



Differential Self-Reported Determinants to Antiretroviral Therapy Adherence: Findings from Caregivers of Children Under Five Years Living with Human Immunodeficiency Virus Infection Attending Al-Sabah Hospital, South Sudan

This article was published in the following Dove Press journal:
HIV/AIDS - Research and Palliative Care

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Aim/Objective: This study explored the caregivers' self-reported determinants of antiretroviral therapy (ART) adherence among children under five years living with human immunodeficiency virus (HIV) infection attending Al-Sabah Hospital, South Sudan.

Methods: A cross-sectional study of 126 caregivers of HIV-infected children under five years was conducted at Al-Sabah Hospital, South Sudan. Data were collected using an interviewer-administered questionnaire. The self-reported adherence was measured as a binary variable using binary logistic regression. Only variables that were significant at bivariate analysis were analyzed at multivariate level and interpreted using the odds ratios ($p < 0.05$).

Results: Out of 126 caregivers with HIV-infected children, 38 (30.2%) did not adhere to ART. Of the proportion that adhered to ART (88, 69.8%), 49 (55.7%) were male. Most of the children (52, 59.1%) were above two years, but under five years. Fifty (56.8%) of those who adhered had completed 3 months on ART, and the majority were at WHO stage-1 of HIV infection. Analysis of the determinants indicated that children's duration on ART ($p=0.001$), type of ART regimen (single, double or triple therapy) ($p=0.065$), type of work done by the caregiver to earn a living (p -value 0.003), time a child was initiated on ART ($p=0.002$), caregiver-child relationship ($p=0.002$), caregiver-spousal support ($p=0.019$), type of support obtained whether monetary or not ($p=0.000$), when the child was started on ART ($p=0.004$), the person administering ART ($p=0.010$), the type of ARVs administered ($p=0.001$), the caregiver detecting ART side effects ($p=0.000$), types of adverse effects suffered by the child ($p=0.043$), time of receiving ART ($p=0.047$), use of western medicine ($p=0.043$), healthcare cadre ($p=0.002$), the kind of attention the healthcare provider offered ($p=0.015$), and improvements in quality of HIV services ($p=0.001$) were significantly associated with ART adherence.

Conclusion: The study findings indicated that ART adherence among HIV-infected children under five years was suboptimal. This will necessitate continuous engagement and education of caregivers on the prominence of adhering to ART.

Keywords: ART adherence, children under five, HIV, caregivers, Al-Sabah, South Sudan

Background

Globally, the acquired immunodeficiency syndrome (AIDS) epidemic remains devastating to all age groups. By the end of 2018, there were 37.9 million people globally living with HIV/AIDS (human immunodeficiency virus/acquired immunodeficiency

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syndrome),¹ of which 1.7 million were children under 15 years.¹ In particular, HIV-infection rates remain unacceptably very high in sub-Saharan African countries, where the number of HIV-positive children was reported at 90%.^{1,2} Statistics by UNAIDS-South Sudan³ indicate that a total of 190 000 people were living with HIV, of whom 19,000 people were newly infected. Furthermore, the HIV prevalence among adults (15–49 years) in South Sudan was 2.7% of which 42% of the new infections were in sex workers and children born by HIV-infected mothers which accounted for 15.7%.³ In Comparison with the 95-95-95 targets, in which by 2030, 95% of people living with HIV/AIDS (PLWHA) ought to be aware of their HIV status, 95% of people aware of their HIV status ought to be on treatment; and 95% of people on treatment ought to achieve a virological suppression; attaining the 95-95-95 target in South Sudan means that 85.5% of PLWHA would be on treatment, and 77.1% of them would have to be virally suppressed.³ Astonishingly in 2018, only 24% of the PLWHA in South Sudan knew their status, and 16% were on ART; and treatment for HIV remains low, with 9% of children aged 0–14 years living with HIV were on ART.³ The burden of HIV-infected children under five is high in South Sudan due to inadequate prevention of mother-to-child transmission (PMTCT) interventions.³ By the end of 2018, only 56% of pregnant women living with HIV were enrolled on prophylaxis to PMTCT.³

As a concerted effort to avert AIDS-related deaths, an estimated at 24.5 million people living with HIV globally had access to antiretroviral therapy (ART) by the end of June 2019,¹ however, a very small proportion of these were from South Sudan.³ While 95% ART adherence among people were living with HIV significantly suppresses the HIV virus progression by maintaining a plasma HIV-1 ribose nucleic acid below quantification limits and improves their quality of life,¹ this is maximized by early ART initiation and adherence (defined as: the extent to which a person's behavior related to taking medications corresponds with agreed recommendations from a health care provider).^{5,6} As a major predictor of survival among PLWHA,¹ ART adherence lessens plasma HIV-ribose nucleic acid levels, increases CD4 cell counts, decreases the incidence of opportunistic infections, improves growth and development, and improves the quality of life.^{5,7,8} On the other hand, poor ART adherence is of critical concern, as this is associated with worsened outcomes such as: limited performance (effect) of ART, repeated hospitalization and increased health care costs, as well as aggravated morbidity and mortality.^{7,9}

ART adherence below 95% increases the risk of a patient developing life-threatening conditions such as multidrug-resistant strains which complicates the limited available treatment options, with eventual mortality.² Practically, children under five (0–4 years) present a unique ART adherence challenge as they solely depend on their caregivers; a basis for which the caregiver report has been universally utilized to assess pediatric ART adherence.^{2,5,6} The intricacy of ART adherence in children was even more amplified by the post-conflict era in South Sudan characterized by inadequate healthcare facilities and poor HIV children prevention strategies.³

Despite the scale-up of pediatric ART programs, and proven positive attributes, ART adherence among children under-five remained sub-optimal.^{9–11} This was as a result of many factors which hinged on the child, caregiver(s) and family, regimen, as well as the society and culture.⁸ As there was limited data on ART adherence, and determining factors in South Sudan; we reported on the different caregivers' self-reported determinants of ART adherence among children under five years living with human immunodeficiency virus infection who attended Al-Sabah Hospital.

Methods

Study Area and Setting

The study was carried out at Al-Sabah Hospital, the main children's hospital in Juba state, South Sudan. It is a state and referral children's hospital with a capacity of 144 beds. The hospital is located in Juba, the capital city of South Sudan. South Sudan had a generalized HIV epidemic that was geographically concentrated in the former Equatorial States which comprised an estimated 47% (88,720 people living with HIV) of the National 2018 estimate. Initiated under Country Operational Plan 2017 (COP17), Test and Treat is being implemented in all President's Emergency Plan for AIDS Relief (PEPFAR) intervention sites.³

Study Design

This study followed a cross-sectional study design, between July and October 2019.

Study Population, Sample Size Estimation, Sampling and Recruitment

The study population comprised adult caregivers of HIV-infected children under five years of age, who had consented. We defined a caregiver as a parent, or guardian, or

person who was charged with administering ART medicines to the HIV-positive child. Using the Leslie Kish 1965 formula,¹² a total of 126 caregivers with HIV-infected children were considered sufficient for the study. This study could not carry out sampling because there were few caregivers with HIV-infected children that came for refills at the facility. Inclusion criteria for caregivers with HIV-infected children in the study were those with children that had taken ART for at least 12 weeks, and were aged six to 59 months. Participants were selected on the basis of their ability to understand and communicate in any of the two languages, ie Arabic and English. The study excluded children who were receiving only cotrimoxazole prophylaxis.

Study Variables

The dependent variable was ART adherence which was categorized into two: adhered (self-reported) and non-adhered. ART adherence was defined according to the WHO guidelines,⁵ HIV adherence was based on caregiver self-report of $\geq 95\%$ administered ART, while non-adherence was assessed based on reportedly missed pills that aggregately was less than 95% in the 7 days prior to the date of interview.

Data Collection Tool

Data were collected using an interviewer-administered questionnaire (Figure 1). The questionnaire comprised: demographic characteristics (age, sex); clinical factors (ART regimen, ART side effect, baseline CD4 count, WHO stages, oral therapy, clinical visits and hospital checkup, waiting time and distances); caregivers/family factors (age, gender, education, religious affiliation, occupation and support groups); societal factors (society may support or discourage ART, alternative medicines, discrimination, stigma, social isolation, HIV disclosure). Also, data on the child and caregiver factors; how ART was administered to the child, health facility and societal factors were collected. The research team with the help of the health workers looked at the patients' medical forms to triangulate the information collected through the interview. The questionnaires were in the language of the participants' choice (English or Arabic), and were administered in a suitable private room where the caregivers would talk freely. To enhance the accuracy of the translation, the questionnaire was originally developed in English, then translated into Arabic, and translated back to English. The questionnaire items were reviewed by five experts

on pediatric HIV care who knew both English and Arabic. Also, prior to the commencement of the study, two research assistants proficient in both English and Arabic languages were trained to help selected caregivers understand each question. The questionnaire was pre-tested with the help of 20 caregivers to ensure clarity and accuracy among South Sudanese seeking ART care at Kisugu Health Centre IV, in Kampala (Uganda), and modifications were made to the effect.

Data Collection Process

The caregivers were interviewed on exit from the HIV clinic. The research assistants were positioned at the exit of the HIV clinic and followed the interview protocol procedures to obtain the required information. Information regarding the CD4 cell count, type of ARVs, laboratory and prescriptions given to the child was verified from the child's medical records, while the other information was received for the study participants (caregivers).

Data Management and Analysis

Data were pre-coded and entered using Epi-data and analyzed using SPSS version 21. After univariate analysis, the results were presented using frequencies and percentages. For bivariate analysis, each predictor was cross-tabulated with the dependent variable (ART adherence) to establish possible associations using the chi-square test statistic at a 5% level of significance. For the multivariate level of analysis, the binary logistic regression was used and interpreted using the odds ratios.

Ethics Approval and Consent to Participate

Ethical approval was obtained from Clarke International University. Thereafter, administrative permission was obtained from Al-Sabah Hospital and written informed consent was sought from each caregiver before the questionnaire was administered. This study was conducted in accordance with the Declaration of Helsinki.

Consent forms were translated into the languages of English and Arabic, the language most commonly used then in South Sudan. Consent forms were read aloud to caregivers by trained research assistants. Caregiver participation was strictly voluntary, and caregivers' withdraw did not carry any consequences to their children's ART care. Also, the confidentiality of information, privacy, non-coercion and respect to their autonomy was observed.

QUESTIONNAIRE**Section I: Child (Patient) related factor**

1. Age of the child
2. Gender of child: a) Male b) Female
3. Child duration on ART: a) 3 months b) 4 – 6 months c) 7 - 12 months d) >12 months
4. What is the CD4 T cell count
5. WHO clinical stage: a) Stage 1 b) Stage 2 c) Stage 3 d) Stage 4
6. ARV regimen: a) First line b) Second line

Section II: Mother/Caregiver/family factors

7. Caretaker's age
8. Gender of caretaker: a) Male b) Female
9. Marital status: a) Married b) Single c) Divorced/Separated/widowed
10. Level of education: a) None b) Primary c) Secondary d) Tertiary and above
11. What work do you do to earn living? a) Peasant farmer b) House wife c) Petty trade/business d) Others
12. Relationship to sick child: a) Biological parent b) Other relative
13. What is the average monthly income (SSP)? a) Less than 10000 SSP b) 10001-50000 SSP c) More than 50000 SSP
14. Do you receive any support from spouse/family or relatives to access HIV services? a) Yes b) No
15. What kind of support are given to access HIV care services? a) Monetary support b) Provision of transport (vehicle) c) Spouse support/family member d) Food supplies for the day
16. When the child started taking medication (after detecting HIV)? a) Immediately (one week after) b) Later (more than a month)
17. Are you the one responsible for giving medication to the child? a) Yes c) No
18. If no for question No 18, who give to child the medicine? a) The mother b) The father c) The sibling d) Other relative
19. What formulation of medicine? a) Syrup b) Tablet
20. How many types of medicines? a) One medicine b) Two medicines c) Three medicines
21. How often do you give medication? a) Once a day b) Twice a day c) Three times a day
22. How do you keep the medicine? a) In refrigerator b) Under water pot c) Room temperature d) Others
23. Have you note any adverse effects on your child? a) Yes b) No

Figure I Continued.

24. If yes for question No 24, what are those adverse effects? a) Nausea b) Vomiting c) Rashes
d) Hypersensitivity e) Others
25. What do you do if note adverse effects on your child? a) Stop medication b) Skipping the dose
c) Re-dosing after emesis d) Take child to hospital e) Others
26. What remind you about time of giving medicine to the child? a) Hand watch b) Mobile alarm
c) Others
27. Have you ever missed the dose for your child? a) Yes b) No c) I cannot remember
28. How many time did the child missed the day's dose? a) Once a week b) More than once
- Section III: Healthcare provision factors**
29. Are ARVs available in health facility? a) Yes b) No c) Sometimes
30. How do you access ARVs? a) For free b) For money
31. Have you received any kind of care/support you expected from health facility?
a) Yes b) No
32. If yes to question No 31, mention the kind of care/support you received from health facility (multiple reasons).
a) HIV lab (CD4 and PCR) b) Support for food items c) Vaccination
d) Vitamins e) Others
33. Do you give a child food to be taken with regimen? a) Yes b) No
34. If yes to question No 33, what type of food would you provide to be taken with regimen?
a) Porridge b) Milk c) Lentils d) Fish e) Chicken f) Beans
g) Others
35. Do you always attend in time at health facility for ARVs? a) Yes b) No
36. How far is the nearest health facility from your home a) < 5Km b) > 5Km
37. What mode of transport did you used to reach the health facility? a) On foot/walking
b) Motor cycle c) Public transport d) Private transport
38. How do you rate the waiting time to receive ARVs? a) 30 minutes to 60 minutes
b) >2 - 5 hours c) Above 6 hours
39. In your opinion, what is the attitude of the health care workers during your last visit?
a) Poor b) Good c) Don't know (uncertain) d) Others
40. What kind of healthcare provider would you feel more comfortable to consult for HIV services?
a) Midwife/nurse b) Clinical officer c) Community heather worker d) Doctor
41. How do you rate the attention given to your partner (spouse) by healthcare providers during your last visit for ARVs? a) Don't know/uncertain b) Not satisfactory c) Satisfactory
d) Very satisfactory
42. In your opinion, what do you think are the reasons why most women in your area do not access HIV care services? (multiple responses possible) a) Long waiting time to receive ARVs
b) Poor response from health providers c) Refusal by partner (spouse) d) Poor quality of care services
e) Busy at home and other responsibilities e) Others

Figure 1 Continued.

43. What do you think can be done to improve on the quality of HIV care services in the health facility in your area?
 a) Ensure availability of drugs and lab equipment and lab services b) Ensure availability of healthcare service providers (facilities)
 c) Increase on the number of healthcare personnel
 d) Reduce waiting time to receive services e) Others.

Society and Culture Factors:

44. Do you give your child the medicine in presence of others (strangers, neighbors)? a) Yes b) No
 45. If no to question No 43, then why not? a) Feel a shame b) Stigma c) To avoid isolation. d) Others
 46. In your opinion, what do society support most? a) Western medicine b) Alternative medicine
 c) Both d) Others

Figure 1 Interviewer-administered questionnaire.

Anonymity was ensured by keeping data secure at all times.

Results

The study enrolled 126 caregivers with HIV-infected children. Of these, 69 (54.8%) were male child participants, and 78 (61.9%) of the child participants were aged 2–5 years. The characteristics of the participants are presented in [Table 1](#).

Out of 126 caregivers of HIV-infected children, 38 (30.2%) did not adhere to ART. Of the proportion that adhered to ART (88, 69.8%), 49 (55.7%) were male 11 of the children (12.5%) were below 1-year-old, while 25 (28.4%) were aged between 1 and 2 years, and 52 (59.1%) were between ages of 2–5 years old. With regard to ART duration, 50 (56.8%) of those who adhered had completed 3 months, 7 (8.0%) had spent 4–6 months, 5 (5.7%) had spent 7–12 months and 26 (29.5%) had spent above 12 months. According to WHO clinical staging, 64 (72.7%), 21 (23.9%) and 3 (3.4%) were in stages 1, 2 and 3, respectively. Also, 83 (94.3%) of the children that adhered were on first-line ART regimen, while 5 (5.7%) were on second line. Bivariate analysis showed that: child's duration on ART ($\chi^2=16.970$, $p=0.001$), ARV regimen (single, double or triple therapy) ($\chi^2=3.403$, $p=0.065$) was significantly associated with ART adherence, as given in ([Table 2](#)).

The caregiver factors; most (65, 73.9%) caregivers were housewives, 5 (5.7%) were peasants, 5 (5.7%) were traders, and 13 (14.8%) used other means to earn a living. Seventy-eight (88.6%) of the caregivers earned below 10,000 South Sudan Pound (SSP), while 10 (11.4%) earned between 10,001 and 50,000 SSP. There were 61 (69.3%) caregivers who received support from their

spouse/family in the form of money (55, 90.2%), and food supplies (N=5, 8.2%). Bivariate analysis showed that: type of work done to earn a living ($\chi^2=14.286$, $p=0.003$), time a child was initiated on ART ($\chi^2=9.681$, $p=0.002$), caregiver–child relationship ($\chi^2=9.567$, $p=0.002$), caregiver-spousal support ($\chi^2=5.467$, $p=0.019$), and the type of support ($\chi^2=16.768$, $p=0.000$) were significantly associated with ART adherence, as shown in ([Table 3](#)).

To explore how the medication was administered to children, 72 (81.8%) of the children that adhered had been initiated on ART instantly after diagnosis, while 16 (18.2%) had started a month later. Also, more children (87, 98.9%) had their mothers in charge of medication. All the children who adhered were taking tablets; and ART was given as one type (61, 69.3%), two types (19, 21.6%), or three types (8, 9.1%). Sixteen (18.2%) were on a single daily dose, 65 (73.9%) received a double-dose, and 7 (8.0%) were on triple dose. ART adverse effects were reported to occur among 14 (15.9%), and these manifested as nausea, vomiting, and rashes; which had prompted the caregivers to either skip a day's dose, or take the child to a health facility. Bivariate analysis found that: when the child was started on ART ($\chi^2=9.681$, $p=0.004$), the person administering ART ($\chi^2=11.369$, $p=0.010$), the type of ARVs administered ($\chi^2=13.516$, $p=0.001$), the caregiver detecting ART side effects ($\chi^2=15.956$, $p=0.000$), and types of adverse effects suffered by the child ($\chi^2=10.411$, $p=0.043$) were significantly associated with ART adherence, as presented in ([Table 3](#)).

The health facility factors revealed that caregivers had received ART at no cost, and 34 (38.6%) of the caregivers lived less than 5 Kilometers (Km) from a health facility. More (84, 95.5%) of the caregivers reported a positive

Table 1 Child Characteristics of the Participants

Variables		Frequency	Percentage (%)
Child Characteristics			
Sex	Male	69	54.8
	Female	57	45.2
Age	0–12 Months	15	11.9
	1–2 Years	33	26.2
	2–5 Years	78	61.9
Child duration on ART	3 Months	59	46.8
	4–6 Months	10	7.9
	7–12 Months	15	11.9
	>12 Months	42	33.3
WHO clinical stage	Stage 1	91	72.2
	Stage 2	30	23.8
	Stage 3	5	4.0
ARV regimen	First-line drugs	115	91.3
	Second-line drugs	11	8.7
Caregiver Characteristics			
Sex	Male	7	5.6
	Female	119	94.4
Age	20–24 Years	24	19.0
	25–29 Years	70	55.6
	>30 Years	32	25.4
Marital status	Married	95	75.4
	Single	18	14.3
	Divorced/ Widowed	13	10.3
	Level of education	None	29
	Primary	63	50.0
	Secondary	26	20.6
	Tertiary	8	6.3

attitude towards healthcare providers, and 74 (84.1%) of the caregivers were satisfied with the attention given to their children. Bivariate analysis indicated that: time of receiving ART ($\chi^2= 3.944$, $p=0.047$), healthcare cadre ($\chi^2= 18.227$, $p=0.002$), the kind of attention the healthcare provider offered ($\chi^2= 8.429$, $p=0.015$), and improved quality of HIV services ($\chi^2= 19.049$, $p=0.001$) were significantly associated with ART adherence, as shown in (Table 3). Relatedly, societal and cultural factors indicated that the use of western medicine ($\chi^2=8.176$, $p=0.043$) was key as it showed a statistical association with ART adherence (Table 3). A binary regression model was fitted using

covariates to ascertain the determinants of ART adherence, and this was associated with such factors as the duration a child spent on ART (COR 2.171; 95% CI: 0.758–6.221), first-line ART regimen (COR 2.199; 95% CI: 0.524–9.230), time a child was initiated on ART (COR 2.494; 95% CI: 0.906–6.868), and time a child had spent on ART (COR 2.171–3.793; 95% CI: 0.758–6.221), as shown in (Table 4).

Discussion

This study's findings revealed a 69.8% level of ART adherence among caregivers with HIV-infected children under five years at Al-Sabah children's hospital in Juba State, South Sudan. This value was lower than the 79% that was reported among caregivers of HIV-infected children in Kabale district, Southwestern Uganda,¹³ 88.7% and 93.3% of caregivers reported adherence from Ethiopia.^{14,15} However, it was higher than the 62.5% reported from Tanzania¹¹ while 34.8% was based on unannounced home-based pill count reported from Ethiopia.¹⁴ The high-edge variance was ascribed to the fact that this was caregiver self-reported data. The caregiver self-report was the mostly used ART adherence assessment method for pediatric HIV care in resource-limited settings, it is prone to error compared to pill counts, pharmacy refill and electronic dose monitoring.⁷ At the same time, the obtained self-reported ART adherence was moderate, considering the global concerted target of 95-95-95 strategy. In this fast-tracking end HIV/AIDS strategy by 2030, 95% of people living with HIV ought to know their HIV status; 95% of people who know their status would be initiated on treatment; and 95% of people on treatment would have with suppressed viral loads as a surrogate for optimal ART adherence.¹⁶ Among the non-adhered, caregivers missed hospital appointments and/or their doses because they were unable to raise money for transport fares. This phenomenon was consistent with data that patients on higher incomes had less difficulty with adherence compared to their counterparts with low-income levels.^{5,7} Although ART was given free of charge in South Sudan, socio-economic challenges were still a hindrance to optimal ART adherence.⁷ The barriers to optimal adherence were multifaceted, as previous studies had described,^{13,14,17,18} and obliged urgent and focused attention to improve ART adherence and reduce HIV-associated childhood morbidity and mortality.

Table 2 Child-Related Factors and ART Adherence Among Children

Child-Related Factors	Category	Adhered to ART		χ^2	P-value
		No	Yes		
Sex	Male Female	20(52.6) 18(47.4)	49(55.7) 39(44.3)	0.100	0.846f
Children Age group	<1 Year 1–2 Years >2 Years	4(10.5) 8(21.1) 26(68.4)	11(12.5) 25(28.4) 52(59.1)	1.008	0.604
Child duration on ART	3 Months 4–6 Months 7–12 Months >12 Months	9(23.7) 3(7.9) 10(26.3) 16(42.1)	50(56.8) 7(8.0) 5(5.7) 26(29.5)	16.970	0.001*
WHO stage	Stage 1 Stage 2 Stage 3	27(71.1) 9(23.7) 2(5.3)	64(72.7) 21(23.9) 3(3.4)	0.241	0.887
ART regimen	First-line drugs Second-line drugs	32(84.2) 6(15.8)	83(94.3) 5(5.7)	3.403	0.065

Note: *Significant $p < 0.05$ using the chi-square test.

Abbreviations: ART, antiretroviral therapy; WHO, World Health Organization.

The child-related factors indicated that a child's duration on ART, type of regimen (single, double or triple therapy) were significantly associated with ART adherence. These findings are similar to previous studies.^{14,19} In this context, previous studies indicated that long duration on ART, and multiple dosing that involved unpalatable constitutions affected ART adherence.^{11,20} These factors highlighted the need for a combined well-tolerated therapy in HIV-infected pediatric population.

The caregivers' self-reported factors indicated that type of work done to earn a living, time a child was initiated on ART, caregiver–child relationship, caregiver-spousal support, and the type of support were significantly associated with ART adherence. These factors in tandem reflected a balance between living conditions and caregiving. While it was a well-known phenomenon that households depended on male partners for survival, this had overtime changed with both partners actively contributing to the family survival. We found that as people's health improved on ART, some individuals moved to places far from their ART refill clinics in pursuit of work to earn an income that resulted in missed ART refill appointments. The missed ART refill appointments could be due to either busy work schedules, or lack of transport fares, as described by other studies,^{21,22} and strongly suggested that committed and well-supported

biological caregivers are a key determinant to ART adherence as these experienced a stronger connotation to promote adherence.²³

Medication-related factors indicated that children who were instantly started on ART after diagnosis were twice more likely to adhere than those started later. While various observational studies had been inconsistent in defining the optimal time to initiate ART, there was substantial evidence that early initiation of ART improved survival and delayed disease progression; a gateway to the “test and treat” strategy.²⁴ This contradicted a previous approach where the urgency to initiate ART was greatest for clients with lower CD4 cell counts in whom there was a high risk of opportunistic infections, and non-AIDS morbidity, and mortality.

The health facility factors included the type of health care cadre preferred by the child's caregiver which showed a positive influence on ART adherence, which correlated well with a previous study.²⁵ Further, the caregiver detecting ART side effects, and types of adverse effects suffered by the child affected ART adherence. This finding was similar to previous studies.^{26,27} Additional factors showed that the kind of attention the healthcare provider offered, improved quality of HIV services, and the use of western medicine were pivotal to ART adherence. This was critical as the use of “alternative HIV treatment options” mainly traditional

Table 3 Predictors of ART Adherence Among Children

Caregiver Factors	Category	Adhered to ART		χ^2	P-value
		No	Yes		
Work done to earn a living	House wife	15(39.5)	65(73.9)		
	Petty trade/business	6(15.8)	5(5.7)		
	Others	14(36.8)	13(14.8)		
Relationship with child	Biological parent	34(89.5)	88(100.0)	9.567	0.002*
	Others relative	4(10.5)	0(0.0)		
Average monthly income	<10000SSP	32(84.2)	78(88.6)	0.469	0.563f
	10,001-50000SSP	6(15.8)	10(11.4)	5.467	0.019*
Receiving spousal support	Yes	18(47.4)	61(69.3)		
	No	20(52.6)	27(30.7)		
Type of support received	Monetary support	9(50.0)	55(90.2)	16.768	0.000*
	Spousal support	0(0.0)	1(1.6)		
	Food supplies	9(50.0)	5(8.2)		
When the child started taking ARVs	Immediately	21(55.3)	72(81.8)	9.681	0.002*
	Later (> 1 month)	17(44.7)	16(18.2)		
Medication-Related Factors					
When the child started taking ARVs	Immediately	21(55.3)	72(81.8)	9.681	0.004f
	Later (>1Month)	17(44.7)	16(18.2)		
Caregiver being responsible for the ARVs	Yes	36(94.7)	87(98.9)	1.945	0.216f
	No	2(5.3)	1(1.1)		
Person who gives the child the medicines	Mother	32(84.2)	87(98.9)	11.369	0.010*
	Father	2(5.3)	0(0.0)		
	Sibling	1(2.6)	0(0.0)		
	Other relatives	3(7.9)	1(1.1)		
Form of medication	Syrups	2(5.3)	0(0.0)	4.706	0.089f
	Tablets	36(94.7)	88(100.0)		
Types of medicines	One	13(34.2)	61(69.3)	13.516	0.001*
	Two	18(47.4)	19(21.6)		
	Three	7(18.4)	8(9.1)		
How often is the medication given?	Once a day	6(15.8)	16(18.2)	0.288	0.866
	Twice a day	28(73.7)	65(73.9)		
	Three times a day	4(10.5)	7(8.0)		
How the ARVs are kept	Below the water pot	1(2.6)	2(2.3)	0.015	0.663f
	In the room	37(97.4)	86(97.7)		
Noticed adverse effects	Yes	19(50.0)	14(15.9)	15.956	0.000*f
	No	19(50.0)	74(84.1)		
Adverse side effects (n=33)	Nausea	2(10.5)	0(0.0)	10.411	0.043*
	Vomiting	0(0.0)	4(28.6)		
	Rashes	2(10.5)	4(28.6)		
	Hypersensitivity	1(5.3)	1(7.1)		
	Others	14(73.7)	5(35.7)		

(Continued)

Table 3 (Continued).

Caregiver Factors	Category	Adhered to ART		χ^2	P-value
		No	Yes		
What action was taken when the child had these side effects (n=33)	Skipped dose	1(5.3)	0(0.0)	1.025	0.795
	Took child to clinic	2(10.5)	2(14.3)		
	Others	8(42.1)	7(50.0)		
	Nothing	8(42.1)	5(35.7)		
Reminders about the child's ARV medicines	Wrist watch	2(5.3)	2(2.3)	5.541	0.063
	Mobile phone alarm	19(50.0)	63(71.6)		
	Others	17(44.7)	23(26.1)		
Health Facility Factors					
Paid to access ARVs	No	37(97.4)	88(100.0)	2.334	0.302f
	Yes	1(2.6)	0(0.0)		
Receive ART in time at the health facility	Yes	35(92.1)	87(98.9)	3.944	0.047f
	No	3(7.9)	1(1.1)		
Distance	<5km	11(28.9)	34(38.6)	1.085	0.320f
	>5km	27(71.1)	54(61.4)		
Mode of transport	On foot/walking	4(10.5)	23(26.1)	5.573	0.134
	Motor cycle	0(0.0)	1(1.1)		
	Public transport	34(89.5)	62(70.5)		
	Private transport	0(0.0)	2(2.3)		
Rating time spent at the health facility	30–60 Minutes	37(97.4)	87(98.9)	0.38	0.514f
	1–5 Hours	1(2.6)	1(1.1)		
Attitude of health care provider	Poor	2(5.3)	3(3.4)	0.635	0.728
	Good	35(92.1)	84(95.5)		
	Do not know	1(2.6)	1(1.1)		
Kind of health care provider preferred	Nurse	2(5.3)	1(1.1)	18.227	0.000*
	Clinical officer	11(28.9)	61(69.3)		
	Community HW	3(7.9)	4(4.5)		
	Doctor	22(57.9)	22(25.0)		
Attention given to partner (spouse) by the health workers	Do not know	7(18.4)	5(5.7)	8.429	0.015*
	Satisfactory	31(81.6)	74(84.1)		
	Very satisfactory	0(0.0)	9(10.2)		
What can be done to improve the quality of HIV services offered at Al-Sabah Hospital	Avail ARVs	7(18.4)	2(2.3)	19.049	0.001*
	Avail services	17(44.7)	5(56.8)		
	Avail personnel	7(18.4)	32(36.4)		
	Reduce waiting time	2(5.3)	1(1.1)		
	Others	5(13.2)	3(3.4)		
Societal and Cultural Factors					
Giving the child ART in the presence of others	Yes	5(13.2)	13(14.8)	0.057	0.812f
	No	33(86.8)	75(85.2)		
Why not?	Feel shame	14(36.8)	33(43.4)	6.074	0.108
	Stigma	16(42.1)	36(47.4)		
	To avoid isolation	0(0.0)	2(2.6)		
	Others	8(21.1)	5(6.6)		

(Continued)

Table 3 (Continued).

Caregiver Factors	Category	Adhered to ART		χ^2	P-value
		No	Yes		
In your opinion, what do society support most	Western medicine	32(84.2)	82(93.2)	8.176	0.043*
	Alternative medicine	2(5.3)	2(2.3)		
	Both	4(10.5)	1(1.1)		
	Others	0(0.0)	3(3.4)		

Note: *Significant $p < 0.05$ using the chi-square test.

Abbreviations: ART, antiretroviral therapy; SSP, South Sudan Pound; χ^2 , chi-square; f, Fisher's exact test.

Table 4 Factors Associated with ART Adherence Among Children

Variable	Category	Adhered to ART	
		COR(95% CI)	P-value
Child-related characteristics	Category		
Child duration on ART	< 3 Months	2.171(0.758–6.221)	0.149
	4–6 Months	1.503(0.308–7.322)	0.614
	7–12 Months	0.222(0.058–0.843)	0.027*
	>1 Year		
ART regimen	First-line drugs	2.199(0.524–9.230)	0.282
	Second-line drugs		
Started on ART	Immediately (1 week)	2.494(0.906–6.868)	0.077**
	Later (> 1 month)		
Caregiver factors Receiving spousal support	Yes	2.101(0.811–544)	0.126
	No		

Notes: *Statistically significant at $P < 0.05$. **Statistically significant at $P < 0.10$.

Abbreviation: CI, confidence interval.

concoctions, holy water, as well as prayers as a cure for HIV had been reported from previous studies;^{27-30,31} and such beliefs showed the growing demand for improved healthcare services, as well as addressing societal and culture barriers of ART.

While the findings of this study are valid, they ought to be interpreted with caution due to the following limitations: a) the study was only limited to Al-Sabah Children's Hospital and cannot be generalizable to other health facility, b) also a small

sample size of 126 caregiver–child pair was used, c) the use of caregiver self-report may have overrated ART adherence due to recall bias as well as attempt to impress the interviewer and healthcare providers, d) ART adherence was assessed based on missed doses with no regard of correct timing of medication, e) caregiver self-reported adherence relied on their giving rightful information, f) the reported past 7 days of ART adherence was a short time and may not have correlated well with annual adherence levels, and g) the study only used interview data.

Conclusion

ART adherence among children under five years at Al-Sabah children's hospital was sub-optimal. To these, Interventions to address barriers to ART adherence under HIV-infected children should be integrated into routine HIV-pediatric care in South Sudan.

Abbreviations

ART, antiretroviral therapy; HIV, human immunodeficiency virus; AIDS, acquired immunodeficiency syndrome; PLWHA, people living with HIV/AIDS; OR, odds ratio; ARV, antiretroviral; CI, confidence interval.

Acknowledgments

The authors express our utmost gratitude to our participants who voluntarily responded to our questionnaire, and the research assistants for the field support.

Disclosure

The authors declare no conflict of interest in this work.

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