measure of reliability and helps identify items that may need to be revised or removed to improve the quality of the measurement instrument.

Cronbach's Alpha is esteemed over other methods owing to its extensive application and dependability in evaluating internal consistency (Hayes & Coutts, 2020). It is highly esteemed across various disciplines, including communication studies, where it is recognized as a robust measure of reliability (Fashina et al., 2021). The calculation of Cronbach's Alpha incorporates the variance of scores on individual items and the total observed test scores, thereby offering a thorough reliability assessment (Fashina et al., 2021). Empirical research has demonstrated that Cronbach's Alpha consistently produces high internal consistency coefficients, signifying strong reliability in data collection. Its capacity to assess the correlation between observed and true scores renders it an invaluable tool for researchers aiming for dependable and valid outcomes. The widespread

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usage, clarity of interpretation, and established reliability of Cronbach's Alpha underscore its status as the preferred method for assessing internal consistency in research studies.

The Cronbach's alpha test has several drawbacks and limitations. It is sensitive to homogeneity issues, assuming all items measure the same construct, which may not always be true. The scale length can also influence the reliability coefficient, potentially leading to overestimation or underestimation. Furthermore, Cronbach's alpha assumes tau-equivalence, where all items are equally correlated with the total score, which may not hold true in practice. Finally, it is susceptible to variability in item difficulty and discrimination, potentially affecting the accuracy of the reliability estimate (Lisawadi, Ahmed, Reangsephet, & Shah, 2018; Pastore & Lombardi, 2014; Roberti, Roberti, Pereira, & Costa, 2016; Saengduenchai, Nilaban, Singtho, Ranuwattananon, & Kalayasiri, 2023; Tavakol & Dennick, 2011).

METHODOLOGY

The research question to be addressed in this paper is to assess the reliability of the attributes, sub-attributes and indicators tested with Cronbach's Alpha. The methodology is 4 stepped shown in **Figure 1**.

3.1 Questionnaire Formation

Multi-Item Measurement Scales (MIMS) questionnaires are used in various research fields to measure complex constructs with multiple dimensions. These questionnaires typically include several questions (or items) related to various aspects of the measured construct (Bhatia & Jain, 2017; Radomska, Szpulak, & Wołczek, 2023; Robinson, 2018). MIMS are valuable tools for assessing and evaluating complex constructs that are not directly observable, such as consumer behaviour and perceptions (Bassi, 2018; Raja, Anand, & Kumar, 2020).

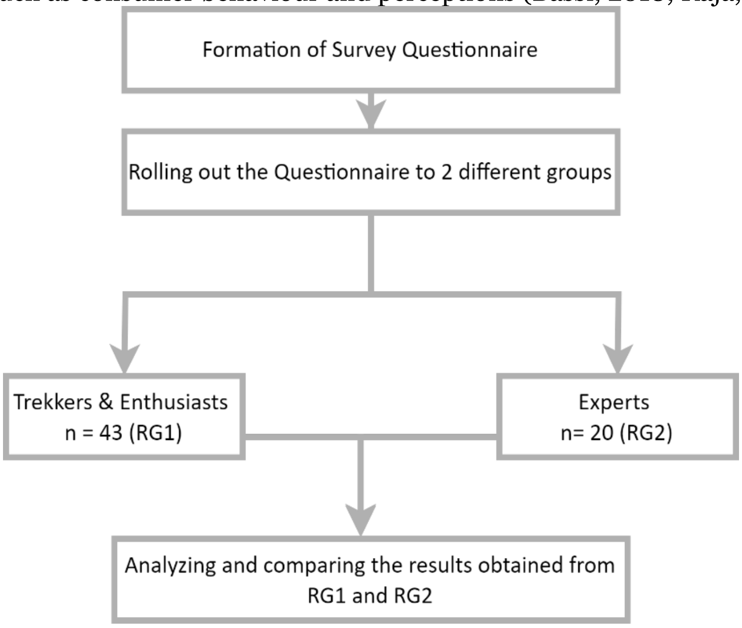

Figure 1 Process of Data collection and Reliability test

A questionnaire is formed based on the 9-point Likert scale (Appendix I). In this questionnaire, the sub-attributes were arranged such that respondents would rate the importance of the sub-attributes on a 9-point scale, 1 being the least important and 9 being indispensably important. Each sub-attribute is evaluated individually in this questionnaire. The motive of designing this type of questionnaire is two-fold, firstly it will provide us individual importance of a specific sub-attribute. Secondly, the data collected shall be analysed by Cronbach's Alpha to check the reliability of the Questionnaire.

The choice of the Likert scale depends on several factors such as the specific research question, the population being studied, and the desired level of precision. Here are some points to consider: Studies suggest that expanding the range of the Likert scale optimizes the performance of reliability and validity of the measurement model. For instance, a study comparing different Likert scales found that a 9-point scale performed well regarding reliability and validity (Malik et al., 2021). Using a 9-point scale can help mitigate response bias and central tendency bias, affecting the validity and reliability of the Likert scale instrument (Kusmaryono,

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Wijayanti, & Maharani, 2022). Adding modifiers to the intermediate anchors of Likert scales can help them become interval-like scales. For example, using strongly disagree, moderately disagree, neutral, moderately agree, and strongly agree can provide more nuanced data (Hutchinson & Chyung, 2023). However, the choice of the Likert scale should also consider practical considerations such as respondent burden and the need to balance detailed responses with the need to keep the survey manageable (Dolnicar, 2021). While a 9-point Likert scale can be a viable choice for a MIMS due to its potential for high reliability and validity, the decision depends on the specific research context and the need to balance various factors.

3.2 Methodology of Cronbach's Alpha

Cronbach's alpha measures the internal consistency or reliability of a psychometric instrument. It assesses the extent to which multiple test items that propose to measure the same general construct produce similar scores. The methodology involves calculating the average of all possible split-half correlations of the items in the test. The first step is to compute the covariance between each pair of items. Then, these covariances are summed and divided by the total variance of the test. The formula for Cronbach's alpha is provided in Equation (i).

$$a = \left(\frac{k}{((k-1))}\right) \times \left(1 - \sum \frac{(\sigma\_i^2)}{(\sigma\_t^2)}\right) \qquad \ldots\ldots\ldots Equation\ (i)$$

where k is the number of items, σ_i^2 is the variance of each item, and σ_t^2 is the total variance of the test. A higher value of Cronbach's alpha, typically above 0.70, indicates better internal consistency. However, remarkably high values above 0.90 might suggest redundancy among items. Cronbach's alpha is sensitive to the number of items in the test; more extended tests tend to have higher alpha values. The iteration process will continue excluding some indicators in every iteration until the Cronbach alpha values are satisfactory or there are no visible improvements even after eliminating certain indicators. Typically, if the Cronbach Alpha value is 0.95 or more, it is considered as redundant when there is a semantic overlap between the items in the measure (Alkhadim, 2022; Kilic, 2016; Prelog, Berry, & Mielke, 2009).

DATA ANALYSIS AND RESULTS

4.1 Respondents' profile

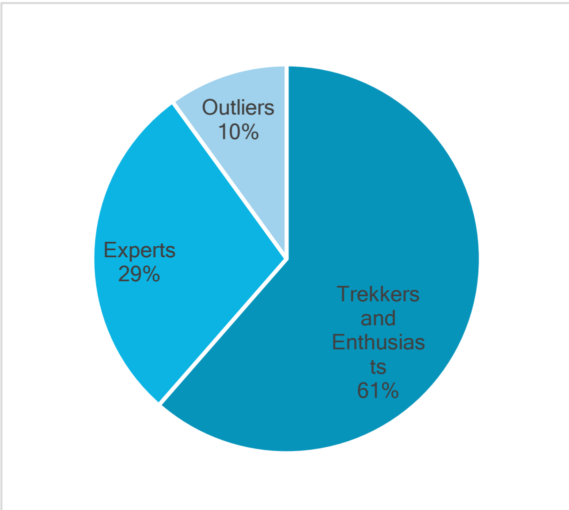

Figure 2 Respondents profile

The same questionnaire was sent to two groups of respondents. A total of 70 responses were collected, out of which 3 samples had not done trekking even once; hence, their responses were excluded. 4 samples were not complete or broken (**Figure 2**). The first group is the group of trekkers and trekking enthusiasts who have experienced at least one trek till now. This group also consists of experienced trekkers *(n=43)*. This paper addresses this group as respondent group 1 (RG1). The second group (n=20) consists of experienced trek leaders and various field experts from related fields like geography, geology, anthropology, etc. This group is addressed as respondent group 2 (RG2). We aim to determine whether the responses of the two groups are in consensus.

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The two groups, i.e. RG1 (n=43) and RG2 (n=20), have different sample sizes. All the computation for Cronbach's Alpha was done in SPSS 25. For RG1, four iterations were computed. In every iteration, a few indicators whose "Cronbach's Alpha if Item Deleted" values were higher, i.e. the indicators, if deleted, would increase the alpha value, were deleted. This is part of reducing the indicators and finding the best-suited indicators for the assessment.

Analysis of RG1: The iterations are assessed using Cronbach's Alpha values, which measure internal consistency, with the values ranging from 0.739 in Iteration 0 to 0.920 in four iterations, indicating improved reliability over time and reducing the total number of indicators to 15. Firstly, the variances are calculated for each item. Then the total variance of the summed scores across all the item is calculated. After that Cronbach alpha is calculated by substituting the values in Equation (i).

The initial iteration began with an Alpha value of 0.739, including all indicators. As the iterations progressed, indicators that contributed less to the overall reliability were systematically excluded, resulting in progressively higher Alpha values as shown in **Figure 3**.

In Iteration 1 (Alpha = 0.814), indicators that did not meet the threshold for inclusion were removed. Specifically, indicators like Acrophobia, Vegetation type, Average annual rainfall of the region, Tourist-oriented Bus Service in the proximity of the start and end point of a trekking trail, and Total trek time were excluded. The threshold for exclusion during this iteration was any indicator with an Alpha contribution less than 0.750.

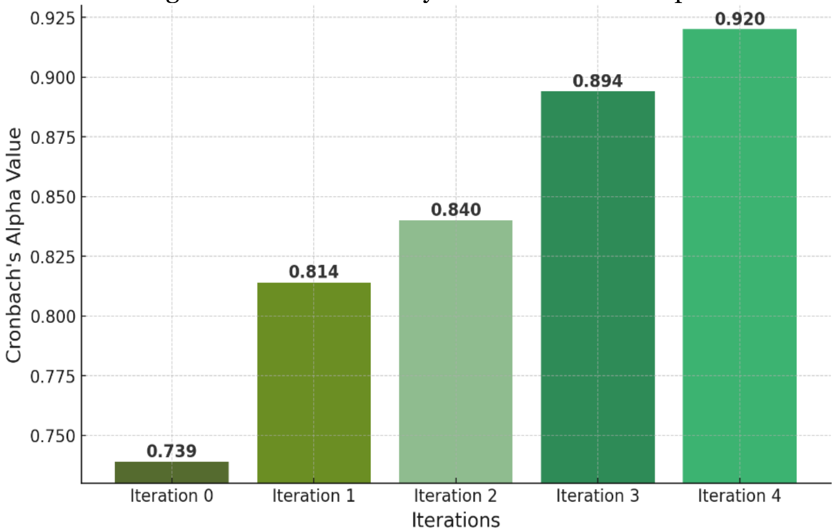

Figure 3 Cronbach Alpha iterations, Respondent Group 1

Moving to Iteration 2 (Alpha = 0.840), the reliability was further refined by excluding additional indicators. These included the Total time taken to acquire drinking water from the campsite, Width & Flow-rate of river/stream, depth of a cliff, Ground Cover, Slope of the trail, and Number of trains running on the same route each day. The exclusion threshold for this iteration was indicators contributing less than 0.824 to the overall Alpha.

In Iteration 3 (Alpha = 0.894), a significant refinement was made, and more indicators were excluded to enhance reliability. This iteration saw the removal of indicators like Acclimatization, Importance of the Perenniality of natural water sources, Quality of water available for drinking purposes, Average daytime temperature, and Average night-time temperature. The threshold for exclusion was set at an Alpha contribution of less than 0.847.

Finally, Iteration 4 (Alpha = 0.920) aimed to maximize the internal consistency by excluding even more indicators. The indicators removed in this final iteration included Climb rate, Descent rate, Aspect Ratio for the slope, Impact of wind speed at campsites, Number of buses running on this route each day, and Uniqueness of the route. The threshold for exclusion in this final iteration was any indicator with an Alpha contribution of less than 0. 895.

The exclusion of certain indicators aimed to enhance the overall reliability of the test, as evidenced by the increasing Cronbach's Alpha values over the iterations. This significant improvement suggests that the indicators retained through each iteration provided a more consistent and reliable measure of the attributes. However, this process might also lead to a loss of some detailed aspects of the attributes. For example,

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indicators like "Acclimatization" and "Gradient" were excluded in later iterations despite being initially considered important. The removal of these indicators means that while the remaining measures are more reliable, the assessment may lack some nuanced insights that these excluded indicators could have provided. The exclusion process simplifies the model by focusing on the most relevant and consistent indicators, thereby streamlining the test. For instance, the exclusion of "Acclimatization" and "Average annual rainfall of the region" likely reduced the complexity of the assessment. However, this simplification comes with a trade-off against comprehensiveness. While the test becomes more straightforward to administer and interpret, it may no longer capture all the intricate details of the trekking environment that were initially considered. Removing "Gradient" and "Total trek time" might lead to a less comprehensive understanding of the trail's difficulty and overall trekking experience, which could be necessary for specific analyses. The retention of indicators such as "Quality of water available for drinking purpose," "Relative humidity for each section of the trail," and "Number of buses running on this route each day" throughout all iterations underscores their robustness and relevance, contributing significantly to the overall reliability of the test.

Table 1 Iterations of Respondent Group 1 and the excluded indicators

Attributes	**Sub-attributes**	**Indicators**	**Iteration 0**	**Iteration 1**	**Iteration 2**	**Iteration 3**	**Iteration 4**
			Alpha = 0.739	**Alpha = 0.814**	**Alpha = 0.840**	**Alpha = 0.894**	**Alpha = 0.920**
Spatial	Altitude	Acclimatization	✓	✓	✓	✓	×
		Acrophobia	✓	×	×	×	×
	Natural drinking water source at camp-site	Total time taken to acquire drinking water from campsite (to and fro)	✓	✓	×	×	×
		If the drinking water source is natural source, then what is the importance of its Perenniality	✓	✓	✓	✓	✓
		Quality of water available for drinking purpose	✓	✓	✓	✓	✓
	Geographic obstacle	Width & Flow-rate of river/stream, depth of a cliff	✓	✓	✓	✓	×
	Land and ground cover	Vegetation type	✓	×	×	×	×
		Ground Cover	✓	✓	✓	×	×
		Wild-life crossings and wild-life habitation areas	✓	✓	✓	✓	✓
	Gradient of the trail	Gradient	✓	✓	✓	×	×
		Climb rate	✓	✓	✓	✓	✓
		Descent rate	✓	✓	✓	✓	✓
		Aspect Ratio for the slope	✓	✓	✓	✓	✓
Climatic	Climatic attribute	Snow Cover for each section of the trail	✓	✓	✓	✓	✓
		Relative humidity for each section of the trail	✓	✓	✓	✓	✓
		Average annual rainfall of the region	✓	×	×	×	×
		Peak rainfall during monsoon	✓	✓	✓	✓	✓
		Solar Radiation Intensity	✓	✓	✓	✓	✓
		Average daytime temperature	✓	✓	✓	✓	×

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Attributes	**Sub-attributes**	**Indicators**	**Iteration 0**	**Iteration 1**	**Iteration 2**	**Iteration 3**	**Iteration 4**
			Alpha = 0.739	**Alpha = 0.814**	**Alpha = 0.840**	**Alpha = 0.894**	**Alpha = 0.920**
		Average night-time temperature	✓	✓	✓	✓	×
		Impact of wind speed at campsites	✓	✓	✓	✓	✓
Connectivity	Regional connectivity	Tourist-oriented Bus Service in the proximity of the start and end point of a trekking trail	✓	✓	✓	×	×
		Number of buses running on this route each day	✓	✓	✓	✓	✓
		Railway Station in proximity to the start and end point of a trekking trail	✓	✓	✓	✓	✓
		Number of trains running on the same route each day	✓	✓	✓	✓	×
		Distance of taxi stand from the start and end point of a trek	✓	✓	✓	×	×
Perception	Perception based	Total trek distance	✓	✓	✓	✓	×
		Other tourist destinations in proximity	✓	✓	✓	✓	✓
		Number of exit points in a trekking trail	✓	✓	✓	×	×
		Total trek time	✓	×	×	×	×
		Trek distance per day	✓	✓	×	×	×
		Altitude gain per day	✓	✓	✓	×	×
		Uniqueness of the route	✓	✓	✓	✓	✓
Threshold value			N/A	0.750	0.824	0.847	0.895

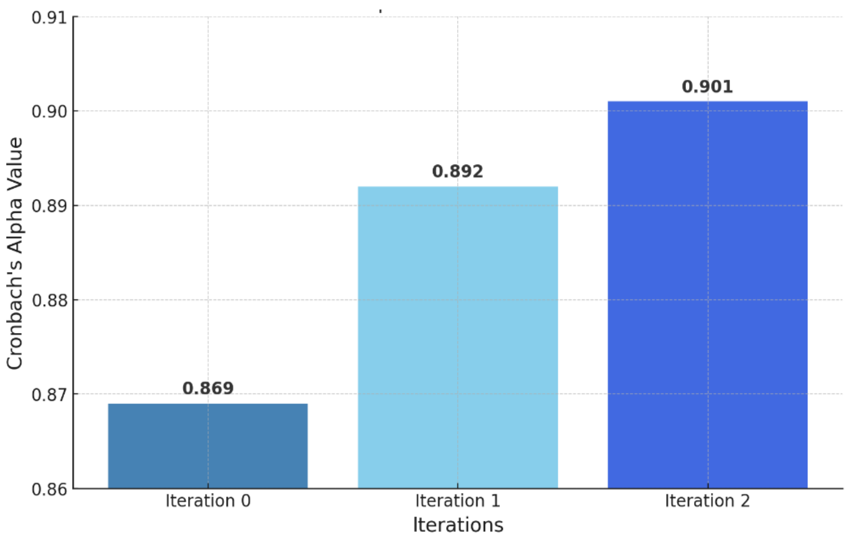

Figure 4 Cronbach Alpha iterations, Respondent Group 2

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Analysis of RG2: The same process was repeated for the RG2, the expert's group. But in this case, the initial Alpha value obtained was already way above the acceptable value of 0.7. So, to obtain an at par Alpha value with that of RG1 and reduce the number of indicators, only two iterations were sufficient. The final alpha value came to be 0.901 shown in **Figure 4**. Initially, in **Iteration 0**, the Alpha value started at 0.869, including all indicators under consideration. As the iterations progressed, specific indicators that contributed less to the overall reliability were excluded, resulting in higher Alpha values.

During **Iteration 1** (Alpha = 0.892), the first set of indicators was excluded based on their contribution to the overall reliability. Indicators such as Acrophobia, Total time taken to acquire drinking water from the campsite (to and fro), Quality of water available for drinking purposes, and Peak rainfall during monsoon were excluded. The threshold for exclusion during this iteration was set at a contribution value below 0.87.

In **Iteration 2** (Alpha = 0.901), further refinement occurred by excluding additional indicators that did not meet the updated threshold for reliability. The excluded indicators included If the drinking water source is a natural source, then what is the importance of its Perenniality, Width & Rate of river/stream, depth of a cliff, Snow Cover for each section of the trail, Average annual rainfall of the region, and Trek distance per day. The exclusion threshold in this final iteration was any indicator contributing less than 0.88 to the overall Alpha.

Table 2 Iterations of Respondent group 2 and the excluded indicators

Attributes	**Sub-attributes**	**Indicators**	**Alpha= 0.869**	**Alpha= 0.892**	**Alpha= 0.901**
Spatial	Altitude	Acclimatization	✓	✓	✓
		Acrophobia	✓	×	×
	Natural drinking water source at camp-site	Total time taken to acquire drinking water from campsite (to and fro)	✓	×	×
		If the drinking water source is natural source, then what is the importance of its Perenniality	✓	✓	×
		Quality of water available for drinking purpose	✓	×	×
	Geographic obstacle	Width & Flow-rate of river/stream, depth of a cliff	✓	✓	×
	Land and ground cover	Vegetation type	✓	✓	✓
		Ground Cover	✓	✓	✓
		Wild-life crossings and wild-life habitation areas	✓	✓	✓
	Gradient of the trail	Slope of the trail	✓	✓	✓
		Climb rate	✓	✓	✓
		Descent rate	✓	✓	✓
		Aspect Ratio for the slope	✓	✓	✓
Climatic	Climatic attribute	Snow Cover for each section of the trail	✓	✓	×
		Relative humidity for each section of the trail	✓	✓	✓
		Average annual rainfall of the region	✓	✓	×
		Peak rainfall during monsoon	✓	×	×
		Solar Radiation Intensity	✓	✓	✓
		Average daytime temperature	✓	✓	✓
		Average night-time temperature	✓	×	×
		Impact of wind speed at campsites	✓	✓	✓

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Attributes	Sub-attributes	Indicators	Alpha= 0.869	Alpha= 0.892	Alpha= 0.901
Connectivity	Regional connectivity	Tourist oriented Bus Service in proximity of the start and end point of a trekking trail	✓	✓	✓
		Number of buses running on this route each day	✓	✓	✓
		Railway Station in proximity to the start and end point of a trekking trail	✓	✓	✓
		Number of trains running on the same route each day	✓	✓	✓
		Distance of taxi stand from the start and end point of a trek	✓	✓	✓
Perception	Perception based	Total trek distance	✓	✓	✓
		Other tourist destinations in proximity	✓	✓	✓
		Number of exit points in a trekking trail	✓	✓	✓
		Total trek time	✓	✓	✓
		Trek distance per day	✓	✓	×
		Altitude gain per day	✓	×	×
		Uniqueness of the route	✓	×	×
Threshold value			N/A	0.87	0.88

DISCUSSION

RG2, i.e. the experts have more synchronized answers to the questionnaire than RG1, i.e., the initial Alpha value (0.869) is higher in the case of RG2 than RG1 (0.739). Hence, for RG1, four iterations were computed. From RG1, total 18 indicators were excluded compared to 12 indicators from RG2. On further inspection, it is observed that RG1 has excluded indicators like Gradient, Number of exit points, total trek time, and acclimatization, which are very significant for the assessment. Since the assessment will be on a trekking route in a hilly region, the gradient or slope becomes an indispensable indicator.

The initial iteration includes a comprehensive set of 33 indicators, providing a broad assessment across various attributes and sub-attributes. The Cronbach's Alpha of 0.869 indicates a high level of internal consistency, suggesting the initial selection was robust. However, the test may be more cumbersome and time-consuming to administer with many items.

The exclusion of seven indicators led to an increase in Cronbach's Alpha to 0.892, indicating an improvement in internal consistency. Removing "Acrophobia" and "Total time taken to acquire drinking water from campsite" suggests these factors were less relevant or introduced response variability. However, their exclusion may reduce the comprehensiveness of the assessment, particularly regarding personal health impacts (acrophobia) and detailed water logistics.

Further exclusions of five indicators increased Cronbach's Alpha to 0.901, indicating an even higher level of internal consistency. Excluding indicators like "Perenniality of water source" and "Width & Flow-rate of river/stream" streamlines the assessment but may overlook important environmental factors. The exclusion of "Snow cover" and "Average annual rainfall" suggests these climatic variables were less consistent or impactful on the overall reliability. Similarly, removing "Trek distance per day" might ease the evaluation process but at the expense of losing specific daily performance metrics.

The iterative process simplifies the model, focusing on the most relevant indicators. This approach enhances reliability but may sacrifice detailed insights, such as the specific effects of acrophobia or detailed climatic conditions. The trade-off results in a more streamlined and easier-to-administer test but at the cost of losing some detailed aspects that could provide a richer analysis of the trekking environment.

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The consistent increase in Cronbach's Alpha values from 0.869 to 0.901 indicates that the exclusions positively impacted the test's internal consistency. This means the remaining indicators are more likely to provide reliable and consistent results across different respondents. The retention of certain indicators across all iterations (e.g., "Acclimatization," "Vegetation type," "Descent rate") underscores their robustness and critical relevance to the assessment.

In summary, the iterative exclusion of indicators has refined the reliability test by concentrating on the most impactful and reliable measures. This process has enhanced the overall reliability and effectiveness of the attributes and sub-attributes being assessed, despite the trade-off between simplification and the loss of some detailed insights. The final set of indicators provides a more dependable framework for evaluating the trekking environment while ensuring the assessment remains robust and meaningful.

CONCLUSION

The study compared two research groups, RG1 and RG2, concerning their internal consistency as measured by Cronbach's Alpha. Initially, RG1 exhibited a lower Cronbach's Alpha of 0.739, signifying less consistency among the responses within this group. In contrast, RG2 demonstrated a higher initial Cronbach's Alpha of 0.869, indicating excellent synchronisation and reliability of responses from the experts involved. Over the course of the study, RG1 required four iterations to achieve a high Cronbach's Alpha value of 0.920, signifying a substantial improvement in the consistency of responses. Meanwhile, RG2 reached a commendable Alpha value of 0.901 in just two iterations, underscoring the group's inherently more consistent and reliable responses from the outset.

In the process of refining their respective models, RG1 excluded a total of 18 indicators, including crucial ones such as "Gradient," "Number of exit points," and "Acclimatization." These exclusions might result in RG1's assessment being less detailed, potentially overlooking important nuances like trail difficulty and acclimatisation factors. On the other hand, RG2 excluded 12 indicators, focusing on streamlining the model while preserving the critical aspects of the assessment. This approach by RG2 aimed to simplify the evaluation process without compromising on essential environmental and perception-based factors, thereby maintaining a balanced and comprehensive assessment framework.

Given the higher initial consistency and fewer iterations required to achieve a high level of reliability, the responses from RG2, the expert group, are recommended for the assessment. RG2's streamlined yet comprehensive model ensures a more reliable and efficient evaluation of the trekking environment, maintaining critical insights while enhancing internal consistency. Future research could explore methods to balance the trade-off between model simplicity and retaining crucial details, potentially integrating more sophisticated statistical techniques or alternative reliability metrics. Additionally, further studies could investigate the practical implications of these findings in real-world trekking assessments to validate and refine the models further.

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