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# Determinants of Kidney Transplantation Uptake Among Hemodialysis Patients in Gaborone, Botswana

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***Abstract*: Chronic kidney disease (CKD) is a growing health concern globally, with a disproportionate burden in low- and middle-income countries, including Botswana, where prevalence exceeds global averages. Although hemodialysis (HD) is the most commonly used form of renal replacement therapy (RRT), evidence consistently shows that kidney transplantation (KT) is more cost-effective, improves quality of life, prolongs survival, and enhances economic productivity. Despite Botswana's provision of fully subsidized RRT services—including HD, peritoneal dialysis (PD), and KT—transplantation remains underutilized. This study assessed the determinants of KT uptake among HD patients in Gaborone, Botswana. A cross-sectional study was conducted among 163 HD patients sampled proportionally across three dialysis centres in Gaborone. Data were collected using structured questionnaires on socio-demographic, patient-related, and healthcare factors. Descriptive statistics summarized participant characteristics, while chi-square tests and linear probability regression were employed to identify predictors of KT uptake. Only 17.2% of participants had initiated the transplantation process, indicating low uptake despite available services. Bivariate analysis demonstrated significant associations between gender, educational attainment, donor availability, and provider-related factors (education and referral) with KT uptake. In the multivariate regression model, age, donor availability, and referral by healthcare providers remained independent predictors ($p < 0.05$). Patient knowledge, comorbidities, and cultural or religious beliefs were not significantly associated. The most cited barriers were lack of a suitable donor (39.4%) and inadequate information (33.6%). Kidney transplantation uptake among HD patients in Gaborone remains low, with most patients not progressing in the transplant pathway. Donor availability, age, and provider referral emerged as key determinants, underscoring the urgent need to strengthen referral systems, improve patient education, and expand donor options to enhance access to transplantation.***

***Keywords*: Kidney transplantation, hemodialysis, determinants, uptake.**

## 1. Introduction

### *A. Background of the Study*

Chronic Kidney Disease (CKD) has emerged as a formidable global health challenge, affecting an estimated one billion people worldwide, with a prevalence ranging from 9.1% to 13.4% (Kovesdy, 2022). Although the burden is global, low- and middle-income countries (LMICs) carry a disproportionate share due to inadequate prevention strategies, delayed diagnosis, and limited access to renal replacement therapy (RRT). In sub-Saharan Africa, prevalence estimates range between 4% and 13%, with CKD increasingly recognized as a driver of morbidity and mortality (Boima et al., 2021; GKHA, 2023). "Within this regional context, Botswana records a high disease burden, with prevalence reaching 13.5% among hospitalized patients (Rwegerera et al., 2017). Kidney disease accounts for 2.6% of all deaths in the country, ranking as the eighth leading cause of mortality (WHO, 2020).

Most patients with CKD eventually progress to end-stage renal disease (ESRD), necessitating RRT such as hemodialysis (HD), peritoneal dialysis (PD), or kidney transplantation (KT). Hemodialysis is the most widely accessible modality in Africa, yet kidney transplantation is globally recognized as the gold standard for ESRD management, offering superior survival, enhanced quality of life, and long-term cost savings (Mtingi-Nkonzombi et al., 2022; Garg et al., 2023). Despite these advantages, KT uptake across Africa remains unacceptably low, with fewer than one in ten patients requiring RRT receiving a transplant (Davies et al., 2023). Botswana mirrors this trend. Although the government subsidizes dialysis and initiated a national transplant program in 2014, uptake remains strikingly limited, with fewer than fifteen transplants performed in the past decade, representing less than 5% of the dialysis population (National Transplant Registry, 2024).

This paradox underscores a critical gap. In many African contexts, financial cost is consistently cited as the greatest barrier to transplantation. However, in Botswana, where both dialysis and transplantation are fully subsidized, persistently low uptake suggests that other determinants—such as patient knowledge and perceptions, comorbidities, cultural and religious beliefs, referral practices, and institutional factors—play a more decisive role in shaping access and utilization.

The disjunction between the availability of transplantation services and their underutilization by patients represents a pressing public health concern in Botswana. The number of

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individuals on dialysis has grown rapidly in Gaborone, rising from 107 patients in 2021 to more than 300 by 2024 (PMH Facility Register, 2024). Yet, kidney transplantation, which is clinically superior and more sustainable, has failed to attract corresponding uptake. This reliance on dialysis is both clinically suboptimal and financially unsustainable, creating long-term risks for patient outcomes and the national health system. Understanding why patients do not access transplantation despite financial coverage is essential to resolving this paradox.

The overall objective of this study is to assess the determinants of kidney transplantation uptake among ESRD patients on hemodialysis in Gaborone, Botswana. Specifically, the study seeks to examine the relationship between patient factors and KT uptake, analyze the influence of healthcare system factors on uptake, and identify the predictors of transplantation among this patient population.

This study is justified on multiple grounds. From a policy perspective, identifying patient-level, cultural, and systemic barriers to transplantation is essential for guiding national strategies to expand access and strengthen the health system. Clinically, kidney transplantation offers survival and quality-of-life benefits far beyond those achieved with dialysis, and interventions that increase its uptake could transform patient outcomes. Contextually, Botswana presents a unique case because financial barriers have been eliminated through full government subsidy, yet uptake remains disproportionately low. This allows for the exploration of alternative determinants that may not be evident in other African countries. Scientifically, the research addresses a major evidence gap in Botswana, contributing to the regional and global literature on kidney transplantation in resource-constrained contexts. By illuminating the barriers specific to Botswana, this study will provide actionable insights for policy, improve equity in healthcare, and lay a foundation for future research.

## 2. Methodology

### *A. Design*

This study adopted an analytical cross-sectional correlation design to investigate the relationships between patients' demographic characteristics, patient-related attributes, and health system factors—as perceived by patients—and their influence on the uptake of kidney transplantation among individuals with ESRD undergoing hemodialysis in Gaborone.

### *B. Study Area and Study Population*

The study population comprised all patients with chronic kidney disease undergoing maintenance hemodialysis at the three major renal centers in Gaborone, Botswana, namely the Renal Care Institute (RCI), Sir Ketumile Masire Teaching Hospital (SKMTH), and Bokamoso Private Hospital (BPH).

### *C. Sampling Method and Sample Size Determination*

The sample size for this study was determined using Cochran's (1977) formula for finite populations. A multistage sampling procedure was applied, beginning with the purposive selection of hospitals providing hemodialysis services in Gaborone. In the subsequent stage, patients within these facilities were conveniently sampled. To ensure fair representation across centers, proportional allocation was used, yielding a final sample of 163 respondents: 95 from the Renal Care Institute (RCI), 35 from Sir Ketumile Masire Teaching Hospital (SKMTH), and 33 from Bokamoso Private Hospital (BPH).

### *D. Inclusion and Exclusion Criteria*

The study included all patients diagnosed with end-stage renal disease (ESRD) and undergoing maintenance hemodialysis in the renal units of the three selected hospitals. Eligible participants were required to be 18 years of age or older and capable of providing informed consent. Patients with cognitive impairments or those too weak to respond to the study questionnaire were excluded. Furthermore, individuals who took part in the pretest were not included in the main study to avoid potential bias.

### *E. Data Collection Method*

Data were collected using both self-administered and interviewer-administered questionnaires. This dual approach was adopted to enhance inclusivity and data quality: self-administered questionnaires allowed participants who were comfortable and able to complete the forms independently to do so, while interviewer-administered questionnaires ensured that patients with limited literacy, physical weakness, or other constraints were still able to participate meaningfully in the study.

### *F. Validity and Reliability of Study Instrument*

The study tool was self-developed and its validity established through content and face validation, including pretesting with 24 hemodialysis patients at the Scottish Livingstone Hospital Renal Care Institute (SLH RCI) and expert review. Reliability testing using Cronbach's alpha yielded a coefficient of 0.723, indicating acceptable internal consistency (≥0.70).

### *G. Study Variables*

The independent variables included socio-demographic characteristics, patient-related factors, and health system factors as perceived by the patients, while the dependent variable was the initiation of the kidney transplantation process (started vs. not started).

### *H. Data Collection Process*

Data were collected by the principal investigator in the renal units of the selected hospitals over an eight-week period between June and July 2025. Questionnaires were administered until 163 were correctly and completely filled, after which they were checked for completeness before entry into SPSS. To enhance clarity and understanding, respondents were given the opportunity to ask questions during data collection.

### *I. Data Analysis*

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 27 and STATA version 17. Descriptive statistics, including means, standard deviations, and proportions, were computed to summarize participants'

demographic characteristics. Bivariate associations were assessed using Chi-square and Fisher's exact tests, while logistic regression analysis was performed to identify independent predictors of kidney transplantation uptake. Statistical significance was set at $p < 0.05$ with a 95% confidence interval.

### *J. Ethical Considerations*

Ethical approval was obtained from Kenya University Ethics Review Committee (KUERC), the Botswana Ministry of Health's HRDC, and participating dialysis centers. Written informed consent was secured from all participants (and guardians for minors), with assurances of confidentiality, voluntariness, and the right to withdraw. No personal identifiers were used, and data were securely stored and managed in line with ethics committee requirements. Data collection was scheduled around dialysis sessions to minimize disruption and ensure representative participation.

## 3. Results

### *A. Social Demographic Findings*

A total of 163 patients undergoing hemodialysis participated in the study (Table 3). The mean age was 54 years (SD = —), with 36 (22.1%) aged 40 years or below and 127 (77.9%) aged 41 years and above. Males accounted for 107 (65.6%) of the participants, while females comprised 56 (34.4%). In terms of education, 38 (23.3%) had primary education or below, whereas 125 (76.7%) had secondary or tertiary education. Regarding marital status, 95 (58.3%) were not married (single, divorced, or widowed), while 68 (41.7%) were married. The majority of participants, 137 (84.0%), identified as Christian, and 26 (16.0%) belonged to other religions, including Muslim, non-religious, and African Traditional beliefs. Employment status indicated that 77 (47.5%) were economically active (employed, self-employed, or students), whereas 85 (52.5%) were not economically active (unemployed or retired).

### *B. Patient Related Factors*

Among the 163 CKD patients on hemodialysis, over half (52.76%) had been on treatment for more than three years, while 25.77% had 1–3 years, 12.88% less than six months, and 7.98% six months to one year (Table 2). Awareness of kidney transplantation (KT) as a treatment option was moderate at 60.12%, yet knowledge levels were high, with 83.44% reporting very good knowledge. Attitudes were predominantly positive (87.73%), with only 4.91% expressing negative perceptions. Comorbidities were common (76.69%), with hypertension most prevalent (50.31%), followed by hypertension with diabetes (11.66%), HIV (6.75%), diabetes alone (2.45%), and others (6.75%). Potential kidney donors *were identified by only 28.22% of patients, mainly siblings (9.20%), children (6.75%),* spouses (5.52%), parents (3.07%), and other relatives (2.45%). Barriers to donor availability included not approaching family (22.09%), family reluctance (19.02%), lack of KT awareness (12.27%), medical unsuitability (9.20%), and other factors (8.59%). Cultural beliefs were minimal, with 99% reporting no influence on KT uptake.

### *C. Healthcare Factors Related to Kidney Transplantation Uptake*

Interactions with healthcare providers played a key role in shaping KT perspectives (Table 6). Just over half (55.6%) of participants had received health education, mainly from nurses, with high satisfaction reported (60.74% very satisfied, 37.42% satisfied). However, referral for transplantation evaluation was limited, with only 20.25% having been referred. At the system level, most participants (77.91%) indicated they would be more likely to pursue KT if services were available in Botswana, while 15.97% were uncertain and 4.91% would not. Policy restrictions confining KT to living-related donors were seen as limiting by 12.27%, though 74.23% felt unaffected. Despite such constraints, willingness to accept alternative donors was strong, with 82.21% open to non-related living donors and 80.37% to deceased donors.

### *D. D. Kidney Transplant Uptake Among Patients on Chronic Hemodialysis at Dialysis Centers in Gaborone, Botswana*

The uptake of kidney transplantation was assessed by evaluating the proportion of patients who initiated the transplantation process. The findings indicated that approximately 17% (n = 28) of respondents had initiated the process, whereas the majority, around 83% (n = 135), had not, as depicted in Figure 4.1.

### *E. Reasons for not Starting the KT process*

Table 1
Reason for not starting the process

| Reason for not starting the KT process | Freq. | Percent |
|---|---|---|
| Do not want transplant | 20 | 14.6 |
| Undecided | 17 | 12.4 |
| Waiting for donor | 54 | 39.4 |
| Lack of information | 46 | 33.6 |
| **Total** | **137** | **100** |

The most common reason cited for not starting the kidney transplant process was waiting for a donor (39.4%), followed by lack of information (33.6%) as show in table 1. A smaller proportion of patients reported being unwilling to undergo transplantation (14.6%) or remaining undecided (12.4%). These findings highlight the importance of addressing knowledge gaps and expanding donor availability to improve transplant uptake.

### *F. Socio-Demographic Factors Associated with Kidney Transplant Uptake Among CKD Patients on Hemodialysis at Dialysis Centres in Gaborone, Botswana*

A Chi-square test was conducted to assess the association between socio-demographic characteristics and kidney transplantation (KT) uptake among CKD patients undergoing hemodialysis in Gaborone, Botswana (Table 4). The analysis demonstrated that gender ($\chi^2(1) = 5.54$, $p = .019$) and education level ($\chi^2(3) = 13.38$, $p = .004$) were significantly associated with KT uptake. These findings underscore the importance of gender and educational attainment as socio-demographic determinants of access to transplantation. In particular, higher levels of education may facilitate greater health literacy, improved

Table 2
Patient characteristics

| Patient characteristics | Categories | Frequency (n) | Percentage (%) |
|---|---|---|---|
| Duration of hemodialysis | Less than 6 months | 21 | 12.88 |
| | 6 months-1 Year | 13 | 7.98 |
| | 1-3 years | 42 | 25.77 |
| | 3 Years | 86 | 52.76 |
| Awareness of KT as an option treatment | No | 62 | 38.04 |
| | Yes | 98 | 60.12 |
| Knowledge about KT | Poor | 2 | 1.23 |
| | Good | 25 | 15.34 |
| | Very good | 136 | 83.44 |
| Attitude and Perception about KT | Negative | 8 | 4.91 |
| | Neutral | 12 | 7.36 |
| | Positive | 143 | 87.73 |
| Comorbidities | No | 38 | 23.31 |
| | Yes | 125 | 76.69 |
| Types of comorbidities present (n = 125) | Hypertension | 82 | 50.31 |
| | Diabetes | 4 | 2.45 |
| | Hypertension/Diabetes | 19 | 11.66 |
| | HIV | 11 | 6.75 |
| | Anaemia | 11 | 6.75 |
| Donor Availability | No | 117 | 71.78 |
| | Yes | 46 | 28.22 |
| Donor Relation | Parent | 5 | 3.07 |
| | Sibling | 15 | 9.20 |
| | Spouse | 9 | 5.52 |
| | Child | 11 | 6.75 |
| | Other | 4 | 2.45 |
| Reason for no Donor | Unaware KT is an option | 20 | 12.27 |
| | Family not willing to donate | 31 | 19.02 |
| | Have not asked the family | 36 | 22.09 |
| | No medically eligible family member | 15 | 9.20 |
| | Other | 14 | 8.59 |
| Cultural Beliefs | No | 162 | 0.99 |
| | Yes | 1 | 0.01 |

Table 3
Social demographic factors

| Variable | Grouped Categories | Frequency (n) | Percentage (%) |
|---|---|---|---|
| Age | ≤ 40 years (0–40) | 36 | 22.08 |
| | ≥ 41 years (41 and above) | 127 | 77.92 |
| Gender | Male | 107 | 65.64 |
| | Female | 56 | 34.36 |
| Education Level | ≤ Primary (None + Primary) | 38 | 23.31 |
| | ≥ Secondary (Secondary + Tertiary) | 125 | 76.69 |
| Marital Status | Not Married | 95 | 58.28 |
| | Married | 68 | 41.72 |
| Religion | Christianity | 137 | 84.05 |
| | Other Religions | 26 | 15.95 |
| Employment Status | Economically Active | 77 | 47.53 |
| | Not Economically Active | 85 | 52.47 |

navigation of referral pathways, and a better understanding of the benefits of KT, thereby enhancing uptake. The observed gender effect is consistent with regional reports that highlight differential access to health resources and caregiving roles, which may influence treatment decisions. Conversely, other socio-demographic variables, including age, marital status, religion, and occupation, were not significantly associated with KT uptake in this cohort. This suggests that while socio-cultural factors may influence patient perceptions, structural and informational determinants such as gender equity and education remain more decisive in shaping transplantation outcomes.

### *G. Patient Related Factors Associated with KT Uptake*

A Chi-square test was conducted to examine the association between patient-related factors and kidney transplantation (KT) uptake among CKD patients on hemodialysis in Botswana (Table 7). Most patient-related variables, including duration of dialysis ($\chi^2$ (4) = 3.21, $p$ = 0.523), awareness of KT ($\chi^2$ (2) = 4.99, $p$ = 0.083), knowledge ($\chi^2(2) = 2.26$, $p$ = 0.324), attitudes ($\chi^2(2) = 2.90$, $p = 0.234$), comorbidities ($\chi^2(1) = 0.52$, $p = 0.470$), and cultural beliefs ($\chi^2(2)$ = 1.29, $p$ = 0.524), were not significantly associated with transplantation uptake. Similarly, the type of comorbid condition ($\chi^2(4) = 7.39$, $p = 0.117$) did not significantly influence outcomes. In contrast, donor-related variables emerged as highly significant predictors. Donor availability strongly predicted KT uptake ($\chi^2(2) = 48.54$, $p <$ 0.001), with patients who had identified donors substantially more likely to undergo transplantation. The relationship of the donor to the patient was also significant ($\chi^2(4) = 69.10$, $p <$ 0.001), with siblings and spouses being the most common donors. Moreover, reasons for lacking a donor showed a strong association ($\chi^2(5) = 46.99$, $p < 0.001$), with barriers such as lack of awareness and family unwillingness to donate identified as

key obstacles. Overall, the results highlight that while most patient-level characteristics were not significant, donor availability, donor relationship, and reasons for absence of a donor were the principal determinants of KT uptake in this cohort.

### *H. Attitudes and Perceptions Associated with Kidney Transplant Uptake*

Table 6 shows the association between patients' attitudes and kidney transplant uptake. Most participants who agreed that kidney transplantation improves quality of life had higher uptake ($\chi^2$ = 12.417, p = .000). Willingness to undergo transplantation if medically eligible was also linked to uptake ($\chi^2$ = 5.970, p = .015). Confidence in managing lifelong treatment after transplant ($\chi^2$ = 8.743, p = .003), comfort in asking a loved one for a kidney donation ($\chi^2$ = 6.841, p = .009), and confidence in the surgical process ($\chi^2$ = 5.912, p = .018) were similarly associated with transplant uptake. Openness to receiving a kidney from another person showed a near-significant relationship ($\chi^2$ = 3.661, p = .056).

### *I. Health Care Factors Associated with KT Uptake*

The analysis of healthcare-related factors revealed several significant associations with kidney transplant (KT) uptake among hemodialysis patients as shown in Table 8. Receipt of health education from a healthcare provider showed a strong

Table 4
Social demographic factors associated with KT uptake

| Variable | Category | KT Uptake | | $\chi^2$ | df | p-value |
|---|---|---|---|---|---|---|
| | | No n(%) | Yes n(%) | | | |
| Age group | ≤ 40 years | 30 (83.3) | 6 (16.7) | 0.617 | 1 | 0.432 |
| | ≥ 41 years | 81 (79.4) | 21 (20.6) | | | |
| Gender | Male | 94 (87.9) | 13 (12.1) | 5.535 | 1 | 0.019* |
| | Female | 41 (73.2) | 15 (26.8) | | | |
| Education level | ≤ Primary | 37 (97.4) | 1 (2.6) | 7.892 | 1 | 0.005** |
| | ≥ Secondary | 97 (77.6) | 28 (22.4) | | | |
| Marital status | Not married (Single/Divorced/Widowed) | 79 (83.2) | 16 (16.8) | 0.017 | 1 | 0.897 |
| | Married | 56 (82.4) | 12 (17.6) | | | |
| Religion | Christianity | 112 (81.8) | 25 (18.2) | 0.185 | 1 | 0.667 |
| | Other religions | 15 (83.3) | 3 (16.7) | | | |
| Employment status | Economically active (Employed/Self-employed/Student) | 58 (75.3) | 19 (24.7) | 2.997 | 1 | 0.083 |
| | Not active (Unemployed/Retired) | 77 (87.1) | 12 (12.9) | | | |

Table 5
Healthcare facility level characteristics

| Health Care provider factor | Category | Frequency (n) | Percent (%) |
|---|---|---|---|
| If ever received health education from a | No | 74 | 45.40 |
| healthcare provider about KT | Yes | 89 | 55.60 |
| Who provided with the information (n=89) | Doctor | 18 | 11.04 |
| | Nurse | 57 | 34.97 |
| | Doctor/Nurse | 10 | 6.13 |
| How satisfied are you with the information | Not satisfied at all | 17 | 7.2 |
| | Satisfied | 82 | 82.8 |
| Have you been referred by healthcare provider | No/not sure | 130 | 78.53 |
| | Yes | 33 | 20.25 |
| Reasons for no referral | Never discussed | 72 | 44.17 |
| | Not Eligible | 11 | 6.75 |
| | No Interested | 11 | 6.75 |
| If KT were done in Botswana, will you likely consider | No/Not sure | 34 | 4.91 |
| | Yes | 126 | 77.91 |
| Limits of current KT policy | Yes, it limits | 20 | 12.27 |
| | No/Not sure | 31 | 74.23 |
| Would consider receiving a kidney from a non-related living donor | No | 28 | 17.18 |
| | Yes | 134 | 82.21 |
| Would you be open to receiving a kidney from a deceased donor | No | 29 | 17.79 |
| | Yes | 131 | 80.37 |

Table 6
Attitudes and perceptions associated with KT uptake

| Statement | Category | KT uptake | | $\chi^2$ | df | p-value |
|---|---|---|---|---|---|---|
| | | No n (%) | Yes n (%) | | | |
| I believe kidney transplant improves quality of life compared to long-term dialysis | Disagree | 71 (92.2) | 6 (7.8) | 12.417 | 1 | 0.000*** |
| | Agree | 109 (77.3) | 32 (22.7) | | | |
| If I am medically eligible, I would be willing to undergo a kidney transplant | Disagree | 34 (94.4) | 2 (5.6) | 5.970 | 1 | 0.015* |
| | Agree | 101 (80.2) | 25 (19.8) | | | |
| I am confident about managing the lifelong treatment following kidney transplant | Disagree | 34 (94.4) | 2 (5.6) | 8.743 | 1 | 0.003** |
| | Agree | 101 (79.5) | 26 (20.5) | | | |
| I feel comfortable asking a loved one for a kidney donation if needed | Disagree | 26 (96.3) | 1 (3.7) | 6.841 | 1 | 0.009** |
| | Agree | 83 (78.3) | 23 (21.7) | | | |
| I feel confident in the surgical process | Disagree | 25 (96.2) | 1 (3.8) | 5.912 | 1 | 0.018* |
| | Agree | 84 (78.5) | 23 (21.5) | | | |
| I am open to receiving a kidney from another person | Disagree | 16 (94.1) | 1 (5.9) | 3.661 | 1 | 0.056 |
| | Agree | 110 (81.5) | 25 (18.5) | | | |

Table 7
Patient related characteristics associated with kidney transplant uptake

| Patient characteristics | Category | KT Uptake | | $\chi^2$ | p-value |
|---|---|---|---|---|---|
| | | No n (%) | Yes n (%) | | |
| Duration of hemodialysis | ≤ 1 year | 30 (88.2) | 4 (11.8) | 1.743 | .187 |
| | > 1 year | 104 (81.3) | 24 (18.8) | | |
| Awareness of KT as treatment option | No | 56 (90.3) | 6 (9.7) | 4.989 | .083 |
| | Yes | 76 (77.6) | 22 (22.4) | | |
| Knowledge about KT | Poor | 29 (85.3) | 5(14.7) | 6.842 | .009** |
| | Good & Very Good | 133 (82.1) | 23 (17.9) | | |
| Attitude and perception toward KT | Negative/Neutral | 19 (90.5) | 2 (9.5) | 3.104 | .212 |
| | Positive | 116 (81.1) | 27 (18.9) | | |
| Comorbidities | Diabetes | 41 (73.2) | 15 (26.8) | 7.388 | .117 |
| | Hypertension/Diabetes | 50 (90.9) | 5 (9.1) | | |
| | HIV | 14 (77.8) | 4 (22.2) | | |
| | Others | 26 (86.7) | 4 (13.3) | | |
| Cultural beliefs | No | 123 (84.2) | 23(15.8) | 1.292 | .524 |
| | Yes | 7(58.3) | 5(41.7) | | |
| Donor identified (availability) | No | 111 (95.1) | 5 (4.9) | 48.539 | .000*** |
| | Yes | 23 (50.0) | 23 (50.0) | | |
| Donor relationship | Immediate family (Parent/Child) | 13 (81.3) | 3 (18.7) | 23.031 | .000*** |
| | Extended family (Sibling/Spouse) | 7 (28.0) | 18 (72.0) | | |
| Reason for no donor | Family-related (Not asked/unwilling) | 64 (95.5) | 3 (4.5) | 46.988 | .000*** |
| | Structural (Unaware KT option/No eligible donor) | 33 (91.7) | 3 (8.3) | | |

Table 8
Health care facility associated with KT uptake

| Variable | Categories | KT uptake | | $\chi^2$ | p-value |
|---|---|---|---|---|---|
| | | No n (%) | Yes n (%) | | |
| Ever received health education by healthcare provider | No | 73 (54.1) | 52 (45.9) | 23.861 | .000*** |
| | Yes | 1 (3.6) | 27 (96.4) | 45.389 | .000*** |
| Information provider | Doctor | 14 (77.8) | 4 (22.2) | | |
| | Nurse | 44(77.2) | 13(22.8) | | |
| | Doctor/Nurse | 3 (30.0) | 7 (70.0) | | |
| Satisfaction with information received | Not satisfied at all | 14 (82.4) | 3(17.6) | 46.569 | .000*** |
| | Satisfied (Very satisfied) | 58(70.7) | 24 (29.3) | | |
| Referred by healthcare provider | No | 136(93.3) | 9 (6.7) | 89.743 | .000*** |
| | Yes | 4 (14.3) | 24 (85.7) | | |
| Transplant done outside Botswana | No/Not sure | 31 (86.1) | 5 (13.9) | 0.674 | .412 |
| | Yes | 104 (81.9) | 23 (18.1) | | |
| Living-related policy limitations | Limits/Not sure | 40 (95.2) | 2 (4.8) | 6.165 | .104 |
| | Does not limit | 95 (78.5) | 26 (21.5) | | |
| Non-related living donor | No | 26 (92.9) | 2 (7.1) | 2.656 | .265 |
| | Yes | 108 (80.6) | 26 (19.4) | | |
| Deceased Donor | No | 27 (93.1) | 2 (6.9) | 3.433 | .180 |
| | Yes | 105 (80.2) | 26 (19.8) | | |

association with KT uptake, with patients who had received education demonstrating markedly higher uptake compared to those who had not ($\chi^2 = 23.861$, $p < .001$). Similarly, the type of information provider was significantly related to KT uptake ($\chi^2 = 45.389$, $p < .001$); patients who received information jointly from both doctors and nurses had a higher rate of transplantation than those informed by either provider alone. Satisfaction with the information received also exhibited a significant relationship ($\chi^2 = 46.569$, $p < .001$), with those reporting satisfaction or high satisfaction showing greater uptake than those who were not satisfied.

Referral by a healthcare provider was another factor significantly associated with KT uptake ($\chi^2 = 89.743$, $p < .001$), with referred patients displaying higher uptake compared to those not referred. Conversely, there were no significant associations between KT uptake and having the procedure done outside Botswana ($\chi^2 = 0.674$, $p = .412$), living-related donor policy limitations ($\chi^2 = 6.165$, $p = .104$), willingness to receive a kidney from a non-related living donor ($\chi^2 = 2.656$, $p = .265$), or willingness to receive from a deceased donor ($\chi^2 = 3.433$, $p = .180$).

### *J. Predictors for Kidney Transplant Uptake Among CKD Patients on Hemodialysis*

The linear probability regression model explained 67.9% of the variation in kidney transplant uptake outcomes ($R^2 = 0.6788$), indicating strong model fit (Table 9). Age emerged as a consistent negative predictor: compared with the youngest group, patients aged 19–30, 31–40, 41–50, 51–60, 61–70, and above 70 years were 37–49 percentage points less likely to undergo transplantation (all $p < 0.05$), suggesting a steady decline in uptake with advancing age. Employment status showed mixed effects, with students being 41.6 percentage points less likely to undergo transplantation ($p = 0.008$), while unemployed, self-employed, and retired participants showed no significant differences.

Health system–related factors were strong positive predictors. Referral by a healthcare professional increased the likelihood of transplantation by 53.8 percentage points ($p < 0.001$), receipt of health education raised uptake by 10.0 percentage points ($p = 0.008$), and having an identified donor increased uptake by 22.6 percentage points ($p < 0.001$). Other demographic variables, including gender, marital status, and

Table 9
Predictors of KT uptake

| Dependent Variable: Kidney Transplant uptake Predictors | | Odd Ratio | Std. err | Z | P>\|Z\| |
|---|---|---|---|---|---|
| Age | (19-30) | -.4738442 | .1188193 | -3.99 | 0.000** |
| | (31-40) | -.48984 | .1637644 | -2.99 | 0.003** |
| | (41-50) | -.4206043 | .1580935 | -2.66 | 0.009** |
| | (51-60) | -.469763 | .1575205 | -2.98 | 0.003** |
| | (61-70 | -.4158183 | .1590763 | -2.61 | 0.010** |
| | (Above 70) | -.3749623 | .1620202 | -2.31 | 0.022* |
| Gender (Female) | | .0329925 | .0456335 | 0.72 | 0.471 |
| Education level: | (Primary) | -.009261 | 0.0451155 | 0.21 | 0.838 |
| | (Secondary) | .0254525 | .0567139 | 0.45 | 0.654 |
| | (Tertiary) | .0365138 | .0550344 | 0.66 | 0.508 |
| Employment status | (unemployed) | -.0922028 | .0491267 | -1.88 | 0.063 |
| | Self-employed | .0461639 | .0758919 | 0.61 | 0.544 |
| | Retired | .0184016 | .0600378 | 0.31 | 0.760 |
| | Student | -.4186104 | .1591107 | -2.63 | 0.009** |
| Attitude of the CKD patients | | .0283153 | .0239424 | 1.18 | 0.239 |
| Knowledge | | -.0866665 | .0733921 | -1.18 | 0.240 |
| Referral by Health care | | .5426547 | .0963789 | 5.63 | 0.000** |
| Any Medical Condition | | -.0121815 | .0587796 | -0.21 | 0.836 |
| Donor identified (Yes) | | .2211924 | .062801 | 3.52 | 0.001** |
| Received health education by HC provider | | .0839493 | .0361286 | 2.32 | 0.022* |
| Policy limitations | | .0085788 | .0176363 | 0.49 | 0.627 |
| Constant | | .4125665 | .2313627 | 1.78 | 0.077 |

education, were not significantly associated. Similarly, knowledge and attitude scores were not significant predictors, although attitudes showed a weak positive, non-significant trend ($p = 0.112$).

Overall, the analysis highlights that older age and student status reduced the probability of transplantation uptake, while referral, health education, and donor availability were the strongest facilitators of successful kidney transplantation among CKD patients on hemodialysis in Gaborone

## 4. Discussion

This study found that the mean age of participants was 54 years, which aligns with findings from Senegal (Mansour et al., 2021) but remains lower than observations in high-income countries such as Canada, where mean patient ages typically exceed 69 years (Bello et al., 2019; Liu et al., 2021). Across Africa and Asia, studies have consistently reported earlier onset of chronic kidney disease (CKD), often between the mid-forties and early fifties (Nduati, 2024; Moshi et al., 2021; Shoo et al., 2024; Farishta, 2022; Jalali et al., 2021). These variations are likely attributable to differences in life expectancy, access to early detection and treatment, and broader epidemiological transitions. Genetic predispositions, particularly APOL1 variants prevalent among populations of sub-Saharan ancestry, have also been associated with accelerated CKD progression (Bamgboye, 2023). Together, these factors help explain the comparatively younger CKD population observed in this and other African cohorts.

Employment participation among study respondents was consistent with patterns reported in Gaborone (Mosiko et al., 2021) and Ghana (Boima et al., 2021), where roughly two in five patients maintain some form of employment. In contrast, European data indicate considerably higher employment rates among CKD patients (Alma et al., 2023). Employment outcomes are shaped by multiple interrelated factors, including age, comorbidities, education level, and national economic conditions (de Jong et al., 2022). In Botswana, where dialysis is fully subsidized, employment remains important for meeting indirect treatment-related expenses and sustaining overall quality of life.

Kidney transplant (KT) uptake was lower than that observed in other regional and international settings such as Kenya (Nduati et al., 2022), Ghana (Boima et al., 2021), and Iran (Jalali et al., 2021). While willingness to undergo transplantation remains high across Africa and Asia, actual uptake continues to be constrained by systemic and policy-related barriers. In Botswana, dependence on living-related donors and the need to conduct procedures abroad limit accessibility despite full financial coverage. In contrast, in Kenya, affordability remains the principal constraint. These differences illustrate how both economic and logistical factors collectively influence transplantation outcomes.

Gender and educational attainment were significant determinants of KT uptake. Women in this study were more likely to undergo transplantation than men, contrary to global evidence that typically indicates male predominance (Vinson et al., 2024; Katz-Greenberg et al., 2022; Harding et al., 2025). This divergence may be partly explained by Botswana's universal subsidy system, which minimizes financial barriers and promotes equitable access. Higher education was also associated with greater likelihood of transplantation, corroborating evidence from prior studies showing that education enhances health literacy, promotes informed decision-making, and facilitates navigation through complex referral pathways (Nduati et al., 2022; Jalali et al., 2021; Chung et al., 2024). These findings underscore education's pivotal role in bridging awareness and health-seeking action, even in subsidized systems.

Employment status, however, did not significantly influence uptake—unlike in Ghana and Kenya, where employment and

health insurance are crucial enablers of access (Boima et al., 2021; Nduati et al., 2022). Botswana's universal healthcare effect of socioeconomic status, thereby reducing inequality in access to transplantation. Similarly, general awareness, knowledge, and broad attitudes toward KT were not directly associated with uptake, echoing findings from other African contexts (Boima et al., 2021; Nduati et al., 2022). In high-income countries, where structural supports are stronger, positive attitudes and awareness more readily translate into uptake (Venkataraman & Kendrick, 2020). However, in Botswana, persistent structural constraints such as donor scarcity and limited referral pathways remain the dominant barriers.

Although aggregate attitudes were not predictive of uptake, certain specific beliefs—such as confidence in lifelong post-transplant care and perceptions of improved quality of life—showed positive associations. This distinction suggests that targeted cognitive or affective factors may influence behavior when systemic limitations are controlled. Cultural constraints were minimal, as very few participants viewed transplantation as conflicting with traditional or religious beliefs. Nonetheless, the limited scope of cultural assessment may have underrepresented subtle influences. Studies from South Africa report stronger cultural and religious opposition (Mojapelo & Maboe, 2019), indicating that deeper sociocultural analyses could yield more comprehensive insights.

Donor availability was the most decisive factor influencing KT uptake, consistent with evidence from Kenya and Ghana (Nduati et al., 2022; Boima et al., 2021). The majority of respondents lacked an identified donor, reinforcing the reality that transplantation rates in Africa remain tethered to the availability of living donors, even in subsidized systems.

Healthcare provider–related variables, particularly transplant education and referral, were strongly associated with uptake. Patients who received structured education, especially from physicians, were more likely to pursue transplantation, reflecting similar findings in Tanzania and the United States (Moshi, 2024; Waterman et al., 2015). The quality and credibility of information provided were essential, emphasizing the importance of multidisciplinary, patient-centered education strategies. Referral by healthcare providers also emerged as a critical enabler, serving as the primary mechanism through which awareness translates into action (Harding et al., 2024; Patzer, 2020).

In contrast, systemic variables such as openness to non-relative or deceased donor transplantation did not show meaningful associations with uptake, despite evident patient willingness. This disparity highlights structural bottlenecks within Botswana's transplantation framework and mirrors patterns documented in other African nations (Mojapelo & Maboe, 2019; Boima et al., 2021). Conversely, countries that have implemented deceased-donor programs and expanded policy frameworks have seen significant improvements in transplantation rates (Lentine et al., 2021).

Multivariate analysis confirmed age, transplant education, referral, and donor availability as independent predictors of KT uptake. Older patients were less likely to undergo transplantation, consistent with literature highlighting clinical hesitancy among elderly candidates (McAdams-DeMarco et al., 2020; Rout et al., 2025). However, recent studies have demonstrated that older recipients can achieve favorable survival outcomes (Heldal et al., 2023; Andres et al., 2023), suggesting that age alone should not limit eligibility. Education from healthcare providers coverage appears to neutralize remained a key determinant, reinforcing findings that structured education improves understanding and decision-making (Nair et al., 2023). Referral also retained its significance, confirming its role as a modifiable determinant of access (Farouk et al., 2020). Donor availability remained the most influential predictor, echoing global evidence on its decisive role in transplantation access (Kazley et al., 2019; Nduati et al., 2022).

In summary, the findings from this study indicate that kidney transplant uptake in Botswana is more strongly shaped by structural and systemic factors than by cultural or attitudinal barriers. Education, referral, and donor availability—factors directly modifiable through healthcare policy and practice—emerged as the most critical determinants. Strengthening patient education, improving referral pathways, and addressing systemic donor constraints are therefore essential strategies for enhancing transplantation access in Botswana and similar low- and middle-income contexts.

## 5. Conclusion

Kidney transplantation uptake among CKD patients on hemodialysis in Gaborone, Botswana, was found to be low (17.8%) despite full government subsidy. The study identified age, education, donor availability, transplant-related education, and referral as the key predictors of uptake. Older age reduced the likelihood of transplantation, while higher educational attainment, structured health education, and timely referral increased it. Donor availability emerged as the most decisive factor, with the majority of patients lacking an identified donor.

These findings demonstrate that low uptake is driven less by cultural or religious resistance and more by systemic and structural barriers within the healthcare system. Addressing gaps in donor availability, strengthening health provider-led education, and streamlining referral pathways are critical for improving access. Ultimately, enhancing health system readiness, rather than changing patient attitudes, holds the greatest potential to increase kidney transplantation uptake in Botswana.

## 6. Recommendations

This study highlights the need for coordinated action at policy, practice, and research levels to strengthen kidney transplantation in Botswana. Policy reforms should expand the donor framework beyond living-related donors to include non-related and deceased donation, supported by ethical and regulatory safeguards. Investment in local transplant infrastructure and stronger integration of transplantation into national health priorities would reduce reliance on external facilities and enhance system readiness. At the practice level, structured provider-led education, standardized referral

pathways, and robust donor counseling are essential to improve patient progression from awareness to uptake. For research, future work should investigate psychosocial and cultural dynamics influencing donation, evaluate the effectiveness of provider-led interventions, and conduct cross-country comparisons within sub-Saharan Africa to identify transferable strategies. Together, these recommendations emphasize that overcoming structural and systemic barriers—rather than changing patient attitudes—is key to improving transplantation uptake in Botswana and other low- and middle-income countries.

## 7. Areas for Further Research

While this study provides important insights into the factors influencing kidney transplantation uptake in Botswana, several areas warrant further investigation. First, qualitative studies are needed to explore in greater depth the lived experiences and perceptions of CKD patients on dialysis regarding kidney transplantation. Such studies would capture nuanced social, cultural, and psychological influences that quantitative surveys may not fully reveal. Second, future research should extend beyond patients to include healthcare providers, whose attitudes, knowledge, and referral practices play a decisive role in shaping transplantation outcomes. Examining both perspectives would provide a more comprehensive understanding of the complex patient–provider dynamics that influence access. Third, longitudinal studies assessing post-transplant outcomes in Botswana are critical to evaluate the sustainability, equity, and quality of transplantation services over time. Evidence on long-term clinical outcomes, psychosocial well-being, and economic impact would inform both policy and practice. Finally, regional comparative research across sub-Saharan Africa could illuminate how variations in health financing, infrastructure, and policy frameworks influence uptake, thereby generating transferable lessons for strengthening transplantation services in other low- and middle-income settings.

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