Original Article

Factors Associated with Outcomes at 1 Year in Paediatric Post-nephrectomy Patients for Nephroblastoma at the University Teaching Hospital and Cancer Diseases Hospital in Lusaka, Zambia

Moonde Zachias Muulu, Bruce Bvulani, Patricia Shinondo[1], Patrick Kaonga[2]

Department of Surgery, University Teaching Hospitals, [1]Department of Surgery, Levy Mwanawasa Hospital, [2]Department of Epidemiology and Biostatistics, University of Zambia, Lusaka, Zambia

Abstract

Background: Nephroblastoma is the most common primary malignant renal tumour of childhood. The survival rates in high-income countries are approximately 90%. However, low-income countries have low survival rates of 20%–50%. This study assessed factors associated with treatment outcomes of children post-nephrectomy for nephroblastoma at the University Teaching Hospital and Cancer Diseases Hospital in Lusaka, Zambia. **Materials and Methods:** A retrospective observational cohort study was conducted, where all children diagnosed with unilateral Wilms tumour below the age of 16 years who had nephrectomy from July 2016 to June 2019 were enrolled. Sociodemographic, clinical characteristics and treatment outcomes were noted. All data were coded and stored in a tabular format using Microsoft Excel. Statistical software STATA version 13 was used for analysis. **Results:** Thirty patients were enrolled. The male-to-female ratio was 1:1. The 1-year event-free survival was 46.7%. Treatment abandonment accounted for 36.6% of the participants. 16.7% of the patients had disease progression. No patient had a relapse or died during the 1-year follow-up period. 66.7% had advanced disease stages III and IV. Advancement in age (above 4.3 years), living in a rural environment more than 100 km away from Lusaka and advanced disease stage were all associated with a poor outcome. **Conclusions:** Factors associated with a poor outcome in this study were advanced age and late presentation.

Keywords: Disease progression, nephrectomy, nephroblastoma, relapse, treatment abandonment

Introduction

Nephroblastoma is the most common primary malignant renal tumour of childhood and comprises 6% of all paediatric tumours;[1] it remained the most common paediatric cancer seen in Zambia as reflected in Figure 1. The survival rates in high-income countries are approximately 90%, while low-income countries have 20%–50%.[2]

It was, therefore, the aim of this study to assess the factors associated with treatment outcomes of children post-nephrectomy for nephroblastoma at the University Teaching Hospital (UTH). Hopefully, this would provide the needed local data and help in recognising any modifiable factors to improve treatment outcomes.

Received: 31-12-2021 **Revised:** 08-03-2022 **Accepted:** 20-07-2023 **Available Online:** 09-08-2024

Access this article online

Quick Response Code:

Website: https://journals.lww.com/AJPS

DOI: 10.4103/ajps.ajps_180_21

Materials and Methods

Setting

The study was conducted at the UTH and the Cancer Diseases Hospital (CDH) in Lusaka, Zambia. Patients with nephroblastoma (Wilms tumour) in Zambia are treated according to a protocol modelled on the Société Internationale d'Oncologie Pédiatrique (SIOP) approach. Treatment is started after imaging through a computed tomography scan or ultrasound confirms an intrarenal tumour. Patients

Address for correspondence: Dr. Moonde Zachias Muulu, University Teaching Hospitals, P/Bag RW1X, Lusaka, Zambia.
E-mail: moondezmuulu@gmail.com

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow_reprints@wolterskluwer.com

How to cite this article: Muulu MZ, Bvulani B, Shinondo P, Kaonga P. Factors associated with outcomes at 1 year in paediatric post-nephrectomy patients for nephroblastoma at the University Teaching Hospital and Cancer Diseases Hospital in Lusaka, Zambia. Afr J Paediatr Surg 2024;21:172-7.

receive neoadjuvant chemotherapy from CDH for 4–9 weeks determined by the extent of the tumour. Surgery is then conducted from the Paediatric Surgery Block at the UTH. Disease staging is performed intraoperatively, and this guides the decision on post-operative treatment which would take 4–15 weeks. In this phase, some patients continue with chemotherapy, while others also receive radiotherapy. During this long period of treatment, food and shelter are freely provided to the patients and parents/guardians. This is done by CDH in collaboration with Kayula Foundation, which was established by the parents to one of the patients who was once managed at this institution.

Study design

A retrospective observational cohort study was conducted, where all children diagnosed with unilateral Wilms tumour below the age of 16 years, who had nephrectomy during 3 years (July 2016 to June 2019), were enrolled. Data were collected for 8 consecutive months after approval from the University of Zambia Biomedical Research Ethics Committee (Ref. No. 521–2019) and permission from the management of the UTH and CDH. All patient records were protected and kept confidential as stipulated in the Health Professions Act. No 24 of 2009 of Zambia.

The inclusion criterion was all children diagnosed with nephroblastoma below the age of 16 years, who had nephrectomy from July 2016 to June 2019, and the exclusion criterion included patients who had nephrectomy for recurrent Wilms tumour or those with bilateral Wilms tumour as these patients undergo a completely different surgical approach during treatment (nephron-sparing approach).

The total enumerative sampling was used, i.e. all patients meeting the inclusion criterion were enrolled. Data were obtained from the notes in the patients' files, from results obtained during investigations and from intraoperative findings using a structured data collection form.

The independent study variables collected included age, gender, residence, date of diagnosis, duration of symptoms, distance of residence to the UTH, disease stage at the time of diagnosis, time from diagnosis to surgery and duration of pre-operative and post-operative chemotherapy. Outcome variables were categorical and included death, abandonment of treatment, progressive disease, relapse, event-free survival and 1-year overall survival. Abandonment of treatment was defined as not continuing planned treatment during four or more sequential weeks.[3] Where necessary, the next of kin was contacted to ascertain that the patient was still alive. The study endpoint was a 1-year outcome.

Data analysis

All data were coded and stored in a tabular format using Microsoft Excel and stored in Microsoft Excel and exported to STATA version 13 (Stata Corp., College Station, Texas, USA) for analysis.

Continuous variables, for example, age at diagnosis and duration of symptoms, were summarised using means and medians, while categorical data such as gender and disease stage were summarised using percentages. For further analysis on outcomes, cases with stage I and II disease were grouped into low-stage and those with stage III and IV disease into high-stage groups.

A patient's residence was used to determine the distance from the UTH, which was subsequently categorised into the distance of 100 km or less, or more than 100 km.

The outcome variables were further stratified into either good outcome or poor outcome. A 1-year event-free survival was identified as a good outcome, while death, abandonment of treatment, disease progression and relapse were identified as a poor outcome.

Against these two outcomes, continuous variables were compared using the *t*-test for parametric data and the Wilcoxon test for non-parametric data.

On the other hand, categorical data summarised as percentages were compared with the two outcome groups using the Pearson Chi-square test or Fisher's exact test as appropriate.

This helped to establish an association, if any, between patient factors and observed outcomes. $P < 0.05$ was considered statistically significant.

Results

Sociodemographic data

During the 3 years from July 2016 to June 2019, a total of 30 patients had nephrectomy for nephroblastoma and were enrolled in this study. The mean age at presentation to the UTH was 5.0 (±3.0 standard deviation [SD]) years. There was an equal distribution of males and females. Most of these patients were coming from outside Lusaka, accounting for 73.4% of the study participants, and 70% of the referring hospitals were located in urban towns.

Clinical characteristics

Before patients could be referred to the study centre, they lived with symptoms for a mean duration of 2.8 (±1.7 SD) months, either at home or at their primary health centres, as shown in Table 1. The most common symptom was an abdominal mass, present in 28/30 (93.3%) study participants. This was associated with abdominal pain in 30.0% of cases. Only 30.0% of the study participants had anaemia, and 16.7% presented with haematuria. Most of the study participants were well nourished as only 10% presented with malnutrition.

Once the diagnosis of nephroblastoma was made at the study site, patients were commenced on neoadjuvant chemotherapy from CDH after 10.2 (±6.0 SD) days, a treatment that would last for a mean duration of 7.9 (±7.6 SD) weeks before surgery. On average, this represented 14.7 (±10.1 SD) weeks from the date of diagnosis.

The surgeries were conducted from the Paediatric Surgical Unit at the UTH, necessitating a transfer of the patients between the

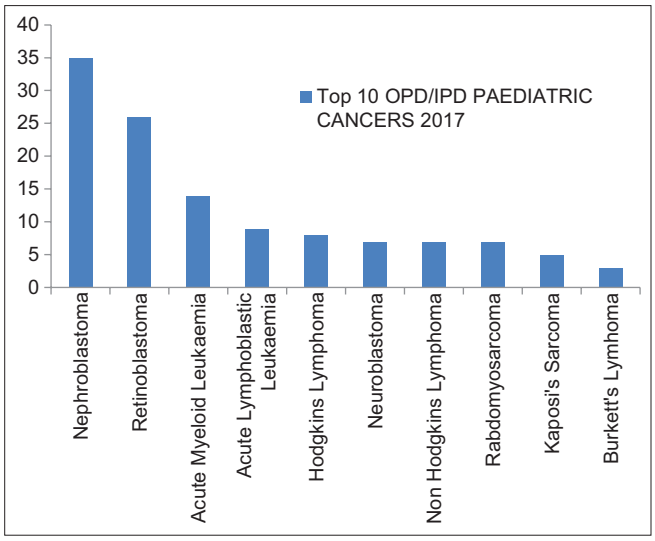


Figure 1: Top 10 outpatient department/inpatient department paediatric cancers (Health Management Information System Cancer Diseases Hospital, 2019)

two institutions. Patients would remain in this unit undergoing post-operative care for 12.8 (±7.6 SD) days before going back to CDH to continue their chemotherapy for another 5.1 (±2.9 SD) weeks.

Most of our patients presented to the study site with advanced disease stage. Only 13.3% had stage I disease, 20.0% had stage II disease, while 66.7% either had stage III or IV disease.

Fortunately, 78.9% of patients who were able to obtain a histological diagnosis of their cancer had a favourable/low-risk type of malignancy. Only 6.7% were diagnosed with an unfavourable/high-risk cancer. Regrettably, 11–30 (36.6%) patients did not have a histological diagnosis of their malignancy. Most of these were patients who abandoned treatment and could have been lost to follow-up.

In addition to chemotherapy, 21–30 (70%) patients needed radiotherapy for their treatment regimen. 42.9% received this treatment, while 57.1% did not receive radiotherapy for various reasons, including failed simulation due to very young age and treatment abandonment.

Treatment outcomes

Table 2 shows the treatment outcomes of our study participants after a follow-up period of 1 year. The 1-year event-free survival was 46.7%. Treatment abandonment was the most common poor outcome. No patient had a relapse or died during the 1-year follow-up period.

The study participants who had a good outcome were relatively younger at diagnosis, 4.3 (±2.5 SD years), compared to those with a poor outcome, 5.7 (±3.3 SD years), $P = 0.23$. Females had a better outcome than boys (57.1% and 42.9%, respectively); however, this was not statistically significant. Patients referred from urban hospitals accounted for most of the survivors (85.7%). The study participants who lived closer to the study site were more likely to have a good outcome than those living more than 100 km away ($P = 0.28$).

Table 1: Baseline clinical characteristics of the study participants with nephroblastoma ($n=30$)

Characteristic		Mean (SD)
Duration of symptoms, months (±SD)		2.8 (±1.7)
Days from diagnosis to the start of chemotherapy (±SD)		10.2 (±6.0)
Duration of pre-operative chemotherapy, weeks (±SD)		7.9 (±7.6)
Time from diagnosis to surgery, weeks (±SD)		14.7 (±10.1)
Days from surgery to the start of post-operative chemotherapy (±SD)		12.8 (±7.6)
Duration of post-operative chemotherapy, weeks (±SD)		5.1 (±2.9)
Characteristic	**Category**	**Proportion, *n* (%)**
Disease stage	Stage I	4 (13.3)
	Stage II	6 (20.0)
	Stage III	14 (46.7)
	Stage IV	6 (20.0)
Histology type	Not available	11 (36.6)
	Favourable/low risk	15 (50.0)
	Intermediate risk	2 (6.7)
	Unfavourable/high risk	2 (6.7)
Radiotherapy	Not required	9 (30.0)
	Required and given	9 (30.0)
	Required, but not given	12 (40.0)

SD: Standard deviation

Table 2: Treatment outcomes of the study participants with nephroblastoma at 1 year ($n=30$)

Treatment outcome	Category	Proportion, *n* (%)
Good outcome	1-year event-free survival	14 (46.7)
Poor outcome	Disease relapse/recurrence	0
	Disease progression	5 (16.7)
	Treatment abandoned	11 (36.6)
	Death	0

The association between treatment outcomes and patients' clinical characteristics is shown in Table 3. There was no statistically significant difference observed in the time taken to commence various treatment modalities or duration of treatment amongst those with good and poor treatment outcomes. The late stage was predictive of a poor outcome with $P = 0.07$.

A univariate logistic analysis was conducted for the association between treatment outcomes and the participants' sociodemographic and clinical characteristics. In this study, an increase in age by 1 year was associated with an 18% risk of having a poor outcome (95% confidence interval [CI]: 0.89–1.56; $P = 0.231$). The odds of females compared to males developing a poor outcome were 0.58 lower (95% CI: 0.14–2.48; $P = 0.466$). Patients referred from places that are more than 100 km away from the UTH were more likely to have a poor

Table 3: Association between clinical characteristics and treatment outcomes

Characteristic	Good outcome	Poor outcome	*P*
Days from diagnosis to the start of chemotherapy (±SD)	10.4 (±6.8)	10.1 (±5.5)	0.88
Duration of pre-operative chemotherapy, weeks (±SD)	7.5 (±5.6)	8.3 (±9.6)	
Time from diagnosis to surgery, weeks (±SD)	13.9 (±8.4)	15.5 (±11.7)	
Days from surgery to post-operative chemotherapy (±SD)	11.9 (±5.7)	13.5 (±9.1)	
Duration of post-operative chemotherapy, weeks (±SD)	6.3 (±2.5)	4 (±2.9)	
Disease stage, *n* (%)			
I	4 (28.6)	0	0.07
II	2 (14.3)	4 (25.0)	
III	7 (50.0)	7 (43.7)	
IV	1 (7.1)	5 (31.3)	
Histology type, *n* (%)			
Not available	2 (14.3)	9 (56.3)	0.07
Favourable/low risk	9 (64.3)	6 (37.5)	
Intermediate risk	2 (14.3)	0	
Unfavourable/high risk	1 (7.1)	1 (6.2)	
Radiotherapy, *n* (%)			
Required and given	4 (50.0)	5 (38.5)	0.60
Required, but not given	4 (50.0)	8 (61.5)	

SD: Standard deviation

outcome with a crude odds ratio of 2.04 (95% CI: 0.38–10.94; $P = 0.407$). Similarly, the odds of those referred from rural hospitals compared to urban hospitals for developing poor outcomes were as high as 4.67 (95% CI: 0.78–28.05; $P = 0.092$).

An increase in the duration of symptoms by 1 month before the diagnosis of nephroblastoma is made was associated with an 18% increased risk of having a poor outcome (95% CI: 0.75–1.88; $P = 0.474$). The study also revealed consistency on the time taken to commence patients on chemotherapy and to have a nephrectomy performed (crude odds ratio [COR]: 0.99; 95% CI: 0.88–1.12; $P = 0.869$ and COR: 1.02; 95% CI: 0.94–1.10; $P = 0.654$, respectively) in both study arms. The odds of late-stage disease patients compared to those with early-stage disease developing a poor outcome were as high as 2.25 (95% CI: 0.48–10.60; $P = 0.305$). Similarly, patients who needed radiotherapy but failed to have this treatment modality were 98% more likely to develop a poor outcome (95% CI: 0.80–4.93; $P = 0.142$).

Discussion

Baseline patient characteristics

A total of 30 patients were included in the study. This was a relatively high number for a malignancy that has a low incidence of 7.6/million in Western countries, but tallies well with the report by George that nephroblastoma is more common in African children.[4] In Canada, Pianezza *et al*. reported on 40 patients over 12 years, but Njuguna *et al*., in 2017, reported on 39 patients in Kenya over 3 years and Wilde had 40 in 6 years in Malawi. The male-to-female ratio was 1:1, similar to other regions in Africa.[5-7]

73.4% of the study participants were coming from outside the capital city, Lusaka. This may be explained by the fact that CDH is the only government institution offering chemotherapy in Zambia. The mean age at diagnosis was 5.0 (±3.0 SD) years. This was higher than the mean age of 3.0 years documented for developed countries,[1] which may be explained by challenges in referring patients and poor health-seeking behaviour. It is possible that urban hospitals have better access to imaging modalities and well-outlined referral systems as they accounted for 70% of all patients who were received at the study centre.

The most common symptom, present in almost all the study participants (93.3%), was an abdominal mass similar to a report of 91% by Verma and Kumar in India.[8] This was associated with abdominal pain in only 30.0% of cases. The fact that 70% of the patients were pain free and able to go about routine activities may explain the observed delay of 2.8 (±1.7 SD) months before being seen at the tertiary hospitals.

Most of our patients presented to the study site with advanced disease stage. 33.3% had a low disease stage (Stage I and II), while 66.7% either had stage III or IV disease. This is expected to be a direct result of late presentation and delay in diagnosis. The outlook was similar to most developing countries that only saw between 21% and 30% of Stage I and II disease but as high as 78% of advanced cases.[8,9] On the other hand, developed countries would receive as high as 60%–90% early-stage disease.[6,10]

78.9% of patients who were able to obtain a histological diagnosis of their cancer had a favourable/low-risk type of malignancy. Only 6.7% were diagnosed with an unfavourable/high-risk cancer. This was not in keeping with the SIOP study, which reported that only 6.6% of tumours were completely necrotic (favourable/low risk) post-chemotherapy. The classification system for tumours not exposed to chemotherapy revealed that 90% of unilateral Wilms have a favourable

histology type.[1] It is possible that the observed difference may have resulted from the use of an alternative classification system in histological reporting. It is, therefore, important that pathologists are informed whether or not a patient had chemotherapy before nephrectomy.

Treatment outcomes at 1 year

The 1-year event-free survival was 46.7%. This was consistent with findings in other low-income countries across the globe with survival rates between 20% and 50%.[2] Particularly, in Southern Africa, the survival rates range between 25% and 53% for almost all institutions.[5,11] Our event-free survival was much lower than the 64.9% reported from Zimbabwe and the 73% in the resource-limited Indian scenario.[8,12] The two institutions attributed their better outcomes to a multimodal and an effective multidisciplinary approach, respectively.

Treatment abandonment was the most common poor outcome accounting for 36.6% of the participants. In Kenya, abandonment of treatment was also the most common cause of treatment failure accounting for 31% of cases.[5] At Queen Elizabeth Hospital in Malawi, only 15% of the patients completed their post-operative course of chemotherapy,[7] while only four out of 37 enrolled patients in Sudan completed treatment.[9] While only 15% and 10.8% of patients completed treatment in Malawi and Sudan, respectively, our study reviewed a much higher percentage of 63.4%. This may have resulted from the provision of free accommodation and food to patients during their long stay in the hospital at CDH and Kayula Foundation in contrast to what was reported from other institutions.

16.7% of the patients had disease progression. All of them had advanced disease at the time of diagnosis. Two patients had stage III disease, while three had stage IV disease.

No patient had a relapse or died during the 1-year follow-up period. As a result, only two poor outcomes were observed, i.e. treatment abandonment and disease progression. This is in contrast to the 41.7% of patients who had a relapse in 1 year reported by Wilde in Malawi.[7] It is important to note that of all patients who completed treatment in this study, 73.7% had an event-free survival at 1 year. For this reason, efforts to have patients complete their treatment plan need to continue being enforced.

Factors associated with treatment outcomes

This study considered multiple sociodemographic and clinical characteristics of the participants in an effort to identify factors that were associated with either good or poor treatment outcomes in Zambia.

The study participants who had a good outcome were relatively younger at diagnosis (4.3 ± 2.5 SD years) compared to those with a poor outcome (5.7 ± 3.3 SD years). However, this did not reach statistical significance ($P = 0.23$). This was consistent with findings in Kenya on 39 patients that age at diagnosis did not significantly influence treatment outcomes or event-free survival estimates.[5] However, a study by the United Kingdom Children's Cancer Study Group on Wilms tumour in 2003 declared that the age of at least 4 years is a significant adverse prognostic factor.[13] These variations may be attributed to differences in the sample size between studies.

Although not significant on regression analysis, females had a better outcome than boys (57.1% and 42.9%, respectively, $P = 0.46$). Sex has not been known to have any significant impact on survival in Wilms tumour.[14]

The study participants who lived closer to the study site were more likely to have a good outcome than those living more than 100 km away ($P = 0.28$), and patients referred from urban hospitals accounted for most of the survivors (85.7%). This was directly related to how soon they presented to the study site after the onset of symptoms. Only 42% of patients living more than 100 km from Lusaka presented within the first 2 months of symptoms; however, 70% of those within a radius of 100 km were seen within 2 months.

This study showed that the late stage was predictive of a poor outcome with $P = 0.07$ due to a small sample size. All patients with disease stage I had an event-free survival consistent with findings in Japan that an initial complete resection followed by standard post-operative chemotherapy substantially improved the outcome of the patients with a 5-year overall survival rate of 90.0%.[15] Stage III and IV disease accounted for 75.5% of all poor outcomes. The disease stage has consistently been identified to have a significant impact on treatment outcomes.[15,16]

Not all patients in our study had a histological diagnosis of their malignancy (36.7%). Most of them abandoned treatment and were, therefore, lost to follow-up. Efforts to identify ways of ensuring that all patients obtain a histological diagnosis of their malignancy are highly recommended.

Radiotherapy is needed to reduce the relapse rate in patients with stage III disease.[17] In our study, patients with advanced disease stage who needed radiotherapy and did not receive this treatment were more likely to have a poor outcome (61.5%) compared to those who received it (38.5%); however, this did not reach statistical significance. This was in keeping with findings by Stokes that there was no significant association between surgery to radiation therapy interval and mortality amongst patients with metastasis.[18] In this study, 30% of advanced cases had metastases and could, therefore, explain poor responses to treatment.

With regard to the initiation and duration of various treatment modalities, including chemotherapy, surgery and radiotherapy, there was no statistically significant difference observed amongst those with good and poor treatment outcomes ($P = 0.88$). This may be a result of the enforcement of a clear written protocol on the management of patients with nephroblastoma at the study site. This must be encouraged as delays in implementing therapy have consistently been identified to negatively impact the treatment outcomes.[18]

Summary

In summary, the 1-year event-free survival was 46.7%. Advancement in age (above 4.3 years), living in a rural environment more than 100 km away from Lusaka and advanced disease stage were all associated with a poor outcome. Patient's sex and radiotherapy in advanced cases did not have an impact on treatment outcomes in this study.

Acknowledgement

Special thanks to the faculty of the Department of Surgery, UTH, and the management of both the Cancer Diseases Hospital and University Teaching Hospitals for allowing this study to be conducted at their institutions.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Coran AG, Adzick NS, Krummel TM, Laberge JM, Caldamone A, Shamberger R. *et al.* Pediatric Surgery. 7th ed. Philadelphia: Elsevier Saunders PA; 2012. P 424.
2. Gleason JM, Lorenzo AJ, Bowlin PR, Koyle MA. Innovations in the management of Wilms' tumor. Ther Adv Urol 2014;6:165-76.
3. Mostert S, Arora RS, Arreola M, Bagai P, Friedrich P, Gupta S, *et al.* Abandonment of treatment for childhood cancer: Position statement of a SIOP PODC working group. Lancet Oncol 2011;12:719-20.
4. Holcomb GW III. Ashcraft's Paediatric Surgery. London, New York, Oxford, Philadelphia, St Louis, Sydney, Toronto: Elsevier Saunders; 2014. P 860
5. Njuguna F, Martijn HA, Kuremu RT, Saula P, Kirtika P, Olbara G, *et al.* Wilms tumor treatment outcomes: Perspectives from a low-income setting. J Glob Oncol 2017;3:555-62.
6. Pianezza ML, Rubin S, Bass J, Chou S, Pike JG, Leonard MP. Wilms' tumor at the children's hospital of Eastern Ontario: 1990-2001. Can J Urol 2004;11:2151-6.
7. Wilde JC, Lameris W, van Hasselt EH, Molyneux EM, Heij HA, Borgstein EG. Challenges and outcome of Wilms' tumour management in a resource-constrained setting. Afr J Paediatr Surg 2010;7:159-62.
8. Verma N, Kumar A. Clinicoepidemiological profile and outcome of children with Wilms tumor in a developing country. J Pediatr Hematol Oncol 2016;38:e213-6.
9. Abuidris DO, Elimam ME, Nugud FM, Elgaili EM, Ahmed ME, Arora RS. Wilms tumour in Sudan. Pediatr Blood Cancer 2008;50:1135-7.
10. Reinhard H, Semler O, Bürger D, Bode U, Flentje M, Göbel U, *et al.* Results of the SIOP 93-01/GPOH trial and study for the treatment of patients with unilateral nonmetastatic Wilms tumor. Klin Padiatr 2004;216:132-40.
11. Israels T, Borgstein E, Pidini D, Chagaluka G, de Kraker J, Kamiza S, *et al.* Management of children with a Wilms tumor in Malawi, sub-Saharan Africa. J Pediatr Hematol Oncol 2012;34:606-10.
12. Nkrumah FK, Danzo AK, Kumar R. Wilms' tumour (nephroblastoma) in Zimbabwe. Ann Trop Paediatr 1989;9:89-92.
13. Pritchard-Jones K, Kelsey A, Vujanic G, Imeson J, Hutton C, Mitchell C, *et al.* Older age is an adverse prognostic factor in stage I, favorable histology Wilms' tumor treated with vincristine monochemotherapy: A study by the United Kingdom children's cancer study group, Wilm's tumor working group. J Clin Oncol 2003;21:3269-75.
14. Yao W, Li K, Xiao X, Gao J, Dong K, Xiao X, *et al.* Outcomes of Wilms' tumor in Eastern China: 10 years of experience at a single center. J Invest Surg 2012;25:181-5.
15. Suita S, Kinoshita Y, Tajiri T, Hara T, Tsuneyoshi M, Mizote H, *et al.* Clinical characteristics and outcome of Wilms tumors with a favorable histology in Japan: A report from the study group for pediatric solid malignant tumors in the Kyushu Area, Japan. J Pediatr Surg 2006;41:1501-5.
16. Sangkhathat S, Chotsampancharaen T, Kayasut K, Patrapinyokul S, Chiengkriwate P, Kitichet R, *et al.* Outcomes of pediatric nephroblastoma in Southern Thailand. Asian Pac J Cancer Prev 2008;9:643-7.
17. Yao AJ, Moreira C, Traoré F, Kaboret S, Pondy A, Rakotomahefa Narison ML, *et al.* Treatment of Wilms tumor in Sub-Saharan Africa: Results of the second French African pediatric oncology group study. J Glob Oncol 2019;5:1-8.
18. Stokes CL, Stokes WA, Kalapurakal JA, Paulino AC, Cost NG, Cost CR, *et al.* Timing of radiation therapy in pediatric Wilms tumor: A report from the national cancer database. Int J Radiat Oncol Biol Phys 2018;101:453-61.