PREVALENCE AND INCIDENCE OF CLINICALLY RECOGNIZED CASES OF TYPE 1 DIABETES IN CHILDREN AND ADOLESCENTS IN RWANDA, AFRICA

Running Head: T1D Incidence and Prevalence in Rwanda

Sara L. Marshall, MPH[1], Deborah Edidin, MD[4], Vincent C. Arena, PhD[2], Dorothy J. Becker, M.B.B.Ch.[3], Clareann H. Bunker, PhD[1], Crispin Gishoma[6], Francois Gishoma[6], Ronald E. LaPorte, PhD[1], Vedaste Kaberuka[6], Graham Ogle, MBBS[5], Laurien Sibomana, MS[1], Trevor J. Orchard, MBBCH, MMedSci[1] **

[1] University of Pittsburgh Graduate School of Public Health, Department of Epidemiology, Pittsburgh, PA, USA

[2] University of Pittsburgh Graduate School of Public Health, Department of Biostatistics, Pittsburgh, PA, USA

[3] University of Pittsburgh School of Medicine, Department of Pediatrics, Pittsburgh, PA, USA

[4] Northwestern University, Feinberg School of Medicine, Pediatrics, Chicago, IL, USA

[5] International Diabetes Federation Life for a Child Program and HOPE *worldwide* (Australia), Sydney, NSW, Australia

[6] Association Rwandaise des Diabetiques, Kigali, Rwanda

**Corresponding Author – email: OrchardT@edc.pitt.edu

Word Count: 2,996

ABSTRACT

AIMS: To determine prevalence and incidence estimates for documented (clinically recognized) cases of type 1 diabetes (T1D) in the Life For a Child Program (LFAC) (with onset $\leq$25 years) from six representative districts and the capital of Rwanda.

METHODS: Cases were identified from the LFAC/ARD registry and visits to district hospitals. Denominators were calculated from district level population surveys. Period prevalence data were collected from August 1, 2011 through July 31, 2012 and annual incidence rates were calculated, retrospectively, from 2004-2011. 95% confidence intervals were calculated using a Poisson distribution.

RESULTS: The prevalence of known T1D in seven districts in Rwanda for ages 0-25 years was 16.4 [14.6-18.4]/100,000 (0-15 years 4.7[3.5-6.1]/100,000), which was significantly lower than other regional reports. Prevalence was higher in females (18.5[15.8-21.4]/100,000) than males (14.1[11.8-16.7]/100,000; P = 0.01) and rates increased with age. The annual incidence rate ranged from 0.79 [0.4-1.4]/100,000 in 2004 to 2.7[2.0-3.6] /100,000 in 2010, a 4 fold increase. Incidence rates were higher in females than males.

CONCLUSIONS: Our report of known cases of T1D shows lower rates in Rwanda than the US and the limited data from other African Countries. Incidence of recognized cases has increased over time, but has recently stabilized. However, the likelihood of missed cases due to death before diagnosis and misdiagnosis is high and therefore more definitive studies are needed.

INTRODUCTION

An estimated 18.7million people in sub-Saharan Africa will be affected by diabetes by 2025.[1] Type 1 diabetes (T1D) is one of the most frequently seen non-communicable disease (NCD) in children and should therefore be of great and increasing importance to public health officials [2], especially those in developing countries where access to insulin is low.[3]

Unfortunately the true burden of diabetes in Africa is not clear, as there are currently very few prevalence and incidence studies, especially of T1D in children and adolescents. Only three prevalence studies[4–6] and five incidence surveys[5,7–10] focus on T1D in this age range, and none within the last 10 years. The prevalence rates in these countries range from 27/100,000 in Algeria (for ages 0-15 years),[5] to 95/100,000 in Sudan (for ages 7-14 years),[4] and incidence ranges from 1.5/100,000 in Tanzania (ages 0-19 years),[8] to 10.1/100,000 in Sudan (ages 0-15 years),[7] highlighting the geographic variation in these rates.

There have been no such studies in the country of Rwanda, even though diabetes awareness and support has increased in recent years.[11] Prevalence estimates that have been previously reported for Rwanda are extrapolated from studies from "similar" populations, but most likely results in inaccurate rates of T1D.[1]

In Rwanda, there are 41 district hospitals and 400 health centers with 0.05 physicians and 0.42 nurses per 1,000 citizens.[12] Specialized diabetes care and supplies are often not available. To address this gap, the International Diabetes Federation's Life For a Child (LFAC) program, which is managed by the Australian Diabetes Council and HOPE *worldwide*, has been working since 2004 with the Association Rwandaise des Diabetiques (ARD), by donating insulin, glucose monitoring supplies, education materials, and specialist training. Due to the overall limited

access to insulin and prohibitively high prices, almost all diabetes cases are referred to the ARD for assistance. The ARD currently provides care to patients in Kigali and over half of the district hospitals in Rwanda.

To assist in closing this gap in prevalence and incidence knowledge, yet recognizing this report is not a full epidemiologic study, we present prevalence and incidence estimates for documented (clinically recognized) cases of T1D in youth and adolescents (≤25 years) from six representative districts and the capital, Kigali City, of Rwanda. We also compare these rates to those of other countries from the region and the US.

METHODS

This project has been determined to be exempt from ethical review by the IRB due to consisting of "Existing Data."

Study Population

All participants are registered in the Rwanda LFAC program. Participants were citizens of Rwanda aged ≤ 25 years needing assistance with obtaining insulin and other diabetes supplies.

Selection of Districts

Districts were selected on: ability to enumerate the ≤ 25 year population, had at least one district hospital where diabetes patients would receive care, and currently being serviced by the ARD/LFAC program. Table 1 lists the selected districts and their hospitals.

Case Ascertainment

Cases were identified from the LFAC registry and data collected on visits to the selected hospitals. Age, date of birth, date of diagnosis and district of residence were extracted from LFAC clinical charts. We believe all sources of insulin were covered (primarily ARD and district hospitals), excluding only those who obtained insulin from outside of the country, a practice we believe to be minimal. Unfortunately, hospitals do not keep records on diagnosed T1D cases. Capture/recapture was not therefore possible as no other secondary source was identified. Yearly incidence estimates were based on self/family reported year of diagnosis and was not verifiable by hospital or other medical records.

Overlapping catchment

To maximize case identification, we also visited hospitals from neighboring districts. Only patients who physically lived in a district of interest (or lived there when they developed diabetes) were included.

Population denominators

In 2006 Rwanda underwent a district re-alignment and the country is now divided into 4 Provinces plus Kigali City, 30 Districts, 416 Sectors, 2,148 Cells, and 14,837 Villages. To account for the new division of the population, a census/survey was initiated for each district in 2006.[13]

The population of each District was reported in 5 year age groups (ex. 0, 1-4, 5-9, 10–14, etc.). Therefore, we summed the 0-24 year age ranges, and then to account for those aged 25 years, we calculated the number of 25-29 year olds that were 25 years using the percentage (23%) of 25-29 year olds that were 25 years in the Population Projection data.[14]

No data were available for the Eastern Province (Rwamagana) from this survey; however, the local government performed their own mini-census.[15] Population data were also presented in age groups, however these were not as uniform (<1, 1-5, 6-13, and 14-35). To account for this, we summed the population counts for 0-13 years and then calculated the number of those who were 14-25 years from the 14-35 year age group, again using the appropriate percentage (46%) from the Population Projection data.[14,15]

The calculated populations for 2006 were then used as a base for estimation of the annual population for each year from 2004-2012, by assuming a 2.8% increase/decrease in population for each subsequent/previous year, which is consistent with data from the Population Projection data and censuses.[14]

Data Analysis

Period prevalence rates were calculated using identified cases that were $\leq$ 25 years between August 1, 2011and July 31, 2012 and the mean population of years 2011 and 2012. Annual incidence rates were calculated using the number of self-reported diagnosed cases for each year (2000-2011) over the estimated population ($\leq$25 years) for that year. Ninety-five percent confidence intervals for rates were calculated using a Poisson distribution. Demographic data (poverty rate, percent ever attended school, literacy rate, percent orphans, percent of homes with phones or radios, mean distance from health center, employment rates) for each district were also examined for associations with rates as possible mediators of within-country variation.[16]

Mean and standard deviation of age at diagnosis were calculated for the overall population, and by district, by sex and by age group. Statistical comparisons of age at diagnosis

were completed using t-tests and ANOVAs and chi square test comparisons were used to compare rates. A nominal p-value of $P < 0.05$ was used to denote significance.

The expected number of total T1D patients was calculated by applying our estimated prevalence rate to the total population ≤25 years (or 0-15 years) in Rwanda.

The analysis for this paper was generated using SAS/STAT software, Version 9.3 of the SAS System for Windows, copyright © 2011 SAS Institute Inc.

RESULTS

Prevalence

A total of 306 T1D cases (≤ 25 years) were identified in Rubavu (N=17), Gakenke (N=37), Rusizi (N=36), Huye (N=28), Rwamagana (N=21), Muhanga (N=41) and Kigali (N=126) from August 1, 2011 through July 31, 2012 (table 2). The mean overall age at diagnosis was 15.1±5.0 years, and ranged from 14.4±5.5 years in Muhanga to 16.5±5.5 in Rusizi. Prevalence estimates range from 7.5 [4.4-12.0]/100,000 in Rubavu, to 22.1 [18.4-26.3]/100,000 in the Capital City of Kigali (table 2). Surprisingly, the district of Muhanga also had a high prevalence (20.1 [14.4-27.2]/100,000) - close to that of the urban Kigali setting. The overall crude prevalence of T1D in Rwanda for 0-25 years was thus estimated to be 16.4 [14.6-18.4]/100,000 (prevalence for 0-15 years was 4.7[3.5-6.1]/100,000).

Prevalence rates of T1D were significantly higher in females (18.5[15.8-21.4]/100,000) than males (14.1[11.8-16.7]/100,000) overall (p = 0.01) (table 2). This trend was seen in each district except for Rubavu and Huye. However, only Gakenke had a significant difference

between the sexes (6.7 [3.1-12.8]/100,000 males; 18.8[12.4-27.4] /100,000 females, p=0.003) (table 2). There were no significant differences (p=0.40) by sex in mean age at diagnosis overall or by district (data not shown).

Prevalence rates increased with age (Supplemental table 1). The lowest prevalence was for the 1 – 4 year age group (0.6 [0.07-2.1]/100,000), while the highest was for the 20 – 24 year age group (54.1 [46.0-63.1]/100,000). Only two cases were identified in the 1 – 4 year age group, both from Kigali. In the Rwamagana district, only one case was identified in the 6 – 13 year age group (1.9 [0.04-10.5]/100,000), while the rest were in the 14 – 25 year age group (46.0 [27.6-72.0]/100,000) (data not shown). The only district demographic variable that was correlated with prevalence was the percent of those who ever attended school, but this was only of borderline significance (r=0.74, p=0.054).

Incidence

A total of 260 registered cases of T1D in youth $\leq$ 25 years were diagnosed from 2004 - 2011 in these selected districts (an additional n=93 cases were diagnosed prior to 2004 or had unknown diagnosis dates). The annual incidence rate from 2004 to 2011 ranged from 0.79[0.4-1.4]/100,000 in 2004 to 2.7[2.0-3.6]/100,000 in 2010 (table 3), a 4-fold variation. Overall incidence rates were higher in females than males, except for 2005- 2007. However, the only significant sex differences were in 2010 (1.9 [1.1-3.1]/100,000 for males; 4.0 [2.7-5.6]/100,000 for females, p=0.004) and 2011 (1.5 [0.8-2.6]/100,000 in males; 3.4 [2.2-4.9]/100,000 for females, p=0.04) (table 3).

Annual incidence rates increased over time, with the highest rates seen in the older age groups in more recent years (Supplemental Table 2). The highest incidence rate, however, was

seen in 2008 for those aged 15-19 years (8.1 [5.0-12.4]/100,000). Sample size was too small and our timeline too short to perform any age-period-cohort analyses at this time.

DISCUSSION

Our report of known cases of T1D in Rwanda suggests that the prevalence may be significantly lower than other African countries[4–6] and less than a tenth of those for US African Americans (table 4).[17] Though incidence of recognized cases has increased, it has recently stabilized. However, the likelihood of missed cases due to death before diagnosis and misdiagnosis is high, suggesting that our results are an underestimation of the true burden of this disease. Early mortality may also distort our estimates.

Prevalence

The overall crude prevalence rate of T1D in Rwanda, for those $\leq$25 years, is 16.4 [14.6-18.4]/100,000. This rate ranged from 7.5/100,000 in the rural district of Rubavu to 22.1/100,000 in Kigali City. These estimated rates are significantly lower than previous prevalence studies from sub-Saharan Africa and the US (table 4). The estimated prevalence rates in Rwanda are 11x lower than the Sudan, 3x lower than Nigeria, 6x lower than Algeria, 47x lower than African Americans aged 0-9 years, and 11x lower than African Americans aged 10-19 years.[4–6,17]

There were, however, some major differences between our study and the previous works. The studies from Sudan[4] and Nigeria[6] were surveys given to schoolchildren on diabetes symptoms, not hospital surveys as ours was. While the prior studies allowed for identification of previously unknown cases, our methodology limited our cases to those who are clinically

recognized and recorded in the LFAC registry. If one only includes the known cases in Sudan and Nigeria (excluding those newly identified by screening), the prevalence rates decreased to 78.8/100,000 and 17.8/100,000 respectively.[4,6] These rates are considerably closer to those in Rwanda – especially for Nigeria, which is then only 1.8X higher. This suggests that if we had the ability to screen our rates may be more similar to the previous reports. However, a school based survey also has weaknesses and may not truly reflect national prevalence in countries with relatively low school attendance as in Rwanda. Attendance for a cohort of T1D patients in Rwanda has been reported to be 51.4%, suggesting that a school survey would have resulted in many missed cases as well.

As with other studies from sub-Saharan Africa,[2,4,6] the prevalence in Rwanda increased with age and was higher in females (table 2). Similar sex differences (females 112/100,000; males 79/100,000) and increases in prevalence with age were seen in Sudan.[4] Nigeria also had increasing rates with age (3/100,000 for those aged 5 – 9.99 years to 74/100,000 in those aged 14-17 years). However, the Nigeria study was different from ours as males had a higher crude prevalence rate (38/100,000) than females (25/100,000).[6] In Ethiopia, the mean age at diagnosis was 10.1 years (for those diagnosed before age 15 years), while in Sudan there was a bi-modal distribution with peaks at 14 and 7 years.[2] Similarly, the mean age at diagnosis for a likewise aged population in our study was 11.1±3.9 years. Trends in age at diagnosis suggest that cases are being detected at earlier ages than previously, possibly due to increased knowledge of diabetes and its symptoms.

Incidence

Our inability to screen for new cases (and thus, dependence on clinically diagnosed cases), our reliance on self-reported dates, and the high likelihood of missed cases have likely affected our incidence rates. The annual estimated incidence rate ranged from 0.79[0.4-1.4]/100,000 in 2004 to 2.7[2.0-3.6] /100,000 in 2010. The incidence rates in Rwanda are lower than rates previously seen in Sudan, Tunisia, Libya and Algeria [5,7,9,10], but similar to Tanzania from 1979-1988 (table 4).[8] In comparison to US African American incidence rates, the rate in Rwanda for those 0-9 years is 1/63 of the rate in the US, and ¼ of the rate for those 10-19 years in the US (table 4).[17]

The prior studies were based on data from national or province registries (Algeria[5], Tunisia[9] and Libya[10]), while we were limited to only cases reported to the LFAC registry. The generalizability of the previous studies, however, are also limited, as the majority of them were for only one city or a few districts in each country and in predominantly urban areas. It is of particular note, that the country located the closest to Rwanda and with the most similar ethnic background– Tanzania – has the most similar incidence rate.

Incidence rates increased in our population - a pattern seen globally[18,19] and locally in sub-Saharan Africa [Sudan (5.9/100,000 in 1987 to 10.1/100,000 in 1992)[7], Libya (7.0/100,000 in 1981 to 7.8/100,000 in 1990)[10], and Algeria (1.6/100,000 in 1981 to 8.1/100,000 in 1998)[5]]. Like Rwanda, Libya also had differences in incidence by sex (females=9.1/100,000 vs. males=6.6/100,000) [10] and age trends were also seen in Tunisia (0-4 years =3.3/100,000 vs 10-14 years =11.5/100,000) [9] and Tanzania (5-9 years= 0.5/100,000; 10-14 years=2.2/100,000; and 15-19 years =3.4/100,000).[8]

Though the hospitals in Rwanda are visited on a quarterly basis, due to high nurse turnover, long travel distances for patients, lack of scheduled consultations, and continued

utilization of traditional healers, it is likely that some known cases were not recorded. Failure to diagnose diabetes in fatal cases further complicates the situation, as shown in a previous study in Tanzania, where 21 of 199 patients diagnosed with cerebral malaria actually had coma due to uncontrolled diabetes.[20] Another study in Tanzania found that poor record keeping and low awareness can lead to misdiagnosis of diabetes.[21] Of 35 people who presented with diabetic ketoacidosis, no diabetes symptoms were recorded in over 40% of patients and a correct diagnosis for only 13 of 33 (39.4%) people was made. Additionally, anecdotal reports have shown that some children/adolescents in Rwanda have an apparent ability to survive with high HbA1c levels and little to no insulin. It is therefore possible that there are undiagnosed children and adolescents living relatively normal lives.

It is highly likely that children with T1D in Rwanda died before they were formally diagnosed. This is supported by the low incidence at younger ages in our population and the knowledge that until 2009, most district hospitals did not have a glucose meter available to them.

Typology was not used to confirm diagnosis in any of these studies. While we believe that the majority of our cases are type 1 based on age at onset and their dependence on insulin, no formal antibody or c-peptide testing was available. Therefore, it is possible that some cases are actually type 2 or another form of diabetes.

While there are several reasons case reporting may be low in Rwanda, district hospitals and the ARD are where diabetes patients will likely seek, or be directed for, care. Even those who can afford insulin are referred for clinical consultations and management guidance. Therefore, we believe that we have a fairly representative cohort of known T1D cases in Rwanda. Thus, it is possible that rates of T1D in Rwanda are truly lower than expected. The previously mentioned geographic variation in T1D [18,19] is likely due to a combination of

genetics, environment, and autoimmune factors.[22] The African studies were in primarily Arab countries, which have been shown to have very high rates of diabetes.[1,18,19] Since the percent of the Arab population in Rwandan is significantly lower than these countries, one might expect to see much lower rates of diabetes in Rwanda. This is further supported by the fact that the data from Rwanda is most similar to Tanzania. Unfortunately, genetic testing was not available at this time, however, this should be considered in future studies.

Early exposure to cow's milk has also been linked to the global differences in diabetes rates,[23,24] as increased consumption of cow's milk is associated with increased incidence of T1D. In previous Demographic and Health Surveys, reported rates of exclusive breastfeeding are higher in Rwanda (91.4% for 0-1 months to 75.7% for 4-5 months) than Nigeria (2.1% for 0-1 months to 0.1% for 4-5 months) and Tanzania (55.2% for 0-1 months to 8.0% for 4-5 months).[25–27] Higher rates of prolonged breastfeeding in Rwanda might, therefore, translate to lower T1D risk.

Despite the high probability of under-ascertainment and the non-formal epidemiologic analysis, this first survey of known T1D cases in youth and adolescents in Rwanda suggests that the local rates are lower than those of other African countries and US African Americans. Estimates of rates of T1D are needed to ensure that necessary support is being provided for countries where insulin and other management necessities are hard to obtain. Based on our estimates, there may be 1,192 T1D cases $\leq$ 25 years in Rwanda (95% CI 1,061-1,337) (239 < 15 years (95% CI 178-309)), each of which will require guidance and additional healthcare over their lifetime. However, due to the high likelihood of missed cases due to death before diagnosis and misdiagnosis, more definitive studies are needed to determine if our estimates are true or an underestimation.

TABLES AND FIGURES

Table 1. Table of selected districts and their associated hospitals.

Region of Country	District	Hospitals in District
North West	Rubavu	Gisenyi
South West	Rusizi	Gihundwe, Mibirizi
Central South	Muhanga	Kabgayi
Far South	Huye	CHUB, Kabutare
North	Gakenke	Nemba, Ruli
East	Rwamagana	Rwamagana

Table 2. Prevalence estimates (per 100,000) of clinically diagnosed T1D in six districts and Kigali City, Rwanda, overall and by sex.

	25 and under	Cases	Overall Prevalence (95% CI)	Age at Diagnosis	Males (95% CI)	Females (95% CI)
Rubavu	227,556	17	7.5 (4.4-12.0)	14.6±5.2	9.9 (5.0-17.8)	5.1 (1.9-11.1)
Gakenke	277,103	37	13.4 (9.4-18.4)	15.3±4.2	6.7 (3.1-12.8)	18.8 (12.4-27.4)*
Rusizi	266,724	36	13.5 (9.4-18.7)	16.5±5.5	11.0 (6.1-18.1)	16.1 (10.0-24.7)
Huye	183,028	28	15.3 (10.2-22.1)	16.2±4.8	15.5 (8.4-26.0)	15.1 (8.2-25.3)
Rwamagana	136,253	21	15.4 (9.5-23.6)	16.1±3.9	14.9 (7.1-27.4)	14.4 (6.9-26.6)
Muhanga	204,092	41	20.1 (14.4-27.2)	14.4±5.5	16.0 (9.1-26.0)	24.0 (15.5-35.4)
Kigali	569,587	126	22.1 (18.4-26.3)	14.5±5.1	19.3 (14.5-25.1)	24.9 (19.4-31.5)
Total	1,864,342	306	16.4 (14.6-18.4)	15.1±5.0	14.1 (11.8-16.7)	18.5 (15.8-21.4)*

* Denotes significantly different rate from males at $p<0.05$

Table 3. Annual incidence estimates (per 100,000) of clinically diagnosed T1D, overall and by sex.

Year	New Cases	Overall Rate (95% CI)	Males (95% CI)	Females (95% CI)
2004	12	0.79 (0.4-1.4)	0.40 (0.08-1.2)	1.4 (0.6-2.6)
2005	23	1.5 (0.9-2.2)	1.8 (1.0-3.0)	1.3 (0.6-2.5)
2006	21	1.31 (0.8-2.0)	1.5 (0.8-2.6)	1.3 (0.6-2.4)
2007	39	2.4 (1.7-3.2)	3.1 (2.0-4.5)	2.0 (1.1-3.3)
2008	41	2.4 (1.7-3.3)	2.0 (1.2-3.2)	3.3 (2.1-4.8)
2009	35	2.0 (1.4-2.8)	1.7 (1.0-2.9)	2.6 (1.6-4.1)
2010	48	2.7 (2.0-3.6)	1.9 (1.1-3.1)	4.0 (2.7-5.6)*
2011	41	2.2 (1.6-3.0)	1.5 (0.8-2.6)	3.4 (2.2-4.9)*

* denotes significantly different rate from males at $p<0.05$

Table 4. Prevalence and incidence estimates (per 100,000) of clinically diagnosed T1D in other countries compared to similarly aged Rwandan populations.

Population (age)	Study Year(s)	Prevalence/ 100,000	Prevalence/ 100,000 In Rwanda (95% CI)	Incidence/ 100,000	Incidence/ 100,000 In Rwanda (2011) (95% CI)
Sudan (7 – 14 years)	1987	95	8.7 (6.3-11.8)	-	-
Nigeria (5 – 17 years)	1990	33	10.0 (7.9-12.3)	-	-
Algeria (0 – 15 years)	1979 - 1988	27	4.7 (3.5-6.1)	4.4	1.3 (0.7-2.2)
US African Americans (0 – 9 years)	2001	57	1.2 (0.6-2.3)	15.7	0.25 (0.03-0.9)
US African Americans (10 – 19 years)	2001	204	18.6 (15.2-22.5)	15.7	4.0 (2.6-6.1)
Sudan (0 – 15 years)	1987 - 1990	-	-	10.1	1.3 (0.7-2.2)
Tunisia (0 – 19 years)	1990 - 1994	-	-	6.95	1.8 (1.2-2.7)
Libya (0 – 14 years)	1991 - 2000	-	-	8.3	1.1 (0.6-2.0)
Tanzania (0 – 19 years)	1982 - 1991	-	-	1.5	1.8 (1.2-2.7)

ACKNOWLEDGEMENTS

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SUPPLEMENTAL TABLES

Table 5. Age-specific prevalence rates of clinically diagnosed T1D in six Districts and Kigali City, Rwanda and mean age at diagnosis.

	Rubavu	Gakenke	Rusizi	Huye	Muhanga	Kigali	**TOTAL**
1-4 Years	0	0	0	0	0	2	**2**
Per 100,000	0.0 (0.0-8.0)	0.0 (0.0-6.4)	0.0 (0.0-6.4)	0.0 (0.0-10.7)	0.0 (0.0-9.5)	1.9 (0.2-7.0)	**0.6 (0.07-2.1)**
Age at Diagnosis	-	-	-	-	-	2.0±1.4	**2.0±1.4**
5-9 Years	1	1	1	0	0	5	**8**
Per 100,000	2.1 (0.04-11.7)	2.4 (0.05-13.3)	1.8 (0.03-10.2)	0.0 (0.0-10.0)	0.0 (0.0-8.5)	4.7 (1.5-11.0)	**2.4 (1.0-4.8)**
Age at Diagnosis	3.0	7.0	5.0	-	-	4.8±2.4	**4.8±2.0**
10-14 Years	2	5	3	1	4	20	**36**
Per 100,000	4.7 (0.6-17.1)	13.0 (4.2-30.5)	6.1 (1.2-18.0)	2.8 (0.06-15.9)	10.4 (2.9-26.6)	23.1 (14.1-35.7)	**12.4 (8.7-17.2)**
Age at Diagnosis	10.0±4.2	9.4±2.6	7.3±7.0	3.0	5.2±5.2	9.4±2.6	**8.6±3.6**
15-19 Years	3	14	9	9	6	24	**71**
Per 100,000	7.6 (1.5-22.3)	34.6 (18.8-58.1)	19.7 (9.0-37-4)	28.6 (13.0-54.3)	17.7 (6.5-38.3)	25.3 (16.3-37.7)	**24.8 (19.4-31.4)**
Age at Diagnosis	14.0±2.6	14.6±2.3	15.4±1.3	14.4±3.1	12.8±6.4	13.4±2.8	**14.0±3.0**
20-24 Years	11	14	17	15	26	63	**158**
Per 100,000	33.3 (16.6-59.6)	43.4 (23.6-72.9)	43.7 (25.4-70.0)	50.1 (28.0-82.5)	76.9 (50.3-112.7)	50.7 (39.0-64.9)	**54.1 (46.0-63.1)**
Age at Diagnosis	16.6±4.2	18.2±2.7	18.0±3.5	17.8±3.9	15.6±3.2	16.7±3.6	**16.9±3.5**
25 Years	0	3	6	2	5	12	**29**
Per 100,000	0.0 (0.0-66.9)	40.4 (8.1-118.7)	84.8 (31.1-183.8)	34.9 (4.2-125.7)	79.3 (25.4-185.5)	43.9 (22.7-76.9)	**48.8 (3.7-70.1)**
Age at Diagnosis	-	19.3±3.8	22.5±1.7	19.0±5.6	20.7±4.9	19.7±4.2	**20.3±3.9**

Table 6. Yearly incidence (per 100,000) estimate of clinically diagnosed T1D, by age range at diagnosis, in Rwanda Africa.

Year	1-4 Years	5-9 Years	10-14 Years	15-19 Years	20-24 Years	25 Years
2004	0.36 (0.07-2.0)	1.1 (0.2-3.3)	0.85 (0.1-3.1)	2.6 (1.0-5.6)	0.0 (0.0-1.6)	0.0 (0.0-7.7)
2005	0.35 (0.07-2.0)	1.4 (0.4-3.7)	2.5 (0.9-5.4)	4.6 (2.3-8.3)	0.41 (0.0 -2.3)	0.0 (0.0-7.5)
2006	0.69 (0.08-2.5)	0.0 (0.0-1.3)	2.0 (0.6-4.7)	3.7 (1.7-7.0)	2.0 (0.6-4.7)	0.0 (0.0-7.2)
2007	0.0 (0.0-1.2)	1.4 (0.4-3.5)	3.9 (1.9-7.2)	7.9 (4.8-12.2)	1.9 (0.6-4.5)	0.0 (0.0-7.0)
2008	0.33 (0.07-1.8)	0.33 (0.07-1.9)	1.9 (0.6-4.4)	8.1 (5.0-12.4)	4.5 (2.3-7.9)	0.0 (0.0-6.9)
2009	0.0 (0.0-1.2)	0.97 (0.2-2.8)	0.74 (0.09-2.7)	4.5 (2.3-7.9)	6.2 (3.6-10.0)	1.8 (0.36-10.1)
2010	0.62 (0.07-2.2)	0.94 (0.2-2.8)	2.9 (1.2-5.7)	5.8 (3.3-9.5)	6.8 (4.1-10.6)	0.0 (0.0-6.5)
2011	0.0 (0.0-1.1)	0.61 (0.07-2.2)	3.5 (1.7-6.4)	4.6 (2.4-7.9)	5.2 (2.9-8.6)	1.7 (0.34-9.6)