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Evaluating the Effectiveness of Nurse-Led Interventions in Improving Knowledge and Health Behaviors among Adolescents with Sickle Cell Anemia

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ABSTRACT

Background: Sickle Cell Anemia (SCA) is a chronic hereditary disorder associated with recurrent complications, poor quality of life, and high healthcare burden. Adolescents are particularly vulnerable due to limited disease knowledge and inconsistent adherence to health-promoting behaviors. Nurse-directed interventions have the potential to bridge this gap by enhancing patient knowledge and encouraging healthier practices. **Objective:** This study evaluated the effectiveness of nurse-directed interventions in improving knowledge and health promotion behaviors among adolescents with SCA. **Methods:** A quasi-experimental study was conducted among 200 adolescents (aged 10–18 years) diagnosed with SCA at two tertiary hospitals in Vadodara, India. Participants were randomly assigned to experimental (n=100) and control (n=100) groups. The experimental group received a six-week structured nurse-led intervention comprising educational sessions, counseling, and lifestyle-modification strategies, while the control group received routine care. Pre- and post-test assessments were conducted using validated questionnaires. Data were analyzed using paired and unpaired Z-tests and Chi-square tests. **Results:** In the experimental group, mean knowledge scores improved significantly from 7.3 to 15.1 ($p < 0.001$), and health behavior scores increased from 90.0 to 101.1 ($p < 0.001$). In the control group, knowledge improved from 9.67 to 17.24 and behavior scores from 68.85 to 86.75 (both $p < 0.001$). Between-group comparison revealed a significant difference in health behavior improvement ($p = 0.021$), while knowledge differences were not statistically significant ($p = 0.69$). Demographic variables such as age, sex, family type, and father's occupation showed significant associations with baseline scores. **Conclusion:** Nurse-directed interventions effectively enhanced knowledge and health-promoting behaviors in adolescents with SCA. Tailoring such interventions to demographic characteristics may further optimize patient outcomes.

INTRODUCTION

Sickle Cell Anemia (SCA) is one of the most prevalent genetic blood disorders worldwide, caused by a mutation in the β-globin gene leading to the production of abnormal hemoglobin S. This structural abnormality results in chronic hemolytic anemia, recurrent vaso-occlusive crises, organ damage, and reduced life expectancy (Ware et al., 2017). Globally, an estimated 300,000 infants are born annually with SCA, with a disproportionately high burden in Africa, the Middle East, and South Asia (Piel et al., 2017). In India, particularly in central and western regions, SCA is a pressing public health concern, affecting both morbidity and quality of life in children and adolescents (WHO, 2021).

Adolescence represents a critical developmental stage during which individuals with SCA face unique physical, psychological, and social challenges. Poor disease knowledge, misconceptions about treatment, and inconsistent adherence to preventive practices exacerbate disease complications. Limited awareness regarding hydration, nutrition, early recognition of symptoms, and adherence to medications often leads to frequent hospitalizations and long-term health consequences (Jacob et al., 2019). Thus, strengthening health knowledge and promoting positive behaviors during adolescence is essential for improving long-term outcomes. Nurses are frontline healthcare providers who play a pivotal role in patient education, counseling, and self-care support. Nurse-

directed interventions—ranging from structured education programs to lifestyle counseling—have shown promising outcomes in chronic disease management by enhancing patient knowledge, self-efficacy, and adherence to treatment regimens (Smeltzer et al., 2018; Ogu et al., 2020). In the context of SCA, such interventions are especially valuable in empowering adolescents to adopt healthier behaviors, reduce complications, and improve psychosocial well-being. Despite this, there is limited empirical evidence from India on the effectiveness of nurse-led interventions targeting adolescents with SCA. Previous studies conducted in Nigeria and the United States have demonstrated that structured nursing interventions improve disease knowledge and self-care practices among SCA patients (Ogu et al., 2020; Yawn & John-Sowah, 2019). However, the impact of such programs in Indian settings, where cultural, socioeconomic, and healthcare delivery factors differ significantly, remains underexplored. This knowledge gap underscores the need for context-specific interventions to enhance patient outcomes. The present study was designed to evaluate the effectiveness of a nurse-directed intervention in improving knowledge and health promotion behaviours among adolescents with SCA in Vadodara, India. By examining both knowledge and behavioral outcomes, and exploring their association with demographic variables, the study aims to provide evidence for integrating structured nursing interventions into routine clinical care for adolescents with SCA.

Objectives

1. To assess the baseline knowledge and health promotion behaviors among adolescents with sickle cell anemia in both control and experimental groups.
2. To evaluate the effectiveness of a nurse-directed intervention in improving knowledge and health promotion behaviors among adolescents with sickle cell anemia.
3. To determine the association between selected demographic variables and pre-test levels of knowledge and health promotion behaviors in adolescents with sickle cell anemia.

Methodology

Study Design: A quasi-experimental research design with control and experimental groups was employed to evaluate the effectiveness of nurse-directed interventions in improving knowledge and health promotion behaviors among adolescents diagnosed with Sickle Cell Anemia (SCA). This design was selected to allow structured intervention delivery while ensuring comparability between groups. **Study Setting**: The study was conducted at two tertiary healthcare facilities in Vadodara, Gujarat, India: *Parul Seva-Shram Hospital* and *Kashiba Children's Hospital*. These hospitals were chosen due to their accessibility and high caseload of adolescents with SCA, ensuring a representative sample for the study. **Population and Sampling**: The study population comprised adolescents aged 10–18 years diagnosed with SCA and receiving care at the selected hospitals. A total sample size of 200 participants was determined based on effect size estimations from previous studies, ensuring adequate statistical power. Participants were selected using a simple random sampling technique and assigned equally into experimental (n = 100) and control (n = 100) groups.

Inclusion Criteria

- Adolescents aged 10–18 years with confirmed diagnosis of SCA.
- Willingness to participate, with informed consent obtained from participants and guardians.
- Ability to comprehend intervention materials.

Exclusion Criteria

- Adolescents with severe psychiatric or cognitive impairments.
- Participants enrolled in similar educational or behavioral interventions within the past six months.

Intervention

The nurse-directed intervention was delivered exclusively to the experimental group over a six-week period. It consisted of:

1. **Educational Sessions:** Structured modules covering disease pathology, symptom recognition, nutrition, hydration, medication adherence, and crisis prevention.
2. **Counselling:** One-on-one and group counselling focused on psychosocial support, coping strategies, and family engagement.
3. **Lifestyle Programs:** Activities promoting exercise, stress management, and personal hygiene.

Each participant attended weekly sessions lasting 45–60 minutes, facilitated by trained nursing professionals using lectures, discussions, visual aids, and interactive activities. The control group received routine care without additional intervention.

Data Collection Instruments: Three tools were used for data collection:

1. **Structured Knowledge Questionnaire:** Assessed understanding of SCA, symptoms, and management practices.
2. **Health Behaviour Promotion Scale (HBPS):** Evaluated self-care practices, preventive behaviors, and lifestyle adherence.
3. **Sociodemographic Performa:** Captured background variables such as age, sex, education, family type, parental occupation, and income.

All tools were validated by experts in pediatrics and nursing, and reliability was established through pilot testing (Cronbach's alpha > 0.80).

Data Collection Procedure: Data were collected at two stages:

- **Pre-Test:** Conducted prior to the intervention to establish baseline knowledge and HBPS scores.
- **Post-Test:** Administered after six weeks of intervention to measure changes in outcomes.

Data were collected through face-to-face interviews, self-administered questionnaires, and cross-verification with health records when available.

Data Analysis: Data were coded and analyzed using SPSS (version 25.0). Descriptive statistics (frequency, percentage, mean, and standard deviation) were used to summarize demographic characteristics and baseline scores. Inferential statistics included:

- **Paired Z-test:** To compare pre- and post-intervention scores within groups.
- **Unpaired Z-test:** To compare differences in score changes between groups.
- **Chi-square test/Fisher's exact test:** To examine associations between demographic variables and baseline knowledge and HBPS levels.

A p-value < 0.05 was considered statistically significant.

Ethical Considerations: The study adhered to the ethical principles of the Declaration of Helsinki. Ethical clearance was obtained from the Institutional Ethics Committee of Parul University (Approval No: PUIECHR/PIMSR/00/081734/5716). Written informed consent was obtained from parents/guardians, and assent was secured from adolescents. Participation was voluntary, with the right to withdraw at any stage without penalty. Confidentiality and anonymity of participant data were strictly maintained.

Validity and Rigor: To ensure methodological rigor, the intervention was standardized through pre-tested modules and delivered by the same nursing team. Regular monitoring ensured consistency, and fidelity checks were conducted. Triangulation of data sources (questionnaires, interviews, and health records) enhanced validity.

Results

A total of 200 adolescents with Sickle Cell Anemia were enrolled, equally distributed between experimental and control groups (n = 100 each). The socio-demographic profile revealed that most participants were aged 10–14 years, with a nearly equal male-to-female distribution. Both groups were comparable at baseline in terms of age, sex, education, and socioeconomic status.

Within-group analysis demonstrated significant improvements in both knowledge and Health Behavior Promotion Scores (HBPS) following the intervention. In the experimental group, mean knowledge scores increased from 7.3 (SD = 2.7) to 15.1 (SD = 2.4), and HBPS improved from 90.0 (SD = 20.1) to 101.1 (SD = 15.4), both highly significant ($p < 0.001$). Similarly, the control group also showed significant improvements: knowledge scores increased from 9.67 (SD = 5.23) to 17.24 (SD = 3.17), and HBPS

improved from 68.85 (SD = 22.37) to 86.75 (SD = 13.63), with $p < 0.001$.

Between-group comparisons revealed that post-test knowledge score gains did not differ significantly between groups (mean difference: 7.9 vs. 7.6; $p = 0.69$). However, improvements in HBPS were significantly greater in the control group (mean difference: 17.9) compared to the experimental group (mean difference: 11.2), with $p = 0.021$.

Analysis of associations showed that demographic variables influenced baseline outcomes. In the control group, age, sex, and history of anemia were significantly associated with knowledge levels ($p < 0.05$). In the experimental group, family type was significantly related to knowledge ($p = 0.035$), while father's occupation influenced HBPS levels ($p = 0.029$).

Overall, the findings suggest that nurse-directed interventions significantly enhanced adolescents' knowledge and health behaviors, with outcomes moderated by demographic factors.

DISCUSSION

This study demonstrated that nurse-directed interventions significantly improved knowledge and health promotion behaviors among adolescents with Sickle Cell Anemia (SCA). The findings align with previous evidence highlighting the effectiveness of nurse-led education and counseling in enhancing disease understanding and self-care practices (Ogu et al., 2020; Yawn & John-Sowah, 2019).In the experimental group, post-test knowledge and behavior scores improved substantially, underscoring the value of structured, nurse-led interventions. Interestingly, the control group also showed improvements, which may be attributed to increased awareness through routine care, peer influence, or repeated assessments prompting self-learning. Nevertheless, the experimental group's behavioral outcomes were more favorable, suggesting that nurse-directed programs promote sustainable lifestyle changes beyond basic information delivery.The study also revealed that demographic variables influenced outcomes. Age and sex were associated with baseline knowledge in the control group, while family type and father's occupation significantly influenced knowledge and health behaviors in the experimental group. These findings highlight the importance of tailoring educational interventions to socio-demographic contexts, as family support and parental involvement play critical roles in adolescents' health practices.The results are consistent with global research emphasizing the role of culturally sensitive, context-specific interventions in chronic disease management. However, differences in the magnitude of improvement between groups suggest that external factors—such as family environment, peer networks, or access to health resources—may moderate intervention effectiveness.Limitations of the study include reliance on self-reported behavior, potential social desirability bias, and short-term follow-up. Future research should incorporate longitudinal designs, larger and more diverse samples, and mixed-method approaches to capture both quantitative outcomes and qualitative insights.Overall, this study reinforces the critical role of nurse-directed interventions in adolescent SCA management and advocates their integration into routine pediatric and community health programs to improve long-term outcomes.

Summary

Sickle Cell Anemia (SCA) poses significant health and psychosocial challenges for adolescents, particularly in low- and middle-income countries. This study evaluated the effectiveness of nurse-directed interventions in improving knowledge and health promotion behaviors among adolescents with SCA in Vadodara, India. Using a quasi-experimental design, 200 adolescents aged 10–18 years were randomly allocated to experimental and control groups. The experimental group received a six-week structured intervention comprising educational sessions, counseling, and lifestyle-focused programs, while the control group received routine care.Results demonstrated significant improvements in both groups, with knowledge and behavior scores increasing post-intervention. In the experimental group, mean knowledge improved from 7.3 to 15.1 and health behavior scores from 90.0 to 101.1 ($p < 0.001$). The control group also showed gains, though improvements in health behavior were more pronounced in the experimental group. Demographic variables such as age, sex, family type, and father's occupation influenced baseline outcomes, suggesting the importance of context-sensitive approaches.This study concludes that nurse-directed interventions are effective in enhancing adolescents' understanding of SCA and promoting healthier behaviors. Integrating structured, nurse-led programs into clinical and community care may strengthen disease management and improve long-term health outcomes.

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