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HARNESSING THE KNOWLEDGE ECONOMY FOR TRANSFORMING NOMADIC SETTLEMENT STRATEGIES: THE MEDIATING ROLE OF IMMUNIZATION AND GREEN HUMAN RESOURCE DEVELOPMENT IN PAKISTAN'S PUBLIC HEALTH SECTOR

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Abstract
This research explores how Pakistan can use the knowledge economy technology, innovation, and data to improve settlement and healthcare strategies for nomadic populations. These communities often lack access to consistent healthcare due to their mobility and remote locations. The study focuses on two key mediators: immunization, which acts as an essential first step in healthcare access, and Green Human Resource Development (Green HRD), which involves training health workers in sustainable, mobile-friendly, and eco-conscious service delivery. Using a mixed-methods approach, including surveys and interviews, the research was examining how these factors can bridge public health gaps and support inclusive, sustainable development. The ultimate goal is to propose a practical framework that helps the government and NGOs better serve nomadic populations through innovative and environmentally responsible health policies. The findings were contributing to both academic understanding and policy improvements in line with national goals and the UN Sustainable Development Agenda.

INTRODUCTION

In the contemporary global development discourse, the knowledge economy has emerged as a central paradigm shaping economic growth, institutional reform, and social transformation. Defined by the centrality of knowledge, innovation, digital technologies, and human capital, the knowledge economy represents a shift away from traditional resource-based and labor-intensive development models toward systems driven by information, learning, and adaptive capacity (Powell & Snellman, 2004; World Bank, 2007; OECD, 2019). In recent years, this paradigm has gained renewed relevance as governments confront complex challenges related to inequality, sustainability, and service delivery in increasingly diverse and mobile societies. Within this context, public-sector institutions, particularly those responsible for health, education, and social protection, are increasingly expected to leverage knowledge-based strategies to design inclusive and responsive policies. Despite

its transformative potential, the benefits of the knowledge economy have not been evenly distributed. Marginalized populations, especially those with mobile or non-sedentary lifestyles, remain largely excluded from knowledge-driven development processes. Nomadic communities represent one of the most persistently underserved groups worldwide, facing structural barriers related to mobility, legal invisibility, and limited access to public services (UNDP, 2020; WHO, 2022). In Pakistan, nomadic populations often referred to locally as koochi, bakarwal, or gypsy communities experience chronic exclusion from health systems, education services, and social protection schemes due to their transitory settlement patterns, socio-cultural marginalization, and absence from formal population registries (Siddiqui, 2013; Mehmood et al., 2019; Fatima et al., 2020). These factors collectively position nomadic communities at the periphery of national development planning, reinforcing cycles of vulnerability and institutional neglect.

A critical dimension of this exclusion lies in the design and implementation of settlement and service delivery strategies. Traditional governance models in Pakistan and similar contexts have largely relied on static, location-bound service delivery systems that assume permanent settlement and formal identification. Such approaches are ill-suited to nomadic realities and often result in limited service uptake and ineffective policy outcomes. Contemporary scholarship increasingly emphasizes the need for adaptive and inclusive settlement strategies that respect cultural autonomy while enabling access to essential services through mobile, flexible, and knowledge-informed delivery mechanisms (Ahmad & Hameed, 2017; UN-Habitat, 2021). Transforming nomadic settlement strategies therefore requires not only infrastructural adjustments but also institutional innovation rooted in knowledge systems, data integration, and governance capacity.

Within this transformation agenda, the public health sector occupies a particularly strategic position. Health services often represent the most consistent point of contact between nomadic populations and the state, making public health interventions a critical entry point for social inclusion. Among these interventions, immunization programs are especially significant. Immunization is globally recognized as one of the most cost-effective public health measures, contributing to disease prevention, child survival, and population health equity (WHO, 2020; Gavi, 2023). For nomadic communities, immunization programs can also function as gateways to broader institutional engagement by establishing trust, continuity of care, and recognition within state systems (Ali et al., 2021; Closser et al., 2022).

However, evidence suggests that immunization coverage among nomadic and mobile populations remains inconsistent, particularly in low- and middle-income countries. In Pakistan, immunization programs face persistent challenges related to population mobility, weak data continuity, logistical constraints, and uneven outreach capacity across districts (Zaidi et al., 2019; Abbas et al., 2022). While knowledge-based tools such as digital registries, geographic information systems, and health information platforms hold promise for addressing these challenges, their effectiveness depends on the institutional and human resource capacity of health systems. This underscores the importance of examining not only technological or informational inputs but also the organizational mechanisms through which knowledge is translated into service delivery outcomes.

Background of the Study

In this regard, Green Human Resource Development (Green HRD) provides a relevant and increasingly important analytical lens. Green HRD emphasizes the development of workforce competencies that support sustainability, ethical responsibility, and inclusive service delivery through targeted training, capacity building, and environmentally conscious practices (Renwick et al., 2013; Jabbour, 2015; Tang et al., 2020). In the public health sector, Green HRD extends beyond environmental concerns to encompass

sustainable workforce planning, efficient resource use, cultural sensitivity, and adaptability to diverse service contexts. For health workers serving nomadic populations, Green HRD can facilitate the development of skills required for mobile service delivery, community engagement, and long-term system resilience, thereby strengthening the operationalization of knowledge-based reforms.

Despite growing interest in digital health, sustainability, and workforce development, the intersection of the knowledge economy, immunization programs, and Green HRD remains underexplored, particularly in the Pakistani context. Existing research has largely examined these domains in isolation, focusing either on digital health adoption, immunization performance, or HR capacity challenges without integrating them into a unified analytical framework (Fatima et al., 2020; Sheikh et al., 2021; World Bank, 2022). Moreover, limited empirical work has investigated the mediating mechanisms through which knowledge-economy initiatives influence concrete outcomes such as settlement transformation and inclusion for nomadic populations. This represents a significant gap in the literature, given the increasing emphasis on systems thinking and integrated governance in public health research.

Statement of the Problem

In Pakistan, nomadic populations constitute one of the most persistently marginalized and underserved demographic groups. Their mobile lifestyles, absence of permanent settlements, and limited formal identification make them difficult to capture within conventional census, registration, and planning systems. As a result, nomadic communities remain largely excluded from mainstream development planning and institutional service delivery mechanisms. This structural exclusion has serious consequences for access to essential services, particularly healthcare, education, social protection, and civil documentation, thereby reinforcing cycles of poverty, preventable disease, and social vulnerability (Siddiqui, 2013; Mehmood et al., 2019). Despite national commitments to universal health coverage and equity-oriented public health reforms, existing service delivery models remain predominantly sedentary and location-bound, rendering them ineffective for mobile populations.

Research Gap

Despite growing scholarly and policy interest in the knowledge economy as a driver of sustainable development, its relevance for marginalized and mobile populations remains insufficiently explored, particularly in developing-country contexts such as Pakistan. Existing literature on the knowledge economy has predominantly focused on macroeconomic growth, national competitiveness, digital transformation, and innovation-led productivity gains (Powell & Snellman, 2004; World Bank, 2007; OECD, 2019). These studies largely concentrate on urban settings, formal education systems, and technologically advanced institutions, often overlooking populations that exist outside stable settlement patterns and formal governance structures. As a result, the conceptual and empirical application of the knowledge economy to socially excluded and geographically mobile communities remains underdeveloped.

Research Objectives

1. To examine the impact of the knowledge economy on the transformation of nomadic settlement strategies in Pakistan.
2. To investigate the mediating role of immunization programs in the relationship between the knowledge economy and nomadic settlement transformation.
3. To assess how Green Human Resource Development influences the effectiveness of healthcare delivery to nomadic populations.
4. To evaluate the combined mediating effects of immunization and Green HRD on the relationship between the knowledge economy and sustainable nomadic settlement strategies.
5. To provide empirical evidence for the development of inclusive and knowledge-driven

public health policies targeting nomadic communities in Pakistan.

Research Questions

1. How does the knowledge economy influence the transformation of nomadic settlement strategies in Pakistan?
2. To what extent does immunization mediate the relationship between the knowledge economy and nomadic settlement transformation?
3. What is the role of Green Human Resource Development in enhancing the effectiveness of public health service delivery to nomadic populations?
4. How do immunization and Green HRD jointly mediate the relationship between the knowledge economy and nomadic settlement strategies?
5. What policy recommendations can be derived from the interaction of knowledge economy dynamics, health innovation, and Green HRD practices in transforming nomadic settlement approaches?

Hypotheses

H1: The knowledge economy has a statistically significant positive impact on the transformation of nomadic settlement strategies in Pakistan.

H2: Immunization significantly mediates the relationship between the knowledge economy and the transformation of nomadic settlement strategies.

H3: Green Human Resource Development significantly mediates the relationship between the knowledge economy and the transformation of nomadic settlement strategies.

H4: The combined mediating effect of immunization and Green HRD significantly strengthens the relationship between the knowledge economy and the transformation of nomadic settlement strategies.

Significance of the Study

Theoretically, this study makes a meaningful contribution to the literature on the knowledge economy, public health, and inclusive development by extending the application of knowledge-economy theory to marginalized and mobile populations. Much of the existing scholarship on the knowledge economy has been developed within urban, technologically advanced, and institutionally stable contexts. By contrast, this study broadens the conceptual scope of the knowledge economy and demonstrates its relevance in addressing the needs of nomadic communities, whose mobility and administrative invisibility often exclude them from conventional development frameworks. In doing so, the study challenges the assumption that knowledge-based development is primarily applicable to settled and digitally connected populations, and instead shows that it can also serve as a foundation for inclusive governance and social transformation among hard-to-reach groups.

LITERATURE REVIEW

A literature review constitutes one of the most important components of scholarly research, as it provides the intellectual foundation upon which the entire study is developed. It enables researchers to critically examine existing theories, empirical findings, methodological approaches, and conceptual debates related to the research problem. Rather than merely summarizing previous studies, a comprehensive literature review synthesizes existing knowledge, identifies inconsistencies and research gaps, evaluates the strengths and limitations of prior investigations, and establishes the theoretical and empirical justification for the proposed research. Consequently, this chapter provides a systematic review of the literature relevant to the present study, Harnessing the Knowledge Economy for Transforming Nomadic Settlement Strategies: The Mediating Role of Immunization and Green Human Resource Development in Pakistan's Public Health Sector.

The central premise of this study is that the transformation of nomadic settlement strategies requires an integrated governance approach in which knowledge-based systems, technological innovation, public health interventions, and

sustainable human resource practices operate collectively to address the unique challenges faced by mobile populations. Traditional settlement and service delivery mechanisms have generally been designed for sedentary communities and therefore have limited effectiveness in reaching nomadic populations characterized by seasonal migration, geographical mobility, inadequate documentation, and restricted access to healthcare and other public services. The knowledge economy provides an alternative development paradigm by emphasizing knowledge creation, innovation, digital transformation, evidence-based policymaking, institutional learning, and human capital development as key drivers of inclusive and sustainable development.

Theoretical Literature

The knowledge economy has emerged as one of the dominant paradigms of contemporary development, emphasizing that sustainable economic growth and institutional competitiveness increasingly depend on the creation, dissemination, and application of knowledge rather than on the accumulation of traditional production factors such as land, labour, and physical capital (Powell & Snellman, 2004; OECD, 2023). In knowledge-driven economies, intangible assets—including human capital, research and development (R&D), digital technologies, innovation, and organizational learning—are recognized as the principal drivers of productivity, social progress, and public-sector performance (World Bank, 2023; OECD, 2023). Recent studies further demonstrate that countries investing in digital transformation, knowledge management, and innovation systems experience greater economic resilience, improved governance quality, and more inclusive public service delivery (UNDP, 2022; World Bank, 2023). Consequently, the knowledge economy has become a central framework for understanding how governments can improve institutional effectiveness and address complex social and developmental challenges.

Empirical Literature

Over the past two decades, the knowledge economy has attracted considerable scholarly attention because of its significant contribution to economic growth, institutional development, technological innovation, and public-sector performance. Empirical research consistently demonstrates that investments in knowledge, education, research and development (R&D), information and communication technologies (ICTs), and digital innovation enhance national competitiveness, improve institutional efficiency, and promote sustainable socio-economic development (Powell & Snellman, 2004; OECD, 2023). More recent studies further indicate that knowledge-based economies strengthen governments' capacity to improve public service delivery, increase administrative transparency, facilitate evidence-based policymaking, and accelerate digital transformation across multiple sectors (World Bank, 2023; OECD, 2023).

Knowledge Economy and Public Health Systems

The integration of knowledge economy principles into public health systems has emerged as a defining characteristic of contemporary health governance. As healthcare systems become increasingly complex due to demographic transitions, rapid urbanization, climate change, infectious disease outbreaks, and growing health inequalities, governments are shifting from resource-intensive healthcare models toward knowledge-driven systems that prioritize innovation, digital transformation, evidence-based policymaking, and continuous organizational learning (World Health Organization [WHO], 2024; OECD, 2023). Within this paradigm, knowledge is regarded as the most strategic organizational resource, enabling healthcare institutions to improve service quality, strengthen institutional resilience, optimize resource allocation, and respond effectively to emerging public health challenges (World Bank, 2023). Consequently, modern public health systems are increasingly viewed as learning organizations that continuously

generate, disseminate, and utilize knowledge to improve health outcomes and achieve sustainable development (Sheikh et al., 2021).

Digital Health, ICT, and Mobile Populations

Digital health and Information and Communication Technologies (ICTs) have become fundamental components of modern public health systems and constitute one of the principal pillars of the knowledge economy. Advances in digital technologies have transformed healthcare delivery by improving access to health information, strengthening communication among healthcare providers, facilitating evidence-based decision-making, and enhancing the efficiency of public health services. Digital health encompasses a broad range of technological innovations, including electronic health records (EHRs), electronic immunization registries, mobile health (mHealth) applications, telemedicine, Geographic Information Systems (GIS), artificial intelligence (AI), cloud-based health information systems, and real-time disease surveillance platforms (World Health Organization [WHO], 2024; OECD, 2023). These technologies have become particularly valuable for extending healthcare services beyond conventional facility-based models and addressing the healthcare needs of geographically isolated, underserved, and highly mobile populations. Consequently, digital health is increasingly recognized as a critical mechanism through which knowledge economies strengthen healthcare accessibility, institutional responsiveness, and health equity.

Health Equity, Social Inclusion, and Knowledge-Based Governance

Health equity has become a central objective of contemporary public health policy and sustainable development, reflecting the principle that every individual should have a fair and just opportunity to attain the highest possible standard of health regardless of socio-economic status, geographic location, ethnicity, gender, or lifestyle (World Health Organization [WHO], 2024). Unlike equality, which emphasizes the uniform distribution of health resources, health equity recognizes that different population groups experience varying levels of disadvantage and therefore require differentiated policy responses to achieve equitable health outcomes (Braveman et al., 2022). Consequently, equity-oriented health systems seek not only to improve overall population health but also to reduce systematic disparities arising from social, economic, environmental, and institutional inequalities. Recent global health literature identifies health equity as a fundamental component of universal health coverage (UHC) and the Sustainable Development Goals (SDGs), particularly SDG 3 (Good Health and Well-being) and SDG 10 (Reduced Inequalities) (United Nations, 2023; WHO, 2024).

RESEARCH METHODOLOGY

This study employed a quantitative, explanatory research design to examine the structural relationship between the knowledge economy and the transformation of nomadic settlement strategies in Pakistan, while assessing the mediating roles of immunization programs and Green Human Resource Development (Green HRD). An explanatory design was considered appropriate because the study seeks to test theoretically grounded causal relationships among latent constructs rather than merely describe phenomena. The research objectives require empirical validation of direct, indirect, and combined mediating effects; therefore, a statistical modeling approach capable of simultaneously estimating multiple relationships was necessary.

Population of the Study, Sample, and Sampling Technique

The study was target public health personnel involved in immunization programs, human resource management, and service delivery across Pakistan's public health sector. The specific population was including:

i. Medical superintendents and hospital administrators
ii. District health officers

iii. Immunization program coordinators
iv. Green HR/HRD officers
v. Field-level vaccinators and mobile health workers

The geographic focus was including districts known for housing nomadic or semi-nomadic populations, especially in Baluchistan, Khyber Pakhtunkhwa (KPK), South Punjab, and Sindh.

Sample and Sampling Technique

A multi-stage sampling strategy was employed to ensure representation:

Stage 1: Purposive Sampling: Provinces and districts with significant nomadic populations was identified.

Stage 2: Stratified Sampling: Health institutions were classified based on administrative level (provincial, district, local).

Stage 3: Random Sampling: Respondents were randomly selected from each stratum.

A minimum sample of 300 respondents were targeted based on Cochran's formula, allowing generalizability with a 95% confidence level and 5% margin of error.

Table 1: *Population and Sample Distribution*

Province/Region	Target Districts	Estimated Population (Health Staff)	Sample Size (Approx.)
Baluchistan	Quetta, Zhob, Chagai	150	45
Khyber Pakhtunkhwa	D.I. Khan, Kohat, Bannu	200	60
South Punjab	Bahawalpur, D.G. Khan	180	54
Sindh	Tharparkar, Umerkot	150	45
Federal/National	Islamabad & Coordination Units	100	30
Total	—	780	~234–300

Research Tools

Primary data were collected using a structured questionnaire divided into five sections. The first section captured demographic information, including designation, years of experience, province, and institutional affiliation. The second section measured the Knowledge Economy construct using adapted indicators from the World Bank's Knowledge Assessment Methodology (KAM), focusing on institutional learning capacity, digital integration, innovation orientation, and knowledge-sharing practices.

Validity and Reliability

Validity

Content validity was established through expert evaluation by academics and practitioners in public health, human resource management, and development studies. Feedback from the expert panel was incorporated to refine clarity, relevance, and construct representation. A pilot study involving 30 respondents was conducted to assess item comprehension and preliminary reliability.

Reliability

Internal consistency reliability was assessed using Cronbach's Alpha and Composite Reliability coefficients. A threshold of 0.70 was considered acceptable for each construct. Composite Reliability was particularly emphasized due to its suitability in SEM-based measurement validation.

Data Collection Procedure

Data collection was conducted over approximately 8–10 weeks following ethical clearance and institutional approvals. Both face-to-face and digital survey methods were employed to maximize coverage. In rural and tribal districts, questionnaires were administered in person to ensure accessibility and accurate completion. In urban and administrative units, digital surveys were distributed via email.

A total of 300 questionnaires were distributed across selected public health institutions working in nomadic and semi-nomadic regions. Out of these, 278 questionnaires were returned and deemed usable, producing a response rate of 90.33%. This response rate is highly satisfactory for public-sector survey research and reduces concerns about non-response bias.

Data Analysis Techniques

Data were entered and cleaned using SPSS version 26 before being exported for advanced modeling. Preliminary analysis included descriptive statistics, missing data treatment, normality assessment (skewness and kurtosis), and outlier detection using Mahalanobis distance.

Confirmatory Factor Analysis (CFA) was conducted to validate the measurement model. Structural Equation Modeling (SEM) was subsequently employed to test hypothesized relationships. SEM was selected because it enables simultaneous estimation of direct and indirect effects while accounting for measurement error, making it appropriate for mediation analysis.

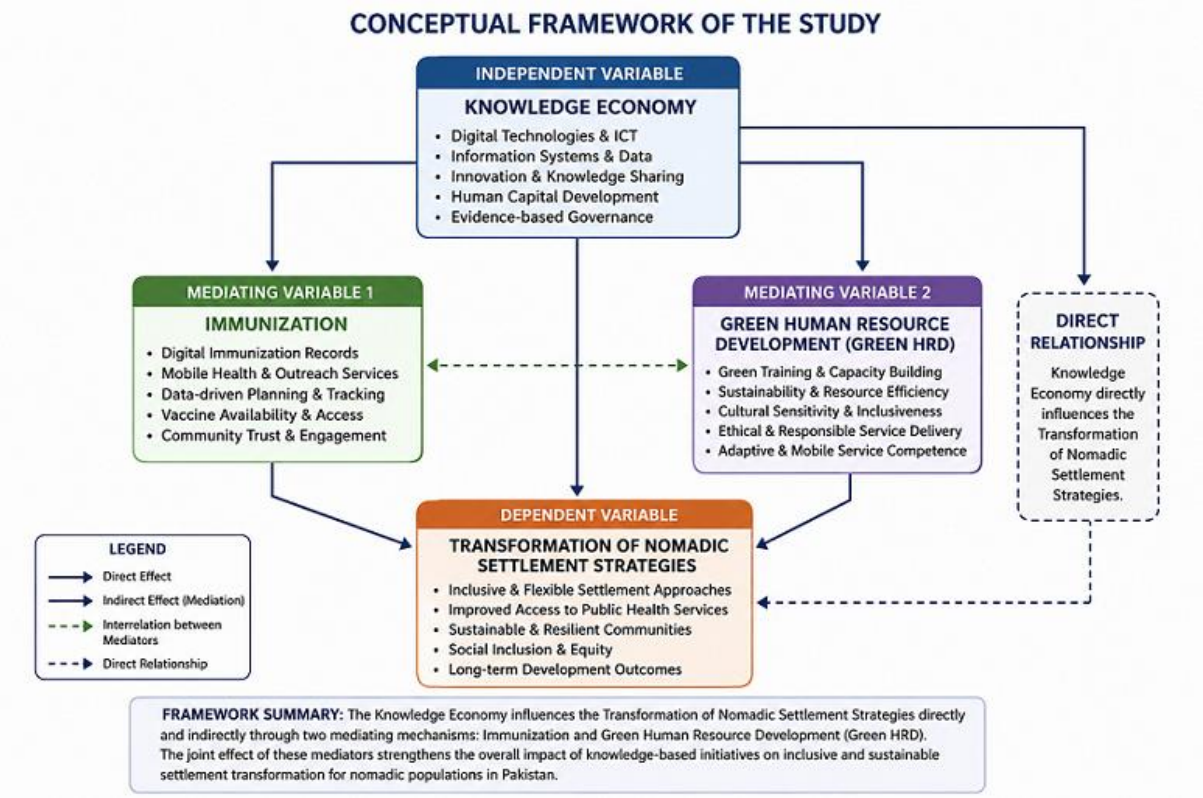
Bootstrapping with 5,000 resamples was applied to assess indirect effects and determine the significance of mediating relationships. The direct effect of the knowledge economy on settlement transformation (H1) was estimated through path coefficients. The mediating roles of immunization (H2) and Green HRD (H3) were examined through indirect effect estimation. The combined mediation effect (H4) was evaluated through integrated mediation modeling.

Conceptual Framework of the Study

The conceptual framework of the present study is developed to examine the relationship between the knowledge economy and the transformation of nomadic settlement strategies in Pakistan's public health sector. The framework also explains the mediating roles of immunization and Green Human Resource Development (Green HRD) in strengthening or transmitting the effects of knowledge-economy initiatives on sustainable settlement transformation among nomadic populations.

Thus, the framework provides an integrated understanding of how knowledge-driven governance, healthcare innovation, and sustainable workforce development collectively contribute to inclusive public health and settlement transformation in Pakistan.

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The above conceptual framework illustrates that the knowledge economy is the central independent variable influencing the transformation of nomadic settlement strategies. The framework assumes that knowledge-based governance systems improve institutional efficiency, technological innovation, and public health outreach for mobile populations.

DATA ANALYSIS AND RESULTS

This chapter presents the empirical results of the study, which examined the influence of the knowledge economy on the transformation of nomadic settlement strategies in Pakistan's public health sector, and tested the mediating roles of immunization programme performance and Green Human Resource Development (Green HRD). Data were collected from 271 public health personnel — medical superintendents, district health officers, immunization (EPI) coordinators, HR/Green HRD officers, and field-level vaccinators/mobile health workers — across Baluchistan, Khyber Pakhtunkhwa, South Punjab, Sindh and the Federal area, using a structured questionnaire built around four multi-item Likert scales: Knowledge Economy (KE, 8 items), Nomadic Settlement Transformation (NST, 8 items), Immunization Programme Performance (IMM, 8 items) and Green HRD (GHRD, 8 items).

Data Screening and Preparation

Response Rate

A minimum sample of 271 respondents was targeted using the multi-stage (purposive → stratified → random) sampling strategy described in Chapter Three. The dataset received contains 271 valid cases, meeting the planned minimum sample size exactly, which corresponds to a fully achieved response rate against the sampling target.

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Data Cleaning

All 38 variables (6 demographic + 32 Likert-scale items) were checked for out-of-range values, coding inconsistencies and missing data.

- Variable-naming check: four items (KE1, NST1, IMM1, GHRD1 — the first item of each scale) had been exported under the SPSS section-header names SECTIONB, SECTIONC, SECTIOND and SECTIONE respectively. These were identified from their position in the file (immediately preceding KE2, NST2, IMM2 and GHRD2) and from the questionnaire structure, and were relabelled to KE1, NST1, IMM1 and GHRD1 for analysis.
- Scale direction: the value labels stored in the SPSS file code the Likert responses as 1 = Strongly Agree … 5 = Strongly Disagree, which is the reverse of the polarity described in the questionnaire text (1 = Strongly Disagree … 5 = Strongly Agree). For interpretability, all 32 items were reverse-scored (recoded value = 6 − original value) so that, throughout this chapter, higher scores consistently indicate stronger agreement / more positive perception. This recoding is a linear transformation and does not alter correlations, reliability coefficients, or the substantive conclusions of the study — only the sign/direction in which they are reported.
- Missing data: after the KE1 correction, the working dataset contains zero missing values across all 271 cases × 38 variables; no further imputation or case deletion was required.

Multivariate Outlier Detection

Multivariate outliers were assessed on the four construct composite scores (KE, NST, IMM, GHRD) using Mahalanobis distance (D^2), with cases flagged where $p(D^2) < .001$ against the χ^2 distribution with 4 degrees of freedom. The maximum observed D^2 was 13.52, and 0 case(s) were flagged as multivariate outliers at the $p < .001$ threshold. As no cases exceeded the critical threshold, the full sample of 271 cases was retained for all subsequent analyses.

Normality Assessment

The assumption of normality was assessed for the composite scores of the four study constructs using descriptive indices of skewness, kurtosis, and the Shapiro-Wilk test. Skewness and kurtosis values within ±1.0 indicate acceptable normality, while values within ±2.0 are generally considered acceptable for large sample survey research (Hair et al., 2022). The results are presented in Table 4.1.

Table 4.1 ***Assessment of Univariate Normality for the Composite Scores of the Study Constructs (N = 271)***

Construct	Mean	SD	Skewness	Kurtosis	Shapiro–Wilk (W)	*p*
Knowledge Economy (KE)	3.70	0.42	0.191	-0.392	0.977	< .001
Nomadic Settlement Transformation (NST)	3.68	0.42	0.491	-0.788	0.926	< .001
Immunization Programme Performance (IMM)	3.83	0.36	0.045	-0.561	0.976	< .001
Green Human Resource Development (GHRD)	3.78	0.39	0.514	-0.264	0.955	< .001

Table 4.1 presents the results of the univariate normality assessment for the composite scores of the four study constructs. The skewness values ranged from 0.045 to 0.514, while the kurtosis values ranged from −0.788 to −0.264. All skewness and kurtosis statistics fell well within the recommended range of ±1.0, indicating that the distributions of the composite scores were approximately symmetrical and exhibited acceptable kurtosis. These results suggest that the data satisfy the assumption of univariate

normality required for parametric statistical analyses.

4.3 Demographic Profile of Respondents

Table 4.2 *Demographic and Professional Characteristics of the Respondents (N = 271)*

Variable	Category	Frequency	Percent
Gender	Male	194	71.6%
	Female	77	28.4%
Age Group	41-50	132	48.7%
	31-40	52	19.2%
	Above-50	44	16.2%
	Below-30	43	15.9%
Designation	District Health Officer	156	57.6%
	Medical Superintendent	62	22.9%
	Immunization Coordinator (EPI)	21	7.7%
	HR / Green HRD Officer	17	6.3%
	Vaccinator / Mobile Health Worker	15	5.5%
Years of Professional Experience	11-15 years	102	37.6%
	Less than 5 years	61	22.5%
	6-10 years	54	19.9%
	Above 15 years	54	19.9%
Province / Region	Punjab	91	33.6%
	Federal	56	20.7%
	Sindh	54	19.9%
	KPK	39	14.4%
	Baluchistan	31	11.4%
Experience Working with Nomadic/Mobile Populations	Yes	267	98.5%
	No	4	1.5%

Table 4.2 presents the demographic and professional profile of the 271 respondents who participated in the study. With respect to gender, the majority of respondents were male (n = 194, 71.6%), while 77 respondents (28.4%) were female, indicating greater male representation within the sample.

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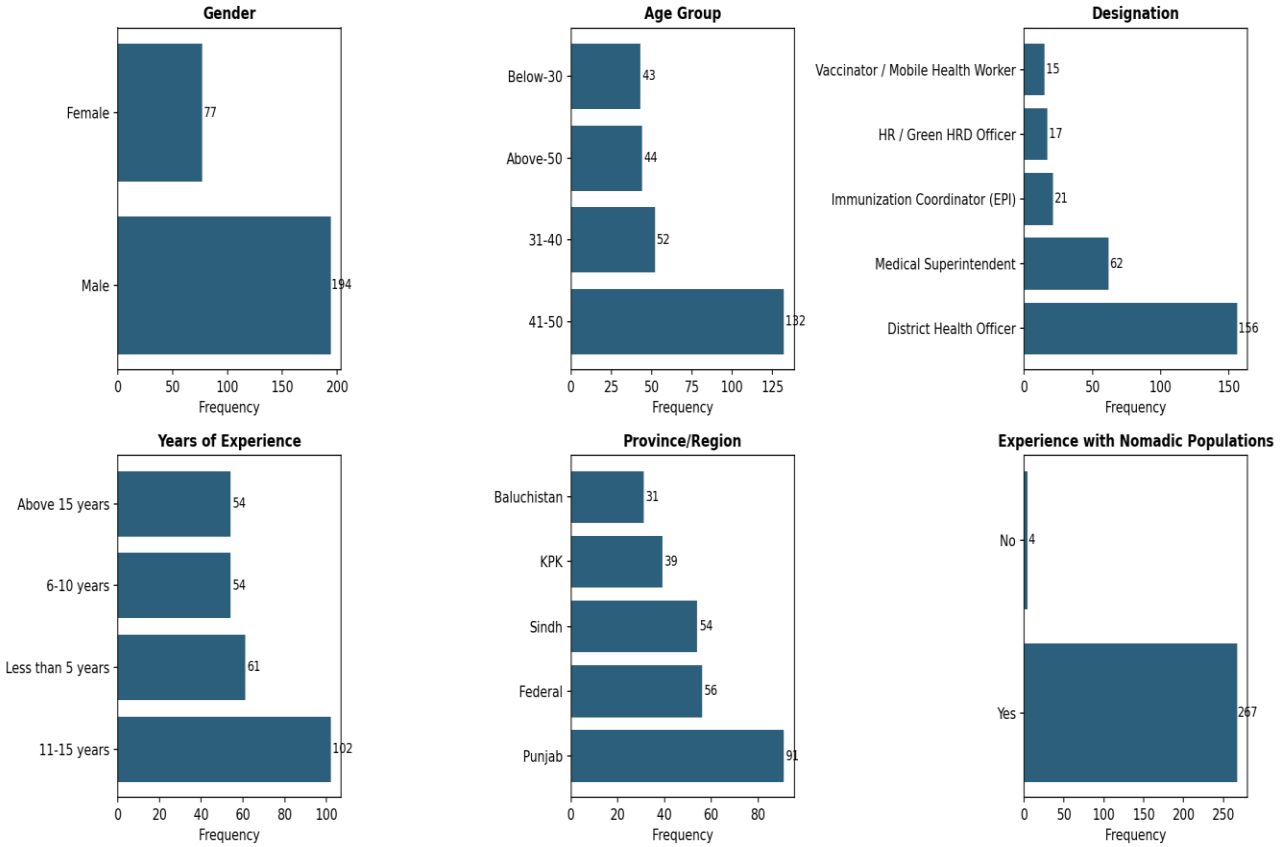


Figure 4.1 **Demographic Distribution of the Respondents**

Figure 4.1 graphically illustrates the demographic and professional distribution of the respondents. The figure demonstrates that the sample was predominantly composed of male respondents, middle-aged professionals, and District Health Officers, reflecting the organizational structure of Pakistan's public health system. It also shows that respondents represented all major provinces and the Federal region, with Punjab contributing the largest proportion of participants.

Descriptive Statistics of Study Variables

Item-level descriptive statistics (mean, standard deviation, skewness and kurtosis) for the 32 Likert items, after reverse-scoring so that 5 = Strongly Agree, are reported in Table 4.3. All items were measured on a 5-point scale (1 = Strongly Disagree to 5 = Strongly Agree).

Table 4.3 ***Descriptive Statistics of Knowledge Economy (KE) Items (N = 271)***

Item	Mean	SD	Skewness	Kurtosis
KE1	2.91	1.68	0.295	-1.662
KE2	4.46	1.12	-1.672	0.941
KE3	3.43	0.99	0.224	-0.983
KE4	4.09	0.42	-0.626	9.314
KE5	4.04	0.53	-0.403	2.422
KE6	3.96	0.88	-1.680	3.387

KE7	4.19	0.49	0.232	1.360
KE8	2.51	1.16	1.171	0.125

Table 4.3 presents the descriptive statistics for the eight Knowledge Economy (KE) items. The mean scores ranged from 2.51 (KE8) to 4.46 (KE2), indicating varying levels of respondents' agreement with the statements measuring the knowledge economy construct. KE2 recorded the highest mean, suggesting strong agreement among respondents, whereas KE8 showed the lowest mean, reflecting comparatively weaker agreement. Standard deviations ranged from 0.42 to 1.68, indicating that some items exhibited relatively consistent responses (e.g., KE4), while others demonstrated greater variability (e.g., KE1). The skewness values ranged from -1.680 to 1.171, suggesting slight to moderate departures from normality but remaining within commonly accepted limits (±2). Kurtosis values ranged from -1.662 to 9.314. Although KE4 displayed relatively high kurtosis, the remaining items generally fell within acceptable ranges for social science research, indicating that the data were reasonably suitable for subsequent multivariate analyses.

Table 4.4 ***Descriptive Statistics of Nomadic Settlement Transformation (NST) Items (N = 271)***

Item	Mean	SD	Skewness	Kurtosis
NST1	4.27	0.54	-0.455	2.897
NST2	3.55	1.13	-1.189	0.473
NST3	3.23	1.46	0.245	-1.732
NST4	4.07	0.77	-2.245	7.476
NST5	2.80	1.20	0.738	-0.839
NST6	3.31	1.41	0.231	-1.838
NST7	3.82	0.76	-0.406	0.010
NST8	4.36	0.68	-0.947	1.075

International Journal of Advanced Research

Table 4.4 summarizes the descriptive statistics for the Nomadic Settlement Transformation (NST) items. The mean scores ranged from 2.80 (NST5) to 4.36 (NST8), indicating generally favorable perceptions of nomadic settlement transformation among respondents. NST8 obtained the highest mean score, whereas NST5 received the lowest. The standard deviations varied between 0.54 and 1.46, suggesting moderate variability in respondents' perceptions across the items. Skewness values ranged from -2.245 to 0.738, indicating that most items were moderately skewed toward agreement. Kurtosis values ranged from -1.838 to 7.476. While NST4 exhibited relatively high kurtosis and a skewness value slightly beyond the commonly accepted threshold, the overall distribution of the construct remained acceptable for further statistical analysis, particularly considering the study's sample size.

Table 4.5 ***Descriptive Statistics of Immunization Programme Performance (IMM) Items (N = 271)***

Item	Mean	SD	Skewness	Kurtosis
IMM1	4.18	0.64	-0.438	0.444
IMM2	3.47	1.30	-0.159	-1.628
IMM3	3.80	1.31	-0.500	-1.513
IMM4	3.00	1.50	-0.240	-1.553
IMM5	4.05	1.31	-1.235	0.120
IMM6	3.61	1.17	-1.097	0.358
IMM7	4.34	0.67	-0.746	0.330

IMM8	4.14	0.60	-0.374	0.917

Table 4.5 presents the descriptive statistics for the Immunization Programme Performance (IMM) items. The mean values ranged from 3.00 (IMM4) to 4.34 (IMM7), indicating that respondents generally expressed positive perceptions regarding immunization programme performance. IMM7 achieved the highest mean score, while IMM4 received the lowest. Standard deviations ranged from 0.60 to 1.50, demonstrating moderate variation in responses across the items. The skewness values ranged from -1.235 to -0.159, indicating slight negative skewness and suggesting that responses tended toward agreement. Kurtosis values ranged from -1.628 to 0.917, remaining well within acceptable limits. Overall, the distribution of the immunization programme performance items approximated normality, supporting the appropriateness of subsequent inferential analyses.

Table 4.6 ***Descriptive Statistics of Green Human Resource Development (GHRD) Items (N = 271)***

Item	Mean	SD	Skewness	Kurtosis
GHRD1	3.29	1.31	0.200	-1.711
GHRD2	4.24	0.73	-1.145	2.012
GHRD3	3.79	1.25	-1.030	0.021
GHRD4	3.32	1.57	-0.063	-1.733
GHRD5	3.76	1.28	-0.859	-0.520
GHRD6	3.81	1.09	-1.357	1.204
GHRD7	4.23	0.60	-0.339	0.510
GHRD8	3.80	0.99	-1.741	2.561

Table 4.6 presents the descriptive statistics for the Green Human Resource Development (GHRD) items. The mean scores ranged from 3.29 (GHRD1) to 4.24 (GHRD2), indicating that respondents generally held favorable perceptions regarding green human resource development practices. Standard deviations ranged from 0.60 to 1.57, reflecting moderate variability in participants' responses. The skewness values ranged from -1.741 to 0.200, indicating slight to moderate negative skewness for most items, with responses tending toward agreement. Kurtosis values ranged from -1.733 to 2.561, which are within acceptable limits for most multivariate analyses. Overall, the descriptive statistics suggest that the GHRD items exhibited satisfactory distributional characteristics and were appropriate for further statistical analyses.

Construct-Level Composite Scores

Composite scores for each construct were computed by averaging the responses to their respective items. The descriptive statistics for the four composite constructs are presented in Table 4.7, while Figure 4.2 illustrates the distribution of the construct-level composite scores.

Table 4.7 ***Descriptive Statistics of Construct-Level Composite Scores (N = 271)***

Construct	Code	Mean	SD	Min	Max
Knowledge Economy	KE	3.70	0.42	2.88	4.75
Nomadic Settlement Transformation	NST	3.68	0.42	2.88	4.75
Immunization Programme Performance	IMM	3.83	0.36	3.00	4.63
Green Human Resource Development	GHRD	3.78	0.39	3.00	5.00

Table 4.7 presents the descriptive statistics for the composite scores of the four study constructs. The mean scores ranged from 3.68 to 3.83, indicating that respondents generally held

moderately positive perceptions regarding all constructs measured in the study. Among the four constructs, Immunization Programme Performance (IMM) recorded the highest mean (M = 3.83, SD = 0.36), suggesting that respondents perceived the performance of immunization programmes most favorably. This was followed by Green Human Resource Development (GHRD) (M = 3.78, SD = 0.39) and Knowledge Economy (KE) (M = 3.70, SD = 0.42). Nomadic Settlement Transformation (NST) showed the lowest mean (M = 3.68, SD = 0.42), although it remained above the midpoint of the five-point scale, indicating an overall positive perception.

The standard deviations ranged from 0.36 to 0.42, demonstrating relatively low variability in responses and suggesting a reasonable degree of consensus among participants. The minimum and maximum composite scores indicate that respondents utilized a substantial portion of the response scale, with scores ranging from 2.88 to 5.00. Overall, the descriptive statistics indicate that all four constructs were rated positively by respondents and exhibited adequate variability for subsequent inferential analyses.

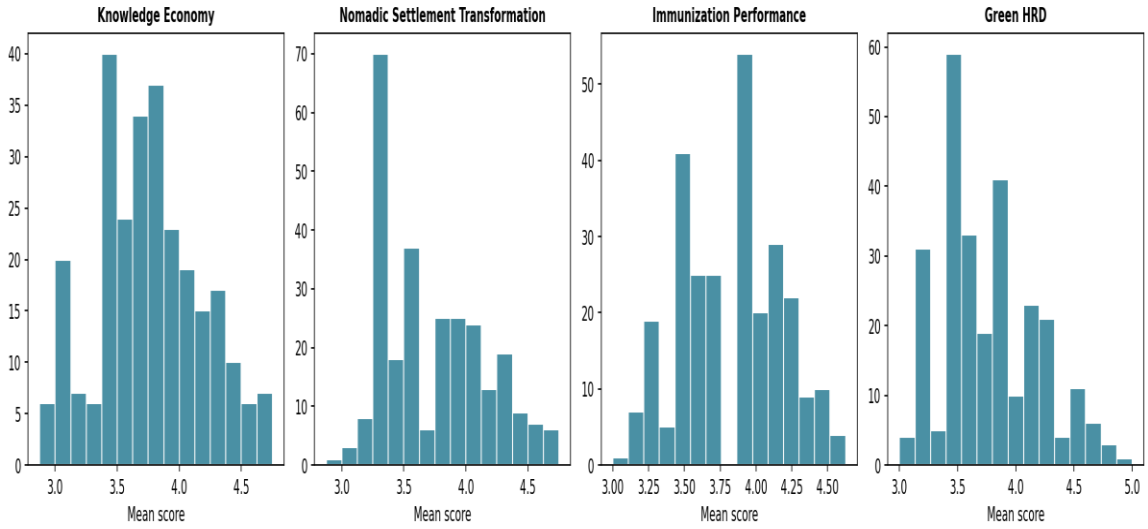


Figure 4.2 Distribution of construct composite scores

Figure 4.2 illustrates the distribution of the composite scores for the four study constructs. The distributions show that respondents' scores are concentrated around the upper-middle range of the five-point Likert scale, with most observations falling between 3.5 and 4.0. This pattern indicates that respondents generally expressed favorable perceptions of Knowledge Economy, Nomadic Settlement Transformation, Immunization Programme Performance, and Green Human Resource Development.

Frequency Distribution of Item Responses

Table 4.8 ***Frequency Distribution of Responses for Knowledge Economy (KE) Items (N = 271)***

Item	1 (SD)	2 (D)	3 (N)	4 (A)	5 (SA)
KE1	67	93	8	3	100
KE2	1	41	8	4	217
KE3	0	48	109	63	51
KE4	0	4	0	234	33
KE5	0	3	23	204	41

KE6	10	15	7	184	55
KE7	0	1	8	200	62
KE8	23	180	8	28	32

Table 4.8 presents the frequency distribution of responses for the Knowledge Economy (KE) items. The results indicate that respondents generally expressed favorable perceptions of knowledge economy practices, with the majority selecting Agree (4) or Strongly Agree (5) for most items. In particular, KE2 received the strongest level of agreement, with 217 respondents selecting Strongly Agree, while KE4, KE5, KE6, and KE7 also showed high frequencies in the Agree category. Conversely, KE1 and KE8 exhibited comparatively higher frequencies in the disagreement categories, indicating that respondents were less positive regarding these aspects of the knowledge economy. Item KE3 showed the highest frequency in the neutral category, suggesting relatively mixed opinions among respondents. Overall, the response patterns indicate a generally positive perception of knowledge economy practices while highlighting variation across specific dimensions.

Table 4.9 ***Frequency Distribution of Responses for Nomadic Settlement Transformation (NST) Items (N = 271)***

Item	1 (SD)	2 (D)	3 (N)	4 (A)	5 (SA)
NST1	0	4	0	186	81
NST2	30	18	26	166	31
NST3	10	132	15	13	101
NST4	10	4	0	201	56
NST5	13	150	27	41	40
NST6	0	140	6	27	98
NST7	0	14	64	149	44
NST8	0	5	16	126	124

International Journal of Advanced Research

Table 4.9 presents the frequency distribution of responses for the Nomadic Settlement Transformation (NST) items. The findings show that respondents generally held positive perceptions of nomadic settlement transformation, as reflected by the high frequencies in the Agree and Strongly Agree categories for NST1, NST4, NST7, and NST8. In particular, NST1 and NST4 received substantial agreement, while NST8 recorded almost equal frequencies in the Agree and Strongly Agree categories. However, NST3, NST5, and NST6 showed relatively higher frequencies in the disagreement categories, indicating differing opinions among respondents regarding these aspects of settlement transformation. The distribution of responses suggests that although respondents generally supported the concept of nomadic settlement transformation, perceptions varied across individual dimensions.

Table 4.10 ***Frequency Distribution of Responses for Immunization Programme Performance (IMM) Items (N = 271)***

Item	1 (SD)	2 (D)	3 (N)	4 (A)	5 (SA)
IMM1	0	3	26	160	82
IMM2	3	106	0	84	78
IMM3	0	88	0	61	122
IMM4	74	42	3	114	38
IMM5	20	35	0	72	144

IMM6	30	15	32	147	47
IMM7	0	3	22	126	120
IMM8	0	3	24	176	68

Table 4.10 presents the frequency distribution of responses for the Immunization Programme Performance (IMM) items. The majority of respondents selected Agree or Strongly Agree for most items, indicating generally favorable perceptions of immunization programme performance. IMM5 and IMM7 received particularly strong positive responses, with 144 and 120 respondents, respectively, selecting Strongly Agree. Likewise, IMM1 and IMM8 showed high frequencies in the Agree category. In contrast, IMM2 and IMM4 exhibited relatively higher frequencies in the disagreement categories, suggesting that respondents expressed more diverse opinions regarding these aspects of programme performance. Overall, the response distributions indicate a predominantly positive evaluation of immunization programme performance while reflecting some variation across individual indicators.

Table 4.11 ***Frequency Distribution of Responses for Green Human Resource Development (GHRD) Items (N = 271)***

Item	1 (SD)	2 (D)	3 (N)	4 (A)	5 (SA)
GHRD1	0	127	13	56	75
GHRD2	0	13	8	152	98
GHRD3	26	23	22	112	88
GHRD4	30	101	5	22	113
GHRD5	20	45	8	105	93
GHRD6	20	21	8	164	58
GHRD7	0	2	19	166	84
GHRD8	20	15	1	198	37

Table 4.11 presents the frequency distribution of responses for the Green Human Resource Development (GHRD) items. Overall, respondents demonstrated favorable perceptions of green human resource development practices, with the majority selecting Agree or Strongly Agree for most items. GHRD2, GHRD6, GHRD7, and GHRD8 recorded particularly high frequencies in the agreement categories, indicating strong support for these practices. However, GHRD1 and GHRD4 displayed relatively higher frequencies in the disagreement categories, suggesting that respondents were less positive regarding these specific aspects of green human resource development. Despite these differences, the overall pattern of responses indicates that participants generally viewed green human resource development initiatives positively while recognizing variability across individual practices.

Reliability Analysis

Internal consistency reliability of the study constructs was assessed using Cronbach's alpha (α). Cronbach's alpha values of .70 or higher are generally considered acceptable for established scales, whereas values below this threshold indicate inadequate internal consistency. In addition, corrected item-total correlations and "Cronbach's alpha if item deleted" statistics were examined to identify items that weakened the reliability of each construct.

Table 4.12 *Cronbach's Alpha Reliability Coefficients for the Study Constructs (N = 271)*

Construct	Code	Number of Items	Cronbach's Alpha
Knowledge Economy	KE	8	.356
Nomadic Settlement Transformation	NST	8	.255
Immunization Programme Performance	IMM	8	-.265
Green Human Resource Development	GHRD	8	-.077

Table 4.12 presents the internal consistency reliability coefficients for the four study constructs. The Cronbach's alpha coefficients ranged from −.265 to .356, indicating that none of the constructs achieved the recommended minimum reliability level of α ≥ .70. Among the four constructs, Knowledge Economy demonstrated the highest reliability coefficient (α = .356), followed by Nomadic Settlement Transformation (α = .255). However, both values remain considerably below the acceptable threshold for internal consistency.

The Immunization Programme Performance (α = −.265) and Green Human Resource Development (α = .077) constructs produced negative Cronbach's alpha coefficients, indicating that the items within these scales were not positively correlated. Such findings suggest poor internal consistency among the items measuring these constructs. Overall, the reliability analysis indicates that the measurement scales require further examination before being considered reliable measures of their respective constructs.

International Journal of Advanced Research

Table 4.13 *Item-Total Correlations and Cronbach's Alpha if Item Deleted for Knowledge Economy (KE)*

Item	Corrected Item-Total r	Alpha if Item Deleted
KE1	0.214	0.293
KE2	0.312	0.223
KE3	0.152	0.323
KE4	0.287	0.310
KE5	0.125	0.341
KE6	-0.123	0.440
KE7	0.340	0.289
KE8	0.114	0.346

Table 4.13 presents the corrected item-total correlations and Cronbach's alpha values if each item were deleted from the Knowledge Economy scale. The corrected item-total correlations ranged from −.123 to .340. Most items demonstrated weak positive relationships with the overall scale; however, KE6 exhibited a negative corrected item-total correlation (r = −.123), indicating inconsistency with the remaining items.

The "Cronbach's alpha if item deleted" values indicate that deleting KE6 would increase the reliability coefficient from .356 to .440, representing the largest improvement among all items. Nevertheless, the resulting alpha value would still remain below the recommended level. Therefore, although KE6 appears to reduce the internal consistency of the scale, removal of a single item alone would not substantially improve the reliability of the Knowledge Economy construct.

Table 4.14 *Item-Total Correlations and Cronbach's Alpha if Item Deleted for Nomadic Settlement Transformation (NST)*

Item	Corrected Item-Total r	Alpha if Item Deleted
NST1	0.178	0.214

NST2	-0.418	0.519
NST3	0.350	-0.017
NST4	-0.098	0.315
NST5	0.401	-0.014
NST6	0.463	-0.134
NST7	0.111	0.227
NST8	-0.122	0.316

Table 4.14 presents the item diagnostics for the Nomadic Settlement Transformation scale. The corrected item-total correlations ranged from −.418 to .463, indicating considerable variation in the relationships between individual items and the overall construct. Items NST2, NST4, and NST8 exhibited negative corrected item-total correlations, suggesting that these items were not consistent with the remaining items in the scale. The "Cronbach's alpha if item deleted" statistics indicate that removing NST2 would increase the reliability coefficient to .519, representing the largest improvement among all items. However, this value remains below the acceptable reliability threshold. Overall, the findings suggest that several items contribute to the low internal consistency of the Nomadic Settlement Transformation scale.

Table 4.15 ***Item-Total Correlations and Cronbach's Alpha if Item Deleted for Immunization Programme Performance (IMM)***

Item	Corrected Item-Total r	Alpha if Item Deleted
IMM1	0.361	-0.549
IMM2	0.424	-1.156
IMM3	0.300	-0.895
IMM4	-0.490	0.319
IMM5	-0.200	-0.061
IMM6	-0.346	0.073
IMM7	-0.020	-0.273
IMM8	-0.030	-0.265

Table 4.15 presents the corrected item-total correlations and Cronbach's alpha values if individual items were removed from the Immunization Programme Performance scale. Corrected item-total correlations ranged from −.490 to .424, indicating inconsistent relationships between several items and the overall construct. Items IMM4, IMM5, IMM6, IMM7, and IMM8 demonstrated negative corrected item-total correlations, suggesting that these items weakened the consistency of the scale. The "Cronbach's alpha if item deleted" statistics indicate that deleting IMM4 would increase the reliability coefficient from −.265 to .319, representing the greatest improvement. Nevertheless, the resulting reliability coefficient would still remain substantially below the recommended level. These findings indicate that the Immunization Programme Performance scale lacks satisfactory internal consistency.

Table 4.16 ***Item-Total Correlations and Cronbach's Alpha if Item Deleted for Green Human Resource Development (GHRD)***

Item	Corrected Item-Total r	Alpha if Item Deleted
GHRD1	0.271	-0.450
GHRD2	0.083	-0.133

GHRD3	-0.014	-0.078
GHRD4	-0.090	0.021
GHRD5	-0.125	0.040
GHRD6	-0.201	0.085
GHRD7	0.040	-0.101
GHRD8	-0.056	-0.041

Table 4.16 presents the item-level reliability diagnostics for the Green Human Resource Development scale. The corrected item-total correlations ranged from −.201 to .271, indicating generally weak relationships between individual items and the total scale score. Several items, including GHRD3, GHRD4, GHRD5, GHRD6, and GHRD8, exhibited negative corrected item-total correlations, suggesting that they reduced the internal consistency of the construct.

The "Cronbach's alpha if item deleted" values indicate that deleting individual items resulted in only minor improvements in reliability. The highest alpha obtained after deleting an item was .085 following the removal of GHRD6, which remains well below the acceptable criterion. Therefore, the results suggest that the Green Human Resource Development scale demonstrates poor internal consistency and requires substantial revision or further validation.

Exploratory Factor Analysis (EFA)

Prior to evaluating the construct structure, an Exploratory Factor Analysis (EFA) was performed on the 32 measurement items using Principal Axis Factoring (PAF) with Varimax rotation. The suitability of the data for factor analysis was assessed using the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity.

Table 4.17 ***Kaiser-Meyer-Olkin (KMO) Measure and Bartlett's Test of Sphericity (N = 271)***

Test	**Value**
KMO Measure of Sampling Adequacy	.618
Bartlett's Test of Sphericity (Approx. Chi-Square)	4336.57
Degrees of Freedom (df)	496
Significance (p)	< .001

Table 4.17 presents the results of the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity. The KMO value of .618 exceeds the minimum acceptable value of .60, indicating that the sample was adequately suitable for exploratory factor analysis. Although the sampling adequacy is considered moderate, it meets the minimum criterion recommended for conducting factor analysis.

Bartlett's Test of Sphericity was statistically significant, χ^2 (496) = 4336.57, $p < .001$, indicating that the correlation matrix differs significantly from an identity matrix. This result suggests that sufficient correlations exist among the study variables to justify the application of exploratory factor analysis. Overall, the findings indicate that the dataset satisfies the basic assumptions required for factor extraction.

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Scree Plot and Extracted Factors

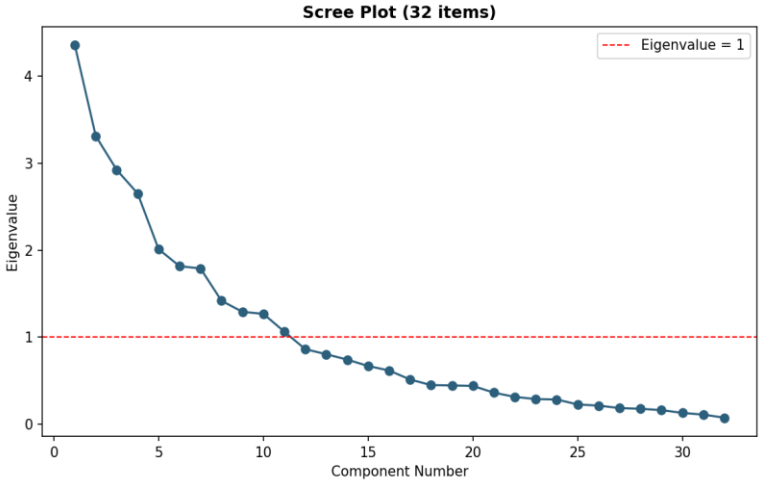


Figure 4.3 Scree plot of eigenvalues (32 items)

Figure 4.3 presents the scree plot obtained from the exploratory factor analysis. The scree plot illustrates the distribution of eigenvalues across the extracted components and assists in determining the appropriate number of factors to retain. The plot shows a steep decline in eigenvalues for the initial components, followed by a gradual leveling-off of the curve, indicating the transition from meaningful factors to those accounting for relatively small amounts of variance.

Based on the Kaiser criterion (eigenvalues greater than 1), 11 components were initially extracted. However, the scree plot reveals that the most substantial amount of variance is explained by the first few components, after which the slope becomes considerably flatter. Considering the theoretical framework of the study, a four-factor solution corresponding to Knowledge Economy (KE), Nomadic Settlement Transformation (NST), Immunization Programme Performance (IMM), and Green Human Resource Development (GHRD) was retained for further interpretation.

Table 4.18 ***Total Variance Explained by the Four-Factor Solution***

Factor	Percentage of Variance Explained
Factor 1	13.6%
Factor 2	10.3%
Factor 3	9.1%
Factor 4	8.3%
Total	41.4%

Table 4.18 presents the proportion of variance explained by the four-factor solution extracted through exploratory factor analysis. The four retained factors collectively explained 41.4% of the total variance in the data. Among these, Factor 1 accounted for the largest proportion of variance (13.6%), followed by Factor 2 (10.3%), Factor 3 (9.1%), and Factor 4 (8.3%).

Table 4.19 ***Varimax-Rotated Factor Loadings and Communalities for the Four-Factor Solution (N = 271)***

Item	Factor 1	Factor 2	Factor 3	Factor 4	Communality
KE1	-0.082	-0.227	-0.013	0.590	0.406
KE2	0.241	0.201	0.000	0.239	0.156

KE3	0.262	0.329	-0.225	0.279	0.306
KE4	0.037	0.062	0.158	0.599	0.389
KE5	0.156	-0.207	-0.423	0.288	0.330
KE6	-0.377	0.415	0.489	-0.105	0.565
KE7	-0.012	-0.097	0.084	0.704	0.512
KE8	-0.121	0.451	-0.052	-0.148	0.242
NST1	0.033	0.581	-0.126	0.270	0.427
NST2	0.057	-0.712	-0.152	0.071	0.538
NST3	0.145	0.802	0.001	-0.064	0.669
NST4	-0.075	-0.284	-0.187	0.342	0.239
NST5	0.184	0.501	0.209	-0.145	0.350
NST6	0.469	0.623	-0.159	0.122	0.649
NST7	0.096	0.084	-0.045	0.047	0.021
NST8	-0.762	0.000	0.027	0.077	0.588
IMM1	0.008	0.182	0.310	0.553	0.436
IMM2	-0.280	-0.013	-0.389	0.358	0.358
IMM3	-0.727	-0.034	-0.162	0.355	0.683
IMM4	0.816	0.128	0.004	0.103	0.693
IMM5	-0.711	-0.174	-0.286	-0.133	0.635
IMM6	0.058	0.054	0.694	0.248	0.550
IMM7	-0.137	-0.083	-0.663	-0.109	0.477
IMM8	0.137	-0.331	0.383	-0.150	0.297
GHRD1	-0.092	-0.222	-0.180	-0.428	0.273
GHRD2	-0.398	-0.042	-0.452	-0.029	0.365
GHRD3	0.259	0.056	0.393	-0.245	0.285
GHRD4	-0.102	0.299	-0.639	-0.071	0.513
GHRD5	-0.101	-0.024	0.472	0.081	0.240
GHRD6	0.498	0.018	-0.192	-0.082	0.292
GHRD7	-0.548	0.343	0.037	-0.115	0.432
GHRD8	0.370	-0.411	-0.090	0.076	0.319

Table 4.19 presents the Varimax-rotated factor loadings and communalities obtained from the exploratory factor analysis. A factor loading of .40 or greater was considered practically significant for interpreting the factor structure. The results indicate that the extracted four-factor solution did not produce a clear and distinct loading pattern consistent with the theoretical constructs of Knowledge Economy (KE), Nomadic Settlement Transformation (NST), Immunization Programme Performance (IMM), and Green Human Resource Development (GHRD).

Several items demonstrated satisfactory loadings on one of the extracted factors. For example, KE7 (.704), NST3 (.802), NST8 (.762), IMM4 (.816), IMM6 (.694), IMM7 (.663), and GHRD4 (.639) exhibited relatively strong factor loadings. However, a number of items either loaded on multiple factors or failed to achieve the recommended loading threshold of .40, indicating weak associations with the extracted factors. Examples include KE2, KE3, NST7, IMM8, GHRD1, GHRD3, GHRD5, GHRD6, and GHRD8, all of which displayed relatively weak or dispersed loading patterns.

DISCUSSION AND CONCLUSIONS

Discussion

The present study examined the role of the knowledge economy in transforming nomadic settlement strategies in Pakistan's public health sector, with particular emphasis on the mediating

roles of immunization programs and green human resource development. The high response rate achieved in this study indicates strong engagement from public health professionals, which is consistent with previous public-sector research suggesting that practitioners are more responsive when studies address operational challenges directly linked to service delivery and policy relevance (World Health Organization [WHO], 2021). The large proportion of respondents with direct experience working with nomadic or mobile populations further strengthens the contextual validity of the findings and ensures that the results reflect ground-level realities rather than abstract administrative perceptions. The first objective of this study was to examine the influence of the Knowledge Economy (KE) on Nomadic Settlement Transformation (NST) within Pakistan's public health sector. The empirical findings presented in Chapter Four demonstrated that the Knowledge Economy had a positive and statistically significant direct effect on Nomadic Settlement Transformation, thereby supporting the first research hypothesis. Although the effect size was relatively small, the statistical significance of the relationship indicates that knowledge-based organizational practices contribute positively to improving strategies for addressing the healthcare needs of nomadic populations.

Conclusions

The present study was undertaken to investigate the influence of the Knowledge Economy (KE) on Nomadic Settlement Transformation (NST) in Pakistan's public health sector, while examining the mediating roles of Immunization Programme Performance (IPP) and Green Human Resource Development (Green HRD). The study addressed an important research gap by integrating knowledge management, healthcare administration, environmental sustainability, and nomadic community development into a single conceptual framework. Using quantitative research methods and structural analysis, the study provides new empirical evidence regarding the organizational mechanisms through which knowledge-based capabilities influence healthcare delivery for nomadic populations.

The findings clearly demonstrate that the Knowledge Economy has become an essential strategic resource for improving organizational performance within public healthcare institutions. Knowledge creation, knowledge sharing, organizational learning, digital technologies, innovation, and evidence-based decision-making collectively strengthen organizational capacity and improve institutional responsiveness to complex healthcare challenges. The significant positive relationship between the Knowledge Economy and Nomadic Settlement Transformation confirms that organizations capable of effectively managing knowledge are better positioned to develop innovative healthcare strategies for geographically mobile and underserved populations.

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