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Contents

Viewpoint

Perspectives on Artificial Intelligence in Nursing in Asia

Nada Lukkahatai[1], RN, MSN, PhD, FAAN; Gyumin Han[1,2], PhD

[1]School of Nursing, Johns Hopkins University, Baltimore, MD, United States

[2]College of Nursing, Research Institute of Nursing Science, Pusan National University, Busan, Republic of Korea

Corresponding Author:
Nada Lukkahatai, RN, MSN, PhD, FAAN
School of Nursing
Johns Hopkins University
525 N Wolfe Street
Baltimore, MD, 21205
United States
Phone: 1 4106145297
Email: nada.lukkahatai@jhu.edu

Abstract

Artificial intelligence (AI) is reshaping health care, including nursing, across Asia, presenting opportunities to improve patient care and outcomes. This viewpoint presents our perspective and interpretation of the current AI landscape, acknowledging its evolution driven by enhanced processing capabilities, extensive data sets, and refined algorithms. Notable applications in countries such as Singapore, South Korea, Japan, and China showcase the integration of AI-powered technologies such as chatbots, virtual assistants, data mining, and automated risk assessment systems. This paper further explores the transformative impact of AI on nursing education, emphasizing personalized learning, adaptive approaches, and AI-enriched simulation tools, and discusses the opportunities and challenges of these developments. We argue for the harmonious coexistence of traditional nursing values with AI innovations, marking a significant stride toward a promising health care future in Asia.

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KEYWORDS

machine learning; ML; artificial intelligence; AI; algorithm; predictive model; predictive analytics; predictive system; practical model; deep learning; ChatGPT; chatbot; nursing; nurse; nursing education; personalized education; Asia

Introduction

Artificial intelligence (AI) is generally defined as a machine-based system that can make predictions, recommendations, or decisions to influence real or virtual environments based on human-defined objectives [1]. These systems—including branches such as robotics, machine learning, deep learning, and natural language processing—can imitate human cognitive functions such as reasoning, learning, and decision-making [2,3]. Over the years, AI has made significant advancements based on improved computer processing capabilities, access to large data sets for training, and algorithm designs [4]. AI-based technologies such as AI-powered decision support systems and AI-powered monitoring systems have been widely adopted by health care systems to improve patient care, enhance efficiency, and reduce costs [5,6]. Nurses are at the forefront of this revolution. AI can augment nurses' abilities, thus improving patient outcomes and increasing clinicians' and patients' satisfaction [7-10].

The adoption of AI in nursing in Asia is varied but is a growing trend in the region. This viewpoint discusses our multifaceted perspectives on the use of AI in nursing practice and education, with a specific focus on Asian countries. It is important to note that this paper is not intended to be a systematic review of the topic but rather aims to highlight developing trends and prospects in the field.

Applications of AI in Nursing

Applications of AI in Nursing Practice and Research

The introduction of AI in nursing in Asia, as in other parts of the world, began to gain prominence in the late 20th century and continued to evolve over the years; however, the specific timeline for the first use of AI in nursing in Asia can vary depending on the region and health care institution (Table 1). Some Asian countries, particularly those with advanced health care systems and a strong focus on technology, may have adopted AI in nursing earlier than others. Regions such as Singapore, South Korea, Japan, India, and China have embraced

AI-powered chatbots and virtual assistants, revolutionizing nursing practice and education, and addressing basic health queries [11-14].

As shown in Table 1, in practice and clinical research, Taiwan, South Korea, Japan, Singapore, and China have demonstrated significant advancements in the integration of AI. In Taiwan, data-mining techniques have significantly enhanced the prediction of nursing issues, while an electroencephalogram classification algorithm has greatly improved seizure monitoring. Hu et al [15] developed an inpatient pressure injury prediction model with an impressive 87.2% recall rate, benefiting high-risk patients. In South Korea, the automated sepsis risk assessment system (Auto-SepRAS) has excelled in categorizing sepsis risk, emphasizing its continuous monitoring value. AI-driven tools have effectively reduced hospital-acquired pressure ulcer rates and intensive care unit stays [16]. Additionally, recent studies in South Korea used machine learning–based analytical methods and natural language processing to accurately predict adverse drug reactions [17], pressure injury staging [18], and improve hospital data management capabilities [19]. Japan's focus on advanced health care analytics is evident through the works of Nakatani et al [20] and Kawashima et al [21], which leveraged natural language processing and machine learning to predict hospital inpatient falls (area under the receiver operating characteristic curve of 0.834) and needs of cancer patients in palliative care, respectively. A study in China used machine learning–based analytical methods for the early detection of delirium in children with critical illnesses [22]. These examples illustrate the remarkable progress in AI integration in nursing across these Asian countries, contributing to improved patient care and safety.

The application of AI-based triage systems in health care facilities and AI-powered telemedicine can further improve access to health care for those who live in remote and conflict-affected areas [23-25]. A research group in Turkey used machine learning to assess pediatric pain to help address patient needs and experiences in clinical practice [26]. Despite the potential benefit of integrating AI into nursing practice to improve patient care and health care delivery, research in this area in developing countries is currently limited, and more studies are needed to explore the feasibility, acceptability, and effectiveness of AI-based solutions in real-world nursing settings.

A bibliometric analysis and science mapping study on AI research in nursing revealed that China has published 89 papers and that Japan and Korea each published 19 papers in this field among Asian countries [27]. In addition, a multinational collaboration network focusing on AI research in nursing has been formed, encompassing nations in Asia such as Japan, Thailand, India, China, Korea, and Singapore. However, the study lacked instances or a comprehensive examination of how Asian nations are implementing AI technology in the nursing domain, and it also failed to address the consequences of such technology on nursing practice and education. These limitations underscore the necessity for increased region-specific research and deliberate global cooperation to optimize the use of AI technology in the nursing domain within Asian nations.

Table 1. Examples of artificial intelligence (AI) in nursing practice and research across Asia.

Authors, year, and country	Study type	AI features	AI feature description	Application in nursing	Key findings
Aydın and Özyazıcıoğlu [26], 2023, Turkey	Primary research; observation study	ML[a] (CNNs[b])	Deep-learning models for visual data analysis, using layers to automatically learn and extract features from images	Postoperative pain assessment in children	ML closely matched children's self-reported pain scores, demonstrating potential for clinical application
Back et al [16], 2016, South Korea	Primary research	AI-powered sepsis risk assessment system (Auto-SepRAS)	AI is used to analyze patient data and predict the likelihood of sepsis	Sepsis risk assessment	Auto-SepRAS demonstrated moderate predictive power for early sepsis identification in hospitalized patients
Hu et al [15], 2020, Taiwan	Primary research	ML (decision tree, logistic regression, random forest)	ML algorithms to make predictions and classifications based on data	Inpatient pressure injury prediction	The random forest model was the most accurate with key identified risk factors, including skin integrity and systolic blood pressure
Jeon et al [17], 2020, South Korea	Primary research	Temporal-difference method in reinforcement learning	Combining aspects of Monte Carlo methods and dynamic programming	ADRs[c]	Employing temporal-difference learning for analyzing ADRs from nursing notes offers promise for drug safety surveillance
Kawashima et al [21], 2024, Japan	Primary research	ML (XGBoost[d])	ML algorithm based on gradient boosting used for classification and regression tasks	Specialist palliative care needs prediction	The predictive model showed potential to replace traditional screening tools, with high accuracy in identifying palliative care needs
Kim et al [18], 2023, South Korea	Primary research	CNN	Deep-learning models for visual data analysis	Pressure injury staging	The CNN model improved the accuracy of pressure injury staging decisions among health professionals
Khan et al [24], 2019, Bangladesh	Perspective	DHIS2[e], EHR[f], big data, AI, ML	The use of AI and ML in medical health record software	Health data warehouse, EHRs, workforce strategy	Bangladesh integrated fragmented health systems into a unified digital health platform, advancing national health care delivery and planning
Lei et al [22], 2023, China	Primary research	ML (XGBoost, logistic regression, random forest)	ML algorithms based on gradient boosting	Delirium prediction in pediatric intensive care	The XGBoost model was the best performer for early prediction of delirium in critically ill children
Nakatani et al [20], 2020, Japan	Primary research	NLP[g] and ML	NLP focuses on the interaction between computers and human language; ML involves prediction algorithms	Predicting inpatient falls	High accuracy in predicting inpatient falls using nursing records with NLP and ML techniques
Shi et al [27], 2023, global (including Asia)	Bibliometric analysis	Various AI technologies	Not applicable	General nursing practice	Rapid growth in publications and citations in the field of AI in nursing, highlighting key areas such as nurse rostering, nursing diagnosis, decision support, and big data management; developed countries lead in publications and collaboration

[a]ML: machine learning.

[b]CNN: convolutional neural network.

[c]ADR: adverse drug reaction.

[d]XGBoost: extreme gradient boosting.

[e]DHIS2: District Health Information Software 2.

[f]EHR: electronic health record.

[g]NLP: natural language processing.

Applications of AI in Nursing Education and Patient Support

As shown in Table 2, in nursing education, the integration of AI promises improved learning outcomes and an overall elevation in the quality of training by allowing personalized learning experiences [28-30]. Through intricate algorithms, educational content can be tailored to resonate with individual student needs, accounting for their unique strengths, weaknesses, and learning styles. This ensures content delivery in a manner most conducive to comprehension and retention. Adaptive learning allows students to assimilate knowledge at their own pace, optimizing their educational journey. Engaging and interactive modules instill genuine enthusiasm in learners, fostering an environment conducive to in-depth exploration and understanding [31,32]. Moreover, simulation tools enhanced by AI capabilities revolutionize hands-on nursing training, providing safe and controlled environments for students to practice and refine their skills. Real-time feedback within these simulations allows for immediate correction and learning that are instrumental in building clinical confidence [33-37]. The specific integration of AI in nursing education in Asia is varied by country and institution. Nevertheless, it is increasingly recognized as a valuable tool for improving the quality of education and for preparing nursing students for the complex health care environment.

While some countries such as India, Pakistan, Bangladesh, Turkey, and Afghanistan may face limited resources and infrastructure, several attempts have been made to develop low-cost, culturally tailored AI technologies to improve patient care, optimize workflow efficiency, and enhance clinical decision-making (Table 2). Examples of such AI applications in these countries include the implementation of AI-powered chatbots for patient education and support [23,38].

Table 2. Examples of artificial intelligence (AI) in nursing education and patient support across Asia.

Authors, year, and country	Study type	AI features	AI feature description	Application in nursing	Key findings
Nurse education and provider training					
Chen et al [31], 2022, China	Primary research	Chatbot	AI program designed to simulate conversation with human users	History-taking instruction program	Identified a need for chatbot-based history-taking instruction to provide more practice and feedback opportunities
Liao et al [8], 2015, Taiwan	Primary research; case study	BPN[a], ANFIS[b]	BPN is a machine-learning model that learns by adjusting its connections based on errors. ANFIS combines neural networks and fuzzy logic to learn and make decisions from data.	Support decision-making in nursing; generate nursing diagnoses	AI can assist in accurately generating nursing diagnoses with an agreement rate of up to 87% between system suggestions and nurse-made diagnoses.
Liaw et al [37], 2023, Singapore	Primary research; RCT[c]	AI in virtual reality simulation	Using AI to create realistic and interactive virtual environments, enhancing the user's experience	Sepsis care and interprofessional communication training	Virtual reality simulations with AI-powered doctors were effective for sepsis team training without inferior outcomes
Castonguay and Lovis [30], 2023, Canada	Reflection article	ChatGPT	A language model developed by OpenAI designed to understand and generate human-like text based on the input it receives	Nursing education, research, and practice	ChatGPT could revolutionize nursing education by supporting students' learning, improving digital literacy, and facilitating critical thinking. Despite potential biases and limitations, it can serve as a tool for research, teaching, and summarizing complex documents. Its integration requires collaboration to establish competencies and ethical guidelines for AI use in nursing
Patient education and support					
Cheng et al [32], 2023, Taiwan	Primary research; interventional study	AI chatbot	AI program designed to simulate conversation with human users	Peritoneal dialysis care	The AI chatbot significantly improved patient satisfaction and reduced infection rates
Castonguay et al [29], 2023, global (including Asia)	Comparative study	AI	A technology that enables machines to mimic human intelligence, allowing them to learn, reason, and make decisions	AI maturity in health care systems	Most OECD[d] countries are at the emerging level of AI maturity in health care. Only the United States and the United Kingdom have achieved the integrated ecosystem level, indicating mature, collaborative AI use in health care. The study underscores the need for adaptable, context-specific AI strategies for health care across different countries.

Authors, year, and country	Study type	AI features	AI feature description	Application in nursing	Key findings
Castonguay et al [28], 2024, global (including Asia)	Editorial	AI language models	Systems that use AI to understand and generate human-like text based on the data they have been trained on	Health care digitalization	AI language models have significant potential to improve decision-making and patient engagement in health care. Challenges include ensuring reliability, transparency, and ethical use. The new journal section aims to explore, showcase, and address these challenges.
Park et al [19], 2024, South Korea	Primary research	NLP[e]	Focuses on the interaction between computers and human language	Patient interaction, health records management	Enhanced communication and improved data management capabilities
Simsek-Cetinkaya and Karaveli Cakir [38], 2023, Turkey	Primary research; interventional design	Interactive screen-based simulation	A digital tool that lets users engage with simulated scenarios on a screen, allowing them to practice skills or experience situations	Breast self-examination training	AI simulation increased student satisfaction but was less effective than standard simulation for teaching skills
Wang et al [23], 2022, India	Primary research; interventional study	AI chatbot	AI program designed to simulate conversation with human users	Sexual and reproductive health education	The chatbot engaged users, particularly young men, providing a private space for discussing sensitive health topics

[a]BPN: back-propagation neural network.

[b]ANFIS: adaptive neuro-fuzzy inference system.

[c]RCT: randomized controlled trial.

[d]OECD: Organisation for Economic Co-operation and Development.

[e]NLP: natural language processing.

Challenges of AI in Nursing Practice in Asia

While AI promises to revolutionize health care in Asia, it also presents several challenges. A primary concern is the lack of consistent standards and regulations for AI tools. This lack of standardization can lead to patient safety issues, particularly if devices from different manufacturers do not integrate smoothly or yield inconsistent results [39]. Biases embedded within AI algorithms are another significant concern. If the training data for these algorithms do not represent diverse populations, the AI systems might produce discriminatory or unequal outcomes. Such biases could exacerbate existing health care disparities or introduce new ones, thus challenging the equity and fairness of care delivery [40].

Ethical challenges—particularly related to data privacy and informed consent—are also paramount. As the health care industry increasingly relies on vast data sets, ensuring data security and transparent usage is crucial. Addressing patient autonomy and consent for data usage is of utmost importance. Moreover, disparities in resources and infrastructure across Asia's vast landscape can hinder uniform AI adoption. While urban health care centers readily adopt AI, rural areas may face challenges such as outdated equipment or inconsistent internet connectivity. Finally, the integration of AI necessitates an educational shift for nurses, emphasizing a balance between clinical knowledge and technological skills [41-44].

The use of an AI-powered chatbot in nursing education presents some challenges. One of the foremost challenges is the need for adequate infrastructure and resources to implement AI technologies effectively. Many educational institutions may face financial constraints or lack the technical infrastructure required for seamless AI integration. Additionally, there are concerns related to the appropriate and ethical use of AI in education, including issues of data privacy, bias in AI algorithms, and transparency in decision-making processes. Educators and institutions must also address the potential resistance to change among faculty members and students who may be unfamiliar with AI-based tools and systems. Balancing the human touch and critical thinking skills that are so intrinsic to nursing with the technological advancements in AI poses another challenge, as this requires a thoughtful approach to curriculum design and the development of AI-enhanced educational content that aligns with nursing practice.

Furthermore, while some AI-powered dialogue systems (eg, ChatGPT, Microsoft Bing AI, Google Gemini) have the potential to enhance nursing education by providing instant access to information, facilitating virtual simulations, and offering personalized learning experiences, there are concerns regarding their potential misuse. Growing concerns are related to students becoming overly dependent on AI-generated responses along with the risk of misinformation or inaccurate guidance because these systems lack access to up-to-date evidence-based knowledge or clinical expertise [29,34,44]. In nursing education,

where critical thinking, empathy, and clinical judgment are vital, overreliance on AI could inadvertently undermine these essential skills.

Introducing AI integration in nursing in Asia presents several challenges that are rooted in resource constraints, technological infrastructure disparities, data privacy concerns, cultural acceptance, resistance to change, education and training gaps, the need for ethical and legal frameworks, language diversity, and integration with existing health care systems. Resource limitations often hinder investments in AI technology and staff training, while disparities in technological infrastructure and connectivity across regions can hinder access to advanced AI tools. Developing robust data-protection regulations and cybersecurity measures is essential to address privacy concerns. Overcoming cultural and traditional health care practices, as well as ensuring that AI is embraced by both health care providers and patients, requires a thoughtful approach. Education and training are crucial, as health care professionals need specialized training to effectively use AI tools. Developing ethical guidelines and legal frameworks, as well as addressing the issues related to language diversity and the seamless integration of AI with existing systems, are complex but necessary steps to ensure successful AI adoption in nursing across Asia. Despite these challenges, many Asian countries are actively working to overcome these barriers, recognizing the potential benefits of AI in nursing for improving patient care, increasing efficiency, and enhancing health care outcomes.

Summary and Prospects

In summary, the advent of AI is indicating a significant transformation in the field of nursing across Asia. Embracing these innovations necessitates the recognition of the enduring importance of the human touch and empathy within the profession. When effectively integrated, AI can complement and coexist with the core values of traditional nursing, paving the way for a harmonious and promising future in health care. Despite our interpretation of current evidence and perspective of the role of AI in nursing practice and education in Asia, this is not a systematic review. The limitation of this viewpoint is that the potential lack of comprehensive data specific to AI use in nursing across all Asian countries, the depth of analysis and generalizability of findings, and cultural and contextual differences across countries may not be fully captured to shape our perspectives. These limitations highlight the need for a follow-up systematic review paper and further research.

Conflicts of Interest

None declared.

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Abbreviations

AI: artificial intelligence

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Original Paper

A Random Forest Algorithm for Assessing Risk Factors Associated With Chronic Kidney Disease: Observational Study

Pei Liu[1*], MSc; Yijun Liu[2*], BS; Hao Liu[3*], MSc; Linping Xiong[2], MD, DSC; Changlin Mei[4], MD; Lei Yuan[2], BS

[1]Department of Mathematics and Physics, Second Military Medical University, Shanghai, China

[2]Department of Health Management, Second Military Medical University, Shanghai, China

[3]Faculty of Health Service, Second Military Medical University, Shanghai, China

[4]Nephrology Department, Shanghai Changzheng Hospital, Shanghai, China

[*]these authors contributed equally

Corresponding Author:
Lei Yuan, BS
Department of Health Management
Second Military Medical University
No.800 Xiangyin Road, Yangpu District, Shanghai, China
Shanghai, 200433
China
Phone: 86 15026929271
Email: yuanleigz@163.com

Abstract

Background: The prevalence and mortality rate of chronic kidney disease (CKD) are increasing year by year, and it has become a global public health issue. The economic burden caused by CKD is increasing at a rate of 1% per year. CKD is highly prevalent and its treatment cost is high but unfortunately remains unknown. Therefore, early detection and intervention are vital means to mitigate the treatment burden on patients and decrease disease progression.

Objective: In this study, we investigated the advantages of using the random forest (RF) algorithm for assessing risk factors associated with CKD.

Methods: We included 40,686 people with complete screening records who underwent screening between January 1, 2015, and December 22, 2020, in Jing'an District, Shanghai, China. We grouped the participants into those with and those without CKD by staging based on the glomerular filtration rate staging and grouping based on albuminuria. Using a logistic regression model, we determined the relationship between CKD and risk factors. The RF machine learning algorithm was used to score the predictive variables and rank them based on their importance to construct a prediction model.

Results: The logistic regression model revealed that gender, older age, obesity, abnormal index estimated glomerular filtration rate, retirement status, and participation in urban employee medical insurance were significantly associated with the risk of CKD. On RF algorithm–based screening, the top 4 factors influencing CKD were age, albuminuria, working status, and urinary albumin-creatinine ratio. The RF model predicted an area under the receiver operating characteristic curve of 93.15%.

Conclusions: Our findings reveal that the RF algorithm has significant predictive value for assessing risk factors associated with CKD and allows the screening of individuals with risk factors. This has crucial implications for early intervention and prevention of CKD.

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KEYWORDS

chronic kidney disease; random forest model; risk factors; assessment

Introduction

Chronic kidney disease (CKD) is characterized by chronic structural and functional impairment of the kidney of >3 months, caused by various factors. CKD is diagnosed based on the presence of pathological injury for more than 3 months, abnormal glomerular filtration rate (GFR), abnormal blood or urine composition, abnormal imaging findings, or an index estimated GFR (eGFR) of <60 mL/minute/1.73 m^2 [1]. CKD is a major global health concern. Between 1990 and 2015, the

annual mortality rate attributed to CKD increased at an average rate of 3.4% per year, and the global prevalence rate of CKD increased to 14.3% [2]. The economic burden due to CKD accounts for 31.4% of the global annual burden of living with disability [3-6]. In China, the prevalence of CKD among patients aged 18 years and older is 10.8%, encompassing approximately 120 million patients, indicating that approximately 1 in 10 Chinese individuals have had CKD [1]. Nevertheless, the awareness rate of CKD is low, and only 12.5% of patients know about their illness. CKD is highly prevalent and its treatment cost is high but unfortunately remains unknown. Therefore, early detection and intervention can mitigate the treatment burden on patients and decrease disease progression.

In recent years, risk factors including hypertension, diabetes, and obesity, which are associated with CKD, have gradually shown a trend toward affecting the younger population [7]. CKD is closely linked with an increased risk of all-cause mortality, cardiovascular disease (CVD), renal failure, and other adverse health outcomes, causing a serious disease burden [8-10]. CKD is a major health concern due to its high prevalence, low awareness rate, high treatment cost, increased risk of combined cardiovascular events, and early mortality. Early intervention, treatment, and controlling the risk factors of CKD can decelerate and decrease disease progression and consequently reduce overall morbidity and mortality. Hence, diagnosis and risk factor assessment for patients with early-stage CKD are of immense significance.

With continuous advancements in artificial intelligence technology, many researchers have attempted to use machine learning models in the medical field. Many studies have reported that machine learning algorithms can improve the decision-making abilities of clinicians in different fields, including clinical prediction. A study published in *The Lancet* [11] developed a feasible and effective machine learning–based risk stratification model for predicting adverse events post hospital discharge in patients with acute coronary syndromes. The random forest (RF) algorithm was first proposed by Leo Breiman and Adele Cutler in the early 21st century [12]. In the last few years, the use of the RF algorithm for disease risk prediction has garnered increasing attention due to its high accuracy. Furthermore, some researchers have used econometric models based on logistic regression (LR) and RF to predict the risk of acute ovarian failure [13]. Additionally, Let et al [14] constructed an RF model to improve the early detection and prediction of the incidence of venous thromboembolism in patients with lung cancer.

Some researchers have explored the application of machine learning algorithms in disease prediction, compared them with traditional statistical regression models, and reported the differences in the performance of various prediction models. While comparing conventional LR models with the RF algorithm, many studies reported that the RF algorithm is more advantageous than the LR model. A previous study investigated the predictability of the RF algorithm, the LR model, and deep neural network models and found that machine learning models, particularly deep neural network models, can improve the long-term prognosis prediction of patients with ischemic stroke [15]. Another study constructed an interpretable RF model to predict severe acute pancreatitis and found that the RF model showed better precision and diagnostic accuracy than the LR and Bedside Index Of Severity In Acute Pancreatitis models [16]. Some researchers used 5 machine learning algorithms separately to predict the malnutrition status of 5-year-old children in Bangladesh and found that the accuracy of the RF algorithm was 68.51%, which was greater than that of other algorithms [17]. Another study reported that the RF algorithm is a better predictive model for older patients with hip fractures and high-risk mortality within 1 year after surgery [18].

A longitudinal study involving 143,043 patients with hypertension was performed to predict long-term CVD risk. The study reported that advanced machine learning algorithms using RF performed better than traditional LR [19]. A longitudinal cohort study compared clinical risk predictions among patients with CVD using 19 prediction techniques. The study also reported that excluding LR and commonly used machine learning algorithms from long-term risk prediction models underestimated the disease risk [20].

Researchers have also investigated the advantages of using RF models in predicting kidney diseases. A previous study reported the performance of 4 prediction tools, namely deep learning, plain Bayesian, RF, and LR, for predicting all-cause mortality in patients with CKD. The study showed that Bayesian networks and LR showed superior prediction abilities [21]. However, another study reported that plain Bayesian, RF, and LR performed adequately well and showed high sensitivity for screening end-stage renal disease in patients with CKD, which is inconsistent with previous reports [22]. Another previous study constructed 3 algorithms, namely RF, plain Bayesian, and LR, to classify glomerular and tubular injury and found that RF showed the best performance in terms of accuracy, sensitivity, and specificity. These findings suggest that RF can facilitate early diagnosis of glomerular and tubular injury to mitigate CKD progression [23]. Therefore, previous studies on the viability of RF models have reported inconsistent conclusions due to differences in research perspectives and subjects.

Methods

Data Source

The data for this study were collected from the CKD screening population in Jing'an District from January 1, 2015, to December 22, 2020. Information obtained included demographic and sociological characteristics, height, weight, diastolic and systolic blood pressure, health insurance type, screening date, urinary protein and urinary albumin-creatinine ratio (UACR), blood creatinine, eGFR, and screening results. In total, 103,960 records were initially screened and CKD diagnoses were categorized based on *ICD-10* (*International Statistical Classification of Diseases, Tenth Revision*) criteria. Records with incomplete or duplicate data were excluded, resulting in a final sample size of 40,686 cases for analysis. These data are considered credible and authentic.

Definition of Grouping

The participants were categorized based on dichotomous variables: 1 for the nonmanagement population (indicating the

absence of CKD) and 2 for the management population (indicating the presence of CKD).

Covariance

We used the 11 factors identified in the univariate analysis as explanatory variables for the LR model. The grouping and assignment of the dependent and independent variables are listed in Table 1.

Table 1. Grouping and assignment of dependent and independent variables.

Name	Variable	Value assignment
CKD[a] screening	Y	1. Nonmanagement population; 2. Management population
Gender	x_1	1. Male; 2. Female
Age	x_2	1. <65 years; 2. 65-75 years; 3. ≥75 years
BMI	x_3	1. Normal: 18.5-24; 2. Underweight: <18.5; 3. Overweight: 24-28; 4. Obesity: ≥28
History of hypertension	x_4	1. No; 2. Yes
Index blood creatinine	x_5	1. Normal; 2. Abnormal
Index eGFR[b]	x_6	1. No; 2. Yes
Index urinary protein	x_7	1. Negative; 2. Positive
Albuminuria	x_8	1. No; 2. Yes
Urine albumin-creatinine ratio	x_9	1. <30; 2. 30-300; 3. ≥300
Working status	x_{10}	1. Retired staff; 2. Unemployed person; 3. Others[c]
Type of medical insurance	x_{11}	1. Urban employee medical insurance; 2. Urban resident medical insurance; 3. Others[d]

[a]CKD: chronic kidney disease.

[b]eGFR: estimated glomerular filtration rate.

[c]Others include students, freelancers, and workers.

[d]Others include the poverty relief system, out-of-pocket insurance, new rural cooperative medical system (NRCMS), commercial medical insurance, and free medical service. The same as below.

Statistical Model

A database was established using Excel (Microsoft Corp) 2010, and SAS (version 9.4; SAS Institute Inc) statistical software was used for data analysis. The chi-square test was performed for 1-way analysis to select variables for inclusion in the model, with the threshold for statistical significance set at $P<.05$. Based on the GFR stage, albuminuria (Alb) grouping, and the distribution of data, the study categorized participants for CKD screening into management (suspected and diagnosed patients) and nonmanagement (healthy individuals) populations. The resulting dichotomous LR model was then used for subsequent analysis.

The RF Algorithm

RF is a classification algorithm that uses multiple decision trees to train and predict samples. Specifically, the algorithm samples the training data set N times with replacement and selects a random subset of training samples each time. The remaining undrawn samples are subsequently used to evaluate the prediction error of the model.

Training Validation Split

The data set of 40,686 participants was randomly split into the following 2 subsets using simple random sampling in Python 3.6: one for validation sample set A including 13,549 cases (or 33.3% of the total data set), and the other for then training sample set B including 27,139 cases (or 66.7% of the total data set). The first subset A constituted the external validation sample set with 3000 cases (accounting for 7.4% of the total data set). The RF algorithm was subsequently applied to the training sample set to evaluate the importance of each variable and construct a CKD risk factor model. This model was used to predict the test sample set, with a minimum prediction accuracy threshold of 70%.

Parameters

The mean number of feature selections was used for each random tree (mtry) in the model.

For a set with predictors, a typical number is the rounded square root of mtry [12]. Only 11 features were used in this study. We did not use the square root method to calculate mtry. However, we randomly selected a certain number of features each time

and fixed ntree to adjust mtry to determine the values that minimized generalization errors as the optimal value of mtry.

The mean number of random trees was used in the RF algorithm (ntree) in the model. (1) Using bootstrap resampling, 20% of the B set was randomly split and was used as an internal validation set and 80% was used as the training set. (2) Assuming that the number of the decision tree was ntree, for each node, mtry features were randomly selected. These mtry features were used to divide the sample set, and the index Gini was used to determine the best partitioning method. (3) For determining the mean error of the test set, steps (1), (2), and (3) were repeated. With each iteration of step (2), the ntree was increased by 1. ntree gradually increased from 1 to 200. We obtained the set for average generalization error, and observed the variation in the average generalization error with ntree. When the optimal model was achieved, we obtained the number of ntrees.

Variable Importance

After establishing the RF model, it was used for prediction. Given the abundance of trees in the forest, determining which variables have the most significant impact on predictions can be challenging. Fortunately, an important method was used to assess the significance of variables in the model. Specifically, for each variable, in each decision tree of an RF, the decrease in the splitting criterion function (residual squared or Gini index) caused by that variable was measured. The decrease in magnitude for each decision tree was then averaged to determine the importance of the variable. The importance of each feature variable was ranked and plotted in order, resulting in a variable importance plot.

Ethical Considerations

The Institutional Review Committee Board at Shanghai Changzheng Hospital affiliated with the Naval Medical University approved this study with written consent (No.2016SL020). This observational study analyzed existing data sources, which did not contain any patient-identifiable information. This study did not involve the collection, use, or transmission of individually identifiable data.

Results

LR Model With 2 Classifications

Results of Single Factor Analysis

An LR model with 2 classifications (CKD and non-CKD) was used for analysis. As shown in Table 2, the results of the univariate analysis indicate a statistically significant distribution of differences in CKD status in the investigated population across 11 variables: gender, age, BMI, history of hypertension, index blood creatinine, index eGFR, index urinary protein, Alb, UACR, working status, and type of health insurance (P<.05).

Table 2. Distribution and comparison of baseline characteristics among patients diagnosed with CKD[a].

Variable name	Total participants, n	Management population, n (%)	Chi-square (*df*)	*P* value
Gender			47.43 (1)	<.001
Male	17,205	16,052 (93.30)		
Female	23,481	21,473 (91.45)		
Age (years)			7811.50 (2)	<.001
<65	9638	6864 (71.22)		
65-75	20,156	19,783 (98.15)		
≥75	10,892	10,878 (99.87)		
BMI (kg/m^2)			220.31 (3)	<.001
Normal (18.5-24)	19,444	17,545 (90.23)		
Underweight (<18.5)	1021	936 (91.67)		
Overweight (24-28)	15,387	14,457 (93.96)		
Obesity (≥28)	4834	4587 (94.89)		
History of hypertension			8.62 (1)	.003
No	37,513	34,556 (92.12)		
Yes	3173	2969 (93.57)		
Index blood creatinine			62.35 (1)	<.001
Normal	39,959	36,798 (92.09)		
Abnormal	727	727 (100)		
Index eGFR[b]			1164.79 (1)	<.001
Normal	16,817	14,603 (86.83)		
Abnormal	23,869	22,922 (96.03)		
Urine protein indicators			387.10 (1)	<.001
Negative	36,557	33,396 (91.35)		
Positive	4129	4129 (100)		
Albuminuria			519.68 (1)	<.001
No	35,329	32,168 (91.05)		
Yes	5357	5357 (100)		
Urinary albumin-creatinine ratio			580.49 (2)	<.001
<30	34,793	31,632 (90.91)		
30-300	5207	5207 (100)		
≥300	686	686 (100)		
Working status			1471.67 (2)	<.001
Retired staff	37,406	35,062 (93.73)		
Unemployed person	204	142 (69.61)		
Others	3076	2321 (75.46)		
Type of medical insurance			111.97 (2)	<.001
Urban worker	22,909	21,405 (93.43)		
Urban resident	16,626	15,055 (90.55)		
Others	1151	1065 (92.53)		

[a]CKD: chronic kidney disease.

[b]eGFR: estimated glomerular filtration rate.

Multivariate Analysis

On univariate analysis, variables with statistically significant differences were subjected to multivariate analysis as explanatory variables in binary LR to establish a regression model. The variables were screened using the input method with a significance level of α=.05. The results of the multivariate analysis are presented in Table 3. The risk of CKD was lower in women than in men (odds ratio [OR] 0.909, 95% CI 0.829-0.997). Furthermore, the risk of CKD gradually increased with an increase in age, with people aged 75 years and older (OR 256.759, 95% CI 151.115-436.259) and those aged 65-75 years (OR 20.471, 95% CI 18.209-23.013) being at higher risk than those younger than 65 years. Moreover, individuals with a BMI above the normal range were at a higher risk of CKD. People with a BMI of ≥28 (OR 2.024, 95% CI 1.426-1.733) and those with a BMI of 24-28 (OR 1.572, 95% CI 1.426-1.733) were at a higher risk of CKD than those with a normal BMI. Similarly, people with an abnormal eGFR index were at a higher risk of CKD (OR 1.397, 95% CI 1.271-1.537) than those with a normal eGFR. Compared with other participants, retirees (OR 2.432, 95% CI 2.162-2.736) and people with medical insurance for urban employees (OR 1.769, 95% CI 1.319-2.372) were at higher risk of CKD.

Table 4 shows that in the test sample, a high proportion of records (98.9%) was accurately predicted. Specifically, the prediction model correctly identified all management population records, whereas only 6.4% of nonmanagement population records were accurately predicted.

Although dichotomous LR offers notable advantages including fast training, easy understanding, and high interpretability, its limitations should be acknowledged. First, its effectiveness may be hampered when managing imbalanced data sets, as observed in this study where indicators including urine routine proteins (PROs) exhibited excessive ORs because of the higher proportion of abnormal values within the management population. Second, similar to the accuracy rates of linear models, the accuracy rates of LR models may not be optimal because the latter can experience difficulty in fitting the true data distribution. Herein, imbalanced data sets in the regression model led to statistically insignificant urine test results. Thus, to overcome these limitations, we considered using a machine learning approach.

Table 3. Logistic regression analysis of factors affecting chronic kidney disease in people with different characteristics.

Variable name	β		Wald chi-square (*df*)	*P* value	Odds ratio (95% CI)
Female gender (reference: male)	–0.095	0.047	4.103 (1)	.04	0.909 (0.829-0.997)
Age (years; reference: ≤65 years)					
65-75	3.019	0.060	2555.045 (1)	<.001	20.471 (18.209-23.013)
≥75	5.548	0.270	420.803 (1)	<.001	256.759 (151.115-436.259)
BMI (kg/m^2; reference: normal [18.5-24 kg/m^2])					
Underweight (<18.5)	–0.286	0.148	3.737 (1)	.05	0.751 (0.562-1.004)
Overweight (24-28)	0.452	0.050	82.521 (1)	<.001	1.572 (1.426-1.733)
Obesity (≥28)	0.705	0.081	76.341 (1)	<.001	2.024 (1.728-2.370)
Having a history of hypertension (reference: no)	0.127	0.089	2.031 (1)	.15	1.135 (0.953-1.352)
Abnormal index blood creatinine (reference: normal index blood creatinine)	16.407	1054.200	0.000 (1)	.99	1.33×10^7 (0.000-0.000)
Abnormal index eGFR[a] (reference: normal index eGFR)	0.335	0.048	47.630 (1)	<.001	1.397 (1.271-1.537)
Positive urine protein indicators (reference: negative urine protein indicators)	15.990	436.534	0.001 (1)	.97	8.80×10^6 (0.000-0.000)
Having albuminuria (not having albuminuria)	17.360	403.317	0.002 (1)	.97	3.46×10^7 (0.000-0.000)
Urine albumin-creatinine ratio (reference: <30)					
30-300	17.435	440.654	0.002 (1)	.97	3.73×10^7 (0.000-0.000)
≥300	15.824	1063.960	<0.001 (1)	.99	7.45×10^6 (0.000)
Working status (reference: other)					
Retired staff	0.889	0.060	218.852 (1)	<.001	2.432 (2.162-2.736)
Unemployed person	–0.032	0.203	0.026 (1)	.87	0.968 (0.651-1.441)
Type of medical insurance (reference: other)					
Urban employee medical insurance	0.570	0.150	14.504 (1)	<.001	1.769 (1.319-2.372)
Urban resident medical insurance	–0.159	0.151	1.116 (1)	.29	0.853 (0.634-1.146)

[a]eGFR: estimated glomerular filtration rate.

Table 4. Classification of model predictions.

Real test	Prediction of chronic kidney disease status		Percentage of accurate predictions, %
	Nonmanagement population, n	Management population, n	
Chronic kidney disease			
Non-management target population	3	44	6.4
Management target population	0	3818	100.00
Total percentage			98.90

Machine Learning: RF Algorithm

Modeling

The data set was split into 66.7% of samples, which corresponded to 27,139 records, randomly selected without replacement. The control method was applied by fixing the ntree (number of means of random trees in the RF algorithm) constant and debugging the mtry (mean number of feature selections used for each random tree) parameter. In each iteration, a certain number of features were randomly selected, and the average generalization error value was computed for 11 trials. The change in the error rate of the model, with respect to mtry, is depicted in Figure 1. The error rate decreased significantly when the number of features changed from 1 to 2, followed by an increase close to the minimum value, which was achieved when mtry=4. Next, the mtry value was set to 4, and the ntree value was adjusted accordingly. In total, 200 random trials were conducted to gauge the average generalization error of the test set (Figure 2). The generalization error rate decreased rapidly from 1 to 10, decreased slowly from 10 to 25, and thereafter flattened and stabilized. Thus, the optimal model was identified when the ntree value was 166.

Figure 1. The effect of mtry on the error rate of random forest algorithm.

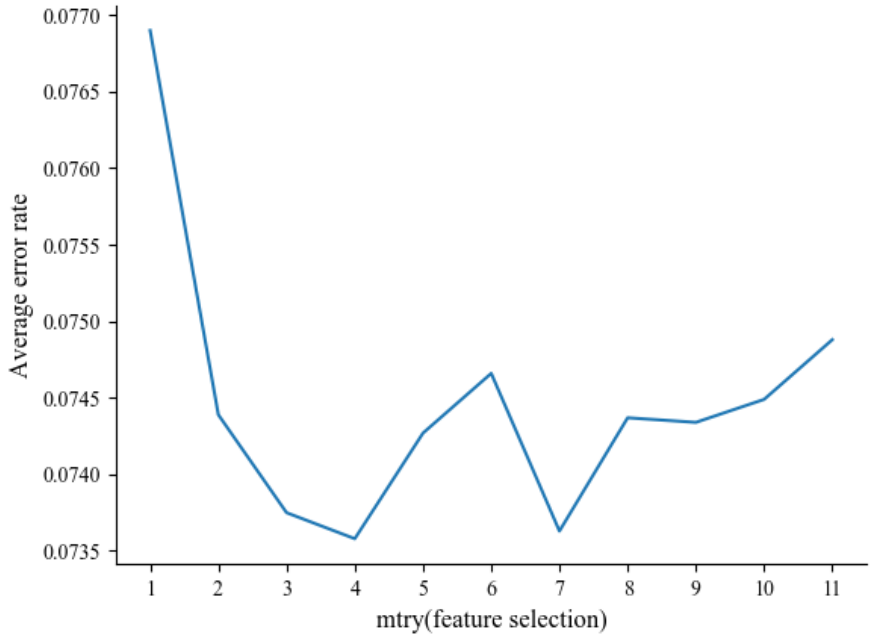
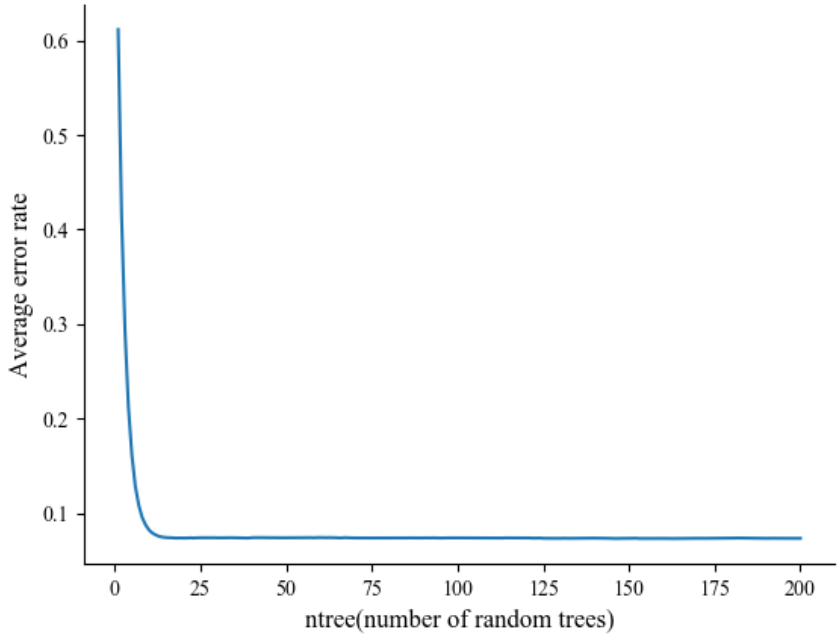


Figure 2. The effect of ntree on the error rate of the random forest (RF) algorithm.

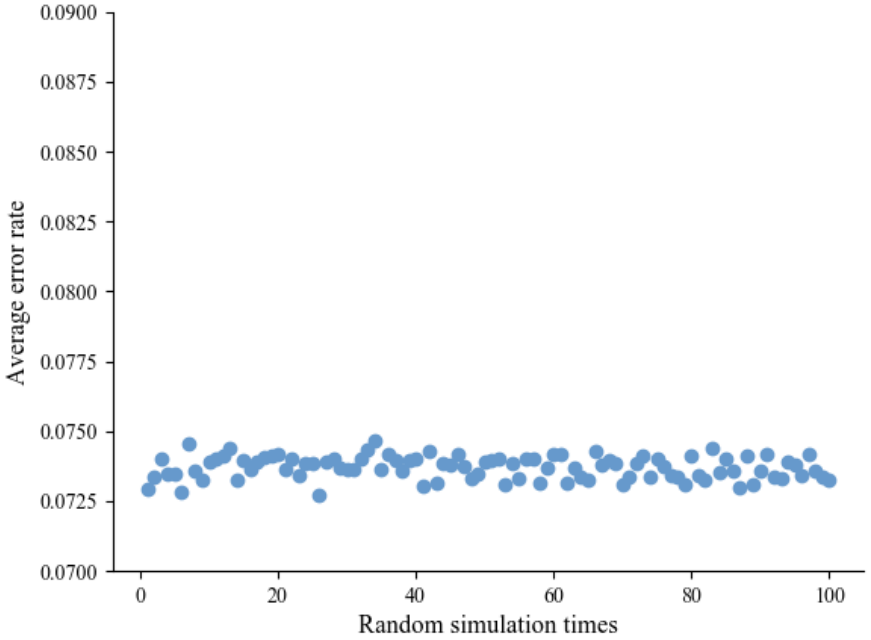


Analysis of the Results of the RF Algorithm

The RF algorithm was trained on a test data set comprising 27,139 records, with ntree=166 and mtry=4. Using these parameters, the algorithm was applied to classify the test set data, and the importance ranking of each feature was determined (Multimedia Appendix 1). The 4 most important features identified were age, Alb, working status, and UACR. These features were further selected for the prediction study, which yield a final classification accuracy rate of 92.67%.

Next, 100 random trials were conducted to ensure the reliability of our results. The generalization error plot is presented in Figure 3. The error was concentrated around 0.0735, with a small fluctuation and an average error of 7.371%. Our results indicate a good generalization ability of the model, suggesting its reliability in classification tasks.

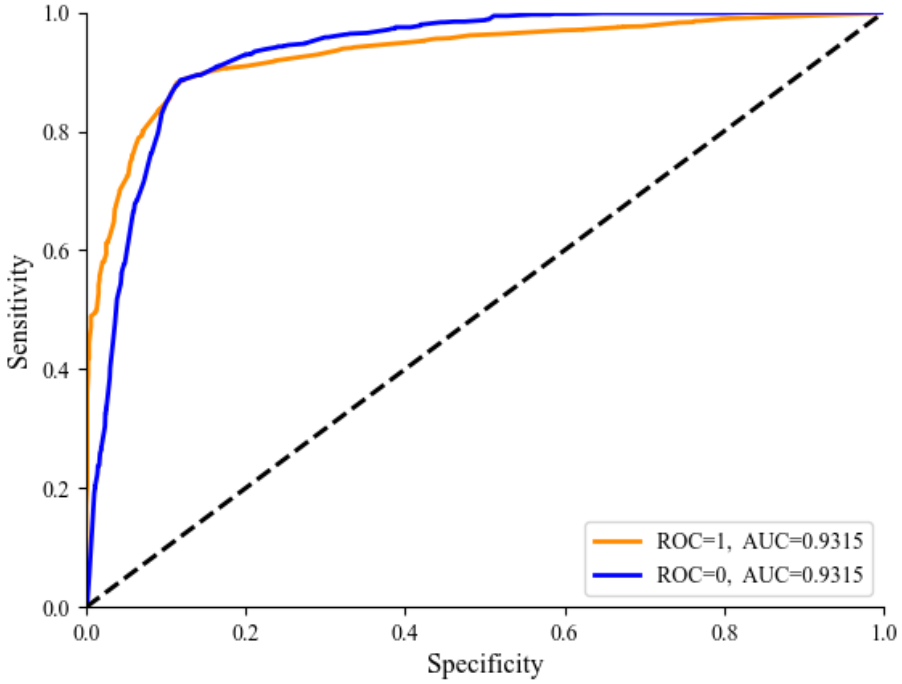
Figure 3. The generalization error rate of the random forest algorithm was estimated by conducting 100 randomized trials.



Comparison of the Sensitivity and Specificity of RF Models

The area under the receiver operating characteristic curve (AUC) of the RF model based on the training and test sets was 93.15% (Figure 4). The RF algorithm outputs voting results (0s and 1s), whereas the receiver operating characteristic curve requires voting probability data. Converting probabilities to voting results can lead to error because of extreme probabilities, such as 0.01515526 and 0.98484474. Therefore, we calculated the AUC to assess model performance and the classification prediction rate to indicate the accuracy of the model. Herein, the RF algorithm achieved an accuracy rate of 92.67%, with some degree of error. These results suggest that the model exhibited good predictive power and accurately classified new data samples.

Figure 4. Receiver operating characteristic (ROC) curve of chronic kidney disease prediction by the random forest algorithm. AUC: area under the receiver operating characteristic curve.



Confusion Matrix

Four possible predicted results were as follows: true positives, false positives, true negatives, and false negatives. Table 5 shows the confusion matrix of the RF model. The precision, recall, and F_1-score were 0.951, 0.984, and 0.967, respectively.

Table 5. Confusion matrix of the random forest algorithm model.

	Predicted values (=1)	Predicted values (=0)
Actual values (=1)	True positive: 12,505	False negative: 209
Actual values (=0)	False positive: 640	True negative: 195

Discussion

Principal Findings

A risk assessment model for CKD was developed in this study using dichotomous LR and RF models. Our results indicate that gender, older age, BMI beyond the normal range, abnormal index eGFR, retirement status, and urban employee medical insurance were significantly associated with a higher risk of CKD. By leveraging the RF model, the most important factors for CKD development were older age, abnormal urinary test results (eg, Alb, UACR, and index PRO indicators), and high BMI.

In China, the number of studies on the assessment of risk factors for CKD and the investigation of methods for risk prediction is increasing and LR analysis is commonly being performed. Feng et al [24] used an adjusted LR model to investigate CKD prevalence and related risk factors in 38 megacities across China. Liu et al [25] and Yang et al [26] performed cross-sectional studies to analyze risk factors for diabetic nephropathy in Shanghai, whereas a community-based, 7-year-long cohort study from Tianjin used LR to examine the association between the high triglyceride waist phenotype and risk of CKD development [27]. Yan et al [28] performed LR analysis to assess the correlation between residual cholesterol levels and CKD, and identify other significant risk factors affecting middle-aged and older individuals residing within a city. Gradual advancements in machine learning models have prompted further scrutiny of the divergent performance and inherent limitations of the conventional LR approach. To distinguish this study from previous studies that followed the LR approach for exploratory purposes, we used the RF algorithm to rank risk factors that were subjected to single-factor analysis according to their relevance and consequently evaluated comparative predictive precision by performing LR analysis using training samples. Our results reveal that both the RF and LR models achieved an overall accuracy rate exceeding 90% in the prediction test set. Conversely, the dichotomous LR model exhibited a marginally superior predictive performance than the RF model. Nevertheless, one should pay attention to the tendency of LR to result in excessive ORs when imbalanced data are used. Although LR exhibits excellent predictive abilities and desirable attributes such as high accuracy and stability, and ease of operation with a minimal possibility of overlearning during classification prediction, RF has the ability to assess the importance of variables when classifying data into suitable categories while compensating for errors in imbalanced sets of categorical data.

Our results indicate that age was the primary significant factor in the RF model, and LR analysis confirmed that higher age was significantly associated with CKD. Compared to participants aged ≤64 years, those aged 65-75 years and older were at a significantly higher risk of CKD, which is in line with previous results [29,30]. The risk of CKD increases with age; thus, early screening and risk prediction for CKD are crucial for middle-aged and older people.

A cross-sectional study published in *The Lancet* [31], using a nationally representative sample of Chinese adults also identified independent factors associated with kidney damage, which included age and gender. Age and gender are independent CKD risk factors [32]. Many studies worldwide have shown that women are at a higher risk of CKD [33,34], and similar observations have been reported in China [24,30]. This correlation may be attributed to differences in the prevalence of primary diseases and the availability of medical resources across genders [35]. However, our results show that females in the survey population were at a lower risk of CKD than were males, which is inconsistent with the majority of previous results. Our data include information regarding the registered population in a district of Shanghai. The exclusion of samples with incomplete information and regional differences, as well as the presence of unregistered patients, may have led to bias, ultimately yielding inconsistent results.

Next, this study shows that people with a higher-than-normal BMI were at a higher risk of CKD, similar to a time-series study that investigated risk factors regarding CKD burden in China from 1991 to 2011 and identified the correlation between high BMI and CKD [36]. Obesity is an important risk factor for CKD worldwide [24,25,37-39]. Potential obesity-associated factors that may lead to or aggravate CKD include hemodynamic disorder and renal tissue hypoxia [40,41]. However, weight loss through diet and regular exercise can reverse kidney damage; hence, maintaining a healthy lifestyle and controlling body weight could prevent or decelerate CKD progression to a certain extent [42]. Additionally, this study shows that CKD risk was higher in people who had urban employee medical insurance. These people were employed and had relatively better economic conditions; however, health risk factors such as work stress and unhealthy lifestyles probably contribute to an increased CKD risk [43].

Moreover, people with abnormal urine test results (Alb, UACR, and PRO indicators) were at a higher CKD risk, which is consistent with previous results reported worldwide [36,44,45]. Similarly, a Chinese study using 4 machine learning models, comprising 19,270 adult samples, showed that UACR, Alb, age, and gender were important CKD risk factors [44]. Urine tests can serve as an early warning system for CKD detection. Similarly, our risk prediction model could guide decision-making regarding early CKD screening.

Limitations

Herein, we effectively assessed the risk of CKD by combining internal data for model construction and testing. However, this study has some limitations. First, the generalization ability of the model remains unknown because the study did not include external data for external validation. Second, owing to the bias in data collection, our results were inconsistent with those of the previous studies. Finally, more prospective studies are required to verify the predictive power and practical utility of our model. Thus, health care professionals should routinely evaluate the level of agreement within and between models before reaching any clinical decision on the basis of the present limitations and previous findings [46].

Conclusions

In conclusion, the RF model has significant predictive value for assessing risk factors associated with CKD and is capable of correcting errors in imbalanced categorical data sets. It can be used to screen individuals with risk factors, which is of great significance for early intervention and prevention of CKD.

For the prevention and treatment of CKD, early intervention can involve a low-protein diet, regular physical examination, actively promoting urine examination, and screening of high-risk groups to achieve early detection, early treatment, early diagnosis, and early intervention of CKD, and to reduce the social and personal losses caused by diseases and improve people’s quality of life.

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Data Availability

The data sets used or analyzed in this study are available from the first author upon reasonable request.

Authors' Contributions

LX and CM obtained the funding. PL, YL, HL, LX, CM, and LY conceived and designed the experiments. PL, YL, HL, and LY performed the experiments, analyzed the data, and contributed reagents, materials, and analysis tools. PL drafted the manuscript. All authors participated in the discussion, revision, and approval of the final manuscript.

Conflicts of Interest

None declared.

Multimedia Appendix 1
Importance ranking of each indicator in the random forest algorithm.
[PNG File , 16 KB - apinj_v8i1e48378_app1.png]

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Abbreviations

Alb: albuminuria
CKD: chronic kidney disease
CVD: cardiovascular disease
eGFR: estimated glomerular filtration rate
GFR: glomerular filtration rate
ICD-10: International Statistical Classification of Diseases, Tenth Revision
LR: logistic regression
OR: odds ratio
PRO: urine routine protein
RF: random forest
UACR: urinary albumin-creatinine ratio

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Original Paper

Toward Sustaining Web-Based Senior Center Programming Accessibility With and for Older Adult Immigrants: Community-Based Participatory Research Cross-Sectional Study

Connie Kim Yen Nguyen-Truong[1], RN, BSN, PhD; Katherine Wuestney[2], RN, BSN, PhD; Holden Leung[3], MSW; Chenya Chiu[3], MPH; Maria Park[3], CIRS A/D, BS; Christina Chac[3], BS; Roschelle Lynette Fritz[1], RN, BSN, MSN, PhD

[1]Nursing and Systems Science Department, College of Nursing in Vancouver, Washington State University, Vancouver, WA, United States

[2]PhD in Nursing Program, College of Nursing, Spokane Health Sciences, Washington State University, Spokane, WA, United States

[3]Asian Health & Service Center, Portland, OR, United States

Corresponding Author:
Connie Kim Yen Nguyen-Truong, RN, BSN, PhD
Nursing and Systems Science Department
College of Nursing in Vancouver
Washington State University
14204 NE Salmon Creek Ave
Vancouver, WA, 98686-9600
United States
Phone: 1 3605469395
Fax: 1 3605469398
Email: c.nguyen-truong@wsu.edu

Abstract

Background: During the COVID-19 pandemic, many community-based organizations serving Asian Americans pivoted to provide web-based care and social services. Asian American community leaders in the United States Pacific Northwest, including Asian Health & Service Center expressed that there are older immigrant adults who experienced backlash from discrimination, fear, and anxiety owing in part to anti-Asian hate and isolation, including from infection precautions. Pivoting supported staying safe from COVID-19 transmission and anti-Asian hate crimes.

Objective: This study aims to examine the readiness of diverse groups of older Asian American immigrant adults (Chinese, Koreans, and Vietnamese) to use a web-based senior center, including technology access and telehealth use, and to identify the psychosocial health impacts that a web-based senior center could be positioned to meet.

Methods: A community-based participatory research approach was used to conduct a cross-sectional survey study in an Asian-based health and service center in 2022. We selected surveys from the National Institutes of Health–supported PhenX Toolkit. Analyses were performed using R software.

Results: There was an 88.2% (216/245) response rate. Overall, 39.8% (86/216) of participants were Chinese, 25% (54/216) were Korean, and 24.5% (53/216) were Vietnamese. There were significant group differences in mobile data plans (P=.0005). Most had an unlimited mobile data plan (38/86, 44% Chinese; 39/54, 72% Koreans; 25/53, 47% Vietnamese). Significant group differences existed regarding whether they started using a new electronic device to communicate with friends or family after the COVID-19 outbreak (P=.0005); most were Korean participants (31/54, 57%). For written text and audio or video apps, most Chinese participants used WeChat (65/85, 76%; 57/84, 68%, respectively), most Koreans used KakaoTalk (49/54, 91%; 49/54, 91%, respectively), and most Vietnamese used Facebook Messenger for written text (32/50, 64%) and Apple Face Time (33/50, 66%) or Facebook Messenger (31/50, 62%) for audio or video. Significant group differences existed regarding whether to try telehealth (P=.0005); most Vietnamese expressed that they would never consider it (41/53, 77%). Significant group differences existed regarding how well they were able to concentrate (χ^2_2=44.7; P<.0001); Chinese participants reported a greater inability (median 5, IQR 4-6). With regard to difficulties in life experiences (χ^2_2=51; P<.0001), the median was 6 (IQR 5-7) for the Vietnamese group. Significant group differences existed in having had a family/household member's salary, hours, and contracts

reduced (*P*=.0005) and having had a family/household member or friend fallen physically ill (*P*=.0005)—most Vietnamese (15/53, 28%) and Korean participants (10/53, 19%).

Conclusions: To build an efficacious, web-based senior center with web-based care and social service options, more older adults need access to the internet and education about using technology-enabled communication devices. Addressing the unique psychosocial impacts of the COVID-19 pandemic on each group could improve health equity. The strength of the participating older adults was observed and honored.

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KEYWORDS

Asian American; Chinese; Korean; Vietnamese; community-based participatory research; CBPR; COVID-19; health equity; immigrants; older adults; psychosocial; technology access; telehealth use; web-based senior center; mobile phone

Introduction

Background

During the COVID-19 pandemic, many community-based organizations (CBOs), such as culturally based health and social service centers quickly pivoted to provide web-based services to maintain contact with clients. Although the pivot to web-based contact helped to maintain care and social services, questions remain about how to best provide web-based care and social services and whether older adults can access care and services in a meaningful way. The sustainability of web-based care and social services is important because of reports by older adults that they continue to experience anti-Asian hate [1,2] and isolation [1]. During the COVID-19 pandemic, many Asian Americans avoid leaving their home to go to public places such as grocery stores, church, and school, and many have not talked with a health care provider or mental health professional about their feelings of isolation [3]. Providing web-based services can address both safety and isolation concerns; however, it is important for CBOs serving older Asian Americans to understand how they engage with technology and which devices and platforms they commonly use. Our community and academic partnership studied these issues at the request of a CBO serving Asian Americans in the Pacific Northwest. Findings reflect a drive toward health equity and responsiveness to community-identified priorities for sustaining and growing web-based social and health services after the COVID-19 pandemic. We intentionally disaggregated group data into granular, within group–specific data to address concerns expressed in the extant literature [2,4,5] and by CBOs that aggregated Asian American data are not always helpful at an actionable community level for countering systemic issues and for advancing health equity ideals.

Many Asian American CBOs serving older adults reported escalated racial discrimination during the COVID-19 pandemic, such as hate crimes or microaggressions [6]. Asian Americans experienced aggravated physical and mental health problems or violence [4]. Many were afraid to seek care because of anti-Asian xenophobia [5]. Older Asian American immigrants continue to be particularly vulnerable when they leave home owing to hate crimes against Asian individuals, with great adverse effects experienced by older adults who are undocumented, facing poverty, and having limited English proficiency [5]. Between March 2020 and April 2023, Stop AAPI Hate received 17,804 reports of hate incidents, including verbal harassment, shunning, physical assault, civil rights violations, harassment via the web, and more [1]. Asian Americans experienced psychological distress, stress, and depression during the COVID-19 pandemic. Southeast Asian individuals experienced more psychological distress than White (not Hispanic) individuals [7]. Chinese and Vietnamese reported that racial and ethnic discrimination and violence against their population led to feelings of stress and depression, and some reported being treated unfairly because of their race and ethnicity [3]. Furthermore, Koreans with preexisting chronic diseases were heavily affected, thus experiencing worse health outcomes [8]. Despite these known discriminations amid the COVID-19 pandemic, studying mental health among Asian Americans, particularly among Asian subgroups, was not prioritized in the United States [7]. Web-based care can be a necessary response to address continuity in delivering care and social services for constituents at risk for infection and criminal victimization.

Web-based care was a part of the pivot during the COVID-19 pandemic; however, this was isolating to many older Asian American immigrants [6]. Older adult users in the general population increasingly integrate technology and mobile devices into their daily lives [9], but this is not necessarily true for older Asian Americans. A study including older White Canadians showed that they were primarily concerned with avoiding the virus and with health care efficiencies [1] that web-based services can address, whereas older Korean immigrants were primarily worried about autonomy, technology dependence, and the burden of learning a new technology for engaging in social and health services [10]. Such worries, along with more broadly reported concerns by older adults about needing to be technology savvy and wanting in-person physical health exams [11] are not easily mitigated with web-based services. Despite these findings, in a national study of 40 CBOs serving Asian Americans, researchers found that technology was a connector for organizations [6]. Thus, understanding how to integrate technology in a meaningful way is important for successfully sustaining web-based contact with clients. Many resilient organizations have reflected on their commitment to serve communities with pride by adapting and preparing to face future crises [6].

Community Context

Asian American community leaders at the Asian Health & Service Center (AHSC) in Oregon in the United States Pacific Northwest expressed concerns that there are older Asian American immigrant adults who experienced backlash regarding

discrimination, fear, and anxiety in part from anti-Asian hate and isolation, including from social distancing for infection protection since the COVID-19 outbreak. AHSC is a culturally diverse, nonprofit CBO and a trusted source for health care and social services [12]. Most clients are older Chinese, Korean, and Vietnamese immigrants [1]. The chief executive director reported that they required a fast pivot to use more technology owing to concerns expressed by older Asian American immigrant adults. This pivot included training staff to deliver health care and social services remotely (ie, distance). COVID-19 Asian response teams were created that consisted of community health workers (CHWs) and behavioral health counselors. Health care and social services were delivered via audio and video calls while attempting to maintain the AHSC holistic health care and social services model of social engagement, public health information, and support for health needs. There is a crucial need to engage to inform rebuilding as a web-based senior center after COVID-19 with a web-based care and social services option. AHSC community leaders identified priorities based on expressed concerns, and this included engaging culturally diverse, older Asian American immigrant adult clients by centering their voice, learning about their technology access and telehealth use to extend reach in client support and mental health counseling, and uplifting a dedicated community workforce of culturally diverse and multilingual CHWs for web-based outreach and care of older Asian American immigrant adults to advance health equity. AHSC community leaders raised that conducting a survey study can be a step in centering the voice and engaging the participation of older Asian American immigrant adults by clarifying what is meant by web-based care.

Community Engagement to Advance Health Equity

Community engagement is essential to advance health equity. Academic and community researchers should comprehensively embed methods of community-based participatory research (CBPR) that is action oriented into the design of research studies [13]. There is a need to fully engage communities in community-involved care settings to ensure sustainability in the context of direct application to real-world care delivery [13]. Community engagement in scientific design and procedures is important for collaborative research decision-making based on a shared working understanding [1]. Community engagement through CBPR and citizen science, where participatory action drives research direction for sustainability in population health science, is important [1,14]. Authentic intentionality for an inclusive collaboration partnership needs to include conceptualization, design, implementation, and dissemination. The Community Connected Health initiative set forth by the White House Office of Science and Technology Policy underscored the need to work with communities. Emphasis is placed on CBOs to prioritize their technological needs and goals while integrating strengths and keeping the end users in mind while designing and have support for a representative and diverse health technology workforce [15]. Furthermore, a need exists for thoughtful approaches to equity and inclusion in collecting and using data and for organizations to be involved in community-based health care delivery through actionable data [15]. We built upon a long-standing, cross-sector, and trusted community-academic partnership between AHSC and a public Washington State University (WSU) College of Nursing since 2015. As a community and academic partnership, we conducted previous CBPR studies regarding capacity building on health-assistive smart home monitoring technology adoption and perceptions about smart home adoption by older Asian American immigrant adults, including Chinese, Koreans, and Vietnamese. Details were reported elsewhere [16,17].

This CBPR Study

CBO leaders organically drove the purpose, aims, and design for this study in partnership with a nursing science research team. The aims they identified for this CBPR cross-sectional survey study were to explore two domains: (1) examine the readiness of diverse groups of Asian American immigrant older adults (Chinese, Koreans, and Vietnamese) to use a web-based senior center, including technology access and telehealth, and (2) identify the psychosocial health impacts of older Asian American immigrants among Chinese, Korean, and Vietnamese groups that a web-based senior center could be positioned to meet. As a step to understand the potential sustainability of web-based social and health services, we investigated the behaviors and attitudes toward the internet; access to the internet and associated devices; experiences and attitudes toward telehealth; and psychosocial impacts, including needs and effects of the COVID-19 outbreak on diverse Asian American immigrant groups of older adults (Chinese, Koreans, and Vietnamese) in the United States Pacific Northwest. Findings may inform future studies in maintaining and growing web-based senior centers with a web-based care option for a culturally diverse, nonprofit, Asian-based health and social service center.

Methods

CBPR Cross-Sectional Survey Study Design

We used a CBPR approach to design, implement, and interpret this cross-sectional survey study and used the principles of mutual trust, rapport, respect, learning, and mentoring [18]. CBPR included equitable involvement of diverse partners throughout the research and dissemination process [18]. Our cross-sector partnership was culturally diverse, multilingual, and multidisciplinary. WSU College of Nursing academic nurse researchers included the principal investigator (PI) with a Vietnamese and Guamanian Micronesian Islander background, specialty in CBPR with immigrants and marginalized communities, and health equity in health-assistive technology adoption; co-PI with a White and Native American background and smart home health-assistive monitoring and informatics specialty; and a statistician with a White background and history in data analysis and management and smart home health-assistive monitoring. AHSC community partners included the chief executive director with a Chinese background and experience in social work and immigrant community health; 3 program managers in community health including the senior program manager with a Korean background and specialty in aging and disability, community program manager with a Chinese background and public health management and policy specialty, and community health project manager with a Chinese

background and public health specialty; and 4 CHWs with a Chinese, Korean, or Vietnamese background and specialties in psychology, communication disorders, and sciences; education; fine arts; or health promotion and health behavior.

We used surveys from the National Institutes of Health–supported PhenX Toolkit that included the COVID-19 Technology Accessibility Survey (for technology access), Technology Telehealth Use, and Psychosocial Impact of COVID-19 Survey [19]. In addition, the PI, co-PI, and AHSC chief executive director codeveloped the items about written and audio or video communication apps, internet service provider, mobile phone use, mobile data plan, and access to the internet via a mobile phone (ie, technology access). The PI and co-PI consulted with a biostatistician and discussed with the nurse researcher statistician regarding the selection of items and technical functionality. The chief executive director and 3 program managers at AHSC reviewed and pretested the survey (Multimedia Appendices 1 and 2) for face validity and technical functionality. AHSC community partners discussed among themselves about meaningful interpretation and discussed with academic nurse researchers on a regular basis throughout the research process. AHSC community partners spoke English and Chinese Cantonese, Chinese Mandarin, Korean, or Vietnamese and assisted the academic nurse researchers with outreach, recruitment, and interpretation. This aligns with the AHSC holistic health care and social services model, which provides cultural and linguistic interpretation in the context of a real-world health and social service setting [12]. The study was conducted at the AHSC in the United States Pacific Northwest between March 2022 and April 2022.

Ethical Considerations

This study underwent a limited review and received a certificate of exemption from full board review by the WSU Human Research Protection Program (18816). Each participant received a shopping gift card worth US $10 (eg, grocery) upon completion that honored and thanked them.

Measurements

As of October 29, 2020, at the beginning of the CBPR design, the PI reviewed 94 COVID-19 survey protocols that were made publicly available for use, the PhenX Toolkit by the trans–National Institutes of Health working group, that consisted of the National Institute on Aging and the Office of Behavioral and Social Sciences Research [20]. Owing to the urgency of need for COVID-19–specific survey measurements at the time, these items did not undergo the same level of standardization, harmonization, or psychometric testing as per the PhenX consensus process [20]. Our academic and community partnership discussed, selected, consulted, and pretested the survey as described previously in the *CBPR Cross-Sectional Survey Study Design* section. Therefore, each item incorporated in the survey was treated as its own variable, rather than contributing to the measurement scales. The survey consisted of the following: sociodemographic and background items from our previous CBPR [17]; technology access items from the National Institute on Aging Alzheimer's Disease Research Centers and Levey [21] and from the items codeveloped by the PI, co-PI, and AHSC chief executive director; telehealth use items from the Institute on Aging at the University of Florida [22]; and psychosocial health impact items from the National Institute of Mental Health Intramural Research Program [23]. Of the technology access items, we incorporated our codeveloped items as described previously. We used the secure and password-protected WSU Qualtrics web-based platform, formatted the survey, and entered the participant responses.

Participants, Recruitment, and Data Collection

Overall, 7 trained program managers and CHWs at AHSC reached out to clients from the AHSC registry and used a script to provide oral information about the study primarily via telephone, with some in-person communication. The script contained information similar to the consent form that included the study purpose, investigators, eligibility, voluntary participation, procedures, shopping gift card for completion, and contact information. If an individual expressed interest, an AHSC community partner referred them to the web-based Qualtrics site that has the combined consent form, eligibility, and survey. Through the consent form, individuals were informed about the study purpose and investigators. Only a unique study number will be used to follow up for providing a shopping gift card, and it will be accessible to community-academic research partnership. Responses will be entered into the secure Qualtrics web-based platform and retained for 3 years. The survey takes approximately 30 minutes. The participants were also informed about the potential for risks, such as emotional discomfort, feeling of embarrassment, or loss of privacy if the participant chooses to have interpretation assistance. Individuals were asked to participate in the study if they were eligible and complete the survey. Participants could choose either Chinese Cantonese, Chinese Mandarin, Korean, or Vietnamese interpretation assistance from an AHSC community partner as they completed the survey. This convenient and purposive sample included a total of 216 individuals who identified as an Asian American immigrant and were aged ≥60 years.

Data Analysis

All statistical analyses were performed using R (version 4.2.0) [24] and RStudio (version 2022.7.1) [25], with the *tidyverse* (version 1.3.1) [26], *arsenal* (version 3.6.3) [27], *labelled* (version 2.9.1) [28], and *psych* (version 2.2.5) [29] packages. We analyzed the data of older Asian American immigrants as a whole and as disaggregated data that are stratified by race and ethnicity. Of the 216 older Asian American immigrant adults, a subtotal was 193 (89.4%) across Chinese, Korean, and Vietnamese groups. There was low participation of Taiwanese and multiracial individuals, and a participant reported as being Asian and having a different ethnicity than listed previously; therefore, we described meaningful interpretation of group-wide comparisons across and among Chinese, Korean, and Vietnamese groups alongside the total group of older Asian American immigrant adults. For the purpose of this paper about learnings from a real-world CBPR survey study, we decided not to combine groups with low participation into less meaningful aggregated data. This also protects the privacy of these individual analyses. Frequencies and percentages were reported for categorical variables, ordinal variables, and

variables with select-all response categories (ie, >1 response). Means (SDs) were reported for continuous variables, and medians (IQRs) were reported for continuous and ordinal variables. We used Bonferroni correction to maintain a cross-study, family-wise error rate of 0.05; thus, α=.0008 was the cutoff for statistical significance among Chinese, Korean, and Vietnamese groups. Therefore, all *P* values were reported to 4 decimals to be specific and align with a meaningful data analysis, and we reported data at a granular level to align with disaggregated data science. For mutually exclusive categorical variables, Fishers exact tests were performed to examine for any group differences and the variables under consideration (*P*=.0008). We also reported χ^2 (*df*) and *P* values for continuous and ordinal variables from Kruskal-Wallis rank sum tests.

We maintained a health equity lens as a community-academic partnership. The PI and statistician discussed the data and data analysis outputs first, and then with the co-PI, and this informed a culturally responsive discussion with AHSC community partners with regard to the observed response patterns. The statistician maintained field note records that captured reflexivity where we discussed potential bias as a community-academic partnership. Analytics and outputs reflected the insights gained from these discussions, contributing to the reflexive nature of the study. These records were reviewed by the PI and discussed within the community-academic partnership. Such discussions and record keeping promoted communication transparency as a way to address potential bias. We achieved meaningful data interpretation by being responsive to community partners.

Results

Overview

In total, AHSC community partners reached out to 245 older Asian immigrant adult clients, of whom 25 (10.2%) declined to participate in the study. Reasons for not participating included the survey length and not having experience with telehealth. The length of time to complete the survey was 60 minutes. After the statistician performed initial screening for duplicate or erroneous entries, then we discussed as a community-academic partnership and 88.2% (216/245) of the survey responses were retained for data analysis—response rate: 216/245, 88.2% and completion rate: 216/216, 100% (ie, started and completed the survey). The completeness rate (ie, no missing responses and completed answering the survey items) was approximately 93.9% (203/216). Absolute and total numbers are shown in all tables.

Sociodemographics and Background of Participants

In total, there were 216 older Asian American immigrant adults. Overall, 39.8% (86/216) identified as Chinese, 25% (54/216) as Korean, 24.5% (53/216) as Vietnamese, 6.9% (15/216) as Taiwanese, and 3.2% (7/216) as multiracial, and 0.5% (1/216) reported as having a different Asian ethnicity than listed previously. There were 89.4% (193/216) participants across older Chinese, Korean, and Vietnamese immigrant adults. Most Chinese (34/86, 40%) and Korean (28/54, 52%) participants had postsecondary education, and most Vietnamese participants (27/53, 51%) graduated from high school. Of the Chinese, Korean, and Vietnamese participants, 60.6% (117/193) reported <US $15,000 as total household income before taxes, of which 59% (51/86) is Chinese, 56% (30/54) is Korean, and 68% (36/53) is Vietnamese. Overall, 97.9% (189/193) of participants have a regular place of care for nonemergency health care services. Furthermore, 95% (82/86) of the Chinese participants and all Korean (54/54, 100%) and Vietnamese (53/53, 100%) participants reported having a regular place of care.

Multimedia Appendix 3 summarizes the sociodemographics and background characteristics of older Asian American immigrant adults and Chinese, Korean, and Vietnamese groups.

Behaviors, Attitudes, and Access to the Internet and Internet-Enabled Devices

Table 1 summarizes the behaviors, attitudes, and access to the internet and internet-enabled devices of older Asian American immigrant adults and Chinese, Korean, and Vietnamese groups. Overall, 13% (7/53) of Vietnamese and 2% (2/86) of Chinese participants reported not having a mobile phone at all. In total, most participants (208/216, 96.3% older Asian American immigrants; 185/193, 95.9% across Chinese, Koreans, and Vietnamese) reported that they have or have access to a smartphone or tablet; 97% (83/86) of Chinese participants, 100% (54/54) of Korean participants, and 91% (48/53) of Vietnamese participants reported access. Less than half (97/216, 44.9% older Asian American immigrants; 85/193, 44% across Chinese, Koreans, and Vietnamese) of the participants have or have access to a PC (either desktop or laptop); 37% (32/86) of Chinese participants, 57% (31/54) of Korean participants, and 42% (22/53) of Vietnamese participants reported access. In total, most participants (160/215, 74.4% older Asian American immigrants; 144/192, 75% across Chinese, Koreans, and Vietnamese) have a national internet service provider; 71% (60/85) of Chinese participants, 82% (44/54) of Korean participants, and 76% (40/53) of Vietnamese participants have a national internet service provider. Some participants (22/215, 10.2% older Asian American immigrants; 20/192, 10.4% across Chinese, Koreans, and Vietnamese) have no internet service provider; 11% (9/85) of Chinese participants, 7% (4/54) of Korean participants, and 13% (7/53) of Vietnamese participants have no internet service provider. Most participants have an unlimited mobile data plan (116/216, 53.7% older Asian American immigrants; 102/193, 52.8% across Chinese, Koreans, and Vietnamese); 44% (38/86) of Chinese participants, 72% (39/54) of Korean participants, and 47% (25/53) of Vietnamese participants have an unlimited mobile data plan. However, there was a statistically significant difference among Chinese, Korean, and Vietnamese groups (*P*=.0005), with Korean participants reporting having unlimited data at a much higher rate (39/54, 72%) than Chinese participants (38/86, 44%) or Vietnamese participants (25/53, 47%). There were also significant differences among groups (*P*=.0005) about having started using a new electronic device to communicate with friends and family after the COVID-19 outbreak with most being Korean participants (31/54, 57%) followed by Chinese participants (15/86, 17%) and a Vietnamese (1/53, 2%) participant. There were no significant differences among groups with regard to technology savvy responses (χ^2_2=3.2; *P*=.202). Overall, very

few participants (9/216, 4.2% older Asian American immigrants; 7/193, 3.6% across Chinese, Koreans, and Vietnamese) perceived themselves to be very technology savvy. Most participants perceived themselves to be only a little technology savvy (76/216, 35.2% older Asian American immigrants; 67/193, 34.7% across Chinese, Koreans, and Vietnamese; 26/86, 30% Chinese; 17/54, 32% Koreans; 24/53, 45% Vietnamese) or not at all (93/216, 43.1% older Asian American immigrants; 82/193, 42.5% across Chinese, Koreans, and Vietnamese; 41/86, 48% Chinese; 25/54, 46% Koreans; 16/53, 30% Vietnamese).

Table 1. Behaviors, attitudes, and access to the internet and internet-enabled devices of older Asian American immigrant adults and Chinese, Korean, and Vietnamese groups.

Variables	Total older Asian American immigrants (n=216)[a]	Subtotal across older Chinese, Korean, and Vietnamese immigrants (n=193)[b]	Chinese immigrants (n=86)[c]	Korean immigrants (n=54)[c]	Vietnamese immigrants (n=53)[c]	*P* value	Chi-square (*df*)[d]
Does not have a mobile phone, n (%)	10 (4.6)	9 (4.7)	2 (2)	0 (0)	7 (13)	.003[e]	N/A[f]
Has a smartphone or tablet or is able to access one, n (%)	208 (96.3)	185 (95.9)	83 (97)	54 (100)	48 (91)	.048[e]	N/A
Has a PC (desktop or laptop) or is able to access one, n (%)	97 (44.9)	85 (44)	32 (37)	31 (57)	22 (42)	.0565[e]	N/A
Has access to other internet-enabled device (eg, smartwatch, smart home device, or television), n (%)	15 (6.9)	13 (6.7)	8 (9)	3 (6)	2 (4)	.4213[e]	N/A
Who is your internet provider? (multiple responses)[g], n (%)						.1794[e]	N/A
National internet service provider	160 (74.4)	144 (74.6)	60 (71)	44 (82)	40 (76)		
Regional or local internet service provider	13 (6)	12 (6.2)	6 (7)	5 (9)	1 (2)		
Mobile phone	7 (3.3)	6 (3.1)	5 (6)	1 (2)	0 (0)		
National internet service provider and mobile phone	2 (0.9)	1 (0.5)	1 (1)	0 (0)	0 (0)		
Regional or local internet service provider and mobile phone	1 (0.5)[a]	0 (0)	0 (0)	0 (0)	0 (0)		
Specified an internet provider different from abovementioned ones	2 (0.9)	1 (0.5)	0 (0)	0 (0)	1 (2)		
Not sure	8 (3.7)	8 (4.2)	4 (5)	0 (0)	4 (8)		
None	22 (10.2)	20 (10.4)	9 (11)	4 (7)	7 (13)		
Mobile data plan type, n (%)						.0005[e]	N/A
Capped or limited plan	10 (4.6)	9 (4.7)	6 (7)	1 (2)	2 (4)		
Capped or limited plan amount unsure	39 (18.1)	36 (18.7)	14 (16)	6 (11)	16 (30)		
Not applicable (ie, no mobile phone)	10 (4.6)	9 (4.7)	2 (2)	0 (0)	7 (13)		
None	4 (1.9)	4 (2.1)	3 (4)	0 (0)	1 (2)		
Unlimited	116 (53.7)	102 (52.8)	38 (44)	39 (72)	25 (47)		
Unsure about plan type	37 (17.1)	33 (17.1)	23 (27)	8 (15)	2 (4)		
Do you consider yourself to be technology savvy?						.202[d]	3.2 (2)
Score, median (IQR)	2 (1-2)	2 (1-2)	2 (1-2)	2 (1-2)	2 (1-2)		
Not at all, n (%)	93 (43.1)	82 (42.5)	41 (48)	25 (46)	16 (30)		
A little, n (%)	76 (35.2)	67 (34.7)	26 (30)	17 (32)	24 (45)		

Variables	Total older Asian American immigrants (n=216)[a]	Subtotal across older Chinese, Korean, and Vietnamese immigrants (n=193)[b]	Chinese immigrants (n=86)[c]	Korean immigrants (n=54)[c]	Vietnamese immigrants (n=53)[c]	*P* value	Chi-square (*df*)[d]
Somewhat so, n (%)	38 (17.6)	37 (19.2)	16 (19)	12 (22)	9 (17)		
Very much so, n (%)	9 (4.2)	7 (3.6)	3 (4)	0 (0)	4 (8)		
Overall, how confident do you feel using computers, smartphones, or other electronic devices to do the things you need to do online?						.4224[d]	1.7 (2)
Score, median (IQR)	2 (1-3)	2 (1-3)	2 (1-3)	2 (1-2.8)	2 (1-3)		
Not at all confident, n (%)	89 (41.2)	80 (41.5)	34 (40)	26 (48)	20 (38)		
Only a little confident, n (%)	66 (30.6)	57 (29.5)	27 (31)	14 (26)	16 (30)		
Somewhat confident, n (%)	50 (23.1)	47 (24.4)	21 (24)	14 (26)	12 (23)		
Very confident, n (%)	11 (5.1)	9 (4.7)	4 (5)	0 (0)	5 (9)		
Have you started using a new electronic device to communicate with friends and family after the COVID-19 outbreak? (yes), n (%)	52 (24.1)	47 (24.4)	15 (17)	31 (57)	1 (2)	.0005[e]	N/A
Before the COVID-19 outbreak, would you say technology has had a mostly positive effect on our society or a mostly negative effect on our society[h]?						.0221[d]	7.6 (2)
Score, median (IQR)	3 (2-3)	3 (2-3)	2 (2-3)	2.5 (2-3)	3 (2-3)		
1=mostly negative, n (%)	7 (3.3)	6 (3.1)	2 (2)	4 (7)	0 (0)		
2=equal positive and negative effects, n (%)	98 (45.6)	88 (45.8)	47 (55)	23 (43)	18 (34)		
3=mostly positive, n (%)	110 (51.2)	98 (51)	36 (42)	27 (50)	35 (66)		
After the COVID-19 outbreak, would you say technology has had a mostly positive effect on our society or a mostly negative effect on our society?						0.2518[d]	2.8 (2)
Score, median (IQR)	3 (2-3)	3 (2-3)	3 (2-3)	3 (2-3)	3 (2-3)		
1=mostly negative, n (%)	6 (2.8)	5 (2.6)	0 (0)	5 (9)	0 (0)		
2=equal positive and negative effects, n (%)	78 (36.1)	69 (35.8)	33 (38)	19 (35)	17 (32)		
3=mostly positive, n (%)	132 (61.1)	119 (61.7)	53 (62)	30 (56)	36 (68)		

[a]Responses from participants who identified as Chinese, Korean, Vietnamese, Taiwanese, and multiracial and a participant who specified Asian race and ethnicity different from those listed previously.

[b]Responses from participants who identified as Chinese, Korean, and Vietnamese.

[c]Responses from participants who identified as Chinese, Korean, or Vietnamese.

[d]Kruskal-Wallis rank sum test.

[e]Fisher exact test.

[f]N/A: not applicable.

[g]Overall, 1 missing response from the Chinese group; total sample size=215; subtotal sample size=192; Chinese sample size=85; Korean sample size=54; Vietnamese sample size=53.

[h]Total sample size=215; subtotal sample size=192; Chinese sample size=85; Korean sample size=54; Vietnamese sample size=53.

Apps Used for Written and Audio or Video Communication

Table 2 shows the apps used for written and audio or video communication by older Asian American immigrant adults and Chinese, Korean, and Vietnamese groups. Approximately half of the participants (103/212, 48.6% older Asian American immigrants; 91/189, 48.1% across Chinese, Koreans, and Vietnamese) used email for written communication, with email use at 44% (37/85) for Chinese participants, 57% (31/54) for Korean participants, and 46% (23/50) for Vietnamese participants. Most participants used mobile phone texting for written communication (131/212, 61.8% older Asian American immigrants; 118/189, 62.4% across Chinese, Koreans, and Vietnamese; 42/85, 49% Chinese; 44/54, 82% Koreans; 32/50, 64% Vietnamese). The following results were regarding written communication apps and audio or video communication apps. Chinese participants used WeChat the most for written communication (65/85, 77%) and audio or video communication (57/84, 68%) among the apps. Korean participants were the only participants who reported having used KakaoTalk with most use for written communication (49/54, 91%) and audio or video communication (49/54, 91%). Vietnamese participants mostly reported the use of Facebook Messenger (32/50, 64%) for written communication and Apple Face Time (33/50, 66%) or Facebook Messenger (31/50, 62%) for audio or video communication. Some participants did not use any of the written communication apps (20/212, 9.4% older Asian American immigrants; 17/189, 8.9% across Chinese, Koreans, and Vietnamese); 18% (9/50) of Vietnamese participants, 7% (6/85) of Chinese participants, and 4% (2/54) of Korean participants did not use written communication apps. Some participants did not use any of the audio or video communication apps (22/211, 10.4% older Asian American immigrants; 20/188, 10.6% across Chinese, Koreans, and Vietnamese); 20% (10/50) of Vietnamese participants, 11% (9/84) of Chinese participants, and 2% (1/54) of Korean participants did not use audio or video communication apps.

Table 2. Apps used for written and audio or video communication by older Asian American immigrant adults and by Chinese, Korean, and Vietnamese groups.

Variables	Total older Asian American immigrants, n (%)[a]	Subtotal across older Chinese, Korean, and Vietnamese immigrants, n (%)[b]	Chinese immigrants, n (%)[c]	Korean immigrants, n (%)[c]	Vietnamese immigrants, n (%)[c]
What communication apps are you using for written communication?[d] (multiple responses)					
Email	103 (48.6)	91 (48.1)	37 (44)	31 (57)	23 (46)
Mobile phone texting	131 (61.8)	118 (62.4)	42 (49)	44 (82)	32 (64)
Facebook Messenger	49 (23.1)	44 (23.3)	7 (8)	5 (9)	32 (64)
WhatsApp	11 (5.2)	9 (4.8)	9 (11)	0 (0)	0 (0)
WeChat	74 (34.9)	66 (34.9)	65 (77)	1 (2)	0 (0)
KakaoTalk	49 (23.1)	49 (25.9)	0 (0)	49 (91)	0 (0)
Line	24 (11.3)	10 (5.3)	10 (12)	0 (0)	0 (0)
Specified a written communication app different from abovementioned ones (ie, Twitter, Google Chat, Skype, LinkedIn, Telegram, Zalo, Viber, Instagram, and TikTok)	29 (13.7)	27 (14.3)	6 (7)	4 (7)	17 (34)
None	20 (9.4)	17 (8.9)	6 (7)	2 (4)	9 (18)
What communication apps are you using for audio/video communication?[e] (multiple responses)					
Apple FaceTime	83 (39.3)	73 (38.8)	21 (25)	19 (35)	33 (66)
Video Android	20 (9.5)	19 (10.1)	6 (7)	13 (24)	0 (0)
Facebook Messenger	39 (18.5)	38 (20.2)	3 (4)	4 (7)	31 (62)
Zoom	31 (14.7)	29 (15.4)	13 (16)	16 (30)	0 (0)
WeChat	65 (30.8)	58 (30.9)	57 (68)	1 (2)	0 (0)
KakaoTalk	49 (23.2)	49 (26.1)	0 (0)	49 (91)	0 (0)
Line	20 (9.5)	7 (3.7)	7 (8)	0 (0)	0 (0)
Specified an audio/video communication app different from abovementioned ones (ie, Skype, WhatsApp, Telegram, Zalo, Viber, Tango, and FCC HD)	24 (11.4)	21 (11.2)	8 (10)	2 (4)	11 (22)
None	22 (10.4)	20 (10.6)	9 (11)	1 (2)	10 (20)

[a]Responses from participants who identified as Chinese, Korean, Vietnamese, Taiwanese, and multiracial and a participant who specified Asian race and ethnicity different from those listed previously.

[b]Responses from participants who identified as Chinese, Korean, and Vietnamese.

[c]Responses from participants who identified as Chinese, Korean, or Vietnamese.

[d]Overall, 4 missing responses, of which 1 (25%) was from the Chinese group and 3 (75%) were from the Vietnamese group; total sample size=212; subtotal sample size=189; Chinese sample size=85; Korean sample size=54; Vietnamese sample size=50.

[e]Overall, 5 missing responses, of which 2 (40%) were from the Chinese group and 3 (60%) were from the Vietnamese group; total sample size=211; subtotal sample size=185; Chinese sample size=84; Korean sample size=54; Vietnamese sample size=50.

Experience With and Attitudes Toward Telehealth

Table 3 summarizes the experiences and attitudes of older Asian American immigrant adults and Chinese, Korean, and Vietnamese groups toward telehealth. Overall, approximately one-fourth of the older Asian American immigrant adults (48/215, 22.3%; across Chinese, Korean, and Vietnamese groups: 42/192, 21.9%) already had a telehealth appointment, with Korean participants at 28% (15/54), Chinese participants at 25% (21/85), and Vietnamese participants at 11% (6/53). There were significant differences among the groups (P=.0005) that expressed they would never consider trying a telehealth appointment. Just less than half of the older Asian American immigrant adults (95/215, 44.2%; 87/192, 45.3% across Chinese, Koreans, and Vietnamese groups; 22/85, 26% Chinese; 24/54, 44% Koreans; 41/53, 77% Vietnamese) reported that they would never consider trying a telehealth appointment. Participants were able to choose >1 response regarding specific concerns about telehealth services. More than half of the participants worried about the quality of health care (121/212, 57.1% older Asian American immigrants; 110/190, 57.9% across Chinese, Koreans, and Vietnamese; 34/83, 41% Chinese; 30/54, 56%

Koreans; 46/53, 87% Vietnamese), less than half of the participants were not convinced that a telehealth diagnosis can ever be truly accurate (93/212, 43.9% older Asian American immigrants; 81/190, 42.6% across Chinese, Koreans, and Vietnamese; 27/83, 33% Chinese; 23/54, 43% Koreans; 31/53, 59% Vietnamese), and approximately one-third of the participants have never used telehealth services before and do not know how to start (68/212, 32.1% older Asian American immigrants; 61/190, 32.1% across Chinese, Koreans, and Vietnamese; 13/83, 16% Chinese; 20/54, 37% Koreans; 28/53, 53% Vietnamese). There were significant differences in perspectives regarding the main advantages of telehealth services among Chinese, Korean, and Vietnamese groups (P=.0005). Approximately half of the total older Asian American immigrant adults (102/214, 47.7%) reported no need for transportation as the main advantage of telehealth services, whereas approximately all Vietnamese participants (47/53, 89%) selected this reason as the main advantage, as compared with half of Korean participants (28/54, 52%), and less than one-fourth of Chinese participants (20/85, 24%). In total, less than half of the participants (95/215, 44.2% older Asian American immigrants; 81/192, 42.2% across Chinese, Koreans, and Vietnamese; 24/85, 28% Chinese; 22/54, 41% Koreans; 35/53, 66% Vietnamese) reported that a telehealth visit will never match an in-person visit. Furthermore, 39% (33/85) of Chinese participants reported that although telehealth does not compare with in-person visits, it Is a good option for initial consultation or basic care; followed by 28% (15/54) Korean participants and 17% (9/53) Vietnamese participants. There were significant differences in having the COVID-19 outbreak change the perspectives about telehealth use among groups (χ^2_2=20.6; P<.0001), and the median was 2 (IQR 2-3) for the Chinese group, 1 (IQR 1-3) for the Korean group, and 2 (IQR 1-2) for the Vietnamese group. Most Korean participants (33/54, 61%) reported to be less likely to use telehealth, approximately half of Chinese participants reported having the same opinion as before the COVID-19 outbreak (47/85, 55%), more than half of Vietnamese participants reported having the same opinion as before the COVID-19 outbreak (29/52, 56%), and more than one-fourth of Chinese participants (25/85, 29%) reported to be more likely to use telehealth in the future.

Table 3. Experience and attitudes of older Asian American immigrant adults and Chinese, Korean, and Vietnamese groups toward telehealth.

	Total older Asian American immigrants[a]	Subtotal across older Chinese, Korean, and Vietnamese immigrants[b]	Chinese immigrants[c]	Korean immigrants[c]	Vietnamese immigrants[c]	*P* value	Chi-square (*df*)[d]
Have you considered trying a telehealth appointment?						.0005[e]	N/A[f]
Sample size, n	215	192	85	54	53		
No, and I would never consider a telehealth appointment, n (%)	95 (44.2)	87 (45.3)	22 (26)	24 (44)	41 (77)		
No, but I would consider a telehealth appoint, n (%)	37 (17.2)	31 (16.1)	20 (24)	7 (13)	4 (8)		
Yes, I have considered it, but I have not yet had an appointment, n (%)	35 (16.3)	32 (16.7)	22 (26)	8 (15)	2 (4)		
Yes, and I have already had a telehealth appointment, n (%)	48 (22.3)	42 (21.9)	21 (25)	15 (28)	6 (11)		
Does anything in particular concern you about telehealth services?[g] (multiple responses)						N/A	N/A
Sample size, n	212	190	83	54	53		
I worry about the quality of health care, n (%)	121 (57.1)	110 (57.9)	34 (41)	30 (56)	46 (87)		
I am not convinced a telehealth diagnosis can ever be truly accurate, n (%)	93 (43.9)	81 (42.6)	27 (32.5)	23 (43)	31 (59)		
I do not want my appointment to be recorded, n (%)	12 (5.7)	10 (5.3)	8 (10)	1 (2)	1 (2)		
I worry about the privacy of my personal health information, n (%)	21 (9.9)	19 (10)	15 (18)	1 (2)	3 (6)		
I do not have an electronic device to access telehealth services, n (%)	26 (12.3)	25 (13.2)	5 (6)	12 (22)	8 (15)		
I have never used telehealth services before and do not know how to start, n (%)	68 (32.1)	61 (32.1)	13 (16)	20 (37)	28 (53)		
A medical interpreter is not available for me, n (%)	19 (9)	14 (7.4)	12 (15)	0 (0)	2 (4)		
Specified reason is different from abovementioned ones, n (%)	27 (12.7)	25 (13.2)	16 (19)	9 (17)	0 (0)		
What do you view as the main advantage to telehealth services?						.0005[c]	N/A
Sample size, n	215	192	85	54	53		
Quicker access to care, n (%)	52 (24.3)	46 (23.9)	32 (38)	9 (17)	5 (9)		
Greater access to care in remote areas, n (%)	14 (6.5)	13 (6.8)	13 (15)	0 (0)	0 (0)		

	Total older Asian American immigrants[a]	Subtotal across older Chinese, Korean, and Vietnamese immigrants[b]	Chinese immigrants[c]	Korean immigrants[c]	Vietnamese immigrants[c]	*P* value	Chi-square (*df*)[d]
No need for transportation, n (%)	102 (47.7)	95 (49.5)	20 (24)	28 (52)	47 (89)		
The ability to take less time out of my day, n (%)	32 (14.9)	28 (14.6)	10 (12)	17 (32)	1 (2)		
Avoid overcrowding of waiting rooms, n (%)	14 (6.5)	10 (5.2)	10 (12)	0 (0)	0 (0)		
Which of the following might deter you from making a future telehealth appointment?[h] (multiple responses)						N/A	N/A
Sample size, n	210	188	81	54	53		
I just prefer to meet with someone in person, n (%)	158 (75.2)	139 (73.9)	43 (53)	44 (82)	52 (98)		
Greater access to care in remote areas, n (%)	18 (8.6)	18 (9.6)	9 (11)	9 (17)	0 (0)		
I do not want to mess with technology, n (%)	49 (23.3)	47 (25)	18 (22)	7 (13)	22 (42)		
I am not convinced that someone could give good health care by telehealth, n (%)	58 (27.6)	54 (28.7)	17 (21)	4 (7)	33 (62)		
I do not think my internet connection is good enough, n (%)	19 (9)	19 (10.1)	7 (9)	7 (13)	5 (9)		
Do you feel that people get comparable health care through telehealth as they do for in-person visits?						.0015[c]	N/A
Sample size, n	215	192	85	54	53		
No, telehealth care will never match the quality of an in-person visit, n (%)	95 (44.2)	81 (42.2)	24 (28)	22 (41)	35 (66)		
No, but telehealth is a good option for initial consultation or basis care, n (%)	60 (27.9)	57 (29.7)	33 (39)	15 (28)	9 (17)		
Yes I think the care is comparable, n (%)	41 (19.1)	37 (19.3)	16 (19)	14 (26)	7 (13)		
I am not sure, n (%)	19 (8.8)	17 (8.9)	12 (14)	3 (6)	2 (4)		
Has the COVID-19 outbreak changed your view of telehealth?						<.0001[d]	20.6 (2)
Sample size, n	214	191	85	54	52		
Score, median (IQR)	2 (1-2)	2 (1-2)	2 (2-3)	1 (1-3)	2 (1-2)		
1=I am less likely to use telehealth, n (%)	72 (33.6)	67 (35.1)	13 (15)	33 (61)	21 (40)		
2=I have the same opinion compared to before the COVID-19 outbreak, n (%)	91 (42.5)	81 (42.4)	47 (55)	5 (9)	29 (56)		
3=I am more likely to use telehealth, n (%)	51 (23.8)	43 (22.2)	25 (29)	16 (30)	2 (4)		
Would you wear a smartwatch to help your doctor track your symptoms between appointments?						.0128[d]	8.7 (2)

	Total older Asian American immigrants[a]	Subtotal across older Chinese, Korean, and Vietnamese immigrants[b]	Chinese immigrants[c]	Korean immigrants[c]	Vietnamese immigrants[c]	*P* value	Chi-square (*df*)[d]
Sample size, n	215	192	85	54	53		
Score, median (IQR)	2 (1-4)	2 (1-3.2)	1 (1-4)	3 (1-4)	2 (1-2)		
1=not likely, n (%)	103 (47.9)	92 (47.9)	45 (53)	23 (43)	24 (45)		
2=somewhat likely, n (%)	31 (14.4)	31 (16.1)	6 (7)	2 (4)	23 (43)		
3=likely, n (%)	26 (12.1)	21 (10.9)	12 (14)	3 (6)	6 (11)		
4=very likely, n (%)	55 (25.6)	48 (25)	22 (26)	26 (48)	0 (0)		

[a]Responses from participants who identified as Chinese, Korean, Vietnamese, Taiwanese, and multiracial and a participant who specified Asian race and ethnicity different from those listed previously.

[b]Responses from participants who identified as Chinese, Korean, and Vietnamese.

[c]Responses from participants who identified as Chinese, Korean, or Vietnamese.

[d]Kruskal-Wallis rank sum test.

[e]Fisher exact test.

[f]N/A: not applicable.

[g]Overall, 4 missing responses, of which 3 (75%) were from the Chinese group and 1 (25%) was from Asian race and ethnicity was different from those listed previously.

[h]Overall, 6 missing responses, of which 5 (83%) were from the Chinese group and 1 (17%) was from Asian race and ethnicity was different from those listed previously.

Psychosocial Needs and Effects of the COVID-19 Pandemic

Multimedia Appendix 4 summarizes the psychosocial needs of and effects of the COVID-19 pandemic on older Asian American immigrant adults and Chinese, Korean, and Vietnamese groups. There were significant differences among Chinese, Korean, and Vietnamese groups, pertaining to overall psychosocial health, social distancing, worries, and functioning. For overall psychosocial health with regard to how well they have been able to concentrate or focus during the COVID-19 outbreak (1=not at all to 10=extremely well; χ^2_2=44.7; *P*<.0001), the median was 8 (IQR 8-9) for the Korean group, 6 (IQR 1-8) for the Vietnamese group, and 5 (IQR 4-6) for the Chinese group. With regard to how much they have been able to maintain social distance (1=not at all to 10=at all times; χ^2_2=33.6; *P*<.0001), the median was 10 (IQR 9-10) for the Korean group, 9 (IQR 9-10) for the Vietnamese group, and 8 (IQR 6-10) for the Chinese group. With regard to how stressful it has been to maintain social distancing owing to the COVID-19 outbreak (1=not at all stressful to 10=extremely stressful; χ^2_2=16.1; *P*=.0003), the median was 7 (IQR 5-9) for the Vietnamese group, 5 (IQR 2-9.8) for the Korean group, and 5 (IQR 1-7) for the Chinese group. For the following worry-related items (1=not at all worried to 10=extremely worried), such as how worried they have been about SARS-CoV-2 (χ^2_2=37.9; *P*<.0001), that they will be infected with SARS-CoV-2 (χ^2_2=75.5; *P*<.0001), that a family member will be infected with SARS-CoV-2 (χ^2_2=55.3; *P*<.0001), and that people around them will be infected with SARS-CoV-2 (χ^2_2=70.1; *P*<.0001), the median was 8 (IQR 7-9), 9 (IQR 9-9), 9 (IQR 9-9), and 9 (IQR 9-9), respectively, for the Vietnamese group; 7 (IQR 4-8), 7 (IQR 4-8), 7 (IQR 5-8), and 7 (IQR 5-8), respectively, for the Chinese group; and 5 (IQR 1-8), 2 (IQR 1-5), 4.5 (IQR 1-7.8), and 2 (IQR 1-6), respectively, for the Korean group. With regard to how worried they have been about not being able to afford or access food during the COVID-19 pandemic (χ^2_2=62.6; *P*<.0001), how worried they were about access to important resources, such as transportation or housing owing to the COVID-19 outbreak (χ^2_2=45.4; *P*<.0001), and how the COVID-19 crisis in their area created financial problems for participants or their family (χ^2_2=17.7; *P*=.0001), the median was 7 (IQR 5-8), 6 (IQR 1-8), and 2 (IQR 1-8), respectively, for the Vietnamese group; 3 (IQR 1-5), 3 (IQR 1-5), and 3 (IQR 1-5), respectively, for the Chinese group; and 1 (IQR 1-2), 1 (IQR 1-1), and 1 (IQR 1-1), respectively, for the Korean group. With regards to functioning, participants have experienced difficulties in life owing to the COVID-19 outbreak (1=experienced no difficulties to 10=experienced extreme difficulties; χ^2_2=51; *P*<.0001) and the distress they have had owing to the COVID-19 outbreak (1=not at all distressed to 10=extremely distressed; χ^2_2=22.1; *P*<.0001), the median was 6 (IQR 5-7) and 7 (IQR 5-7), respectively, for the Vietnamese group; 5 (IQR 2-6) and 5 (IQR 2-6), respectively, for the Chinese group; and 1 (IQR 1-3) and 4.5 (IQR 1-6.8), respectively, for the Korean group.

Most participants reported that 2 people lived in their house including themselves (112/215, 52.1% older Asian American immigrants; 99/192, 51.6% across Chinese, Koreans, and Vietnamese; 51/85, 60% Chinese; 27/54, 50% Koreans; 21/53, 40% Vietnamese). There were *significant* differences with

regard to having had a family/household member's salary, *hours*, or contracts significantly reduced (*P*=.0005) and having had a family/household member or friend fallen physically ill (*P*=.0005) owing to the COVID-19 outbreak. Most Vietnamese participants (15/53, 28%) had a family/household member's salary, *hours*, or contracts significantly reduced, followed by Korean (8/53, 15%) and Chinese (2/81, 2%) participants. Most Korean participants (10/53, 19%) reported having had a family/household member or friend fallen physically ill, followed by Chinese (7/81, 9%) and Vietnamese (0/53, 0%) participants. There were *significant* differences among Chinese, Korean, and Vietnamese groups in how relationships have been between members of family/household during the COVID-19 outbreak (1=extremely negative to 10=extremely positive; χ^2_2=33.2; *P*<.0001), and the median was 9 (7.2-10) for the Korean group, 9 (IQR 7.8-9.2) for the Vietnamese group, and 6 (IQR 5-8) for the Chinese group. There were *significant* differences among Chinese, Korean, and Vietnamese groups regarding what the exercise activity level has been (χ^2_2=20.2; *P*<.0001) and how much they have engaged in hobbies (χ^2_2=26.6; *P*<.0001) since the COVID-19 outbreak—the median was 5 (IQR 4-5) and 6 (IQR 5-7), respectively, for the Vietnamese group; 5 (IQR 3-5) and 5 (IQR 5-5), respectively, for the Korean group; and 4 (IQR 3-5) and 5 (IQR 5-5), respectively, for the Chinese group.

Discussion

Principal Findings

In a group of 216 older Asian American immigrant adult participants, we found significant differences in technology access, telehealth use, and psychosocial health impacts among the Chinese, Korean, and Vietnamese groups. In our CBPR cross-sectional survey study, we examined the readiness for a web-based senior center among older Asian American immigrant adults and specifically among Chinese, Korean, and Vietnamese groups. We also identified the psychosocial needs and effects of the COVID-19 pandemic that a web-based senior center could be positioned to meet.

Socioeconomic status is an important context when planning a web-based senior center because financial resources are often limited. It is important to avoid adding financial burden while trying to be intentional in providing web-based care and social services via mobile apps. In our study, most Chinese (38/86, 44%), Korean (39/54, 72%), and Vietnamese (25/53, 47%) older participants had an unlimited mobile data plan, followed by a small group that had a limited mobile data plan. Of those using limited plans, many (39/216, 18.1%) were unsure about their data limits. More than half of older Asian American immigrant adult participants (123/216, 56.9%), including older Chinese, Korean, and Vietnamese participants, reported <US $15,000 as total household income before taxes. According to an AHSC leader, staff has assisted many older Asian American immigrant clients and applied for an affordable internet plan during the COVID-19 pandemic.

Overall, more than half of the older Asian American immigrant adult participants (131/212, 61.8%), including older Chinese, Korean, and Vietnamese participants, reported using mobile phone texting for written communication, followed by approximately half of the participants (103/212, 48.6%) using email for written communication in our study. Both mobile phone texting and email can present challenges for older adults. Challenging intrinsic factors can affect the adoption of a web-based senior center. For example, having less dexterity, experiencing tremors or physical changes resulting from arthritis or stroke, not having confidence in using new apps or platforms, and not being interested in learning new ways to access social and health services are known barriers to using technology for health purposes [30-32]. Extrinsic barriers include limited to no access to digital communication devices for all older adults, not having trust in technology, belief that mobile phones are for communication rather than accessing health and social services, and cultural beliefs that technologies detract from family time [31] or may dismantle cultural expectations for children and grandchildren to care for their older family members as they age [17].

There is a gamut of available information and communication technology devices and apps, including written and audio or video. We found that only 2% (1/53) of the Vietnamese older participants started using a new electronic device to communicate with friends and family after the COVID-19 outbreak, followed by more than half of Korean older participants (31/54, 57%) and less than one-fifth of Chinese older participants (15/86, 17%). This may be owing to not knowing what is available, not knowing how to use the device, or the degree of comfort with use. Our findings differ from those of a study that focused on South Koreans, where researchers identified themes that included a reluctance to learn about and use new technology and ambivalence regarding using technology-enabled services for connection with family or acquaintances [10]. In our study, for written and audio or video communication apps, most older Chinese participants (65/85, 77%; 57/84, 68%, respectively) used WeChat, most Korean participants (49/54, 91%; 49/54, 91%, respectively) used KakaoTalk (this app was exclusively used by the Korean group), and most Vietnamese participants used Facebook Messenger for written communication (32/50, 64%) and Apple Face Time or Facebook Messenger for audio or video communication (33/50, 66%; 31/50, 62%, respectively). Our results suggest that there are differences among groups that must be considered by CBOs offering web-based care and social services. Different communities tend to use specific communication platforms and have preferences regarding the types of services that are acceptable when using web-based platforms. It is important to note that, early in the COVID-19 pandemic, there was no existing cross-cultural communication system that was free, quickly available, and easy for symptom monitoring of large, diverse populations [33]. For example, in China, WeChat is mostly well known and is among the frequently used, web-based, health service social media platforms [34]. Our community-academic partnership kept in mind that individual COVID-19 prevention and control apps, such as WeChat in China, were developed by adding to existing social apps with regard to the management of the COVID-19 outbreak [35]. KakaoTalk is a mobile instant messenger based in South Korea (ie, host country) and is the most popular and cross-platform

social media service in South Korea [36]. In our study, findings imply that cultural and country-based web-based communication platforms, such as WeChat and Kakao Talk, are important sustainable connections with diverse Asian immigrant groups [34-36] for sustainable accessibility [37]. Our study results suggest that culturally based CBOs serving diverse communities need to navigate community contexts, capacity, and operations and determine the capacity for providing sustainable cultural, linguistic, and health care services via web-based care. CBOs and researchers need to consider how to best use these platforms, given that personal health information may be a part of certain communications. Authenticity and intentionality will be needed regarding which web-based services are best suited for these various platforms.

Web-based care is different from in-person care. In our study, few older Asian American participants, including Chinese, Korean, and Vietnamese participants perceived themselves to be very technology savvy. Furthermore, most Vietnamese older participants (41/53, 77%) expressed that they would never consider trying a telehealth appointment. A few older Chinese and Korean participants expressed the same view. Thus, CBOs and researchers need to consider intentionally using multiple communication platforms; ones that each community group is already familiar with. This will likely improve sustainability because it will relieve community members from having to learn something new to access health and social services.

We made additional important contributions to the literature about what to consider regarding sustaining accessibility in telehealth. We found that more than half of older Asian American immigrant adults (121/212, 57.1%) worry about the quality of health care with web-based care and social services. Less than half (93/212, 43.9%) were not convinced that a diagnosis made via telehealth would result in an accurate diagnosis. For example, most Vietnamese among Asian American immigrants (28/53, 53%) had never used telehealth services and do not know how to start. These findings align with what CBOs have reported—that is, most older Asian American clients struggled to use web-based platforms and web-based programs and had limited technological literacy despite having compatible computers and platforms [6]. Of importance, according to older Chinese, Korean, and Vietnamese immigrants, the main advantage of telehealth was not needing transportation services. Implications from our study suggest that there is a need to further enhance older Asian American immigrant clients' readiness for a web-based senior center, and one way is to engage and collaborate with more clients in subsequent intervention design and training in technology and telehealth delivery. According to AHSC community partners, regarding their work with older Asian American immigrant adult clients, they expressed the importance to build trust over time. For example, there are clients who were more willing to share concerns after their staff built personal connections.

Regarding overall psychosocial health in our study, older Chinese immigrants had a reduced ability to concentrate or focus during the COVID-19 outbreak. Furthermore, older Chinese, Koreans, and Vietnamese engaged less in exercise and hobbies. According to a program manager at AHSC, many older Chinese clients enjoyed being at the center in person for physical activity (eg, Tai Chi and light aerobics) and hobbies (eg, singing, dancing, and social groups) before the outbreak. A few older Chinese participants expressed that they did not have a place to go to for physical activity or engaging in hobbies. Some chose to stay at home and away from crowds owing to infection precautions, and in particular, Chinese older adults wanted to avoid anti-Asian hate. AHSC community leaders examined anti-Asian hate more specifically in another initiative apart from what our community-academic partnership's CBPR research cross-sectional survey study aimed in this study. Our partnership remains cognizant that among the anti-Asian hate incidents was the use of the terms, China virus or Wuhan virus, which relates a virus with a race, ethnicity, or city instead of to the biological SARS-CoV-2 or COVID-19, and this does not align with the World Health Organization [37]. Researchers discovered profound discrimination and violence among Asian American populations; for example, Chinese and Vietnamese commonly experienced being yelled at and being given *dirty looks* for carrying the virus [3]. Our findings suggest that there may be a need for increased caregiving efforts; a need for caregiver support; and a need for increasing services for social, health, and financial stressors; however, the extent is different among groups. For example, most Vietnamese immigrants, followed by Chinese and Korean immigrants, experienced stress owing to maintaining social distancing, worry about SARS-CoV-2, and worry about infecting themselves and people. In another example, most Vietnamese immigrants, followed by Chinese and Korean immigrants, worry about not being able to afford or access food and important resources, such as transportation or housing; feel that the crisis created financial problems for them or their family; experienced difficulties in life and distress; and had a family/household member's salary, hours, or contracts significantly reduced. These results align with the findings by Quach et al [3] and Tiwari and Zhang [7]. CBOs should include psychosocial services in the web-based portfolio. Psychosocial services will likely need to be administered on different platforms to different community groups. Psychosocial services will need to be tailored to the specific needs of each community group because they would be different across groups.

To meet these needs and to support safety while offering the broadest possible access to care, CBOs may wish to consider rebuilding after the pandemic by adding web-based health and social services for older adults. To reduce barriers for clients, consideration should be given to the needs of specific cultural groups and the technology platforms already in use by each group. A CBO web-based senior center should be designed for use across multiple free platforms such as Facebook, WeChat, KakaoTalk, or any other platform used by a specific group that a CBO serves. An important component of intentional planning and design includes conducting a survey to discover which social media platforms the CBOs clientele is familiar with and which ones they trust. Delivering services across multiple platforms may add burden to CBOs, but it will improve access and acceptance of web-based programming, thus providing the opportunity to extend reach and support more older adults and their families.

Limitations and Future Studies

Although the timing of the survey limits this study in part owing to recall consideration, this is an important step. We conducted the survey in the second year of the COVID-19 pandemic, in 2022 [38]. Community-academic partners originally planned to implement the study starting in July of 2021, but this was not possible owing to concurrent Asian American immigrant community needs driven by the COVID-19 pandemic. We honored the need to pivot, so that AHSC could focus on addressing staffing, vaccinations, and other needs in response to the virus and the increasing anti-Asian hate. AHSC community leaders expressed that the ability to recall psychosocial impacts based on ratings from 1 to 10 may have influenced the ability for some older adult participants to differentiate between 2 numbers that are next to one another (eg, 5 vs 6). Often, in health technology studies focused on individuals of Asian descent, the research data of subgroups within the large Asian population are aggregated. We examined our study data as a large group of older Asian American immigrant adults and among Chinese, Korean, and Vietnamese participants. However, further studies are needed to examine at a large scale and longitudinally and to examine additional Asian subgroups, for example, Taiwanese and multiracial groups, as they may have different needs. The response rate and completion rate were high in our study, even though a small portion of clients declined to participate. Reasons for rejection included survey length and not having experience with technology or telehealth, and, according to AHSC leaders, some may have declined because of not having a need to use a technology to access health care or having had a bad experience with technology. Although the instruments that we adapted from the PhenX Toolkit [19] have not been formally tested and validated, we pretested them with community partners for face validity and technical functionality before use in this study. We recommend further studies for additional psychometric testing and continuing engagement of older Asian American immigrants in co-designing for adoption research and building upon a CBPR approach using both quantitative and qualitative methods. This may increase meaningful use and sustainability [9,13,39]. Further studies need to address continuing engagement of older immigrant clients in building and sustaining a senior center, completely web-based versus hybrid—combination of web-based and in-person services, and essential trust in web-based continuity of health care and social service. We also recommend further examination of technology accessibility, technology literacy, and complexity of interventions as barriers to or facilitators of uptake [40] and the ethics and utility of using different types of technologies in service and clinical care from the perceptions and experiences of older Asian American immigrant adults, CBO leaders, and health care providers.

Conclusions

Results from our community-academic partnership study inform the rebuilding of an efficacious web-based senior center, where more older Asian American immigrant adults who need can obtain access to the internet and education about using technology-enabled communication devices. Differences in psychosocial needs and the effects of the COVID-19 pandemic were reported among Chinese, Korean, and Vietnamese groups. The strength of the participating older adults was observed and honored. There is a need to engage clients and culturally diverse CBOs in technology access and telehealth as a part of bridging care. This includes uplifting the communication about clients' health and extending the reach of providing care remotely through distance learning and distance integrative health care and social service delivery. There are different psychosocial needs and effects of the COVID-19 pandemic that a web-based senior center could be positioned to meet. Consideration should be given to intragroup and intergroup needs across older Asian American immigrant adults such as among Chinese, Korean, and Vietnamese groups within the large older group. Our study results illuminate the conventional challenges in delivering health care since the COVID-19 pandemic and a pathway forward for improving care and advancing health equity for culturally diverse, older, Asian immigrants.

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Authors' Contributions

The following are individual contributions from authors who have contributed substantially to the work reported. CKYNT and RLF were the 2 senior authors for this study. CKYNT, RLF, and HL were involved in conceptualization. CKYNT, RLF, HL, C Chiu, C Chac, MP, and KW contributed to the methodology. KW dealt with the software. KW, CKYNT, C Chiu, C Chac, MP,

and RLF were involved in validation. KW and CKYNT were involved in formal analysis. CKYNT, KW, HL, C Chiu, C Chac, MP, and RLF contributed to analysis review. CKYNT, KW, HL, C Chiu, C Chac, MP, and RLF contributed to the investigation. CKYNT, HL, KW, C Chiu, C Chac, MP, and RLF dealt with the resources. KW and CKYNT were involved in data curation. CKYNT and KW contributed to the original draft preparation. CKYNT, KW, HL, C Chiu, C Chac, MP, and RLF were involved in reviewing and editing the draft. CKYNT and KW contributed to visualization. CKYNT, HL, and RLF were involved in supervision. CKYNT and HL were involved in project administration. CKYNT and RLF were involved in funding acquisition.

Conflicts of Interest

None declared.

Multimedia Appendix 1
Combined consent; eligibility; and technology access, telehealth, and psychosocial health impacts survey—Microsoft Word document version.
[DOCX File , 224 KB - apinj_v8i1e49493_app1.docx]

Multimedia Appendix 2
Combined consent; eligibility; and technology access, telehealth, and psychosocial health impacts survey—PDF version.
[PDF File (Adobe PDF File), 410 KB - apinj_v8i1e49493_app2.pdf]

Multimedia Appendix 3
Sociodemographics and background characteristics of older Asian American immigrant adults and Chinese, Korean, and Vietnamese groups.
[PDF File (Adobe PDF File), 196 KB - apinj_v8i1e49493_app3.pdf]

Multimedia Appendix 4
Psychosocial needs of and effects of the COVID-19 pandemic on older Asian American immigrant adults and Chinese, Korean, and Vietnamese groups.
[PDF File (Adobe PDF File), 340 KB - apinj_v8i1e49493_app4.pdf]

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Abbreviations

AHSC: Asian Health & Service Center
CBO: community-based organization
CBPR: community-based participatory research
CHW: community health worker
PI: principal investigator
WSU: Washington State University

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Original Paper

Exploring Nursing Research Culture in Clinical Practice: Qualitative Ethnographic Study

Hyeyoung Hwang[1,2], RN, MSN, MBE; Jennie C De Gagne[3], RN, DNP, PhD, NPD-BC, CNE; Leeho Yoo[1], RN, MSN; Miji Lee[1], RN, MSN; Hye Kyung Jo[1,4], RN, MSN; Ju-eun Kim[1,5], RN, MSN

[1]College of Nursing, Ewha Womans University, Seoul, Republic of Korea

[2]Adventist HealthCare Shady Grove Medical Center, Rockville, MD, United States

[3]School of Nursing, Duke University, Durham, NC, United States

[4]Jeonbuk National University Hospital, Jeonju, Republic of Korea

[5]Health Insurance Review & Assessment Service, Wonju, Republic of Korea

Corresponding Author:
Ju-eun Kim, RN, MSN
College of Nursing
Ewha Womans University
52, Ewhayeodae-gil, Seodaemun-gu
Seoul, 03760
Republic of Korea
Phone: 82 10 7259 9699
Email: jueun.kimmm@gmail.com

Abstract

Background: Cultivating a positive research culture is considered the key to facilitating the utilization of research findings. In the realm of clinical nursing research, nurses conducting research may find the utilization of findings challenging due to the lack of a positive research culture.

Objective: This study aims to identify and describe the sociocultural context of nursing research in a clinical setting at a Korean tertiary hospital.

Methods: We included participant observation and ethnographic interviews with 6 registered nurses working in a medical-surgical unit in a Korean tertiary hospital who had experience conducting nursing research in clinical settings in this qualitative ethnographic study. The study was conducted from April 2022 to May 2022. Data analysis was conducted using Spradley's ethnographic approach, which includes domain analysis, taxonomic analysis, componential analysis, and theme analysis, and occurred concurrently with data collection.

Results: The overarching theme identified for nursing research culture in clinical practice was the development of a driving force for growth within the clinical environment. This theme encompasses (1) balancing positive and negative influences in the research process, (2) fostering transformational change for both nurses and patients, and (3) promoting complementary communication among nurses.

Conclusions: Clinical research plays a vital role in nursing practice that requires a balance of supportive elements, such as patient-driven research questions and hospital research support, with practical challenges such as shift work and high work intensity. This study found that a positive clinical nursing research culture can serve as a unifying bridge, connecting researchers, patients, who serve as both the origin and ultimate beneficiaries of research, and hospitals that facilitate research endeavors. Future research should explore whether the themes derived from this study fully reflect a clinical nursing research culture comprising patients, nurses, and the hospital environment and determine what requirements are needed to establish such a nursing research culture.

(Asian Pac Isl Nurs J 2024;8:e50703) doi:10.2196/50703

KEYWORDS

clinical nursing research; ethnography; evidence-based nursing; nursing research; qualitative research

Introduction

Overview

Nurses are increasingly expected to understand and actively participate in research endeavors and to use emerging research evidence as a foundation for their professional practice [1]. This expectation is highlighted by the International Code of Ethics for Nurses, a widely esteemed code of ethics in the nursing profession that explicitly stipulates that nurses should engage in research as an integral aspect of their profession, cultivate research-driven professional acumen, and implement evidence-based findings into their practice [2]. Similarly, the Korean Code of Ethics for Nurses underscores the responsibility of professional nurses to contribute to the development of nursing standards and the advancement of nursing research [3].

Nursing research is defined as a systematic inquiry designed to develop evidence-based information about issues important to the nursing profession, including nursing practice, education, administration, and informatics [1]. Clinical nursing research is a subset of nursing research that focuses specifically on nursing practice to promote and support patients' health, well-being, and quality of life [1,4]. Because nurses constitute the largest group of frontline providers of health care, clinical nursing research has increasingly gained recognition as a vital path to implementing practical, efficient, and economically viable strategies that reduce hospital errors, minimize unnecessary expenditures, and enhance patient outcomes [5].

Research utilization, also referred to as knowledge translation, is a pivotal component of the clinical nursing research process; it involves the generation, distribution, and integration of research findings into clinical practice [4]. Research utilization entails not only the implementation of evidence into practice but also the continuous monitoring and evaluation of changes in practice [6]. Given their role as frontline caregivers in clinical settings, nurses are crucially responsible for translating research findings into clinical nursing practice [7]. Nurses must be motivated and prepared to synthesize the results of existing studies, apply them to clinical practice, and formulate research questions directly within the clinical setting to generate new evidence, yet nurses may remain unengaged in research activities due to a lack of capacity or support to implement research findings into their daily clinical practice [4,8].

The effective utilization of research findings relies on three essential factors: (1) fostering a positive research culture, (2) garnering interest from individuals capable of applying these findings in practice, and (3) securing comprehensive support from governmental bodies, managers, and peers [9]. This study posits that fostering a positive research culture inherently encompasses the other 2 factors because a thriving research culture naturally generates interest and encourages support to translate research findings into practice. We posit, therefore, that a positive research culture is foundational to enhancing individual research interests and garnering organizational support.

Cultivating a positive research culture is essential because research utilization can prove challenging for clinical nurses due to a lack of time, knowledge, research supervision, and support [8]. This study seeks to explore the culture of clinical nursing research in Korea to provide substantive insights for cultivating a positive research culture.

Background

Defining culture poses a formidable challenge due to its inherent complexity; however, adopting a cultural perspective enables an understanding of why certain phenomena may occur in specific ways [10]. Consequently, to understand the essence of any phenomenon, it is necessary to explore the specific culture to which it belongs. A comprehensive understanding of clinical nursing research requires a deep familiarity with the culture of nursing research within specific clinical settings.

In the United Kingdom, because nursing functions within the National Health Service framework, government-led health care changes have seldom been research-based, and few studies have investigated the nature of clinical nursing research culture [9]. The United Kingdom has two distinct nursing subcultures: one for nurses and another for researchers, each characterized by differing values and language use [9]. Despite efforts to bridge these cultural differences, an explicit definition of a nursing research culture in clinical practice in the United Kingdom remains elusive [9]. The United Kingdom has encountered challenges in fostering a nursing research culture due to such factors as a shortage of adequately qualified research-active personnel, underdevelopment of research culture in many departments, limited dedicated research funding, and recurring competing demands on nurse academics [11].

A recent study in Denmark explored nurse researchers' experiences in clinical roles and their perceptions of the nursing research culture in clinical practice [12]. In their case study of nurse researchers' experiences of the presence of a nursing research culture in clinical practice, Berthelsen and Hølge-Hazelton [12] described nursing research culture as "caught between a rock and a hard place," reflecting the dual pressures arising from a limited academic tradition among nurses and a lack of recognition from physicians. In Australia, the authors of a survey of interdisciplinary researchers concluded that an enabling research culture should comprise research productivity, positive collegial relationships, inclusivity, noncompetitiveness, and effective research processes and training [13], but notably, all participants in this study were researchers rather than clinical nurses. Given that clinical nurses are increasingly tasked with involvement in clinical nursing research [14,15], relying solely on nursing researchers to depict the entirety of the clinical nursing research culture presents inherent limitations.

In South Korea, nursing research has been active since the 1980s [16], with clinical nursing research primarily conducted at the tertiary hospital level [14,17-19]. Studies conducted in Korea have explored facilitators and barriers to nursing research in clinical practice, including clinical nurses' knowledge and skills, acknowledgment of the importance of nursing research, organizational support, resource and facility constraints, time limitations, lack of leadership interest, challenges in statistical analysis, and the generalization of research results [14,20-22]. Although these studies have identified factors influencing the

research performance of clinical nurses, the specific nature of the clinical nursing research culture in Korea remains largely unexplored.

To gain a nuanced understanding of the sociocultural context surrounding nursing research in clinical settings, it is essential to explore the culture of the nursing research environment from both observer (etic) and insider (emic) perspectives. Our theoretical framework emphasizes the central role of research utilization in clinical nursing research and has guided each step of our inquiry. In alignment with this framework, our research questions were designed to explore the interplay between the prevailing research culture and the practical utilization of research findings within clinical settings. The selection of participants, the structure of the interviews, and the focal points of our observations were carefully aligned with our framework's emphasis on discerning the sociocultural nuances inherent to nursing research.

Purpose

This study aims to identify and describe the sociocultural context of clinical nursing research within a Korean tertiary hospital. The guiding research questions are the following: (1) what is the sociocultural context of clinical nursing research in a Korean tertiary hospital, and how does it impact clinical nurses' research activities? (2) How do clinical nurses perceive the research environment's culture, and what shared values and beliefs do they hold regarding nursing research in this context? (3) What are the facilitating and hindering factors impacting clinical nurses' research activities? Through participant observation and ethnographic interviews, we sought to uncover shared values and beliefs inherent in the visible phenomenon of the research environment culture of clinical nurses.

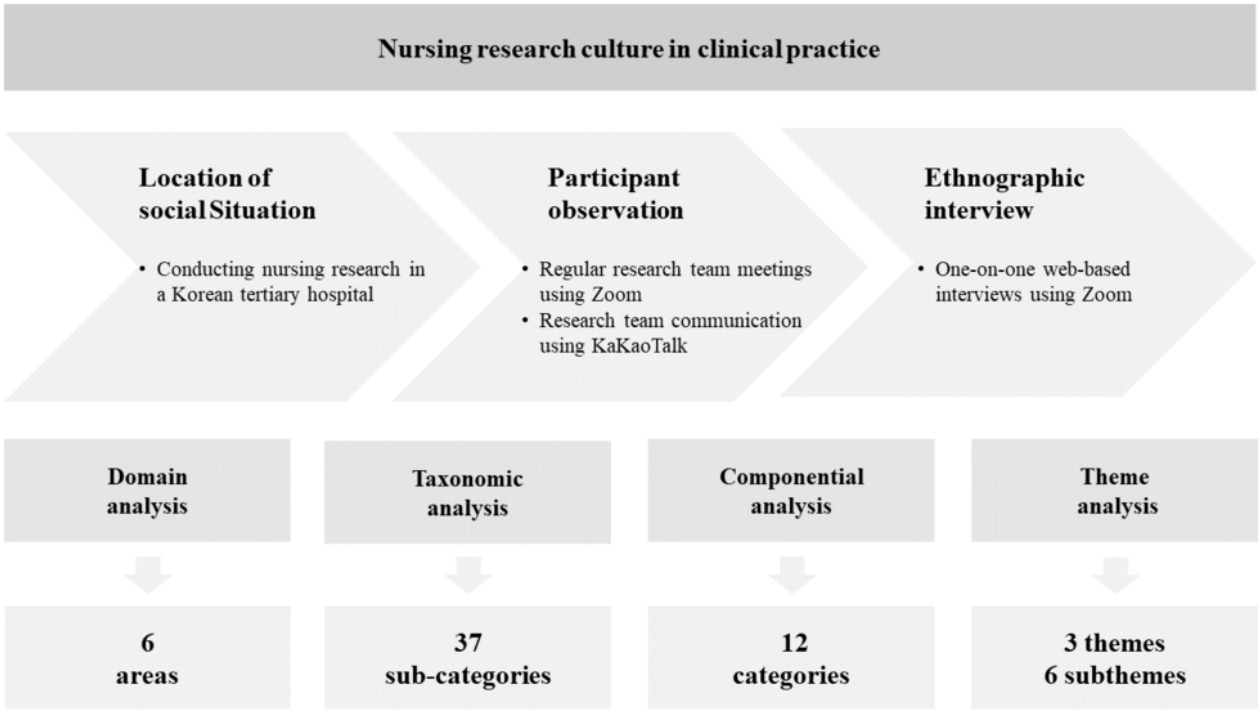
Methods

Overview

Ethnography facilitates the understanding of cultural phenomena, enabling in-depth comprehension of the subject culture from the vantage point of its native participants [23,24]. Therefore, Spradley's [23,24] ethnographic method is aptly suited for this study as it focuses on conducting in-depth interviews with clinical nurses and gaining understanding of the context from both internal and external perspectives.

Our analytical approach, deeply rooted in the emphasized theoretical framework, enabled us to interpret our findings in the broader context of research utilization in clinical nursing. This harmonious amalgamation of theory and method allowed us to unearth insights deeply rooted in the lived experiences of clinical nurses, illuminating the multifaceted nature of research engagement in clinical practice. By detailing the application and influence of our theoretical framework explicitly at each research stage, we aimed to provide a clearer and more comprehensive picture of how theoretical underpinnings shaped this study, addressing any potential concerns regarding the role and application of the theoretical framework in our research. An overview of the method is presented in Figure 1.

Figure 1. An overview of research methods.



Design

Initially, social situations were identified based on Spradley's [23] participant observation, analyzing places, actors, and activities. Participant observation and ethnographic interviews explored and described the research environment and culture of clinical nurses. This study adhered to and was reported according to the Standard for Reporting Qualitative Research (SRQR) [25]. The result of SRQR is presented in Multimedia Appendix 1.

Setting

In a tertiary hospital in South Korea, nurses submit clinical questions annually, and those whose questions are deemed valuable are given opportunities for advancement in clinical nursing research. In a participating medical-surgical unit of this hospital, clinical nursing research is underway that explores the following clinical question: "Is high-dose bowel preparation necessary before colonoscopy?" The research study compares bowel cleanliness, patient compliance, and side effects arising from different bowel preparations for patients undergoing colonoscopy.

Participant observation occurred both within the hospital's actual clinical environment and in cyberspace. Spradley's [23] definition of participant observation entails observing people's activities, the physical attributes of the social context, and experiencing the scene as a participant. This term was chosen as 1 author actively participated in the entire research process, while the remaining 4 authors observed solely in cyberspace, utilizing the mobile messenger app Kakao Talk (Kakao Games) and the video communication platform Zoom (Zoom Video Communications). Consequently, the use of the term adequately aligned with Spradley's approach.

Participants

The selection of research participants and social situations followed the ethnographic research methodology [23,24] to accurately describe clinical nurses' research environment and culture. Participants were purposefully selected based on factors that potentially influence research cultures, including position, research experience, education, and clinical experience. To attain a representation that resonates with the research culture of clinical nurses, recruitment focused on nurses with research experience, particularly those who had completed nursing research-related courses at a university hospital. Furthermore, as the research meetings were primarily conducted through Kakao Talk and Zoom, the inclusion criterion was the ability to use cell phones and computers.

Ethnography acknowledges that the required number of research participants varies depending on the cultural context [23]. Drawing from previous qualitative research [22] that focused on similar research topics and participants, a blend of purposive and snowball sampling strategies was used to recruit nurses engaged in nursing research in a hospital. The sample comprised 5 staff nurses and 1 nurse unit manager affiliated with the medical-surgical unit of a Korean tertiary hospital. One participant (who is a member of the hospital nursing research team and a contributing author to this ethnographic study) was actively involved in both participant observation and the ethnographic interview; this dual role allowed for close and continuous observation of the progress of unit-based nursing research from an actual internal perspective, enriching the study with insight from active engagement in research subjects.

Data Collection

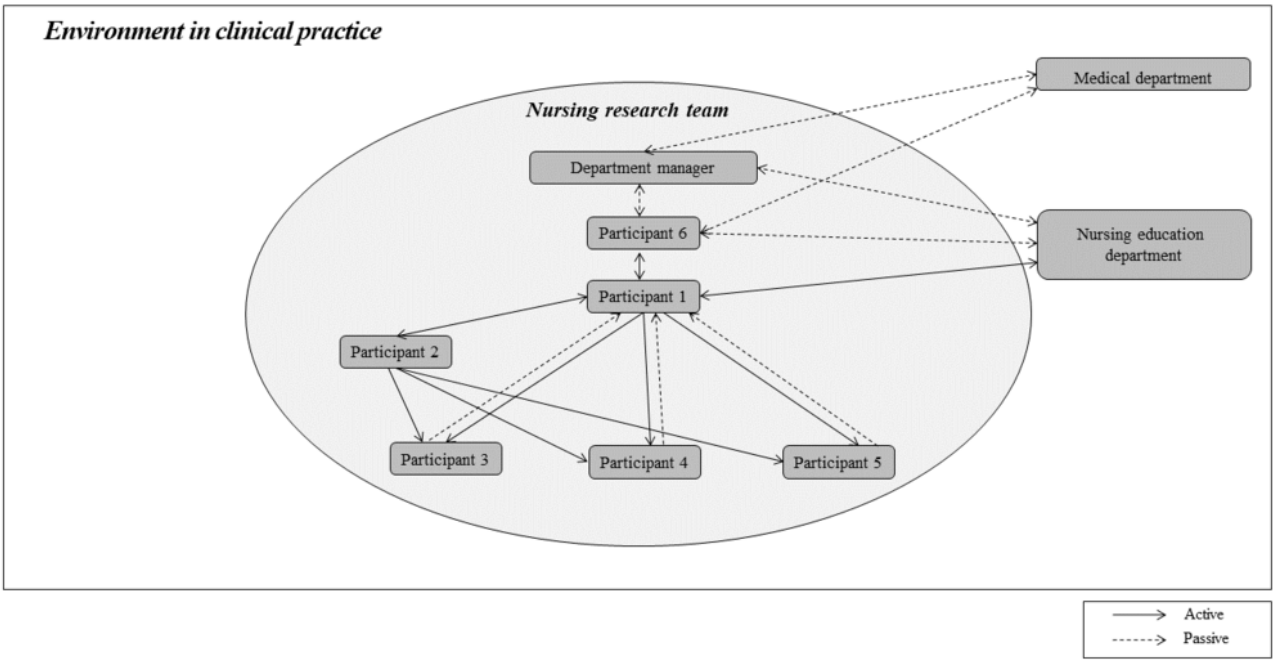
Data collection for this study was executed from April to May 2022, involving several methods, namely participant observation and ethnographic interviews. These diverse methodologies enabled researchers to garner rich data, obtain a deeper understanding of the cultural context, and address the study's queries effectively.

Participant Observation

Participant observation encompassed interactions both within the actual clinical environment of the hospital and in web-based spaces during video research conferences. One of the authors, who was also a participant in the research, conducted in-depth observations, involving monitoring of the research process in the clinical setting and active involvement as a member of the hospital's nursing research team. The remaining 4 authors observed remotely through video meetings on Kakao Talk and Zoom to oversee the research process.

The focus of both forms of participant observation was on noting participants' activities and cultural and environmental characteristics, as well as identifying various aspects such as space, actors, activities, objects, behaviors, events, time, purpose, and emotions. The relationships between research participants, as identified through participant observation, are illustrated in Figure 2.

Figure 2. Interaction of the research participants.



Ethnographic Interviews

Ethnographic interviews were conducted as one-on-one web-based sessions through Zoom in adherence to COVID-19 regulations. These interviews were facilitated by a single, experienced qualitative research interviewer who was not a part of the hospital nursing team. The interviews involved a mix of open-ended and semistructured questions, commencing with the following initial question designed to engage participants with the research topic: “What is the topic of your current hospital research?” Subsequent questions were aimed at eliciting in-depth, voluntary explanations from participants.

The structure and content of the interview questions and guidelines were informed by previous research on clinical nursing research in Korea [14,21,22,26] and were aligned with Spradley’s [24] ethnographic interview approach. Following the outlined interview guide (Multimedia Appendix 2), the interviews were conducted individually and typically lasted between 35 and 50 minutes, with the average duration being 40 minutes.

Data Analysis

In this study, 5 authors acted independently as data coders, each coding the collected data. Discrepancies in the coding results were discussed in research meetings and subjected to a consensus process until an agreement was reached. Word (Microsoft Corp) and Excel (Microsoft Corp) were used for data analysis. Initial transcripts of reported activities were compiled in Word, and meaningful data related to the topic were identified and listed in Excel, with each sentence recorded in a separate row. Subsequently, related sentences were grouped to derive themes.

Data analysis was conducted iteratively alongside data collection, using Spradley’s [24] 4-step method consisting of domain analysis, taxonomic analysis, componential analysis, and theme analysis. In the domain analysis, we reviewed ethnographic interviews and transcripts of reported activities to identify meaningful domains related to the culture of clinical nursing research. These domains were categorized into six areas of clinical nursing research culture: (1) clinical application of nursing research, (2) research role assignment, (3) shift work, (4) hospital research resources, (5) interaction between researchers, and (6) purpose of nursing research.

Taxonomic analysis led to the construction of meaningful terms within the identified domains, resulting in 37 subcategories. Componential analysis distinguished the characteristics of terms used by participants in each classification, leading to the derivation of 12 categories. All authors revised and integrated these categorizations through meticulous review. Subsequent to the categorization and integration, we performed a theme analysis and selected the final meaningful data to provide insight into the culture of clinical nursing research. Contents with similar meanings were classified and categorized, revealing 6 subthemes related to the culture of the nursing research environment among clinical nurses. These subthemes were then synthesized into 3 overarching themes that offered a comprehensive and integrated understanding of the culture of nursing research in the clinical setting.

Rigor

The rigor of this study was bolstered by using a variety of strategies recommended by Lincoln and Guba [27]. To ensure the accuracy of the interview content and methodology, the trained interviewer engaged in discussions with the other authors. All authors maintained transparency through critical reflection on their own beliefs, documented self-critical memos, and participation in deliberative discussions. Dependability was assured by integrating data collection and analysis in a simultaneous, cyclic approach. Additionally, a nursing professor well-versed in qualitative research continuously reviewed the processes of data collection and analysis to maintain the integrity of the study. Lastly, to assess their transferability, the findings

were presented to other clinical nurses to gauge their applicability in varied settings.

Ethical Considerations

This study received approval from the institutional review board of Ewha Womans University (202204-0002-01) and adhered to ethical guidelines. Potential participants were adequately informed about the study's purpose, methods, and incentives, and voluntary participation was emphasized. Sufficient time was provided for potential participants to consider their involvement. Interested participants provided written informed consent and were assured of their right to withdraw from the study at any time. Participants were informed that the collected data would be used only for research purposes and that they could discontinue participation at any time during the study. Access to the collected data was restricted to the authors of the study. To maintain confidentiality, any identifying information and files that could link data to individual participants were securely discarded upon the completion of the study.

Results

Participant Characteristics

This study included 6 participants, all female, comprising 5 staff nurses and 1 unit manager from a ward. The participants were aged between 26 and 53 years and had clinical experience ranging from 2 to 30 years. The number of research experiences among the participants varied from 1 to 7 instances. Additional details on the participants' characteristics are provided in Table 1.

The findings of the study are subsequently presented, supplemented by excerpts from the observations and interviews conducted with the participants.

Table 1. Demographic characteristics of the participants.

Number	Position	Number of research experiences	Education	Age (years)	Clinical experience (years)
1	Staff nurse	6	Doctoral student	34	6
2	Staff nurse	2	Master's student	30	4
3	Staff nurse	2	BSN[a]	26	2
4	Staff nurse	1	BSN[a]	28	3
5	Staff nurse	1	BSN[a]	27	3
6	Unit manager	7	MSN[b]	53	30

[a]BSN: Bachelor of Science in Nursing.

[b]MSN: Master of Science in Nursing.

Balancing Positive and Negative Influences in the Research Process

Shift Work and High Workload Negatively Impacting Research Progress

Nurses working in shifts and experiencing high workloads expressed feeling too exhausted to balance their work and research responsibilities. Most participants viewed research as a separate entity from their clinical roles and expressed that they found the research process arduous and challenging to juggle alongside their work duties. Nurses' varying schedules resulting from shift work made finding a suitable meeting time challenging. Participants in this study used web-based meetings as a solution that allowed maximal participation, and they provided recordings for those who could not attend due to scheduling conflicts. Nonetheless, some participants found it difficult to discuss and share progress updates due to shifting work schedules and reported feeling too drained to attend research-related training sessions given their substantial workload. Consequently, the demands of high workloads and shift work often resulted in deprioritization and postponement of research activities.

> *The process of moving forward seems very arduous. Balancing work and research is challenging, and maintaining focus is difficult.* [Participant 2, observation]

> *Due to shift work, only a few nurses discuss and are informed about the progress of the research. This sometimes leaves others struggling to understand and keep up with the research's progress, which can be embarrassing.* [Participant 3, interview]

> *Sometimes, I feel so tired and overwhelmed by the high workload that I cannot afford to participate in research-related training.* [Participant 4, interview]

Positive Utilization of Hospital's Research Support Resources

The research support resources provided by the hospital positively impacted the progress of the research. Nurses shared that they were able to submit clinical questions about which they were curious through a hospital program, leading to the formation of a research team and the initiation of research. The hospital provided various research support resources, such as research-related education and academic services, support for educational expenses, and dedicated human resources to assist with research. During meetings, participants referenced books provided by the hospital that contained essential information for advancing research. The accessibility of these resources cultivated a supportive environment that enabled participants

to conduct more efficient and effective research, which could be translated into positive outcomes.

> *Every year, our hospital holds an event encouraging nurses to formulate research questions stemming from their clinical curiosities. I found myself jotting down sporadic thoughts, and these activities naturally evolved into nursing research.* [Participant 4, interview]

> *The Nursing Education Department collaborates with our research team leader, offering support including statistical consulting.* [Participant 2, interview]

> *Detailed information useful for assessing the "Risk of Bias" of the selected literature can be found on page 62 of the book provided by the hospital.* [Participant 1, observation]

Fostering Transformational Change for Both Nurses and Patients

Selection of Research Topics Derived From Clinical Settings

Participants acknowledged the need for change to enhance the working environment for nurses and create a safer hospital environment for patients. They engaged with questions emerging from their daily practices and evolved these inquiries into research topics. They perceived that addressing these topics could trigger significant changes that would benefit both nurses and patients. This approach seemed to deepen their understanding of the prevalent issues and elevate the relevance of the research to clinical practice.

> *This research topic came about because nurses noticed issues while doing their jobs. They were thinking about other possible solutions since patients were having a hard time taking a lot of laxatives, causing them discomfort and making nursing tasks take longer.* [Participant 6, interview]

> *The issue we chose as our research topic was something I often pondered over during work. It was a mutual concern among all nurses and patients in our unit, and it's intriguing to see it evolve into a research question.* [Participant 4, interview]

> *I firmly believe the clinical setting is the optimal environment for nursing research. Numerous topics are inherently connected to nursing practices and patient care, highlighting the immense value of conducting research in such settings. Given the chance, I aspire to continue pursuing research in clinical environments.* [Participant 1, interview]

Meaningful Outcomes Obtained Through the Research Progress

All participants regarded the knowledge obtained through research as a common, meaningful outcome, signifying that the acquisition of new knowledge was a significant and shared benefit experienced by the entire group. In addition to the shared benefit of knowledge, participants anticipated obtaining various individual benefits from their research process, including the development of leadership and followership skills, expertise in their field, tangible rewards, increased satisfaction, improved confidence, reinforced trust within the team, and a sense of group unity. The participants expressed that they enjoyed the research process and that the array of rewards it offered led to positive experiences for all involved.

> *Even if the results of our research don't align with our hopes, I think our nurses have already grown personally during the process and can act as positive influences for our younger colleagues.* [Participant 6, interview]

> *I studied article search and analysis techniques in nursing school, but doing research in a clinical environment has allowed me to realize the importance of these skills firsthand, enhancing my learning confidence. I'm also thinking about attending graduate school, and I feel that my current research experience will be beneficial then.* [Participant 5, interview]

> *If our research is published in a scholarly journal, it would be a personal achievement, so I'm even more motivated to work harder.* [Participant 2, interview]

Promoting Complementary Communication Among Nurses

Varied Research Participation Based on Research Competency

The level of involvement of nurses in the research varied, influenced by their previous research and postgraduate course experiences. This involvement was also correlated with the relationships among participants, as depicted in Figure 2. In essence, team members who were actively engaged in the research demonstrated more active relationships within the team, while those who were less active exhibited more passive relationships. Participants with research experience actively shared their opinions; however, as the research progressed, they felt the burden of the uneven distribution of tasks. Conversely, those without previous research experience performed only the roles assigned to them by their more experienced peers and felt apologetic toward other participants.

> *Having engaged in similar research during my master's program, I find the current research less challenging. However, colleagues lacking research experience may find it somewhat hard to keep pace with the progress of the research.* [Participant 2, interview]

> *As the research becomes more complex, the team is finding it difficult, increasing my workload. I feel that if I don't keep at it, the research might halt, so I'm pushing through. Honestly, it's somewhat overwhelming.* [Participant 1, interview]

> *My team leader assigns tasks to members. Since I lacked knowledge about research, my participation has been more passive. So, these days, when I observe some team members struggling with the research, I feel a profound sense of guilt. It's challenging for me*

to decide what to do initially. [Participant 5, interview]

Differences in Researcher Roles Depending on Research Participation

Participants' roles in the research process were diversified, reflecting individual research capabilities and experience, which correlated with the level of their involvement in research. Those actively involved, particularly individuals with previous research experience or a master's degree, autonomously delineated their roles, aligning them with the team members' strengths and competencies. This strategy fostered a cooperative environment and optimized the unique skills of each member. Conversely, participants engaged more passively, typically those lacking research or a relevant educational background, conformed to the leaders' opinions, and concentrated solely on assigned tasks, expressing that they found this approach to be less burdensome. To mitigate the disparities in research capabilities and experiences, participants maintained consistent meetings and endorsed reciprocal, complementary communication. Participants expressed that this emphasis on open dialogue and collaboration imbued them with a sense of preparedness to tackle challenges arising during the research process.

> *I believe that fostering learning and robust teamwork can simplify the research process. I often contemplate the optimal distribution of types and volumes of work, respecting individual researchers' competencies and workload.* [Participant 1, interview]

> *I appreciate our task assignment approach. Given our shared workspace, we understand each other's strengths, which, coupled with my professional and research commitments, makes focusing on my strengths less burdensome.* [Participant 3, interview]

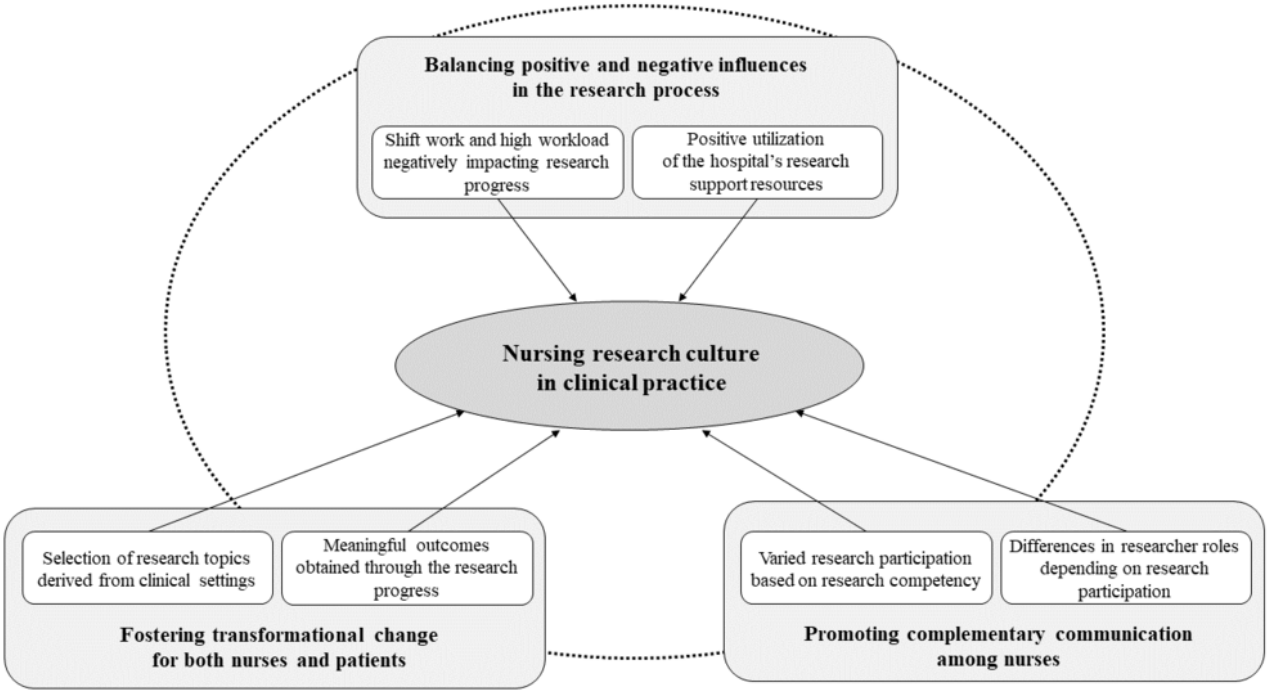
> *Maintaining regular communication is pivotal. The nature of our shift work complicates assembling everyone for research meetings, but I am confident that persistent communication can deepen our understanding of individual roles in research and enable us to offset each other's limitations.* [Participant 5, interview]

Discussion

Overview

The findings of this qualitative study offer insights into the culture of nursing research in clinical settings, showcasing its potential to empower nurses to bring about positive transformations in patient care and their professional practice while bolstering collaborative efforts. The 3 identified themes are balancing positive and negative influences in the research process, fostering transformational change for both nurses and patients, and promoting complementary communication among nurses with different research competencies and roles. Figure 3 provides a visual representation of these themes. These findings underscore the crucial ability of nursing research to enhance nurses' working environments, foster a safer atmosphere for patients, and facilitate overall progress and development in the clinical context.

Figure 3. Essential themes of nursing research culture in clinical practice.



Principal Findings and Comparison With Previous Work

The first emergent theme was the balance between positive and negative influences in the research process. The clinical environment may serve as both a facilitator and a barrier for nurses conducting research. The availability of diverse research support resources plays a crucial role as a facilitator in enhancing clinical nurses' research progress. A variety of research support resources can have a positive impact on clinical nursing research, including both material resources (eg, research-related education, academic services, and educational expense support) and human resources (eg, designated departments and personnel to assist with research progress) [28]. In Korea, clinical nurses have exhibited low research competency, a factor significantly correlated with the amount of organizational support [28]. Previous studies have indicated that organizational support and a strong belief in the value of clinical research enable research activity by fostering a culture that encourages the crucial exploration and application of research evidence in everyday practice [29]. Cultivating an organizational culture supportive of research at the institutional level is, therefore, essential to facilitating the clinical utilization of research findings.

Moreover, research participation by clinical nurses was observed to involve navigating between work and research commitments. Shift work creates challenges for scheduling regular research meetings on fixed dates and coordinating times when all research team members can gather. For example, a study in 2017 to describe the infrastructure supporting research in Magnet hospitals found that nearly half (44%) of the 249 hospitals responding required clinical nurses to conduct research activities during their regular clinical hours, and 40% reported nurses conducting research in their personal time; consequently, research activities often take a backseat to patient care priorities, making it challenging to allocate time for nurses away from direct patient care [30]. To encourage research by clinical nurses, dedicated time for research activities should be provided, and enhancements to the nursing working environment are imperative. Hospitals should acknowledge and account for the time invested in clinical nursing research within regular working hours.

The second theme underscored the transformative potential of clinical nursing research for both nurses and patients. Such research serves as a catalyst, allowing nurses to realize personal goals, such as enhancing their research capacity, while simultaneously fostering improved and safer environments for patients and health care providers. Consequently, deriving research questions from the clinical field and applying the research results to actual clinical practice is at the core of clinical nursing research [4].

In this study, participating nurses formulated research questions from their experiences caring for patients who had difficulty taking high-dose bowel cleansing solutions. Because clinical nursing research directly affects nurses' work, specifically patient care, all our participants empathized deeply with the need for this research, and the practical applicability of the research results encouraged their active participation. The predominant themes identified in a previous study conducted with 64 perioperative nurses in a hospital in Korea (ie, learning how to solve problems in practice, facilitating team activities through motivation, barriers to large participation, and rewarded efforts and inflated expectations) [31] were congruent with the insights gained in this study, suggesting that to bolster clinical nursing research, it is essential to create opportunities for field-based question formulation and foster a belief in the capability to induce change. However, the urgency to partake in clinical nursing research should not overshadow the importance of undertaking thorough literature reviews on existing research findings related to clinical issues. Clinical nursing research should be pursued only when there is a paucity of evidence, and it must always adhere to ethical standards. Motivating nurses to engage in research, allowing for continual identification of pertinent research questions, and promoting thorough reviews of relevant existing literature can yield benefits for both nurses and patients and pave the way for research in previously unexplored areas.

The final theme revolves around complementary communication, accommodating the diverse competencies of nurses. The research team in this study encompassed nurses with varied research-related experiences. Differences in research competency among team members, attributable to varying levels of research experience, led them to adopt distinct approaches to research. Participants with extensive research experience had a better understanding of the research progress, which allowed them to take charge compared with those with less experience. Conversely, those with limited research exposure struggled with the unfamiliar content discussed in meetings and were uncertain about participation modalities. These findings are consistent with a previous study indicating that individuals lacking research experience or knowledge exhibit reluctance toward research participation [31]; therefore, research competency, inclusive of experience and knowledge, emerges as a pivotal facilitator in research implementation.

Despite the associated challenges, participants maintained complementary communication through regular web-based meetings to fulfill their research objectives. Successful complementary communication is straightforward, reciprocally advantageous, and reinforces continuous interaction and relationship development [32]. Given the evident benefits of such communication, we posit that fostering it within teams can significantly enhance nursing research in clinical settings. The diversity in research competency and roles among nurses highlighted in this study accentuates the necessity of nurturing complementary communication within research teams, thus ensuring equitable and balanced interactions and contributions among team members. In the research team examined in this study, the team leader allocated tasks, and nurses with less research experience assumed a more passive stance, fulfilling only the minimal tasks assigned. Communication was then leveraged to mitigate any arising discrepancies. We therefore suggest that championing complementary communication to address variances among research nurses while leveraging the individual strengths of nurses not only sustains clinical nursing research but also cultivates a positive research culture in clinical nursing.

Limitations

This ethnographic study explored the nursing research culture in clinical nursing practice by examining the experiences of 6 nurses working at a tertiary hospital in Korea. The small sample size and the single-site setting may affect the transferability of the study's findings, as they may not represent the broader population of clinical nurses. To mitigate this possibility, we amassed data until saturation was reached, with no additional information emerging. To bolster the study's rigor, we shared the findings with nurses from various units and hospitals to assess transferability.

Due to the COVID-19 pandemic, participant meetings were held through Zoom, with scenes recorded for repeated review during analysis. This format hampered direct observation, however, limiting field notes to within-frame elements and omitting potentially significant out-of-frame expressions and movements. The shift to web-based methods challenges the traditional notion of "placeness of ethnography" [33], and some might argue that without physical immersion in the research area, there is no true fieldwork. However, digital platforms are enabling research in spaces where people are active, allowing a re-evaluation of the necessity of physical presence in traditional ethnographic fieldwork [34]. The paradigm that field research mandates physical colocation with participants [35] is undergoing reconsideration, especially given the COVID-19 pandemic, as technological advances redefine the concept of the research field [36].

Conclusions

Clinical nursing research is pivotal in fostering nurse development and refining nursing practices by juxtaposing challenges such as intensive shifts and heightened workloads with facilitators such as patient-centric research questions and institutional research support. The clinical environment may serve dual roles as a facilitator by providing the requisite infrastructure for research and as a barrier when intensive shifts persist and research time is not allocated. Institutionalizing infrastructure for nursing research and earmarking time for such activities is crucial in clinical settings to facilitate continual knowledge circulation, thereby allowing nurses to generate and apply well-substantiated knowledge effectively. Adequate clinical nursing research enhances both professional development and patient care; therefore, nursing education programs should emphasize the importance of pinpointing apt research topics, reviewing existing research, and executing clinical nursing research. Subsequent research should probe whether the themes uncovered in this study accurately represent the nursing research culture in clinical settings and should identify the prerequisites for establishing an exemplary nursing research culture.

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Conflicts of Interest

None declared.

Multimedia Appendix 1
Standard for Reporting Qualitative Research (SRQR) checklist.
[PDF File (Adobe PDF File), 130 KB - apinj_v8i1e50703_app1.pdf]

Multimedia Appendix 2
Interview Guide.
[DOCX File , 24 KB - apinj_v8i1e50703_app2.docx]

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Abbreviations

SRQR: Standards for Reporting Qualitative Research

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