

Infant and Child Mortality on Kilimanjaro, 1894-1935

Stacie Colwell

A. Stacie Colwell, Harvard School of Public Health, Boston, Massachusetts 02115, USA
Ulla Larsen, Harvard School of Public Health, Boston, Massachusetts 02115, USA

This paper uses Lutheran and Catholic parish registers, comparable to those used by historical demographers of Europe, to analyze infant and child mortality in the Kilimanjaro Region of Tanzania between 1894 and 1935. Frequently lacking written records, historical demographers of Africa have had to reconstruct past population parameters from oral birth histories and by indirect methods of estimation. The unique African data source analyzed herein—detailed, meticulously updated, century-old registers broadly representative of a generally closed community—reveals levels of infant and child mortality analogous to those of turn-of-the-century Europe. To contextualize these levels, this paper also reexamines studies of infant and child mortality conducted before 1936 by the colonial administrations in Tanzania. This analysis challenges assumptions of universally high precolonial mortality, providing support instead for recent reinterpretations positing moderate mortality in some parts of East Africa before the ecological disasters and social upheaval of the late nineteenth century. (149 words)

Introduction

“Africa remains largely terra incognita to the student of mortality,” begins the introduction to *Mortality and Society in Sub-Saharan Africa* (van de Walle, Pison, and Sala-Diakanda 1992, p. 1). While contemporary demographers regularly lament the paucity and unreliability of mortality data from Africa, such laments are voiced even more insistently by historical demographers studying pre-colonial and colonial African populations who, per the title of Bruce Fetter’s collection, must resign themselves to manufacturing *Demography from Scanty Evidence* (1990). Where historical demographers of Europe have been able to reconstruct past population trends—albeit painstakingly—from church and local government records, their counterparts in Africa have generally had to rely upon oral birth histories or have had to develop various indirect methods of estimation, both of which are usually more limited in accuracy and backward reach than are European archival sources. Even in those rare instances in Africa when comparable church and local government records were kept, most have since disappeared. With far more pressing needs than archival collection, colonial and post-colonial regimes surrendered their documents to the humidity and insects, leaving a paper trail typically measured in months or years, seldom in decades, and rarely in centuries. This paper describes a fortunate exception: meticulously updated, detailed, century-old African parish registers directly comparable to those used by historical demographers of Europe, records that were produced and preserved by favorable coincidences of climate and history. The climate is the temperate highlands of Kilimanjaro and the history is the long chronicle of would-be settlers drawn to that verdant slope. Among those drawn during the early 1890s were the Holy Ghost Fathers from Alsace and various Lutheran evangelists from Leipzig. These missionaries brought with them to Kilimanjaro copies of the registers used by

their home churches. On the stiff pages of these leather-bound registers, the missionaries recorded the life events—baptism, confirmation, communion, marriage, death, and burial—of their Chagga converts, just as they had done for their European parishioners. Moreover, the missionaries on Kilimanjaro also entered not just infants' baptism dates but also their birth dates, along with the birth and death dates of unbaptized infants and children, and the delivery dates of miscarriages and stillbirths, often with estimates of gestational age.

Drawing on one set of these registers, the Lutheran and Catholic family registers, this paper (a) reports on the levels and patterns of Chagga infant and child survival between 1894 and 1935 and (b) uses the mortality figures to explore the divergence between the story the registers reveal and the assumption that has long stood in the stead of reliable statistics. That assumption, the reflexive application of the demographic transition theory to East Africa, held that before colonization and the modernization processes it initiated, fertility and mortality were both high and that after colonization and the concomitant extension of biomedicine and public health measures, both declined. However, the results of this data base, supported by a reanalysis of other contemporary data bases, suggest that the infant and child mortality on Kilimanjaro during the early colonial period was, in fact, comparable with or even lower than in Germany, the home country of the region's first European colonizers, and, moreover, that no appreciable mortality decline occurred during this period despite the extension of colonial policies and services. Lastly, in an Appendix, a fuller description of the data base is provided, including the application to the African parish registers of the tests developed by E. A. Wrigley et al. for their English parish data base (1997, pp. 574-577).

The Representativeness and Reliability of the Family Registers

The southern slope of Kilimanjaro—a fertile, defensible mountainside amply watered year round by glacial streams and an ingenious system of furrows and sluices—had been home to the Chagga for perhaps a millenium before the first recorded European followed the African caravan routes inland to this resupply point (Fosbrooke and Sasoon, 1965; Odner, 1971). That European was Johannes Rebmann, a zealous German Protestant with the British Church Missionary Society [CMS], who in May 1848 confirmed the existence of the great mountain, its glacial crown, and the Chagga peoples who farmed its slopes and controlled a wide trade network from that aerie (Stahl, 1964, pp. 35-36). Though Rebmann immediately proposed establishing a CMS station on Kilimanjaro and, thirty years later, Rindi, the *Mangi* of one of the many autonomous Chagga chiefdoms, even wrote to the CMS headquarters requesting a missionary be sent to educate his people, the first mission station was not established until 1885 (Bennett, 1964). That fall, as a group of German colonial enthusiasts were traveling about East Africa’s interior gathering treaties, two British missionaries from the CMS hurried to Kilimanjaro to answer Sir Harry Johnston’s plea that Kilimanjaro, with its “singularly fertile soil and healthy climate,” be in “the hands of Englishmen” (Johnston, 1886, p. 87-88). The two Englishmen, however, arrived too late to make an effective claim. The Anglo-German Treaty signed in 1886 drew a zigzag border between Deutsch Ostafrika to the south and the British colony of Kenya that put Kilimanjaro under German control through World War I. Only after the war, when the Versailles treaty granted Deutsch Ostafrika to the British as the League of Nation’s Mandate of Tanganyika Territory, did Kilimanjaro finally come into “the hands of Englishmen,” where it remained until independence in 1961.

From 1886 through 1892, the Englishmen doggedly persisted in their efforts to maintain CMS mission stations on Kilimanjaro, despite growing friction with the Chagga *Mangi* and with the arriving German officers and settlers. The *Mangi* welcomed secular education and permitted some religious services, but otherwise they effectively contained the missionary influence, cutting off the missionaries' water supply, boycotting their churches and schools, and even evicting them when they threatened the *Mangi's* authority or challenged certain revered cultural practices (Meyer, 1891, p. 98; Moore, 1977, p.14). In 1892, when some Chagga chiefs rebelled against the German colonizers, the British missionaries were charged with collaboration and, after much protest and lengthy negotiations, the CMS withdrew from Kilimanjaro. In their stead came two new mission societies: the Leipzig Mission, a Lutheran group long interested in the highlands of *Deutsch Ostafrika*, and the Holy Ghost Fathers, a Catholic Congregation in Alsace whose new Apostolate was "the Black People in the Americas and Africa" (Centenary Committee, 1990, p. 31-32). From 1892 through Tanzania's independence in the early 1960s, the Lutherans and Catholics remained essentially the only mission groups on Kilimanjaro. It is the registers of these two mission groups that are analyzed herein.

Capitalizing on Chagga enthusiasm for the CMS education and innovations, both the Lutherans and the Catholics enjoyed rapid growth in their de facto sectors (the Catholics mostly to the east and west and the Lutherans to the center of Kilimanjaro's southern slope). In this regard, the missions on Kilimanjaro were exceptional among inland stations in East Africa, which rarely enjoyed rapid rates of conversion. In fact, because conversion rates were usually low, missionaries typically founded outpost stations in East Africa with converts they brought with them from their coastal mission headquarters and with converts drawn from the

margins of the inland society, e.g., manumitted slaves, widows, lepers, and orphan (Bennett, 1966; Kiernan, 1971). The outpost stations then typically grew slowly as the missionaries struggled to broaden their appeal beyond that of a sanctuary for migrants and local outcasts. Until the missionaries' gifts to the local leaders were sufficient to force a mandate for church attendance, or until the communities' appreciation of the missions' medical and educational services were strong enough to win over the average family, the mission station converts were often not representative of the surrounding communities. Indeed, many early Christians—particularly those living in designated Catholic villages or *Chrétientés*—actively distinguished themselves from those of their ethnic group who had not converted. When, for instance, *Deutsch Ostafrika* Medical Officer Dr. Schornich tried to gather vital statistics from the “natives” near a mission station at Amani and asked for their “tribal affiliation”—were they WaSwahili? WaZigua?—the converts insisted that they were WaChristi and their unregenerate neighbors, WaHeretiki (Clyde, 1962, p. 39).

Unlike elsewhere in East Africa, the missionaries did not happen upon the Chagga, did not build their stations against the wishes of hostile or impotent chiefs or in isolation from the native communities, and did not dictate the cultural practices of their converts. Instead, Rindi, the *Mangi* of Moshi, sent a written invitation to the CMS missionaries to settle in his chiefdom. Though Rindi professed an interest in Christianity per se, his invitation was a calculated strategy to gain benefits that he believed the missionaries' presence would bring. First, Rindi sought to gain political and military alliances with the missionaries and, through them, with their home countries. To this end, following Rindi's defeat in 1889 to Sina, the *Mangi* of Kibosho, Rindi sent emissaries to Berlin to present a huge elephant tusk to the Kaiser, hoping that more firearms might be among the presents he received in return (Ilfie, 1979, p. 100).

Second, Rindi sought from the missionaries more European goods for himself and vocational and secular education for his people. Rindi had long retained literate WaSwahili from the coast to act as scribes and accountants, and desired such learning for his own tribespeople. As Missionary Charles New recorded their conversation, Rindi stated in 1874: “I want you very much to return to [Moshi], particularly if you can bring some artisans with you. I shall be glad to have my young people taught to read and write I want paints and dyes of all colours; I want tools—saws, planes, a brace and bits, a screw-making machine, etc. etc.” (New, 1874, p. 433).

Hence, in inviting the missionaries into his chiefdom, Rindi was not ceding authority to them but rather using their connections, goods, knowledge and teaching to increase his own power—to capitalize on the growing long-distance trade that passed through his chiefdom and to renegotiate the balance of power between himself and other *Mangi*, and between the mountain and the coastal and lake-region kingdoms. For these reasons, Rindi also requested that the German administrative headquarters be built in his chiefdom and then he effectively played the German administrators off the British missionaries to his own advantage. When he did not receive all that he expected (particularly as regards firearms) from the Europeans, he kept the mission stations “in a constant state of insecurity” and the German colonial administrators on their guard (Iliffe, 1979, p. 86). Rindi’s success, moreover, in negotiating with the Europeans for political and material gain prompted other *Mangi* to follow suit. The *Mangi* of Marangu, Ndegoruo “Marealle” Kilamia, gained material and political leverage against his rival, also Sina of Kibosho, by welcoming both the Catholics and the Lutherans into his chiefdom. Marealle followed Rindi’s lead and alternated his favors between the two to further his gains, going so far as to have one son baptized Catholic and

another Lutheran while he himself remained “Pagan” (Stahl, 1964, p. 325). Relatively unimportant *Mangi*, such as Pfumba of Kilema, recognized that they could boost their standing vis-à-vis their fellow *Mangi* and bring benefit to their people through alliances with the Europeans. In September 1890, Pfumba permitted the Holy Ghost Fathers to establish their mission headquarters in his chiefdom, but “only on condition that they opened schools” (Iliffe, 1979, pp. 100-102; Stahl, 1964, pp. 194-198).

Of course, not all the *Mangi* initially adopted this strategy of negotiation. Sina and Meli, Rindi’s son, opposed the colonial presence on Kilimanjaro: in February 1891 the former led the fiercest battle that the seasoned German commander, Hermann Wissmann, ever experienced in Africa, while in August of 1893 the latter temporarily forced German troops off the mountain entirely (Iliffe, 1979, p. 100-101). These Chagga victories, however, were short lived, and the superior German firepower convinced most *Mangi* to pursue strategies of diplomacy, duplicity, and/or collaboration. That Marealle was believed to have orchestrated rumors of a conspiracy against the Germans that resulted in their hanging 17 of his rival *Mangi*—including Meli and Molelia—further recommended a strategy of manipulation rather than one of armed opposition in dealing with the Europeans on Kilimanjaro (Iliffe, 1979, pp. 100-102; Stahl, 1964, pp. 194-198).

Not only were the Chagga *Mangi* strongly motivated to negotiate alliances with the missionaries, the Chagga people, too, had an incentive to convert to Christianity: coffee. With the Holy Ghost Fathers came coffee-seedlings from their station on Reunion. The economic possibilities of this crop were almost immediately apparent. The compact *arabica* bushes could be planted between the plantains on the small Chagga farms and the beans sold to pay taxes or for luxury items. This system of income generation, moreover, provided a much-desired

alternative to working for wages on recently established European plantations. However, for many of the years before the Chagga organized their own cooperative—which they did in 1925—virtually the only source of coffee seedlings, arboricultural training, and berry marketing was the missions (Lawuo, 1984, p. 23). Not surprisingly then, the number of coffee trees and Christian converts on Kilimanjaro increased in concert. After the arrival of the first seedlings in the 1890s, their number expanded exponentially so that by 1925 the Chagga had planted 987,175 *arabica* bushes and by 1930, six million (Iliffe, 1979, p. 274). The first baptisms also occurred in the early 1890s and spread outwardly from the mission stations almost as rapidly as did the *arabica*. By independence in 1961, more than 85% of the Chagga consider themselves Christian (Iliffe, 1979, p. 467).

As a consequence of this history, the families entered in the Catholic and Lutheran registers are broadly representative of all Chagga on the mountain (Rogers, 1972, p. 159). Iliffe, for instance, calls the Chagga an “exception” for having “the first Christians com[ing] from all social groups” (Iliffe, 1979, p. 222). True, Father Martin Rhomer did bring “eleven Christian Boys” from the coastal station at Bagamoyo with him to Kilema in February 1891. However, beside the five of those coastal “Boys” who settled permanently at Kilema, only very infrequently was the birthplace of a convert outside the immediate station area, much less off the mountain. Instead, most of those entered in the registers were Chagga, essentially the sole ethnic group living in the mountain’s “banana belt,” the well-watered southern and eastern slopes between 3,500 and 6,000 feet. Moreover, except for the occasional chief, teacher, carpenter, or smith, most of Chagga listed in the family registers and in the death registers are not identified by occupation. It is implied that, like the rest of the Chagga, the converts were self-sufficient farmers, raising stall fed cattle, cultivating small tidy highland

vihamba of plantain bananas (and, later, coffee), hunting in the forests above the *vihamba*, and cutting grass for the cattle and growing various grains for beer-brewing on the plains below.

Not only were Christian converts on Kilimanjaro more likely than those of other inland stations to be drawn from the mainstream of society, but their daily existence and cultural practices were less likely to be changed by their baptism. The continued local authority of the *Mangi* and the shrewdness of the converts contained the influence of the Church. (It should be noted, too, that the philosophy of the Leipzig Lutheran mission advocated accepting or adapting rather than replacing native customs, see Wright, 1971 and Winter, 1976.) Over the decades, when Church interference in secular life exceeded boundaries acceptable to the *Mangi* or to the congregation, the Chagga boycotted the station activities or negotiated compromises. In fact, the Chagga were in the vanguard demanding the “indigenization” of the Church in Africa and, aided by the internment of the German missionaries during both World Wars, had rapid success in integrating the Church hierarchy (Iliffe, 1979, pp. 258-260).

Finally, not only were the families that converted generally representative of their Chagga communities, the physical situation of the mission stations was also representative of Chagga settlements. Though the different Chagga dialects were not all mutually intelligible, the patterns of settlement and other cultural practices overlapped substantially, reflecting the Chagga’s long co-existence and common dependence on plantain agriculture. The three Lutheran mission stations and the six Catholic sub-stations whose family registers survive are all located in the densely settled “banana belt,” above the hot, dry, malarious plains and below the chilly camphor forests. The Lutheran stations of Mwika and Masama are located in the west-central portion of this belt, while the Lutheran station of Mamba and the six Catholic

substations of Kilema parish are located in the east-central portion. All are favorably situated near mountain streams, as were most contemporary Chagga homesteads; all were within recognized chiefdoms and thus not particularly vulnerable to rivals or raiders; and all were relatively buffered from the locusts, drought, famines, and veterinary and human diseases that cursed East Africa in the 1890s. Indeed, possibly because the Chagga feared the diseases, animals, and nomadic peoples of the surrounding plains, there was very little migration off the mountain during this period, making Kilimanjaro the demographer's preferred closed-community.

If, as we argue, the Chagga families entered in the mission station registers were broadly representative of neighboring families who did not convert, and if those areas with mission stations were broadly representative of Chagga settlements on Kilimanjaro, the question then becomes whether the parish registers are sufficiently detailed and complete to capture the lived experiences of the recorded families. Regarding the sufficiency of detail, the answer is yes. During the roughly seventy years of colonial occupation, the Lutherans and Catholic missionaries on Kilimanjaro kept careful record of the birth, baptism, confirmation, marriage, and death of each convert. The early Lutheran registers are particularly detailed, recording, for example, the time of death and even the churchyard coordinates of the burial plot. As it did in Germany, however, the format of the registers varied between the two church organizations on Kilimanjaro and over time.

When the Leipzig Lutherans arrived in October 1893, they brought with them the official register books: the family, baptism, and death registers that were printed in Stuttgart in accordance with the Lutheran Synod Code 291.2577 of May 1876. The large, leather-bound *Kirchliches Familien Register*, the subset of registers used in this analysis, entered couples at the

time of their wedding; if a married person converted later in life, his or her entire family was registered as well. On the upper half of the left-hand page of the register, the names, birth dates, birthplaces, baptism dates, and, if applicable, wedding date of the couple or convert[s] are entered in the given columns. Beneath this section, on the bottom of the left-hand page, are boxes for the names and particulars of the parents of the couple or convert[s]. The right-hand page is devoted to children, with columns provided for their names and the exact date and place of their birth, baptism, confirmation, wedding and death. All three sections of the register pages include boxes to cross-list the life events with the page and volume of the baptism, death, or other family registers. The Leipzig Lutherans maintained this system through August 1920, when the last of the German missionaries were expelled from Kilimanjaro during the region's hand-over from Germany to Britain as prescribed by the Treaty of Versailles and codified in the charter of the League of Nations.

The Catholics used a slightly different record keeping system, including the same details but not the cross-references to the other register books. Families in the six Catholic substations of Mkyashi, Utawa, Marawe, Leo, Mulo, and Kilema Chini were listed in a single leather-bound ruled ledger kept at mission headquarters in Kilema. In this ledger, the *Familiae Christianae*, the families were recorded free-form, listing the names (the Christian baptismal names and/or the Kichagga "pagan" names) of the parents; their birth date and birth place, if they were baptized as infants; their baptism date if they converted; their Christian wedding date, if both parents converted; and the same particulars for their children as in the Lutheran registers. The family records for the six Catholic substations were updated through the mid-1930s. At that time, with much of Kilema converted to Catholicism, the *Familiae Christianae* was discontinued because the infant baptismal books sufficed as a register of new community

members. (The thirty-seven volume *Liber Baptisorum* begins with a convert made en route to the mountain in 1890 and is complete through 1970.) It should be mentioned that there was a second volume of *Familiae Christiane* for other substations. Sadly, that volume was lost in 1991-2, when all the registers were brought to Moshi for display at the Diocese's hundred-year Jubilee Celebration.

There are two important differences between the Lutheran and Catholic registers. Though both the Lutherans and Catholics are detailed about the events that occurred in families after one of the parents converted, only the Lutheran registers provide estimates of certain earlier events, specifically the birth date of those who were not baptized as infants. Led, no doubt, by the extraordinary anthropologist-missionary Bruno Gutmann, the Lutheran missionaries had collected sufficient information on circumcision age-grades, agricultural cycles, and historical events to establish reasonable estimates of the birth dates of those parishioners baptized after infancy. The Lutheran missionaries, moreover, indicated their certainty of that estimate by the information they recorded, whether they supplied month and year ("April 1886") for example, year only ("1886"), approximate year ("~1886" or "etwa 1886") or decade only ("1880s"). In contrast, the Catholic registers begin with baptism and provide no estimation of the birth dates of parishioners born before the conversion of one or both parents. It is important to note that neither the Lutheran nor the Catholic records include any information about children who died before their parents' conversion. Consequently, it is not possible to know the parity of children whose parents began their families before their conversion.

The second important difference between the Lutheran and Catholic registers is the supplemental information they include. As mentioned, the Lutheran registers were typically

more detailed than the Catholic ones. Moreover, the Lutheran records also include cross-references to their death registers, the *Todes und Begräbnisbücher*, which not only repeat the information on the time and place of a family member's death, the person's age and marital status, and the number of surviving children, if any, but also provide some information on the cause of death. That information entered under the heading "Ursache des Todes," is either a description of symptoms (e.g., "died after three days of bloody diarrhea") or, if the dying person's ailment was unambiguous or identified by a mission health worker, a diagnosis (e.g., "hanging" or "smallpox").

The Data Base

Using the Kilimanjaro Lutheran and Catholic family registers, a data base was created of the 1,850 Chagga children who were born after the baptism of at least one of their parents. Though children born before their parents' baptism were recorded in the family registers, these children were excluded from the data base because they might represent a select subset of their birth cohort—that is, from concern that not all the children who died before their parent's baptism were recorded, especially if those children were not the biological offspring of both the registered husband and wife. For this reason, the data base was restricted to children born—though not necessarily conceived—after at least one parent entered the parish family record system. The collection and preparation of the raw data, along with further details of the data base constructed from it, are described in the Appendix.

In this data base, 264 of the children born after their parents' baptism died during the first year of life and another 156 before their fifteenth birthday. Because there was little birth-baptism delay and, moreover, because stillbirths and other unbaptized offspring were eligible

for burial in the churchyard, the record of deaths of children born after their parents' baptism was reasonably complete. Moreover, because the family registers recorded births, baptisms, marriages, and deaths on a single page of a single register, in addition to the separate, scattered entries in the separate baptism and burial registers, many of the challenges and pitfalls of calculating mortality from parish records using family reconstitution methods were avoided. Not only were the problems of linking baptism and death records avoided but also concerns about the representativeness of "the reconstitutable minority" were sidestepped because all the families in the register entered the data base (Levine, 1976, p. 119).

In the data base of children born after their parents' baptism, the left censor was set to the child's birth date and the right censor was set to the first of the following events to occur: the child's fifteenth birthday (the demographer's standard terminus of childhood), the child's death date, the last day that the parish record was updated, or the date that the child's family moved from the parish, ceased being active in the church, or was excommunicated from it. Because there were distinct benefits to membership in the Church community and because the missionaries were required to report at least annually on the number of active church members, care was taken to note exactly when and why a family ceased to be in good standing. As elaborated in the Appendix, such notes make it possible to censor those infants and children whose deaths might no longer be reliably recorded. Finally, the few family records which had a hiatus of more than four years (a period of time somewhat longer than the mean birth interval) between life events were examined to determine if the hiatus was plausible (i.e., that the children's ages during the hiatus placed them between baptism and confirmation or between confirmation and marriage). With a single exception, the hiatuses were all plausible. The exception was a family whose children were orphaned during the

period. Though the records of families in which a single parent died during the observation period were found to have been maintained after that parent's death, two of the eight families in which both parents died were not updated after the death of the remaining parent. Consequently, the right censor of orphaned children was set to the death date of the remaining parent. With this careful right censoring, we believe that the information on infant and child mortality is reasonably reliable.

The years selected for the analysis—1894 to 1935—capture the first birth and last death in the active registers. (Two Catholic substations maintained their registers through February 25, 1936, but there were no births and only adult deaths entered during those two months.) The births and deaths, however, were not evenly distributed over this period. During the five-year period from 1894 to 1899, there were only fifteen births and two infant deaths, and in 1935 there were only ten births, one infant death, and two child deaths. In contrast, between 1913 and 1919, the yearly average was 96 births and 25 infant and child deaths. After August 1920, when the last Lutheran registers were discontinued, the number of births and deaths was essentially halved, being drawn only from the Catholic registers. On average, there were 46 births and 12 infant and child deaths per year between 1920 and 1934.

Infant and Child Mortality on Kilimanjaro, 1894-1935

We begin the discussion of this data set with the survival curves because they speak both to the overall pattern of infant and child survival on Kilimanjaro and to the quality of the data. From the data base a series of life tables was produced to describe infant and child survival between 1894 and 1935. Figures 1 and 2 present the survival curves of all post-baptism births stratified, respectively, by religion (Lutheran versus Catholic) and by sex. Figure

1 reveals smooth curves, with no substantive differences between the survival of Lutheran and Catholic infants and children on Kilimanjaro. The overall pattern—the unerratic, initially steep and then tapering decline—was reassuring, since the Chagga had no childrearing practices that would have predicted a deviation from this typical pattern of infant and child survival. The lack of significant difference ($p > 0.05$) between Lutherans and Catholics was also reassuring for three additional reasons. First, there was no reason to expect a difference between Lutherans and Catholics, since neither the Lutheran nor the Catholic missionaries substantively altered the cultural practices or physical environment that their converts had originally shared. Second, the tight overlap in survival curves is reassuring because the Lutheran and Catholic family registers used different recording formats and, of course, different scribes (see the Appendix for details). The fact that these differences produced almost identical survival curves suggests that the methods of recording did not significantly bias the results. Thus, in effect, the two record systems function as complementary documentary sources that Henry long ago recommended (Henry, 1968, p. 78). Finally and most importantly, the tight overlap between the survival curves is particularly welcome given the above-described uneven distribution of Lutheran and Catholic births during the 1894-1935 time period. Because there was no significant difference between the Lutheran and Catholic survival curves overall—nor any difference when restricted to 1894-1920, the years that the Lutheran and Catholic records overlap—it is reasonable to assume that the survival curve of Catholics born after 1920 would continue to be representative of Lutherans born after 1920 as well.

[Insert Figures 1 and 2 approximately here]

The survival curves for boys and girls presented in Figure 2 were also anticipated. There were no erratic peaks in mortality, suggesting that the unusual cultural practices described by ethnographers either were in decline or did not contribute substantively to infant and child mortality. The preeminent Chagga anthropologist, Sally Falk Moore, suggests that Chagga practices highlighted by colonial ethnographers (the removal of the permanent eye teeth, the piercing of the ear pinnae, extended seclusion, trials of strength and courage during initiation into warrior age-grades, more severe forms of female circumcision, etc.) were becoming extinct during the 1894-1935 period, including among families who converted to Christianity (Moore, 1996, p. xi). Moreover, the colonial ethnographers all stress the very high value that the Chagga placed upon children, making it unlikely that they would maintain cultural practices that were clearly harmful to child survival; the absence of mortality peaks at the age when these practices were customarily done corroborate the ethnographers' testimony. Additionally, because the colonial-era ethnographies also did not suggest that Chagga boys and girls were treated differently in ways that would cause significantly divergent mortality rates, we expected that the survival curves of boys and girls, following the classic excess of male mortality during the first year of life, would run parallel. As illustrated by Figure 2, this expectation was confirmed.

The pattern of infant and child survival on Kilimanjaro—the overlapping survival curves of Lutherans and Catholics and parallel curves of boys and girls—was anticipated; the levels of infant and child survival were hypothesized to be at least comparable to those of pre-industrial Europe and this was confirmed. Infant mortality between 1894 and 1935 was 142.7 (264 infant deaths among 1850 livebirths). The annual infant mortality rates and the five-year

moving average are presented in Figure 3. (The first seven years, 1894-1901, are not included on the graph because there were only 1-4 births each year and thus the infant mortality rates—respectively, 0, 0, 333, 500, 0, 0, and 0—were from samples too small to be meaningful.) As illustrated in Figure 3, in only 6 of the 33 years between 1902 and 1935 did infant mortality exceed 200 per 1000 live births (1919, 1920, 1921, 1924 and 1925). In 9 of the 33 years, infant mortality was below 100 per 1000 live births (1902-1908, and 1926-1927). Between 1902 and 1908, 11 of the 174 infants born in those years died, while in 1926-27, 7 of 94 died. For the remaining 19 of the 33 years, infant mortality was between 100 and 200 infant deaths per 1,000 live births. As Figure 3 illustrates, there was a slight overall increase in the infant mortality rate during this period. The relatively few number of cases in the left-hand side of the graph (238 births and 19 infant deaths between 1894 and 1909) precludes definitive declaration that infant mortality increased substantively between 1894 and 1935. The upward slant, however, does complicate claims that mission biomedicine, colonial sanitation regulations, or other contemporary developments reduced infant mortality during this period.

[Insert Figure 3 approximately here]

Table 1 illuminates sex differences in the level of infant mortality during this period. While the probability of dying during the first year of life is 0.147 for all children born between 1894 and 1935, the probability for male infants is 0.170 compared to 0.125 for female infants. While males had a higher probability of dying than females in each month of their first year of life, the greater excess of male mortality was concentrated in the first six months. The higher mortality of male infants during that first year was anticipated, as was the slight

surplus of male births: 101.3 male per 100 female. (Though this ratio is well within the 95% confidence limit [94.5-118.9] of the usual sex ratio of 103-105 males per 100 females, it is possible that it reflects not sampling variation but the material reality of a lower sex ratio of 100-104 in historical and contemporary African populations [Chahnazarian, 1986; MacGillivray, 1986; Waldron, 1998]). As Wrigley et al. note, in populations where mortality rates are generally high, this surplus typically disappears during that first year (1997, p. 298). As evident from the relative sample sizes of males and females in Table 1, this was the case on Kilimanjaro, where the surplus of males had disappeared by the end of the first year.

[Insert Table 1 approximately here]

Mortality during the subsequent years of childhood followed the predictable pattern of a steep decline after the first year, with an additional step-wise decline after early childhood. The mortality among children in the data base during the second year was one-fifth the level of the first, and the mortality during the third through sixth years was relatively constant at a level somewhat lower than the second year. After the sixth year, the yearly mortality rates were lower yet; the conditional probability of dying among children age five to nine years old was 0.0530. Per Table 1, Chagga boys generally experienced higher mortality than girls did during the neonatal period (days 1-28) and infancy (months 0-11) and slightly higher mortality during the second year. Thereafter, from the third through fifteenth year, boys and girls experienced generally the same probability of dying. Among the children in the last five years of childhood, there were 98.7 males per 100 females.

In order to examine infant and child mortality on Kilimanjaro by cohort, the data base was divided into birth cohorts. In selecting the cohort groupings, we sought to achieve roughly equal sample sizes and meaningful historical frames. The six cohorts created (mean sample size of 306) were: 1894 to 1909, 1910 to 1913, 1914 (the outbreak of World War I) to 1916 (the year the British captured Kilimanjaro), 1917 to 1920 (the year the British formally assumed control over Kilimanjaro), 1921 to 1927, and 1928 (the onset of the economic decline) to 1935. The conditional probabilities of dying by birth cohort and age cohort are presented in Figure 4. Evident in this graph is the pervasive effect of Spanish Influenza, which struck Kilimanjaro in late 1918-early 1919 and was largely responsible for the tallest columns in the 0, 1-4, and 5-9 year age groups in Figure 4. Also of particular note is the evident lack of an appreciable decline in under-five mortality between 1894 and 1935. In fact, if one attributes the peak in mortality of the under-fives in the 1917-1920 birth year cohort to aberration of the Spanish Influenza epidemic, then it appears that mortality may not only have been increasing among infants between 1894 and 1935 but also among children age one to five.

[Insert Figure 4 approximately here]

If the under-five mortality did not decline, and possibly even increased slightly between 1894 and 1935, and if the mortality in later childhood—barring global pandemics—remained largely unchanged from its relatively low levels, the final puzzle-piece in this description of infant and child mortality on Kilimanjaro is the distribution of deaths. That the overall level of under-five mortality did not decline appreciably does not mean that there were

not important changes in the distribution and pattern of mortality on Kilimanjaro during those years. This, however, is difficult to determine from the data available. Our preliminary analysis of the Lutheran death registries, mentioned in the appendix, found a comparatively low average crude death rate of 20.9 for the 9,358 Lutherans in Moshi-Kidia for the years 1898-1913, 1916, 1920, and 1925, with rates of 19.3, 20.0, 14.2, and 30.0, respectively, for those individual time periods. Finally, there is indication also in both the death and family registers that infant and child deaths on Kilimanjaro were clustered in specific families.

Other Studies of Infant and Child Mortality in Tanzania, 1894-1935

Though there is, as mentioned, a dearth of written sources for historical demographers of East Africa, there were substantially more colonial-era demographic studies of Tanzania than of its neighbors. The German administration in Tanzania before World War I was unique in its efforts to map and survey its natural and human resources in East Africa (Koponen, 1991, p. 135). After the war, the British administration in Tanzania, then called Tanganyika Territory, was forced by the Territory's status as a League of Nations Mandate to prepare annual reports, including information on demography, and, as a result, the British produced more information about Tanganyika than they did ordinarily for their African possessions. Of course, though comparatively numerous, the demographic studies conducted by the German and British administrators, missionaries, and others in Tanzania must still be read with caution, their methodologies scrutinized, and their conclusions interpreted through the biases of their producers. Below is an examination of local studies of infant and child mortality conducted in colonial Tanzania during the years covered by the family books, 1894-1935.

Though several demographic studies had been done earlier in *Deutsch Ostafrika*—most notably the earliest, financed by a private company, which supposedly proved the land it coveted was “uninhabited”—the first major study of infant and child mortality in East Africa was conducted by Dr. Otto Peiper, a German military staff physician, who spent 6 weeks in the fall of 1909 travelling a 185-kilometer circuit inland from Kilwa, collecting birth histories (Baumann, 1891; Koponen, 1994, p. 189; Peiper, 1910, p. 233). “[C]ollecting the following statistics was not as easy as their final form might suggest,” Peiper stresses; only after much “harmless conversation” and the liberal distribution of “gifts and flattery” would the women overcome their “great suspicion” and answer his questions. From these “conversations,” Peiper made a list of the 472 women interviewed which included the following: the women’s village, tribe and approximate age; the sex and ages of their 436 living children; and the sex, ages, and causes of death of their 492 deceased children. Reentering and reanalyzing Peiper’s data on the 17 villages he visited, we found the mean infant mortality rate was 200 (169-232), the sex ratio was 105 boys per 100 girls, and the percentage of deceased children who died before weaning was 52 (Peiper, 1910).

Peiper was rightly alarmed at the fact that only 48% of live-born infants survived childhood, and in the essay accompanying his raw data he identifies local domestic practices as the most salient contributor to the low child survival rates, though he also alludes to recent historical events. In particular, he expresses concern over the delay in nursing newborns until the colostrum has cleared, the very early introduction of other foodstuffs into the infant’s diet, the institution of fostering-out very young children, the mishandling of the umbilical cord and stump, and the possibility of infanticide. The results of the reanalysis of Peiper’s data, however, make these explanations partial at best. The infant mortality rates calculated from

Peiper's data are comparable to regions of his home country, Germany, where such cultural practices were likely to have been uncommon. Moreover, it is important that roughly half of the deaths occurred to children who were not "nurslings" and, consequently, were too old to be vulnerable to the cultural practices Peiper deplored. Thus, compared to Germany, the excess mortality in Peiper's villages was more likely attributable to the tragic recent history of Kilwa. That history includes the German colony army's extremely brutal suppression of the large-scale insurgency, the *Maji Maji* Rebellion, in the Kilwa region three years before Peiper's study, an area already devastated in the 1880s and 1890s by colonial conquest, local conflicts, famines, locusts, rinderpest, drought, and "slaving raids." In his tabulation of causes of death, the second most frequent cause of death, killing 57 of the 494 deceased children, was "In the Rebellion of 1905/6." The most frequent cause, responsible for 165 or one third of all deaths, was "intestinal catarrh" which, according to Peiper, the mothers typically blamed on the "lack of food" during the Rebellion, its brutal suppression, and the following famine. However, Peiper himself attributed more to the above-mentioned local feeding practices than to consequences of German colonization (Peiper, 1910, pp. 252-253).

An achievement despite its shortcomings, Peiper's investigation provides a context for our Kilimanjaro data and presages the subsequent studies his investigation inaugurated. In effect, Peiper's investigation of the devastated, drought- and famine-prone Kilwa region serves as a bad case scenario (as opposed to worst case scenario, for Tanzanian history contains even worse moments). The infant mortality rate of 200 in the Kilwa villages in 1909 was higher than in the Christian communities in our Kilimanjaro data base (139.5 in 1909), and the percentage of children dying after infancy was higher yet (48% in Kilwa versus the 9.1% five-year moving average calculated for Kilimanjaro in 1909). The lower survival detected by

Peiper, along with his method and analysis, set the stage for the infant and child mortality studies that followed. Peiper, foreshadowing this omission by subsequent colonial authors, did not specify his sampling and interview methods, but it is likely that both were liable to bias. Given the disastrous experiences the local population had recently had with German administrators during the Maji Maji Rebellion, it is not surprising that it was “not easy” for Peiper—a Caucasian military physician presumably wearing a uniform and undoubtedly accompanied by government porters and armed guards, if not armed himself—to collect his data and that he only succeeded in soliciting the women’s cooperation with persistence and unspecified “gifts.” It is possible, on the one hand, that women who had surviving children were more likely to be found at home by Peiper or, on the other hand, that women who had lost children were more likely to consent to interviews about child survival. Additionally, Peiper’s complaint that the women he did interview persisted unreasonably, in his opinion, in blaming their children’s death on Maji Maji and its aftermath underscores, if nothing else, the interpretive distance between the interviewer and his interviewees. Lastly, Peiper’s study foreshadows many subsequent studies in its blindered insistence on relating the mortality to native cultural practices rather than to the direct and indirect disruptions of colonialism. While Peiper does acknowledge that the Maji Maji Rebellion contributed to the regions’ high mortality, he situates those deaths in a continuum of local conflict and insists that mothers “who could no longer remember the cause of death” of their children blamed the Rebellion or the famine that followed (Peiper, 1910, p. 253). Furthermore, in postulating that “unhygienic” and “primitive practices” were the main reasons for the presumed high native mortality, the authors typically located the solution in the adoption of European domestic practices and Christian morality codes.

A relative flurry of studies on infant and child survival in *Deutsch Ostafrika* followed as a result of the coincident publication of Peiper's report in 1910 and the exacerbation of the *Arbeiterfrage*, "the labor question." Administrators in Berlin and Dar es Salaam, not to mention the investors and settlers in *Deutsch Ostafrika*, had long been anxious about the immediate shortage of wage laborer and were now becoming panicky about future shortages. Peiper's study tapped into this growing concern over the reproduction of the labor force. Within a year of Peiper's investigation, another government physician, Dr. Schörnich, surveyed 526 women in the Usambara Mountains. Though his study found much lower rates of infant and child mortality than Peiper did in Kilwa (the infant mortality rate for his data was 147—almost exactly that of our Kilimanjaro dataset—and the percent of livebirths surviving childhood was 78), Schörnich's study amplified alarm over the extremely low number of children per woman in *Deutsch Ostafrika*: the 526 women had only 342 surviving. The demographic concerns heightened by Peiper's and Schörnich's studies soon prompted the *Kolonialinstituts* in Hamburg to offer a prize of 6000 Marks for the best solution to the question: "Through what practical measures can we achieve an increase in births and a reduction in child deaths among the native colored population—that valuable economic asset—in our colonies?" (Ittameier, 1923, p. v).

In 1910, in response to the alarm Peiper and Schornich raised, Dr Hugo Meixner, the Chief Medical Officer in *Deutsch Ostafrika*, solicited "Proof of Infant Mortality among Black Africans" from physicians staffing the district "hygiene" offices and the mission hospitals. These "proofs" were presented in statistical tables in the last two volumes of the annual Medical Report for the German Protectorates, the *Medizinal-Berichte über die Deutschen Schutzgebiete für das Jahr 1910/11* (1913, pp. 179-185) and *1911/12* (1915, pp. 180-184).

Approximately one third of the 5,760 birth histories published in these “proofs” were reported by missionaries and the remaining two thirds by government medical personnel. In total, roughly half of the women (48%) were reported as being post-menopausal. Reanalyzing the raw data, we determined that these women had 14,640 live births, of which 5,531 died as infants, resulting in an overall infant mortality rate of 377, ranging from 328 for premenopausal women in the mission reports to 413 for premenopausal women in the government reports. Only 50% of the 14,640 children born to these women were alive at the time of the interview.

The accumulating statistics suggesting that less than half of the children born in *Deutsch Ostafrika* survived to adulthood exacerbated German anxiety over the future labor pool and prompted further investigation. The Chief Medical Officer, Dr. Meixner, requested that all district medical officials submit statistics similar to Schörnich’s Usambara study and the “proofs” recently published in the *Medizinal-Berichte*. Meixner summated the returns and published them in the 1914 *Deutsches Kolonialblatt*. His results were somewhat reassuring to the colonial government. Summating and reanalyzing the fourteen pages of data collected on 99 different tribes in *Deutsch Ostafrika*, the infant mortality rate for the 85,535 children in Meixner’s report was 228, the sex ratio was 102 male infants born per 100 female, and 41% of newborns died in childhood (*Deutsches Kolonialblatt*, 1914; Külz, 1918; Graham, 1921). (The statistics on the Chagga in Meixner’s report—probably contributed by Lutheran missionary Johannes Raum—indicated higher mortality than the report mean and much higher mortality than the children in the family registers: the infant mortality rate among the 167 children of the 85 Chagga interviewed was 461, the sex ratio was 143 male births per 100 female, and 50% of all children died in childhood.) In keeping with Peiper’s analysis, however, Meixner did

sustain the connection between infant and child mortality in *Deutsch Ostafrika* and native cultural practices. In the same issue of the *Deutsches Kolonialblatt*, in the pages immediately preceding his table of birth histories, is another article by Meixner providing a district-by-district analysis of “Infant and Child Feeding Practices in Deutsch-Ostafrika” (Meixner, 1914, pp. 354-364).

If the birth histories summarized in Meixner’s publication were actually collected, his study represents one of the most remarkable feats of demographic research. To interview 46,503 women in a single calendar year—collecting information on their age, tribe, marital history, number of miscarriages and stillbirths, number of children born alive and surviving, number of children who died before their first birthday, number of children who died after their first birthday, and their causes of death—would be a challenge in Tanzania today. To have done so 87 years ago, with limited roads, rails, communication, and without a reliable lingua franca, in a sparsely populated area among a people extremely distrustful of European authorities and without previous experience with survey research, would have been a Herculean accomplishment, if it were truly done. Not surprisingly, the data quality appears uneven. The historical record suggests that while some physicians undertook the surveys themselves, others delegated the responsibility to orderlies or other subordinate staff (Clyde, 1962, p.47). Unfortunately, unlike the statistics provided in the *Medizinal-Berichte*, Meixner’s summary table does not state who collected birth histories. In fact, the arrangement of the table by tribe and the different locations where tribe members were interviewed (which usually included Dar es Salaam and the plantation areas) suggests that the data were rearranged and that the information on any given tribe was collected by more than one researcher.

It would seem that such an enormous study would have put to rest rumors that infant and child mortality in the German colony was markedly different from that in the metropole. As Ludwig Külz writes in his 1919 review of the study, the percent of children dying in infancy in *Deutsch Ostafrika* (23%) was the same as the percent dying in Saxony that year (Külz, 1919, Table III). However, other reports were published, particularly from missionaries, which continued to posit extremely high rates of infant and child mortality. If government officials and other supporters of the colonial regime might have been predisposed to find that the native mortality rates were not as dire as suggested, the opposite might be said of the missionaries, who were generally inclined to believe that the native population was threatened with extinction. The suggestion that *Deutsch Ostafrika* was being depopulated both substantiated the missionaries' criticisms of the colonial administration and confirmed the need for their own project of Christianization and "civilization." That project of overcoming the "destructiveness of 'animistic beliefs,'" it was implied, would lead to the preservation of infant and child life (Håkansson, 1998, p. 1764). "The missionaries," Håkansson writes, "had an interest in showing both catastrophically high mortality figures as well as great improvements supposedly due to their own efforts" (Håkansson, 1998, p. 1769).

One of the first missionaries in *Deutsch Ostafrika* to publish on infant and child mortality was Dr. Jakob J. Dannholz. When his district office solicited information on infant and child mortality in the regions, Dannholz requested that the local chief send fifty women to his house. Of the 282 children that the women reported in the birth histories, only 84 (30%) survived infancy (Håkansson, 1998, p. 1764-1765). Extrapolating from this sample, Dannholz wrote his study, published in 1914, which reported that infant mortality in the region ranged from 50-70% and that, when this figure was combined with mortality in later childhood,

roughly 1 in 5 children born survived to adulthood (Dannholz, 1914, pp. 123-127). His study was consonant with the reports of other missionaries: a Catholic priest wrote that between 1910 and 1913 in Ussambiro, 72-80% of infants died within their first year, and a Leipziger missionary estimated that “among the heathen” in Wilhelmstal District, 75% of newborns died in infancy (Peiper, 1920, pp.388-389).

The most influential missionary report, however, was that of Carl Ittameier, who did not report such high mortality rates. His study, conducted in 1912, won the *Kolonialinstituts* contest and should have even enjoyed wider circulation than it did, its publication being delayed by the War until 1923. Ittameier’s study is of particular importance to this paper, moreover, as it was conducted among the same people and during the same period as the Kilimanjaro dataset presented above. Ittameier collected abbreviated birth histories from 2,901 Chagga women from the various Kilimanjaro districts, asking the following: whether the woman was living in a monogamous or polygamous marriage, whether she was pre- or post-menopausal, how many children she had birthed, how many of those were born alive and how many were stillbirths or miscarriages, how many of the children who died after birth died before weaning and how many died after weaning and before puberty, and of the children who died while still nursing, how many died from lung ailments, digestive ailments, infections, other causes or unknown causes. Ittameier found that the birth rate was low and the infant and child death rate high. Summating his tables, one finds that 36% of live-born infants died before weaning, and an additional 7% died after weaning and before puberty.

Because Ittameier had a very large sample size and because there was possibly some overlap between the women entered in the family registers and the women Ittameier interviewed, the discrepancy between the levels of infant and child mortality calculated from

the registers and the levels he reports must be interrogated. Though Ittameier, like Peiper and the others before him, does not describe his sampling or interview method, and though the lack of detail in his data makes careful comparisons with the parish registers difficult, fortunately the discrepancy can be understood without this information. It is possible to disaggregate from his tables the death rates for children born to women who were postmenopausal at the time of interview from women who were premenopausal. Of the children born to women who were postmenopausal in 1912, 19% died before weaning and only 47% survived to adulthood. The children born to women who were premenopausal in 1912 fared better, with 14% dying as nursing infants and 67% surviving to adulthood. Restricting our Kilimanjaro data set to children born to women who would have been premenopausal in 1912 and running a life table analysis for survival from birth to three years (an approximation of the age of weaning, Moore, 1977, p. 57), we found that 12.2% of children died before weaning and that 77.5% survived childhood. Thus, despite Ittameier's overall finding of higher infant and child mortality than the overall parish register showed, restricting both data sources to the years of their overlap minimizes the apparent discrepancy. Moreover, the higher mortality of children born to women who were postmenopausal when Ittameier interviewed them raises the possibility that from colonial conquest in the mid-1880s to 1894, when the parish registers began, infant and child mortality may have been higher—a possibility all the more plausible in light of the disasters that occurred during that period.

By the time Ittameier's study finally appeared in 1923, *Deutsch Ostafrika* had become Tanganyika Territory, a British League of Nation's Mandate. The region's new status, together with the vagaries of the world economy, muted concern over the reproduction rate of the colonial labor force, and the British administration gave considerably less attention to

demographic surveys than had the previous German one. The so-called census of Tanganyika in 1921 was largely produced by multiplying the old German taxpayer roles by arbitrarily produced ratios of taxpayers to dependents (Colwell, 2000). Also in 1921, the District Officer in Kilimanjaro, Charles Dundas, reported to the Director of Medical Services that the 34 Chagga chiefs he interviewed had an average of 9 wives each and that each wife bore an average of 2.5 children, of whom only two thirds survived. The 67% survival rate of this much smaller sample, it should be noted, is the same as that of the children of premenopausal women Ittameier interviewed in 1912. Another District Officer, Philip E. Mitchell, reported a survey of the Fipa along the shores of Lake Tanganyika. Fipa women, Mitchell wrote, had an average of 3.4 children, of whom less than half survived (Great Britain, 1922, p. 8.). In 1924, in neighboring Kenya Colony, F. J. Carlyle Johnstone collected birth histories from 2591 women in central Kavirondo District, northwest of Kilimanjaro. Johnstone's statistics—that the 7843 children experienced an infant mortality rate of 413 and that only 43% survived childhood—were published in *the Transactions of the Royal Society of Tropical Medicine and Hygiene* and then reprinted in the journal of the Kenyan and Tanganyikan branches of the British Medical Association (Johnstone, 1924; Johnstone, 1924). Enjoying wide circulation, Johnstone's figures buttressed assumptions that Tanganyika's infant and child mortality rates were correspondingly high.

The results were never published from the only other study of infant and child mortality in Tanzania completed before the last family registers were retired in 1936. Between 1927 and 1931, the British colonial administration in Tanzania initiated the Kahama Maternity, Child Welfare and Health Investigation, an investigation designed, in the words of Governor Cameron, “ to ascertain whether there is any truth in the repeated statement that the natives

are diminishing rather than increasing in numbers” (Clyde, 1962, p. 128). Though the global economic crisis forced the already cash-strapped administration to abandon the Investigation before many of its components were even begun, the Investigation’s initial survey suggested that infant and child mortality in Kahama were lower than expected. Even among sick infants and children in the field hospitals established in the Kahama survey era, only four percent of the pediatric admissions died (Colwell, 2000). Additionally, a territory-wide census undertaken in 1928, the year after the Kahama Investigation was initiated, which also suggested lower mortality and higher fertility than expected (Taeuber, 1948, p. 108; Colwell, 2000). However, the belief that mortality was high and fertility low had become so entrenched that no official report on either the Kahama Investigation or the 1928 census was ever published (Taeuber, 1948, p. 72; Dubester, 1950, p. 39; Domschke, 1986, p. 447).

The contemporary demographic studies conducted by colonial administrators and missionaries contextualize the levels of infant and child mortality revealed by the family parish register; let us now briefly contextualize the use of the parish registers themselves. Three major studies using African parish records from former British colonies have been published. The first, by A. M. M. Nhonoli in 1954, examined the parish records of the Ndala mission in Unyamwezi, Tanganyika, and reported the infant mortality rate for 1941-1952 to be 308, ranging from 462 in 1942, a year of famine, to 145 in 1948, a year of low but adequate rainfall and thus low malaria (pp. 3-5). The second study, by J. Katzenellenbogen, D. Yach, and R. E. Dorrington, examined three birth cohorts (1837-46, 1870-1879, and 1900-1909) reconstructed from the Moravian Mission at Mamre in Western Cape, South Africa, and reported adjusted infant mortality rates for males and females ranging between 156 (females in 1900-1909) and 211 (males in 1837-46). Lastly, in 1996, Veijo Notkola published his analysis of the 1925-1990

Ovambo parish records from the Evangelical Lutheran Church in Namibia. Because the mean birth-baptism interval in his data set was six months, suggesting that a significant number of deceased infants were not registered, Notkola used the Coale-Demeny model life tables to produce an estimated infant mortality rate of 110-140. The data of Nhonoli and Notkola have sex ratios of under 100 male infants to female infants (95 and 97 respectively), while the data of Katzenellenbogen have a sex ratio of 125 male infants per 100 female infants.

Discussion and Conclusions

By 1936, when the last of the Kilimanjaro parish family registers were retired, the assumption was well established that East African infants and children in the colonial era experienced high mortality, as they had from time immemorial. The statistics from family registers, however, suggest that between 1894 and 1935 the Christians on Kilimanjaro and experienced infant mortality rates comparable to regions of Germany, Italy, Austria, and England during part or all of that same period (Knodel, 1974, p. 156; Del Panta, 1997, p. 15; Viazzo, 1997, p. 64; Woods, 1997, p. 81). That the infant mortality rate between 1894 and 1930 on Kilimanjaro was 142.7 is significant, furthermore, given the extreme duress that the population experienced during those years: the social upheaval of colonial conquest, the local rebellions of 1891-93, the Maji Maji Rebellion, and World War I, when Tanzania was, at times, as muddy and lethal a battlefield as Flanders; the economic disruption as the local markets shifted to colonial production schemes, followed by the economic downturns of the war years and then the global market crash of the late 1920s and early 1930s; the ecological disasters of rinderpest, droughts, and locusts; epidemics of smallpox, sleeping sickness, measles, Spanish

Influenza, and cerebral-spinal meningitis; and famines. It seems reasonable to assume that if infant and child mortality were comparable to Europe during this period of synergistic tragedies, then they were not likely to have been substantially higher earlier in the nineteenth century, when warfare was conducted with fewer firearms, when lower population mobility spread epidemic diseases less widely, and when the economy was geared more to diversified production for local consumption than to cash-crop monoculture for overseas markets. The data from Kilimanjaro, therefore, provide support for the proposition that mortality in at least some areas of precolonial Tanzania was moderate and not high, as assumed by many colonial administrators and missionaries and, later, by the popular understanding of the demographic transition theory (Koponen, 1986, p. 41). Furthermore, the reanalysis of the data from some of the contemporary colonial also suggests infant mortality was also modest in other parts of German colonial Tanzania. The famed anthropologist and erstwhile scribe of some of the Kilimanjaro registers, Bruno Gutmann, cautioned that the “dreadful statistics” on infant mortality in *Deutsch Ostafrika* “bear for the main part witness only to disasters of the new times” (Gutmann, 1925, p. 144; Koponen, 1986, p. 41).

Equally well-established as the assumption of high precolonial and colonial mortality was the assumption that the colonial regime’s biomedicine and its steps against unsanitary and otherwise harmful native cultural practices drove down mortality in East Africa. The Kilimanjaro data dispute this assumption also. As Figures 3 and 4 indicate, despite almost a half-century of Christian missions on Kilimanjaro, during which time biomedical services were supposedly extended and European hygiene and domestic practices adopted, the levels of infant and child survival did not improve significantly and may, in fact, have worsened.

On reflection, this is not so improbable. The armamentarium of the European physicians and nursing sisters on Kilimanjaro during this period did not include antibiotics, and while it did include quinine, malaria was not as endemic at the higher altitude of Kilimanjaro as it was on the plains and coast. Other biomedical treatments introduced on Kilimanjaro may have been ineffective or possibly even dangerous and the crude hospitals may not have improved the survival of the sick and may possibly even have facilitated the spread of their sicknesses. Moreover, access to biomedicine between 1894 and 1935 should not be overstated. The government hospital in Moshi was a military institution until 1906 and even afterward treated only a restricted number of native patients, most of whom were adult males. The Lutherans also operated a hospital during this period, which opened in Machame in 1902 and was staffed by one German physician through his death in 1907 who was assisted in 1905-1906 by one German nurse. Between 1909 and 1914, Dr. Carl Ittameier and two nurses reopened and staffed the Machame hospital until World War 1 intervened and Ittameier and one of the nurses left. Two other German nurses came to assist the one remaining and even opened a dispensary in Mwika in 1917, which they operated until all the German nationals were expelled from the now British Territory of Tanganyika between 1920 and 1925. The Lutheran services were resumed and expanded, however, between 1926 and 1935 (*Africa in German Missions Archives Website*, 2000; Kiesel, 1993, p. 6-7). The Catholic services were not begun until the arrival of three medically trained nuns from the Precious Blood convent who opened their first dispensary in 1921 and their second in 1924. Very little information is available on the services that they offered before World War II. The government and mission biomedical services even on Kilimanjaro had difficulty retaining a regular staff, the numbers being reduced by illness, home leave, and even death. Nineteen of

the fifty-four Precious Blood sisters in Kilema before World War II died prematurely on Kilimanjaro (Centenary Committee, 1990, p. 107). In sum, the biomedical services available were neither extensive nor always fully operational.

Additionally, it is questionable whether the native practices against which the colonial administration legislated and the missions preached actually changed and whether the changes the colonial regime did effect were beneficial in toto. Infants may have benefited, on the one hand, from receiving colostrum rather than gruel during their first days of life (Binka et al., 1995; Moore, 1986, p. 110) but been harmed, on the other hand, by the shorter birth intervals that may have followed the exhortations against polygamy and postpartum abstinence practices. The relative healthfulness of the often-unmaintained colonial-mandated pit latrines versus older customs of waste disposal can also be debated.

“Africa remains largely terra incognita to the student of mortality” was the quotation that began this paper. The student of mortality, however, should not replace the pluripotent unknown with either unfounded assumptions or overgeneralizations. Hence, we do not advocate replacing the old assumption of high and then falling mortality in the precolonial and colonial “terra incognita” with the generalization from our data of moderate and possibly rising mortality. Instead, we must consider carefully the degree to which the parish data on Chagga Christians can be extrapolated to Kilimanjaro and the degree to which the experience of Kilimanjaro can be extrapolated to other East African regions.

In the section on representativeness and reliability, we argued that the history, pattern, and motivation for conversion and the location and limited authority of the mission combined to mitigate differences between Christian families in the parish registers and the other Chagga peoples on Kilimanjaro. In the previous sections, we argued that the pattern of infant and

child survival on Kilimanjaro was not atypical or unexpected, that the methods of data-recording did not appear to significantly influence the results, and that the results are consonant with the more reliable government and mission demographic studies produced concurrently. The children in the Kilimanjaro family registers experienced lower mortality than children in the devastated area visited by Peiper in 1909, and similar mortality to the children born to the premenopausal women interviewed by Ittameier, children who would have been born at roughly the same time and place. Lastly, the infant mortality rates derived from the Kilimanjaro parish records are not inconsistent with those of the other parish record studies: the infant mortality rate from our data set is similar to the low-malaria year in Nhonoli's study, slightly lower than in the less hospitable Ovamboland of Katzenellenbogen's group's study, and slightly higher than the more recent (1925-1990) data of Notkola's study. The families in the parish registers, we conclude, are broadly representative of Chagga families on Kilimanjaro.

The same peculiarities of Chagga history and geography, however, that made the Christians representative of their natal communities make the Chagga as a people unrepresentative of most other Tanzanian ethnic groups. Unlike the peoples of the coast and the plains, the Chagga were somewhat buffered against droughts, famines, raiders, and many water- and vector-borne diseases by the mountain's favorable ecology, geology, and climate. The mountain's bounty and location, moreover, enabled the Chagga to enter into and gain some control over the precolonial trade economy which, in turn, better positioned their consolidating leadership to negotiate with and temper the influence of the European missionaries, military men, administrators, and settlers drawn in ever-increasing numbers to

their prime real estate. Few other Tanzanian peoples were so well positioned and almost none capitalized so shrewdly upon their strengths as did the Chagga.

If the Chagga are unusual, why should one care about their demographics? First, because there were other exceptional communities: other mountain regions in Northeast, East Central, and Southwest Tanzania also enjoyed relatively fertile soil, regular rainfall, and a healthful climate and, consequently, also attracted the early and intense interest of missionaries and settlers. Historical demographers of Europe describe an “Alpine Pattern” of mortality which functions as a single “demographic regime” typified by lower mortality than the surrounding lowlands (Viazzo, 1989; Viazzo, 1998). It is probable that the East African mountain communities also share a demographic regime and that the Chagga are exemplary of it. Second, knowledge of this African community serves both as a better-case scenario, to be read against worse-case scenarios such as Peiper’s Kilwa, and possibly as a harbinger of demographic change in Tanzania. According to preeminent Tanzania scholars Moore, Koponen, and Iliffe, Kilimanjaro was among the first, if not the first, community in the colonized territory to show evidence of the soon pervasive rise in fertility during the first decades of this century (Moore, 1977, p. 5; Iliffe, 1979, p. 316 footnote 1; Koponen, 1994, pp. 560, 603). Moreover, Hollos and Larsen, and Vavrus have identified Kilimanjaro as the region at the vanguard of the East African fertility decline in the last years of the 20th century (Hollos and Larsen, 1997; Vavrus, 1998). It is possible that mortality, like fertility, on Kilimanjaro might foreshadow changes in Tanzania. This would be particularly likely if fertility change and mortality change covaried, a relationship of continued attention among European historical demographers and one we intend to explore for colonial Kilimanjaro using the family and death registers.

Should the Chagga on colonial Kilimanjaro serve as harbingers of mortality trends in Tanzania, their mortality between 1894 and 1935 indicates arenas in which further investigation might prove fruitful. First, their mortality pattern, as indicated, problematizes the assumed relationship between mortality, biomedical care, sanitation, and domestic practices and childcare practices. Perhaps a threshold had not yet been met and that once a critical level of biomedical services was available and enough cultural practices were changed, a real decline in infant and child mortality began (the infant mortality rate in the Northern Highlands of Tanzania in 1996 being 41 and the under five mortality, 69) (*Tanzania Demographic and Health Survey 1996*, 1997, p. 99-100). Alternatively, it is possible that biomedical services and the extinction of certain cultural practices may have contributed less substantively to the mortality decline but have nonetheless long overshadowed or entirely obscured other factors. We intend to explore these questions using the family registers in tandem with the death registers, which cover the years 1894-1961, and with a detailed social history of Kilimanjaro (Colwell, 2000).

Another arena to interrogate is whether the apparent lack of significant mortality change between 1894 and 1935 reflects a relatively unchanging pattern of mortality or whether the constant level is the result of zero-sum changes. The 1894-1935 time period was one of substantial political, social, and economic change on Kilimanjaro and it is possible that while the level of infant and child mortality was largely unchanged, the pattern and distribution of deaths did change. It is our hypothesis that the colonial administration's buttressing of chiefly, patriarchal authority, together with the introduction of coffee and other cash crops, redistributed wealth and power on Kilimanjaro and that the resultant social strata experienced different levels of infant and child mortality. We intend to use the family and death registers to

explore this possibility, particularly the clustering of mortality within families, a situation already hinted at in the cohort data.

One such hint is the spike in mortality among five to nine year olds in Figure 4. The mortality spike corresponds to the thirteen girls and six boys born between 1910 and 1913 who died between their sixth and tenth year. Though the conditional probability of dying between the sixth and tenth year was 0.048 for boys and 0.057 for girls born 1894-1935, it was 0.070 for boys and 0.122 for girls born 1910-1913. It was the Spanish Influenza, which ravaged Kilimanjaro from mid-November 1918 to early-March 1919, that was responsible for the excess of deaths, but it is interesting to note the greater vulnerability of girls in that epidemic. Mortality among the siblings of those five to nine years olds, moreover, was significantly higher than the mean for the data set, suggesting that infant and child death cluster in families.

Lastly, there is yet another demographic assumption about East Africa that we hope will be challenged, an assumption we ourselves made in the introduction. We hope to be proven wrong that our data set is unique and to learn instead that there are more written sources of historical demography for Africa than has been believed. Certainly more parish registers exist, though their reliability and utility remains to be determined. As Håkansson has argued recently, the demographic and ethnographic work done by the German administration in Deutsch Ostafrika has been underutilized (Håkansson, 1998, p. 1770). Perhaps further archival research might make it possible to winnow the data from Meixner's 1914 study, separating the wheat, such as Peiper's contribution, from the chaff of the manufactured statistics. There are hopeful avenues into the British-era demography of Tanzania; we have learned, for instance, that the raw data from the late colonial East African Medical Survey may

still exist. Perhaps the data from the Kahama investigation, the 1928 census, or the 1948 samples might also be found and reanalyzed.

The “student of mortality” has had some questions answered and many new and interesting ones raised as the demographic history of Europe unfolds. A more nuanced demographic history of Africa is—or, more precisely, a number of nuanced histories of different demographic regimes are—needed. The exploration of the demographic history of Europe began in earnest after Europe had already passed through its transition to low fertility and mortality. Africa, in contrast, is currently in the midst of a major population change and presents historical demographers with the opportunity to identify variables and patterns correlated with the past mortality decline, information which could be employed to promote further gains in infant and child survival.

Appendix:

Data Collection, Censoring, Manipulation, and Tests:

The Lutheran and Catholic family records were collected in during April and May of 1996 from several locations in the Kilimanjaro region. Though the Lutheran mission stations at Moshi-Kidia and Machame probably also had family registers, along with baptism, confirmation, and death registers, only five volumes of Lutheran family registers were recovered: two complete volumes each for Mwika and Mamba parishes and one partial volume for Masama. With the permission of the KKKT Lutheran Center and the assistance of Jane Mateyo, Asia Makundi, and Janet Lefroy, arrangements were made for all five volumes to be photocopied. Colwell then translated the photocopies from German, entered the data

into a spreadsheet program, and then rechecked the data for accuracy. The 319 family records provided information on the children born to 381 women.

The records for the six Catholic sub-stations came from a single bound volume. Because of the loss of the second volume of the *Familiae Christianae*, the Diocese did not permit this remaining volume to leave the Kilema station for photocopying. Instead, with Father Benedict's permission, Father Mark and Sister Laurentia graciously hosted Colwell at Kilema while she made two sets of dictations of the substation records. Using the first set of dictations, Colwell translated the records from French and Latin into a spreadsheet program and then used the second set to double-check the data. The number of Catholic families entered totaled 288, providing information on the children born to 324 women.

The data available on each family depended upon the family's conjugal structure (whether polygamous, formerly polygamous but now monogamous, or monogamous), the pattern of conversion (whether one, some, or all of the adults in the family converted), and the age at conversion (whether the converts were baptized in childhood or adulthood). The registers recorded four general family conversion patterns. The first is the simultaneous conversion of monogamous adults who were baptized along with their children and then had their "pagan" marriages sanctified by the missionary. Toward the end of the record period, a second pattern emerged in which young adults who had been raised in the church married, began their families, and remained in monogamous unions. The third pattern consists of the conversion of only one member of a monogamous or polygamous union, while the fourth and most complicated pattern was the conversion of more than one member of a polygamous household.

For both the Holy Ghost Fathers and the Lutheran missionaries the first two patterns posed no major theological or transcriptional challenges. Both the Fathers and the missionaries entered the monogamous couples in the registers at the time of their marriage. The Fathers would list the couples' names, baptism year, and marriage year, and the names and baptism date of the children born before their parents' conversion. Thereafter, they would update the record with the names and birth dates of subsequent children and the marriage and death dates of the listed family member. The Lutheran missionaries maintained even more detailed records of the monogamous baptized couple. In addition to the basic record entered by the Fathers, the Lutheran missionaries also included information on the couples' parents (names and whether or not they survived), the place of the life events, and, as described above, estimates of the birth year of the husband and wife and of any children born to them before their conversion. Thereafter the Lutheran records would be regularly updated, including both the date (month, day, and year) of subsequent events (births, baptisms, confirmations, marriages, and deaths) and the cross-reference to the corresponding registers (baptism, confirmation, and burial).

The Fathers and the Lutheran missionaries differed more in their record keeping of the third and fourth family patterns. The Fathers, who maintained a comparatively laissez-faire attitude to polygamy, used the same basic record format for all families. For polygamous families, all members of the household would be listed, the children listed under their respective mother's name. Household members who converted would have a baptism date recorded; those who did not, would not. In fact, while the Fathers expected monogamous couples to remain so, there are a few cases where men began second families after their conversion to Catholicism. In those instances, rather than force a divorce from the first wife

or declare the children of the second illegitimate, the Fathers simply added the new family to the existing record. In contrast, the Lutheran missionaries did not sanction any polygamous marriages, including pre-baptism ones. In their registers, they would not list more than one wife on the left-hand page. (If, however, as was often the case, a man was a widower who remarried, his subsequent wives would be listed with all the pertinent information of the same left-hand sheet.) A polygamous husband who converted to Lutheranism would then have the choice of having no recognized wife, of marrying one of his wives and divorcing the others, or, probably to the annoyance of the missionaries, divorcing all his wives and taking an altogether new and younger woman as his Christian wife. In the first instance, the register would list just the man on the left-hand page; on the right, the mothers' names would appear written above the information on their children. In the other two instances, the full information on the Christian wife would appear on the left-hand page while, again, just the names of the previous wives who had surviving children would appear on the right. Polygamous wives who converted to Lutheranism but did not become their husband's Christian wife would receive their own page in the register, as would women married to "heathens." Probably because of the opportunity for education in the mission schools, in cases where only one parent converted there is no mention of the non-Christian parent objecting to the inclusion of his or her children in the parish registers.

The censoring has been described in part above. Because of the lengthy conversion process, the left censor was set to the birth date of all children born after the conversion of one of their parents rather than to the birth date of all children born after the marriage of their parents. In the data base, there were 51 children born after their parents' baptism but before their Christian wedding; in 46 of those cases, the children's birthday, month, and year were

recorded, while in the remaining five, the birth month and birth year were recorded. In three of those cases, the infants were recorded as dying before the Christian marriage occurred. It thus appears that once parents had begun the process of converting, the children born to them were included in the registers, regardless of the children's ultimate survival, and were recorded with sufficient detail to be included in the data base.

As for the right censor, the list of censoring events is described above and includes the date that a child was orphaned and the date that the register was closed. Like the decision to use baptism rather than marriage in the left censor, the decision to use the death of both rather than the death of one parent follows from an analysis of the cases involved. The family record continued to be updated after the death of one parent in 65 of the 92 instances. (That a family's record was not updated did not necessarily mean that they fell from observation but that no births, weddings, or deaths occurred between the parent's death and the register's closure.) However, the family record was updated after the death of both parents in only 3 of 8 instances. Thus, for orphaned children the likelihood that the children had either been placed away from the parish or with a non-Christian family was twice as high. As for the censoring at the closure of a parish register, in the Lutheran parishes of Masama, Mamba, and Mwika, the registers were closed, respectively, on 10 January 1913, 2 July 1920, and 5 August 1920. The register in the Catholic substations of Utawa was closed 16 June 1910; of Leo, 16 July 1934; of Marawe and Mulo, 16 March 1935; of Mkyashi, 10 April 1935; and of Kilema Chini, 25 February 1936.

To clean the data, we checked to make sure that all calendar months and days were in the appropriate range (only two such mistakes were found). To test the data, we adapted the "Tests for Logical Errors in Reconstitution Data" described in Appendix 4 of Wrigley, Davies,

Oeppen and Schofield's *English Population History from Family Reconstitution, 1580-1837* (1997, p. 574-577). Appendix 4 provides a set of six tests to catch gross errors—i.e., individuals who were recorded as baptized or dying before their birth—and to alert to unlikely circumstances, —i.e. individuals who died 105 years or more after their birth, who married under age 15 or for the first time after age 60, or who were born more than 300 days after the death of their father or less than 270 days after a surviving sibling. Beside four instances where the children were listed in the incorrect birth order and two additional typographical errors, there were 9 observations that failed the various tests. After consultation with the original records, we decided that these failures were nonetheless plausible.

Lastly, several passing references were made in the above to the Lutheran death registers, which were procured at the same time, in the same manner, and with the same gracious assistance as the Lutheran family registers. The format of these registers is more straightforward, with the calendar year recorded at the top of each page and below, in numbered rows, the information on the deceased parishioners. In each row, from left to right, the following data is entered: the date, hour, and place of death; the date, hour, and place of burial; the deceased's full name and sex, if an adult, or the first name and parents full names, if a child; the deceased's age in years, months, and days; whether the deceased were single, married, divorced or widowed; whether the deceased had children and, if so, how many of each sex; the cause of death; and name of the burial officiate and grave location. Collected were three volumes from Moshi-Kidia (1897-1961), one from Mwika (1907-1951), two from Mamba (1908-1962), and one from Masama (1939-1952). The data from these volumes, comprising 11,287 deaths from the colonial period, have also been translated, entered, and cleaned.

Acknowledgement

This research was supported by a National Institutes of Health NRSA F32 grant: HD 084575-02. Stacie Colwell and Ulla Larsen wish to thank Rick Canning, Frances Vavrus, and Lisa Richey for their always-helpful comments and to thank Sid Atwood for his patient assistance with the programming. Stacie also thanks the Evangelical Lutheran Church of Tanzania in Moshi and the Catholic Diocese of Moshi for permission to use their parish registers and to Jane Mateyo, Asia Makundi, Janet Lefroy, Father Mark, Father Benedict, and Sister Laurentia for their gracious and good-humored assistance in obtaining the raw data.

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Figure 1. The probability of survival by age for Catholics and Lutherans on Kilimanjaro, 1894-1935.

Figure 2. The probability of survival by age for boys and girls on Kilimanjaro, 1894-1935

Figure 3. Infant mortality rate on Kilimajaro, 1894-1935

Figure 4. The conditional probability of dying by age and by birth cohort on Kilimanjaro, 1894-1935

Table 1. The conditional probability of dying by sex and age for children born on Kilimanjaro, 1894-1935

Moreover, progress in reducing child mortality has been accelerated in the 2000â€“2018 period compared with the 1990s, with the annual rate of reduction in the global under-five mortality rate increasing from 2.0 per cent in 1990â€“2000 to 3.8 per cent in 2000â€“2018. Despite the global progress in reducing child mortality over the past few decades, an estimated 5.3 million children under age five died in 2018â€“roughly half of those deaths occurred in sub-Saharan Africa.Â Infant mortality rate: Probability of dying between birth and exactly 1 year of age, expressed per 1,000 live births. Neonatal mortality rate: Probability of dying during the first 28 days of life, expressed per 1,000 live births. News, comment and features on infant and child mortality, exploring where and why children die in the developing world.Â Spending on health will double by 2025, with India intent on improving its record on mortality of mothers and infants. Published: 14 Dec 2018. Healthcare to get \$100bn boost as India aims to cut maternal deaths.