Age-for-grade heterogeneity and primary school dropout in Karonga district, northern Malawi: Causes and consequences

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ABSTRACT

Age-for-grade, a marker for school progression, is defined as the extent to which pupils are underage or overage for their grade. This thesis explores the causes and consequences of age-for-grade heterogeneity and its influences on school dropout and life transitions. Data for the analyses originate from a demographic surveillance site in a population of about 36,000 in Karonga district, northern Malawi. Linked surveys include data on socio-economic status, schooling, sexual behaviour, pregnancy and marriage.

The first paper examines the effects of growth faltering (low height-for-age or stunting) in early (11-17months) and late childhood (4-8years) on school outcomes (age at enrolment, age-for-grade at age 11 and grade repetition) to explore early causes of delayed enrolment and poor school progression.

The main reason for being overage-for-grade is grade repetition. The second paper uses cross-sectional data on 8174 children in 2010, to examine the prevalence and risk factors (individual, household and school-level) for grade repetition in the following year.

Using longitudinal data from 2007-2015, the third paper examines the relationship between age-for-grade and primary school dropout, with school completion as a competing event. The median age of dropout for girls is 19, with almost 90% still enrolled at age 15. Those overage were more likely to drop out of school than those on track, with girls having a higher rate of dropout than boys.

The fourth paper shows that girls who were sexually active, as early as age 14, were five times more likely to drop out, while sexually active boys were twice as likely to drop out of school, compared to their sexually inactive peers. This was not explained by underlying poor school performance: the association with sexual debut and dropout was as strong among those on track in school as among those 3 or more years behind.

In a companion paper, the opposite relationship is examined. Being out of school was strongly associated with increased rates of pregnancy, of sexual debut for girls not boys, and of marriage for girls and boys. Age-for-grade as early as age 10 predicted age of pregnancy and marriage.

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DECLARATION OF WORK

I, Bindu Sara Sunny, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

ABBREVIATIONS

A4L- Assessment for Learning Initiative

DHS -Demographic Household Surveys

DSS -Demographic Surveillance System

DEMIS- District Education Management Information Systems

DEO- District Education Office

DEM- Division Education Manager

EFA- Education for All

ESCOM- Electrical Supply Corporation of Malawi

GPS- Geographical Positioning Systems

GABLE- Girls Attainment of Basic Education and Literacy

GAL- Global Alliance to Monitor Learning

GERs- Gross Enrolment Ratios

HAZ- Height-for-age z-score

HIV- Human Immunodeficiency Virus

JCE- Junior Certificate Examination

KPS- Karonga Prevention Study

MDG- Millennium Development Goal

NERs -Net Enrolment Ratios

PTAs- Parent Teacher Associations

PEA -Primary Education Advisor

PSLCE -Primary School Leaving Certificate Examination

PCA- Principle Component Analysis

MIITEP- Malawi Integrated In-service Teacher Education Project

MSCE- Malawi School Certificate Examination

MoEST- Ministry of Education, Sports and Technology

SMCs -School Management Committees

SSA -Sub-Saharan Africa

UPE- Universalisation of Primary Education

UNESCO- United Nations Educational, Scientific and Cultural Organization

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INTRODUCTION

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CHAPTER 1: INTRODUCTION

1.1 Introduction

Access to education is a fundamental right and an important catalyst for improving health outcomes, reducing poverty and gender inequality(1,2). The benefits of education are known, and include delays in age of marriage, reduced fertility levels and a reduction in maternal mortality(3). Health benefits gained are transferred to the next generation: higher vaccine uptake, lower childhood malnutrition and dramatic reductions in infant and under-five mortality were attributed to increased levels of maternal education(3,4).

Over the last three decades, progress to improve access to education has been steadily on the rise through the inception of the Education for All (EFA) movement in the 1990s, up to the recently launched initiative to meet the 2030 Sustainable Development Goals. As a result, significant gains were made with the number of children out of school being nearly halved; primary school Net Enrolment Ratios (NERs)[1] increased from 84% in 1999 to 93% in 2015; and gender parity was achieved in primary schools in 70% of countries(5,6).

However, despite progress made, 61 million children of primary school age were still out of school in 2015(6), with more girls than boys being out of school and with many more overage children who had not completed primary school not included in this statistic. In 32 countries, mostly in sub-Saharan Africa, almost 20% of children enrolled in school were expected to drop out prior to primary school completion(5). Learning outcomes for those in school were also poor with one in two children in primary school predicted to reach adolescence without the basic skills in reading and mathematics(7,8).

Malawi envisaged achieving the Millennium Development Goal (MDG) target of universalizing primary education ahead of the rest of the developing world and was the first country in sub-Saharan Africa(SSA) to introduce Free Primary Education in 1994(9). The opportunities of free education and the "open-door policy" of allowing children to enrol or re-enrol at any age or grade in school(10) led to a sudden surge in Gross Enrolment Ratio

[1] NERs for primary school are calculated as the ratio of students of primary school age enrolled in school over the total number of primary-age children in the population.

(GER)[2] to 138%. High enrolments lead to an over-burdened school system, with poor school quality(11), demotivated parents and children, higher levels of dropout, and completion levels remaining unchanged(10,12). School persistence declined drastically with only 35% completing primary education (8 years in Malawi) or 52% completing six years of primary, compared to 61% in SSA, highlighting substantial schooling inefficiencies which was counter-productive to any progress made so far(13).

Disinterest in school (48%), lack of fees/uniform to attend school (16%) and pregnancy or marriage (11%) were reported by students as the main reasons for dropping out of school(13). Poor school quality, manifested in inadequate resources, poorly qualified teachers, high student-teacher ratios (averages 80:1 for Malawi or >100:1 in rural areas) (13) was a possible pre-cursor for dropout.

The large extent of overage children in school suggests that school progression is slow and children are likely to enter adolescence, experience first sex, get pregnant and consider the prospects of marriage while still being enrolled in primary school(14,15). Sexual debut, early pregnancy and marriage are likely to conflict with schooling and contribute to dropout(16,17). Overage children are considered to be more likely to drop out of school prior to completion(18–20).

The dynamics of schooling and sexual debut are complex and are not well understood. Studies that have previously examined this have mostly been cross-sectional, addressing some but not all aspects of this intricate relationship. In Karonga district, the setting for my research, the median age of sexual debut was 17.5 for girls and 18.8 for boys. Girls who experienced early menarche (<14 years) had earlier sexual debut, pregnancy and marriage, and dropped out of school sooner than their peers; while those with later menarche had attainment levels similar to boys(21). At least 50% of girls reported pregnancy or marriage as the primary reason for leaving school, while those who remained in school had a higher probability of postponing sexual debut and marriage(21).

My thesis aims to understand the causes and consequences of age-for-grade heterogeneity (or the extent of being overage or underage for current grade) and school dropout, within the context of sexual debut, pregnancy and marriage that young people experience while in and out of school.

[2] GERs for primary school are calculated as children of all ages who are currently enrolled in primary school as a ratio of the total population of primary school-aged children in the population: ages 6-13years(primary); ages 14-17years(secondary)

1.2 Thesis Aims & Objectives

AIMS

The overall aims of this research are to examine the causes and consequences of age-for-grade heterogeneity and school dropout among those in and out of primary school in Karonga district, northern Malawi.

OBJECTIVES

The specific objectives of this research are to:

a. Examine the influences of nutritional status in early childhood on school enrolment and age-for-grade heterogeneity in school.
b. Clarify the relationship between age-for-grade heterogeneity and grade repetition in primary school
c. Ascertain the risk factors for school dropout, looking specifically at the influence of age-for-grade heterogeneity on school dropout
d. Understand the association between sexual debut as a risk factor for school dropout and whether age-for-grade heterogeneity confounds or moderates this relationship
e. Establish the effects of age-for-grade heterogeneity and schooling status (in or out of school) on sexual debut, early pregnancy and marriage

1.3 Thesis Overview

This thesis examines the causes and consequences of age-for-grade heterogeneity and school dropout among those in and out of primary school in Karonga district, northern Malawi.

Chapter 2 provides a background to the current status of schooling in sub-Saharan African and Malawi. I will elaborate on the context of schooling, looking specifically at the geographical, historical, political, economic and cultural context of schooling which influences education patterns seen in the country.

Chapter 3 reviews the literature on school dropout in order to develop a conceptual frame-work for my research.

Chapter 4 provides a description of the study setting, preliminary investigations carried out prior to the start of the study, data sources and methods used to answer each of my research questions.

The next five chapters (Chapters 5-9) present five papers that address each of the research objectives outlined earlier.

Chapter 5 examines the early causes of age-for-grade heterogeneity by examining the relationship between early childhood stunting and school outcomes (specifically age at enrolment, grade repetition in year one, and age-for-grade at age 11).

Grade repetition is one of the causes of age-for-grade heterogeneity. Using cross-sectional data for 8174 children in 2010, **Chapter 6** examines the prevalence and risk factors (individual, household and school-level) for grade repetition; and whether age-for-grade heterogeneity is not just a consequence but also a risk factor for future grade repetition.

Chapter 7 uses longitudinal data from 2007-2015 to extend the previous analysis by examining whether being overage for grade is associated with dropout, with school completion as a competing event.

The relationship between sexual debut and school dropout is examined in **Chapter 8**, looking specifically at whether school performance moderates or confounds this

relationship. This is looked at separately from other risk factors as the data on sexual debut were only available on a subset of the population.

Finally, in further investigating the consequences of school performance and dropout, **Chapter 9** examines whether age-for-grade heterogeneity and school status (being in/out of school) is associated with subsequent sexual debut, early pregnancy and marriage.

Each of the papers will include a brief overview of the literature, details on the study rationale, data sources used, methods of analysis, results, discussion of results and conclusion drawn from the findings.

Chapter 10 discusses the overall findings of my research and its implications on future research, education programmes and policies in Malawi; along with the conclusions

Appendices include appendices from previous chapters.

chapter 2
BACKGROUND

2

CHAPTER 2: BACKGROUND

This chapter provides a background to the current status and patterns of schooling in sub-Saharan Africa (SSA) and Malawi, highlighting the differences in schooling contexts by geographic area. As part of the background, I will examine the context of schooling in Malawi, looking specifically at the geographical, historical, political, economic and cultural context of schooling, which influences education patterns in the country. I will also examine the evolution of education policy; and how it continues to shape priorities and resource allocation within the education sector.

2.1 Introduction

Out-of-school children or those 'excluded' comprise of children who are of primary school age and have never enrolled in school; those who were in school but have now dropped out (19,22). Around 61 million children of primary school age (ages 6-11) are out of school around the world, with dropout proportions remaining stagnant since 2008(6). **Global trends** show that girls are less likely than boys to enter primary school, though boys are more likely to repeat a grade or drop out of school(23).

2.2 Schooling Trajectories in sub-Saharan Africa and Malawi

Sub-Saharan Africa

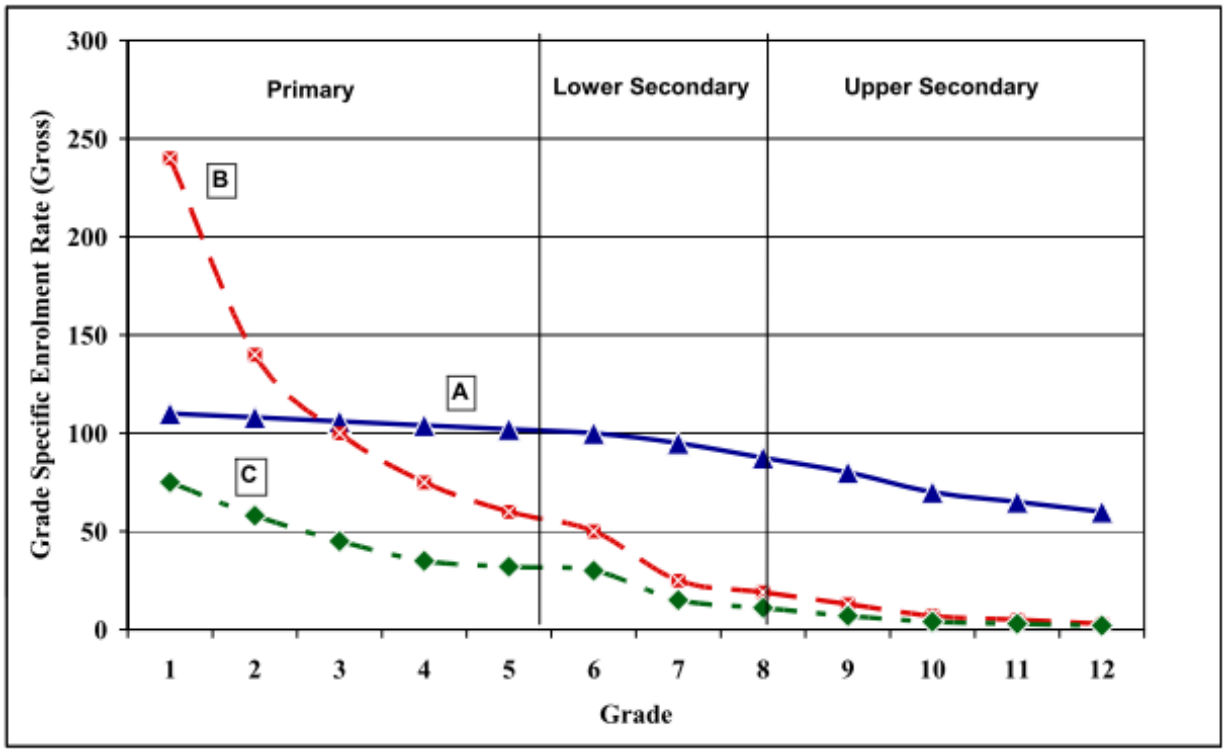
The burden of out-of-school children is highest in sub-Saharan Africa (21%) though has been on the decline(6). The region also bears the highest burden of global repetitions and the widest gender disparities in schooling across the world(23,24).

Most countries in sub-Saharan Africa are characterised as having high enrolments in early grades, high attrition in Standard 1, with fewer children making it to the end of primary school and transitioning into secondary(23). Since 2000, 15 countries in sub-Saharan Africa (SSA) adopted legislation to abolish fees in primary schools. As a result, 46 million children enrolled in primary school, resulting in a one-third increase in net enrolment ratios(24), although 13 countries in SSA still have net enrolment ratios below 80%(5).

In SSA, in 2008, just over half the children who enrolled in primary school started at the right age(24). Though girls are less likely to enrol in school, once enrolled, girls' persistence up to grade 5 is on par or higher than that of boys(5). Learning outcomes are also low: a child in eastern and southern Africa takes six or seven years to achieve the same level of learning as a child in developed countries completes in two to three years(25). In 2010, SSA had the highest level of dropouts at 42%, with most dropouts taking place in the first two grades of school(23). Dropouts were defined as those who had enrolled in school but had left prior to completing primary school(24). Children who are poor, living in rural areas or from ethnic or minority groups are most likely to drop out of school(24).

Using data from 40 countries in sub-Saharan Africa, Lewin et al and Ricardo et al (19,20)identified three main trajectories for school participation (Figure 1).

Figure 1 Patterns of school participation



Source: Reproduced from Lewin et al (2009), Sabates et al (2010)

Figure 1 shows three trajectories of school participation in sub-Saharan Africa. [A] countries with high participation, low dropout and high completion levels [B] are those with high enrolment in Grade 1, high GER>100% and high dropout rates.[C] are those with GER<100%, moderate dropout based on levels of participation in the early grades, progression and dropout in primary and secondary schools.

The first category includes countries with high participation rates across primary school with low dropout rates and high completion levels. Examples of countries in this category include South Africa, Namibia and Botswana (A in Figure 1). The second group of countries (B in Figure 1) are those with high enrolment rates in the first year of primary school, with high Gross Enrolment Ratios (GERs) over 150%. These countries have moderate to high dropout on account of overage enrolment and poor progression through schools. Examples include Malawi, Uganda, Rwanda, Kenya. The third category of countries(C) are those with GERs<100% indicating low uptake of primary education. These countries have low participation in Standard 1 (<85%), moderate dropout rates and completion rates below 50%. Examples of countries in the third category include Ethiopia, Senegal.

Malawi

In Malawi, despite high enrolment rates, completion rates were quite low with only around 40% of children managing to complete primary education (which is 8 years in Malawi). High enrolments in school do not guarantee learning: 96% of children in grade 2 were unable to read a single word in Chichewa, which is the national language and is taught

through primary school(26). Early disadvantages in learning only exacerbates at later ages and stages of school, with weaker learners being more likely to drop out of school (4). 35% of children in the first grade of school and 80% of those who persisted till grade 5 were overage by 2 or more years(18). Malawi, which has one of the lowest overall promotion rates in primary school (67%), had a clear positive relationship between age-for-grade and promotion: i.e. those who were overage were more likely to be promoted than those underage(18). Dropouts are low in the early grades but are highest in the last two grades of school (Standards 7-8)(18).

2.3 Schooling context in Malawi

Introduction

In 1994, Malawi became the first country in sub-Saharan Africa to introduce the Universalisation of Primary Education (UPE) policy, which aimed to make primary education free for all. This promoted an "open-door" policy allowing children to enrol or re-enrol in any grade irrespective of age(10), which lead to the influx of overage children into schools(10). This was done with very little prior planning and was followed by an unprecedented surge in primary school enrolments from 1.8 million to 2.8 million within a span of six months(9).

High enrolments lead to an over-burdened school system, with poor school quality(11), demotivated parents and children, higher levels of dropout and completion levels remaining unchanged(10,12). The introduction of UPE in Malawi was accompanied by a number of other policies including the ban on corporal punishment in schools, non-requirement of school uniforms, re-vitalising parent-teacher associations, changes in the curriculum, promoting the use of the mother tongue in the first four grades of school and decentralisation of activities at the district levels (10,27,28).

The next few sections provide a background on the context of schooling in Malawi. I specifically examine the geographical, historical, political, economic, socio-cultural contexts that influences the status of schooling in the country today.

Background

Malawi is a land-locked country located in the southern Africa region, bordered by Lake Malawi on the east, Zambia to the West, Tanzania to the North and Mozambique to the East and South. Malawi became independent from colonial rule in 1964 and became a Republic in 1966. The total population of the country is 18 million with approximately 90% living in rural areas and heavily dependent on subsistence farming, though only 20% of the available land is arable(9). Food shortages and high levels of malnutrition on account of the growing diversification of crops to cash-crop cultivation- mainly tobacco, tea and sugar- exacerbates the slow overall health, economic and social development of the country(9). In 2017, Malawi was ranked 170 out of 188 countries on the United Nation's Human development Index, with socio-economic indicators among the lowest in the world.

Malawi is divided into three regions (North, Central and South) which covers 26 districts. The population consists of ten ethnic groups, with the Chewa, Yao and Tumbuka being the dominant groups in the central, southern and northern regions, respectively. There are 16 languages spoken across the country(29), with Chichewa being the national language which is spoken mostly in the Central and southern regions, and Chitumbuka spoken in the north. Karonga district, which is the study site for this research, is located in the northern region of Malawi. The district has historically experienced higher levels of educational attainment, compared to the Central and the Southern regions.

The education system in Malawi is an 8-4-4 structure comprised of primary, secondary and tertiary education. Secondary education comprises of Forms 1-4 divided into lower and upper secondary of two years each. Tertiary varies between 2-4 years and includes technical and vocational education, primary teacher training diplomas and university education. The official age of entry into primary school is at age 6, with completion expected around age 14 assuming students progress through school on time. Completion of primary school is dependent on students' performance in the external, national-level Primary School Leaving Certificate Examination (PSLCE) at the end of Standard 8. In Secondary, completion of Forms 2 and 4 is based on successfully completing the Junior Certificate Examination (JCE) and Malawi School Certificate Examination (MSCE), respectively. The school calendar was set up in 1997 and is divided into three semesters or terms commencing in September and ending in July (previously January-November but changed with political leadership). Each term ends with a holiday of three-four weeks, with a two-month break at the end of the academic year(30).

The administration of schooling in Malawi is divided in three Regions in the country, the Northern, Central and Southern Regions; by six Education Divisions and 32 Education Districts[3]. The District and Divisional offices within each region are headed by the Division Education Manager (DEM) and the District Education Officer(DEO), respectively, who are responsible for the implementation and management of secondary and primary schooling, respectively, with the former reporting directly to the Ministry of Education, Sports and Technology (MoEST) and the latter reporting to the Divisional office. Karonga District lies within the Northern Division and contains 160 primary schools (including 12 private schools) and 32 secondary schools in ten education zones(31). Each education zone is managed by a Primary Education Advisor (PEA), who is responsible for

[3] http://www.unesco.org/education/wef/countryreports/malawi/rapport_1.html

approximately 15 schools within the zone and acts as the key liaison between the schools and the DEO, towards monitoring day-to-day progress and ensuring schools' compliance with education policies and regulations. At the school level, the head teacher is the key liaison between the PEA and the community, represented by Parent Teacher Associations (PTAs) and School Management Committees (SMCs).

Historical context

The origins of formal education date back to the arrival of Scottish missionaries in the northern region and the establishment of the first primary school in 1875. Education was considered as the means to deliver the message of the church with the curriculum being diverse enough to cover topics ranging from literacy, numeracy, religion and agriculture, to sports and artisan skills. The Dutch and the Roman Catholic (from Holland and France) missionaries who soon followed and settled in the Central and Southern regions disagreed with the notion of educating Malawians and instead focused on proselytization and provision of moral and religious education(32,33). This highlights the historical roots of educational access and disadvantage, which persists even today between the Northern, more educated and less impoverished region; and the Central and Southern, socially and economically disadvantaged regions.

Political context

Through the 1980's, a democratisation wave with multi-party elections led to the upheaval of the 30-year old dictatorial regime of Dr.H.K Banda and the formation of a new government with Dr. Bakili Muluzi at the helm. With impending pressure from international donors to improve access and delivery of basic education as a human right, one of the first acts of the newly elected President was the roll-out of the UPE in 1994. Using the UPE as a means to legitimize his electoral mandate and gain respect within the international donor community(9), the new policy was rolled out with very little understanding of its implications. Prior to this, the education system was already over-stretched and weakened by high student-teacher ratios of 70:1 with around 13% of teachers being unqualified (28). The need to provide trained teachers led to the creation of the Malawi Integrated In-service Teacher Education Project (MIITEP), which aimed to recruit and deploy 18,000 teachers in a shorter period than the conventional teacher-training programme. This was done to bridge the existing shortfall of 25,000 primary school teachers in schools(28); it reduced pupil-teacher ratios though at the cost of teacher quality. 90% of the teachers who were recruited had lower education qualifications (completion of lower secondary rather than upper secondary) and were trained for three months

(compared to the 1-2 year programme that was run prior to this)(10). Therefore the hasty roll-out of the UPE meant there were fewer qualified teachers recruited in schools(34), with new recruits provided with additional training only two years after the policy roll-out(10), which compromised overall school quality. After UPE more than half of teachers were not fully trained and pupil-teacher ratios were 119:1 (28).

Other policies that were also introduced in an attempt to improve girls' enrolment and persistence in schools, which are directly relevant to my research, included those on age at entry, repetition and pregnancy:

Age at Enrolment

During the USAID-funded Girls Attainment of Basic Education and Literacy (GABLE) Program, age at entry was set at a minimum of 6 years and a maximum of 12 years, to curb the enrolment of over-age children in school. However due to the absence of birth certificates and of alternative programmes for underage and overage children, this policy was discontinued (35). The open door policy of the UPE saw a growing surge of overage and underage children in school(36). Underage and overage enrolment are quite common in school, leading to GERs in primary >100%. Underage enrolment is common as parents perceive schools as providing free child-care while they work, and also allows younger siblings to accompany older children to school(30).

Grade Repetition

Under the GABLE program, repetition was capped at three-tiers: Standards 1-2 (18%), Standards 3-7(at 10%), and 25% in Standard 8. Lack of data management systems in school made it difficult to administer and track repetitions. However, repetition caps in Standard 8 were successfully implemented (35). More recently, the MoE had indicated the possibility of applying a cap on repetition at 10% of pupils per class in 2011 (37), but this has not yet been implemented.

Policy on teenage pregnancy and re-entry

Prior to the introduction of UPE, girls who got pregnant while in school faced the possibility of permanent expulsion from school(35). Interviews with teachers in southern Malawi revealed the use of mandatory pregnancy testing in schools (which also happened in schools in South Africa and Sierra Leone)(38). The expulsion policy was reviewed in December 1993 to allow girls, who were expelled from school on account of pregnancy, to re-enter school after a year(39,40). Though the revised policy also extended punitive

measures to boys who were responsible for a school pregnancy, girls were more likely than boys to be reprimanded and face expulsion from school. While similar policy initiatives have been implemented in other countries, like South Africa and Botswana(41,42), to encourage girls to re-enrol in school and complete their education, the implementation of such policies is deterred by negative student and teacher attitudes and stigma towards school pregnancies(41–43). Access to child care support, financial security and parental support were key determinants for girls to re-enrol and complete their education(43).

Economic context

Despite financial instabilities faced in the early 1990s on account of drought, rising inflation, currency depreciation, lower revenues and the cessation of funding from other donors, political opportunism dominated decisions to continue the roll-out of UPE(9,10).Prior to the introduction of the UPE, families of children attending school had to bear a significant share of the cost of education. In addition to fees, households bore other expenses like purchase of textbooks, exercise books, writing materials and school uniforms(36,35). Communities also had to contribute (finance and labour) to the construction and maintenance of schools. In the years prior to the UPE, Malawi went through a period of piloting several fee subsidisation programmes to assess if they had an impact on schooling. This included a tuition fee waiver programme in Standard 1, which was phased in in Standards 2 and 3 over two years. The USAID funded GABLE program waived school fees for nonrepeating girls in standards 2-8. The success of these programmes reinforced their underlying assumption that the costs of education were the greatest barrier for school enrolment(10,35).

The response to the changes brought in by the UPE was mixed. Malawi's recurrent budget for education had doubled, with an increased allocation of resources to cover teachers' salaries(28). The budget share towards primary education increased from 45% to 65%, with almost 40% of the primary education budget being financed by external donors(28). However, the conceptualisation of the UPE policy was rife in contention in its top-down, unplanned, donor-driven approach to implementation without adequate consultation with education stakeholders, which compromised quality for quantity. The Gross Enrolment Ratios (GER) soon after the introduction of UPE in Malawi was 138% (values over 100% imply enrolment of children outside the primary school age range). Despite greatly increased enrolment, only about one-tenth of them persisted until the end of primary(19) with higher dropout levels.

The abrupt implementation of the UPE amidst national and international pressure was perceived as an opportunistic political ploy to fulfil an electoral mandate, but also one that simultaneously compromised school quality and threatened school sovereignty(27). In financial terms, the new policy meant that capitation grants (to cover school costs) were no longer being sent to schools and instead resources were instead were decentralised to the district level, which affected school monitoring and provision of teaching and learning materials which had to be financed by parents(44). UPE was perceived as a relinquishment of responsibility by the state and an over-reliance on communities to deliver services(27,34,44). In contrast, at the national level, UPE was considered successful in the eyes of international donors, with a sudden boost in school enrolments and a simultaneous increase in borrowing to finance the implementation of the policy.

Socio-cultural context

Discriminatory attitudes towards girls' education is widely prevalent in Malawi, with even further restrictions on girls' mobility once they reach the age of puberty(36,45). The northern region of Malawi is mostly patrilineal and Christian, while the southern region is matrilineal, with lower levels of education attainment compared to the north. The cultural dominance of patrilineal property rights and patri-local residence in the northern region are thought to undermine the value of girls' education; while the practice of initiation rites, predominantly among the Yao and Chewa communities in the central and southern regions reinforces gendered roles that limit the role of the woman to the home. Initiation rites encourage girls to engage in sexual activity and marriage as a rite of passage into adulthood(35,46), which is a deterrent for schooling. Women fulfilled parenting, household and agricultural responsibilities(9). Low expectations of future employment of girls, marriageable prospects and future loss on investments push households to not send girls to school(36).

One of the positive outcomes from the introduction of UPE was the equitable access to education, increasing access to those economically and socially disadvantaged, including children from poorer households and girls. Gender disparities which were previously quite stark were soon on the decline with girls' initial enrolment in school being on par with that of boys by 2004(10,35). Despite these improvements, setbacks in school quality meant that those who could afford to pay would send their children to private schools, while children from poorer households attended but did not complete primary school.

By 2002, attrition levels were high with dropouts among girls far exceeding that of boys(36,35). Gendered roles within society may contribute to the disadvantages girls experience in participating in school (9). Discrimination towards girls may also be reinforced in teaching and school practices. A sign on the blackboard during a life skills education class, in a primary school in Karonga district read:

"Definition of gender equality - treating men and women the same

Men and women's different positions in life

Men: Rule Women: Respect

Men: School Women: Marriage"

(Based on correspondence from a volunteer teacher's observations in a primary school in Karonga district)

The next chapter will examine the literature on school dropout, looking specifically in the context of poor progression and sexual debut while in school.

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chapter 3
LITERATURE REVIEW ON SCHOOL DROPOUT

3

CHAPTER 3: LITERATURE REVIEW ON SCHOOL DROPOUT

3.1 Introduction

The introduction of free primary education in sub-Saharan Africa lead to an increasing prevalence of overage and underage students in school, with young people being more likely to enter adolescence and experience first sex while in school. This literature review examines the determinants of school dropout, looking specifically at the relationship between sexual debut, school performance and dropout, within the wider socio-economic context of the individual, household, school and community. Literature on specific research questions is also given in the relevant results chapters/papers.

3.2 Methodology

The search strategy for the literature review involved detailed searches of Medline, Pubmed, JSTOR, BASE, First Search and Web of Science, using the following combination of search terms:

1. Young adult or adolescen*
2. School# or dropout or promotion or enrol?ment or progress#
3. Sexual health or sexual behavi?r or sexual partners or condom# or sexual relation#

In addition to this, a "snow-balling approach" of references cited in the original search was conducted through Google Scholar, Mendeley, World Bank, UNICEF, UNESCO websites to identify additional papers on adolescent sexual behaviour and schooling. Exclusion criteria included: pre-1990, non-English research, married adolescents, developed countries or states which are politically fragile or conflict immersed, never enrolled adolescents or adolescents enrolled in higher, university or tertiary education; students with disabilities or special education needs. This review utilized *a priori* knowledge of the researcher; and builds upon Hunt's extensive review of the risk factors of school dropout in developing countries(1).

3.3 Findings

Key factors that determine school dropout are poor school progression, sexual debut (and pregnancy and marriage) and the broader socio-economic factors at the individual, household, school and community level. I will examine each of these factors and how they interact with each other, in order to develop my conceptual framework for the subsequent analyses.

SCHOOL PROGRESSION

In sub-Saharan Africa, the official age of entry into school is around age 6 though many children do not enrol at the prescribed age, with children of varying ages enrolled in the same class in school(2). Delayed enrolment is wide-spread and is one of the main causes of age-for-grade heterogeneity (3,4), with children enrolling in school up to age 11. The reasons for delayed enrolment in school include poor nutrition and delayed cognitive development(5) and poor household socio-economic status(6,7). The effect of household structure on enrolment varies by context, for example, living in female-headed household was a risk-factor for late school enrolment in Ethiopia(6), but not in Malawi(8). In Ghana, Fentiman et al(9) observe that parental perceptions of children's social and cognitive maturity and their apparent readiness for school, may also contribute to delayed school enrolments.

Poor school performance and grade repetition also causes heterogeneity in ages in school. Girls are more likely to perform better and be less overage than boys in school(4,10,11), though are more likely to dropout sooner than their male peers. Repeating early grades was not associated with dropping out, but repetition in interim grades (Grade 3 in Uganda and Grade 5 in Kenya), which also coincides with transitions in school from the use of the mother tongue to English as the language of instruction, was associated with dropout(12,13). In Malawi, grade repetition was more common among those with high absenteeism, being a younger sibling, low parental education and large classroom sizes(14). In Kenya, those who were overage were also more likely to repeat and dropout than those underage or on track in school(13).

The association between being overage and dropping out has been mostly examined through descriptive, cross-sectional studies, without accounting for wider socio-economic influences on dropout(1,15–19). Two studies that have examined this empirically show that age-for-grade is associated with dropout, though one used cross-sectional data (4); and the

other is a longitudinal study in South Africa, where schooling levels are relatively high, which limits comparability to other countries in the region(20). Both studies conclude that being overage is a risk factor for school dropout and that compared to boys, girls are less likely to be overage though more likely to drop out of school..

SEXUAL BEHAVIOUR

The relationship between sexual behaviour and school dropout is complex. School disengagement and dropout can lead to risky sexual behaviour and early pregnancy(21); while unintended pregnancies and early marriage, as an outcome of high-risk sexual behaviour, can also lead to school dropout. Studies across sub-Saharan Africa have shown a protective effect of school enrolment on sexual debut(22–24). However the school environment provides a conducive space for adolescents to interact more freely, away from the supervision of parents and "traditional care-takers"(25), providing more opportunities to engage in sexual activities. Kaaya et al's systematic review of adolescent sexual behaviour among 14-24 year olds in primary and secondary schools showed that both boys and girls engage in risky sexual activity while still attending school. Respondents reported having early sexual debut (mean ages of 12-15.5 for boys and 13.6-15.9 for girls), high levels of unprotected sex (10-48% reported consistent condom use) and having more than one life-time partner(up to 83% for boys; 49% for girls)(26). Associations between sexual debut and school dropout in Burkina Faso, Ghana, Uganda and Malawi (27) showed that the risk of dropping out of school doubled for girls who experienced sexual debut while in school in all countries except Burkina Faso. In Malawi, sexual initiation while enrolled in school was reportedly the highest at 57% and 24% for males and females, respectively.

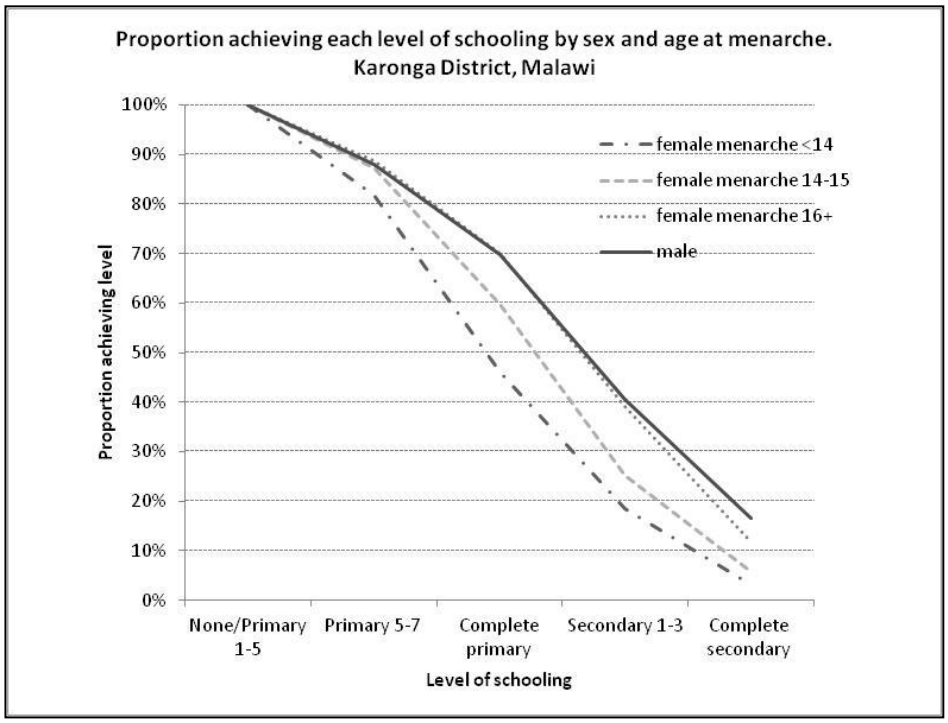
Experiencing first sex in school increases the odds of early pregnancy and marriage, which are among the main reasons reported for dropping out of school(28). In South Africa, girls who had repeated a grade and had temporarily withdrawn from school prior to becoming pregnant, were at least twice as likely to drop out as girls who performed well or never withdrew prior to pregnancy(24,29). Access to child care support, financial security and parental support in rural Kenya were key determinants for girls to re-enrol and complete their education(30).

Studies which examined the context of schooling and performance, as an antecedent to sexual debut and school dropout, showed that low levels of motivation to continue schooling(31), low grade attainment, poor attendance, and reporting sexual debut in school

increased the odds of later school dropout (28,32). This suggests that poor performance and school disaffection may be a precursor for dropout. Recently conducted randomized control trials in southern Malawi(33) and Kenya(34) reported effective interventions in improving school enrolments and delaying sexual behaviour (or transactional sex in the Kenyan study) through the provision of conditional cash transfers and free uniforms as incentives to reduce school dropouts. While the success of these trials indicates that household poverty is an underlying factor that influences decisions to stay in school or engage in sexual activity, the study in Malawi did not show any effect on pregnancy and marriage(35). Moreover, issues around school performance, grade transitions and school completion were not addressed in either study.

In Malawi, school dropout is particularly high: only 52% complete six years of primary school compared to 61% for sub-Saharan Africa(36). A recent analysis (37) on the association between age at menarche, sexual debut and school dropout in Karonga district (figure 1 below), showed that more than half of girls who attained menarche before age 14 dropped out of school, had sex by 16 and were married by 17. 70% of girls who reached menarche at 16 years or older showed persistence levels similar to boys, by completing primary school, transitioning into secondary school and delaying sexual initiation and marriage until after the age of 18. This suggests that puberty influences decisions to continue schooling for girls. The onset of menstruation and the lack of adequate sanitation facilities in schools for girls is also a reason for temporary periods of absence and has been suggested as a cause of dropout, although there is no empirical evidence to support this claim (38).

Figure 1 Proportion achieving each level of schooling by sex and age at menarche, Malawi



Source: Glynn et al, 2010

WIDER SOCIO-ECONOMIC INFLUENCES ON SCHOOL DROPOUT

In a comprehensive review of the literature on school dropout, Hunt (1) posits a wide range of contextual factors that contribute to dropout. These factors range from individual, household (household income, size and structure, education and employment status of household members), school (direct and indirect costs of schooling, location, student-teacher ratios, sanitation facilities) and to the broader transitional effects of adolescence (gendered roles, puberty, pregnancy, early marriage, employment). Understanding these determinants and the context in which schooling and sexual behaviour takes place becomes important in understanding the links with school dropout(27,39).

Individual effects

In sub-Saharan Africa, gender disparities in education, measured by the Gender Parity Index (GPI), have declined with the GPI increasing from 0.85 in 1999 to 0.92 in 2012. The GPI represents the number of females relative to the number of males in any aspect of education (enrolment, repetition, dropout). Values ranging between 0.97 and 1.03 is indicative of parity. Variations in gender disparities within the region still exist, and more girls than boys never enrol in school and of those that do, fewer manage to complete primary school(40). Cultural practices within a society largely determine the opportunities

for girls and boys to participate in school. In countries where patriarchal and male-dominant practices prevail, gendered division of labour and low socio-economic status prioritises time allocated towards household chores and child-care duties for girls more than boys, leaving little time to attend school(41,42).

Children from poorer households are less likely to enrol, attend and complete school(40). Poverty and socio-economic deprivation, especially in the first two years of life, may also have an irreversible, negative impact on the nutritional status of children and their overall development(1,43). Inadequate access to water and sanitation systems and poor nutritional intake makes children more prone to infection, diarrhoea and further depletion of vital nutrients for growth during this critical stage. Poor maternal nutrition at the pre-natal stage leads to restricted foetal growth (44). Growth in early life, especially the first 1000 days since conception, is important for physical, sensory, brain and motor-neuron development, language and cognitive functioning, with implications for future success in schooling, employment and health outcomes(43). Those stunted in the early years are more likely to be stunted through adulthood, with the possible effects of stunting being transferred to subsequent generations(45). Stunting, a marker for chronic malnutrition, has been linked to delays in school enrolment and poor performance in schools(46).

Household Effects

The family environment plays a critical role, outside of school, in influencing adolescents' decisions on schooling and sexual behaviour. The odds of dropping out of school for children coming from larger households, depends on the number of co-resident children and resource availability, which determines household reliance on children to undertake household responsibilities or to enter the labour force, further influencing decisions to drop out (30,47). Household level shocks and economic volatility, like crop failure, drought, disease or death of a household member may increase the likelihood of children being pulled out of school to support the household in times of need(48). In many countries in sub-Saharan Africa, living in an urban area, with parents, particularly fathers, who have higher education levels, a stable source of income and employment, delayed sexual debut and increased school persistence for girls (1,28–30). Lockeheed et al's study (49) in Thailand and Malawi highlighted the strong influence of family background on student performance, which is an important indicator for school persistence. Studies in both countries indicated that broader socio-economic factors, like household wealth, social class showed strong associations with school performance, as compared to previous studies

that side-lined family influences on account of weaker associations with mother's education status and father's occupation alone.

In sub-Saharan Africa, between 18-42% of unmarried adolescents within the ages of 12-14 years live without their parents(50). Fostering as a cultural practice is widely prevalent in the region and is commonly utilized as a poverty coping mechanism between families and households. Children from one family are "moved" temporarily to a relative's house in the event of migration, death of one or both parents, employment or illness. Non-traditional household structures, characterized by single-parent household or households with fostered children or extended family households, increased the likelihood of children leaving school earlier than others(51).

While the presence of both parents in Nakuru district, Kenya and Muslim-dominated Bida district, Nigeria, is seen to have a protective association with adolescent sexual behaviour (52,53), other studies have shown contrary evidence with regard to this relationship. In patriarchal and male dominated settings in Kenya, Cote d'Ivoire and South Africa, the presence of only fathers at home had a greater effect in delaying sexual activity and lowering the incidence of unwanted pregnancies among adolescent girls, as compared to those living with both parents(29,54,55). Father-daughter relationships were characterised as being vertical or authoritarian or disciplinarian; as compared to mother-daughter relationships, which are based on companionship and flexibility in responding to risky behaviour(54), thereby off-setting the level of control set by the more-dominant parent. Dimbuene's study in Western Cameroon(56) found that adolescents living in no-parent households showed higher levels of educational attainment and an increased use of condoms, compared to those living in single or two-parent families. However, adolescents living in no-parent households also reported having more sexual partners and a higher probability of initiating sex at an earlier age, as compared to those from two or single-parent households.

In many developing countries, older siblings play a critical role in supporting and managing the economic and social processes within the family. The meaning and definition of siblings in this regard extends beyond the Western notion of siblings of common parentage; to cousins and siblings born within an extended family, village or tribe(57). Relationships between same and opposite sex siblings also determine the dynamics of sibling relationships and the levels of influence that exist between siblings within a household. Tambashe's study in present day DRC, showed that living in families with four

or more siblings provided a protective influence in delaying sexual initiation among adolescent girls, as compared to those living in smaller families(55), suggesting that hierarchical sibling structures provide a role-modelling effect on younger siblings to respect and obey older siblings, and endorsing their perceptions of risk and sanctions on sexual behaviour. On the other hand, in Cote d'Ivoire, having an older sibling who had experienced pre-marital childbirth increased the acceptability and likelihood of younger siblings to engage in sex and child-bearing at an earlier age than others(58). Older siblings' characteristics, attitudes and behaviour are impressed upon younger siblings, thereby influencing adolescent behaviour, particularly school attendance and sexual behaviour, which is most relevant in this study.

Effects of School Quality

Time spent in school has been associated with delaying or deterring risky sexual behaviour among adolescents although the underlying aspects of school quality and its effects on schooling intentions is less understood. School effectiveness has traditionally been viewed by economists as an input-output or cost-effectiveness model, wherein inputs were viewed as investments in schooling (teacher-pupil ratio, teacher's education, experience, per pupil expenditure); and outputs referred to achievements and school test scores. This implied that spending more on each student or achieving high test scores(59) identified some schools to be of better quality than others. Hanushek et al's study(60) in 40 countries showed that investments in teacher-student ratios and student per capita expenditure had no direct impact on school quality. Heyneman et al (61), who criticized this study for its estimation errors and lack of data generalizability to African school settings, went on to repeat the analyses and concluded that returns to investments in school inputs had a greater impact on school quality in developing countries than in developed countries, further emphasising the contextual relevance of how school quality is defined.

Following Heyneman's study, Yu's (62) systematic review of the school effectiveness literature drew clear distinctions on the aspects of school quality in developed and developing country settings, wherein the former focussed on process-oriented qualities of strong administrative leadership, frequent monitoring and evaluation of student performance, pedagogy and a conducive teaching and learning environment; while, in developing countries, school quality was determined by tangible indicators, like the school's physical environment (school location, size, number of shifts, teacher-student ratio, access to electricity, water, sanitation); availability of school inputs (textbooks, teaching manuals);

human resources (teacher gender, qualification, teaching experience, pre/in-service training); and management structures (regular school monitoring visits).

Though conceptually, teaching and learning behaviours are important measures of school quality, few studies have shown evidence of their effect on school effectiveness, which suggests limitations in empirically measuring teaching/learning processes, which are less tangible than the structural/infrastructural factors identified earlier. Fuller's study in Botswana's secondary schools(63) showed a positive association between school inputs, teacher characteristics and school performance (literacy and reading scores), while teaching practices and pedagogical behaviours did not have any effects on student achievements.

While examining the effects of school quality on academic achievement and school dropout, Lloyd et al's study concluded that gender equality and the treatment of girls in schools (by their teachers and peers) was a critical determinant of school dropout in Kenya, thereby challenging the conventional measures of school quality cited earlier. Gender bias, manifested in discriminatory teacher attitudes, curriculum content and teaching practices often discouraged the participation of girls' unlike that of boys (64).This imbalance in gender dynamics within school also facilitates "offensive and unwanted" sexual advances made by male peers or teachers towards adolescent girls, which over time result in girls dropping out of school sooner than boys (65). The effect of school quality on grade attainment in Egypt (66) showed that the odds of girls' performing poorly was determined by the school environment (poor facilities, untrained teachers); whereas boys were more affected by poor household socio-economic status and lower levels of mother's schooling. This suggests the need to explore wider social determinants of schooling, including a more qualitative exploration of the schooling experiences of adolescents, in contrast to the more tangible, measurable aspects of school effectiveness and quality, as a determinant of school persistence or dropout.

Peer Effects

Few studies have examined the influence of peer behaviour on the sexual activity and academic performance of adolescents in schools. Mmari's global review on the determinants of adolescent sexual and reproductive health showed that being male and influenced by peers (perceptions of peer's sexual behaviour), family factors (including sibling's sexual behaviour) and engaging in other risky behaviour (alcohol and substance abuse, smoking) significantly increased the odds of engaging in premarital sex at an early

age(31). Engaging in common activities, like attending church groups, discos or spending holidays together allowed greater interaction between both sexes, away from the close monitoring and supervision of parents, thereby enabling opportunities to engage in risky behaviour, including sexual activity(67). Barker et al's qualitative study among adolescents in and out of school in Nigeria and Kenya showed that peer groups play a pivotal role in shaping the knowledge, attitude and behaviour of adolescents, especially in conservative societies where parental communication on sexual and reproductive health is weak or non-existent(68).

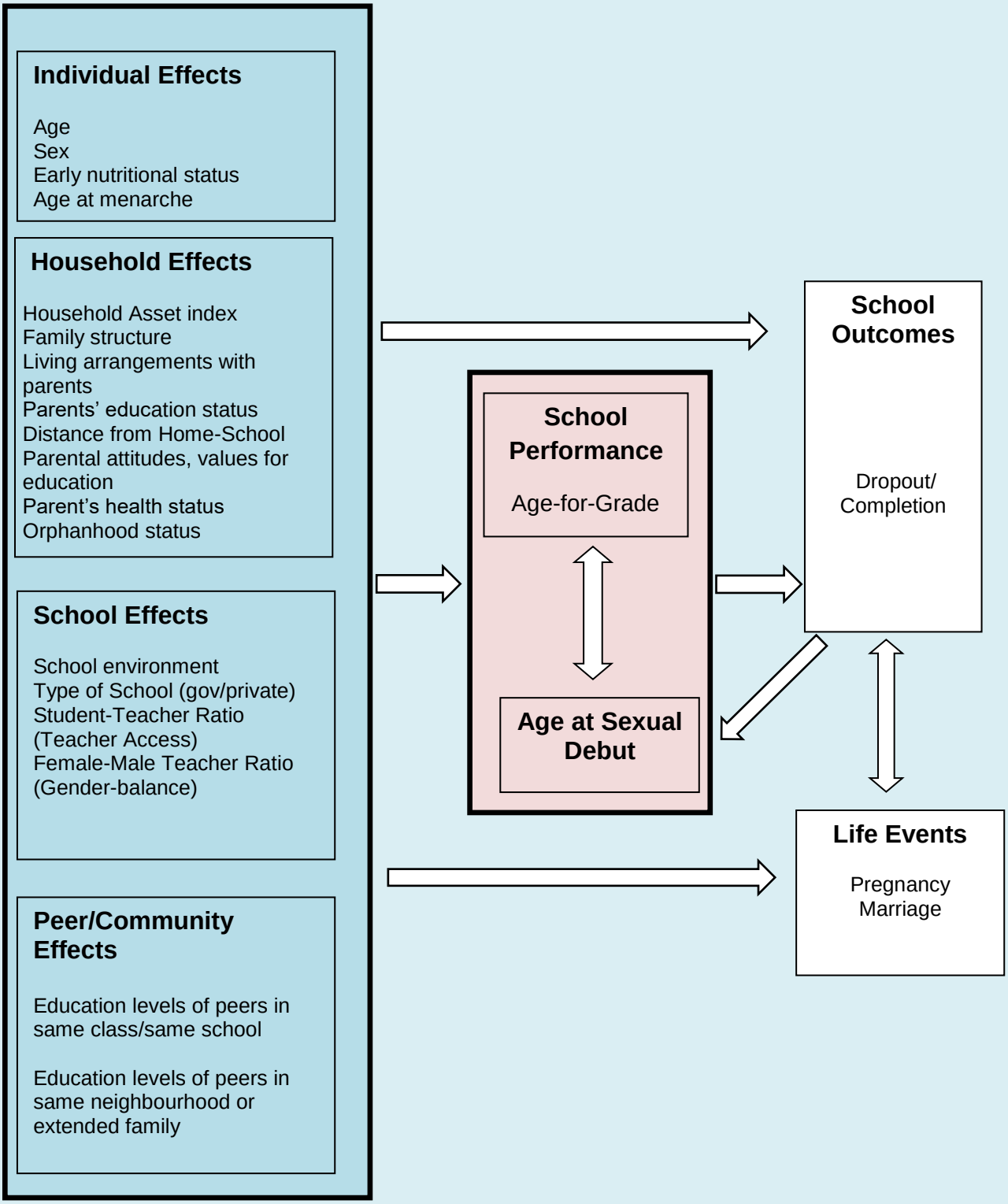
The effect of peers is most prominent when vicarious learning through others' behaviours sets the model for one's own behaviour. In South Africa, Lam et al(69) found that girls' increased exposure to overage classmates (overage by two or more years) increased their likelihood of becoming sexually active and droping out of school. Studies in primary schools in Kenya showed that adolescent boys who have sexually active peers, of either gender, showed poorer academic achievement and were more likely to be sexually active than those whose peers are not sexually active(52). In Nigeria, the notion of male dominance, among boys in secondary school was positively correlated with engaging in risky sexual behaviour, which included forced and unprotected sex with multiple partners with the objective of getting "at least one girl pregnant". Boys who were younger, living in rural areas and had been sexually initiated, felt the need to be sexually active and have multiple partners as a sign of machismo and to "be a real man"(70). Dlamini et al's study by contrast suggests a protective effect of peer influence, wherein female adolescents in rural South African high schools, drank less alcohol and abstained to deliberately avoid an unintended pregnancy(71). Within a context of delayed age at entry, high repetition rates and multi-grade classrooms, the dynamics of peers remains vital to understand, especially with older and sexually active adolescents who are likely to influence their younger peers to engage in sexual activity (29), thereby off-setting any gains made in academic achievements.

3.4 Conceptual Framework

Drawing from the findings of the literature review, a conceptual framework (see Figure 2 below) highlighting the main influences on schooling and sexual behaviour of adolescents was developed, to guide the direction and analyses for this study.

The main outcome of interest is the age and stage of school dropout. The influences of sexual debut and of school performance, measured by age-for-grade (or the extent to which one is overage/underage for current grade) will be analysed in stages. Other covariates, include, **individual effects**, mainly age, sex, nutritional status or stunting in early years, age at menarche; **family effects** which includes the socio-economic status of the household, including household wealth, family size, household structure (male/female headed), parental presence (father/mother/both/none), parental education status, presence of younger children within the same household. **School effects** include broader school-level factors such as, school size (male-female student ratio), student-teacher ratios, male-female teacher ratio, and distance from school and home (using GPS locations). Where possible, **peer effects** will look specifically at school performance of peers within the same class, school and neighbourhood. Conversely, the effects of being in/out of school and age-for-grade on later life events, sexual debut, pregnancy and marriage, will also be examined.

Figure 2: Conceptual framework for school dropout



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chapter 4
METHODS

4

CHAPTER 4: METHODS

4.1 Introduction

This section provides details of the study site, the Karonga Prevention Study, in Karonga district in northern Malawi and the data sources used for my research. Detailed description of the methods used for the analyses is presented in each of the papers found in Chapters 5-9.

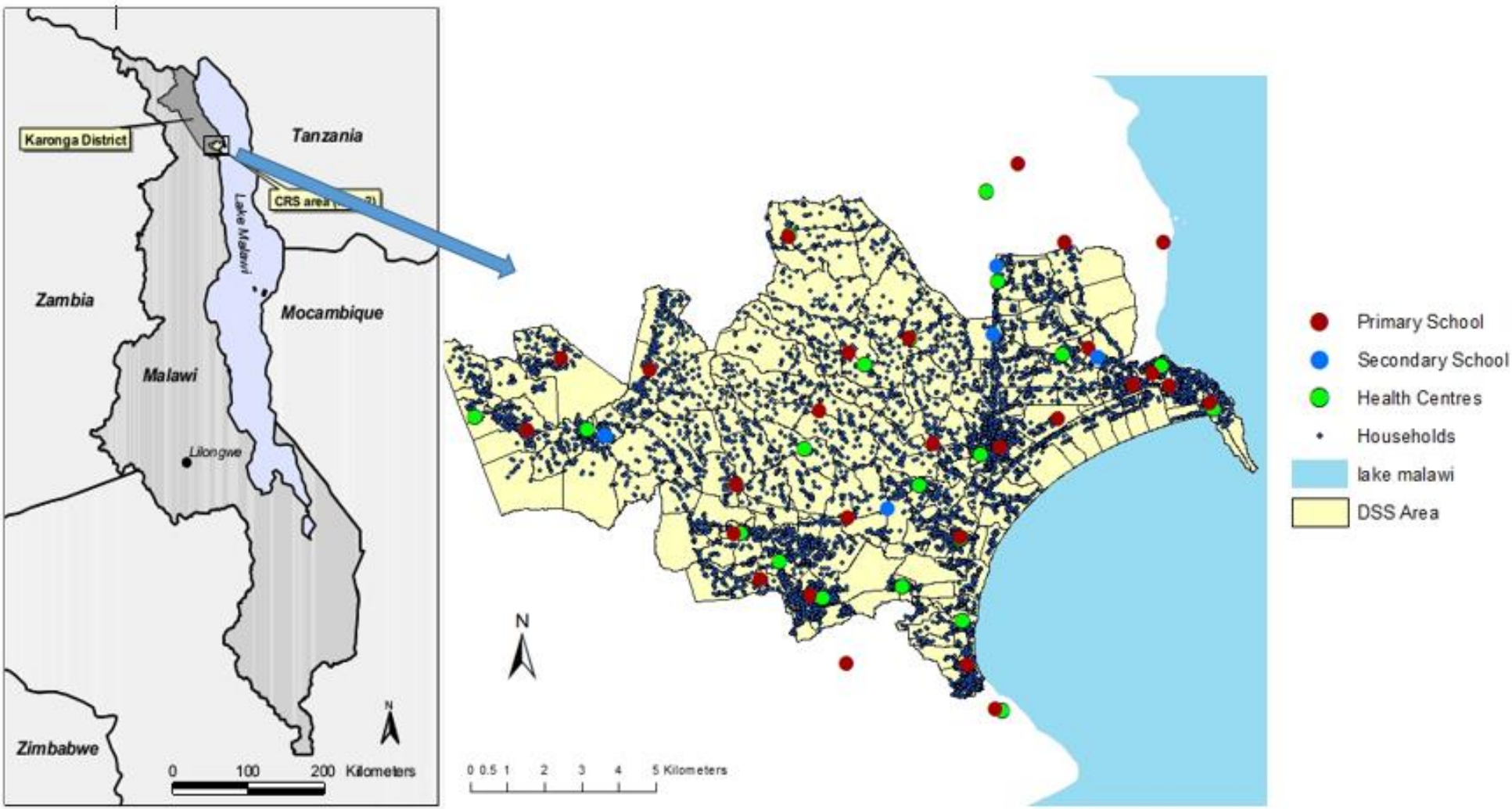
4.2 Study Site: Karonga Prevention Study, Northern Malawi

Data for my research originates from the Karonga Prevention Study (KPS) site, located in the southern part of Karonga district, in northern Malawi (Fig 1). KPS has been carrying out a Demographic Surveillance System (DSS) collecting routine data on births, deaths and migrations from about 36,000 individuals from about 7,000 households since 2002.

The DSS collects monthly data on births and deaths (or vital events), with annual censuses to update migrations. The DSS population, like the rest of the country, is predominantly rural and depends on agriculture, fishing and trading as the main means of subsistence. The two most densely populated habitations are in the villages of Uliwa and Chilumba with around 50% of the population residing within 1km off the main highway, which is the main trading link between Tanzania and the rest of the country, or off the tarmac road to the port area (Chilumba). The DSS area is divided into 21 reporting groups, with each group divided into ten clusters, and each cluster consisting of 20-30 households.

Prior to the inception of the study, village volunteers or *ndunas* were traditionally appointed for life by the village headman to take responsibility for a group of households within the village(1,2). Responsibilities extended from broadcasting the news of any deaths, organisation of funerals or approving the arrival of any new households or members within the community. Since study inception, key informants (often ndunas) have been employed on a voluntary basis and are provided a nominal fee to be a suitable liaison between the communities and the study site. Key informants are trained to record births and deaths in

Figure 1: Map of the Karonga Demographic Surveillance Site, Karonga district, northern Malawi



their area, and report to a KPS staff member every month. All births are visited, and relatives of deceased individuals are interviewed to conduct verbal autopsies.

Changes in household structure/membership, including migratory movements within or outside the catchment area are documented separately by the key informant, and reported annually to project staff. These data are verified by KPS staff during household visits which take place as part of the annual census. Surveys following the census include detailed household and individual socio-economic, schooling, and demographic data, which are linked to the underlying framework of the DSS, allowing socio-economic and demographic changes of individuals and households to be tracked over time.

The utilisation of KPS data for my research has been extremely beneficial for a number of different reasons. Apart from tracking the demographic and migratory patterns of a population, the sampling framework of the study and the nested nature of the DSS data, with the socio-economic, nutritional, sexual behaviour and schooling surveys, enabled inter-linking individual level data with other studies that allowed exploring individual and household changes longitudinally. The use of traditional authorities as key informants, has enabled us to efficiently use existing structures that are the locus of trust within a community to reliably collect and corroborate data on vital events. For instance, the detailed process of collecting data on births within the DSS, allowed us to capture accurate, reliable data on age, especially for the younger cohort who are key participants in my research, and otherwise hard to measure in a rural, remote setting void of universal birth registration systems. GPS systems are also used to track the physical locations of households with respect to other infrastructure, like schools and roads, thereby understanding access to economic and social services.

4.3 Data Sources

The KPS dataset provides repeated observations of participants of primary and secondary school age with schooling history data from 2007 to 2012; and sexual behaviour data from 2008 to 2011. Nesting of socio-economic, sexual behaviour and schooling data within the DSS, allows for easy identification and tracking of individual members within each household. Table 1 below, summarises the data and survey instruments; and the period for which data was available for analyses. Sample survey forms have also been included in the last section of the Appendix.

Table 1: KPS data sources used for analyses

Surveys	Variables included	2002-04	2003-06	2007	2008	2009	2010	2011	2012	2013	2014	2015-16
Anthropometric Surveys	Birth length/height (at birth, 1 year and ages 4-8)	[4]	[5]									
Socio-Economic Survey (Individual)	Schooling history, including age at entry, highest grade attended, grade repetition, absenteeism, drop out and reason for drop out, name of school. Relationship to head of household, parent's education											
Socio-Economic Survey (Household)	Household assets (land, consumer durables, type of dwelling)											
Sexual Behaviour Survey (women and men ages 15-59)	Age at first sex, age at menarche, first marriage, first pregnancy, first birth											
School Surveys (collated from Karonga District Education Office)	School size, teacher student ratios, male-female teacher ratios, access to toilets, water, electricity, distance to school, PSLE pass rates											

[4] Baseline census
[5] 1 year follow-up

Anthropometric data close to birth were collected for children born between 2002-2004, with follow-up visits after 12 months. Additional anthropometry data was collected for children age <10 between 2008-2011.

Schooling histories collected annually for those below the age of 30, include data on current enrolment status, year of school entry, school attendance, grade attainment, timing and reason for school exit.

Sexual history of adolescent boys and girls, of ages 15 and above, include data on age at first sex, pregnancy, marriage, birth and enrolment in school at the time of event, number of sexual partners and frequency of sexual activity and use of contraception.

School-level data, including data on the physical environment and characteristics of 31 schools (20 primary and 11 secondary schools) located within the DSS catchment area, were collected from the District Education Management Information Systems (DEMIS) Office for the 2007-2012 period.

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RESULTS

chapter 5

PAPER 1

Does early linear growth failure influence later school performance? A cohort study in Karonga district, northern Malawi

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RESEARCH PAPER COVER SHEET

PLEASE NOTE THAT A COVER SHEET MUST BE COMPLETED FOR EACH RESEARCH PAPER INCLUDED IN A THESIS.

SECTION A – Student Details

Student	Bindu Sunny
Principal Supervisor	Prof. Judith Glynn
Thesis Title	Age-for-grade heterogeneity and school dropout in primary schools in Karonga district, northern Malawi: Causes & consequences

If the Research Paper has previously been published please complete Section B, if not please move to Section C

SECTION B – Paper already published

Where was the work published?			
When was the work published?			
If the work was published prior to registration for your research degree, give a brief rationale for its inclusion			
Have you retained the copyright for the work?*	Choose an item.	Was the work subject to academic peer review?	Choose an item.

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SECTION C – Prepared for publication, but not yet published

Where is the work intended to be published?	Journal of Biosocial Sciences
Please list the paper's authors in the intended authorship order:	Bindu Sunny, Bianca DeStavola, Albert Dube, Amelia Crampin, Judith Glynn
Stage of publication	**Not yet submitted**

SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I conceptualised the study design for this manuscript, with support from my supervisor Judith Glynn. I led on the data management, analysis with support from Judith Glynn. I wrote the first draft of the manuscript and incorporated revisions suggested by co-authors in the final mansucript.

Student Signature: [redacted] Date: 25.10.17

Supervisor Signature: [redacted] Date: 25.10.17

5

CHAPTER 5: PAPER 1- Does early linear growth failure influence later school performance? A cohort study in Karonga district, northern Malawi

Introduction

Stunting or linear growth retardation in childhood is known to delay cognitive development and lead to poor school outcomes at later ages though evidence of this association within the sub-Saharan African context is limited.

Methods

Anthropometric data at birth (0-4 months), early (11-17 months) and late childhood (ages 4-7years) along with school outcomes up until the age of 11 were analysed for a cohort of 1,044 respondents, born between 2002-2004 in Karonga district, northern Malawi. The schooling outcomes were age at school enrolment, grade repetition in Standard 1 and age-for-grade by age 11. Height-for-age z-scores (HAZ) and growth trajectories were examined as predictors, based on stunting (<-2SD HAZ) and on trajectories between early and late childhood (never stunted, improvers, decliners or persistently stunted). Multinomial and logistic regression were used to estimate the association between stunting/trajectories and schooling, adjusted for socioeconomic confounders.

Results

The effects of stunting on schooling were evident in early childhood but were more pronounced in late childhood. Children who were stunted in early childhood were less likely to be underage at enrolment, more likely to repeat Standard 1 and were 2-3 times more likely to be overage for their grade by the age of 11, compared to their non-stunted peers. Those persistently stunted between early and late childhood faced the worst consequences on schooling, being three times as likely to enrol late and 3-5 times more likely to be overage for their grade by the age of 11, compared to those never stunted. Compared to improvers, those persistently stunted were three times as likely to be overage by two or more years by the age of 11, with no effect on enrolment or repetition.

Conclusion

Our findings confirm the importance of early childhood stunting on schooling outcomes and suggest some mitigation by improvements in growth by the age of starting school. The nutritional and learning needs of those persistently stunted may need to be prioritised in future interventions.

5.2 Introduction

Linear growth failure or stunting is a key measure of chronic malnutrition. In 2013, over a third of the global estimate of 161 million stunted children below the age of five were in Africa (1). Stunting in early childhood is a marker for adverse influences on growth and development. The first 1000 days since conception, until 24 months when growth faltering plateaus (2), is critical for the development of physical, sensory, language and cognitive function and reflects the period most sensitive to nutritional deficiencies, poor stimulation and social neglect, with severe effects on child development and adverse implications in later life (3). Catch-up growth may happen but those who are stunted in the early years are more likely to be stunted through adulthood (4,5), with possible inter-generational effects of stunting on the growth and development of subsequent generations (6). At the prenatal stage, poor maternal nutrition (low BMI) is an important risk factor for restricted foetal growth and low birth weight. Poverty, marked by inadequate access to water and sanitation systems, poor nutrition and susceptibility to gastro-intestinal infections and diarrhoea, is strongly associated with stunting in the early years (7). Growth in early life is also the period for brain development and cognitive functioning(8), while growth (specifically weight gain >24 months) in later life is predictive of substantial weight gain and the increased risk of chronic diseases in adulthood(5).

Studies on malnutrition and child development in low and middle-income countries have shown that linear growth in the first two years of life is predictive of early(<24 months) and later physical(9) and cognitive development (10–12), loss in economic productivity(13) and increased risk of chronic diseases(7,14). However recovery from growth delays in early years is possible and has been found to be associated with improvements in cognitive development (15–17) though the extent of this growth recovery, and its impact on overall development is not well understood.

Early stunting has been found to be linked with late enrolment in school, grade repetition and poor school achievement (5,13,18–22) though few studies have examined this relationship within the sub-Saharan African context within the past decade. A longitudinal five-country birth cohort study, including South Africa, on the effects of early malnutrition and schooling(23) showed that stunting at the age of two was associated with delayed school enrolment, a greater chance of repeating at least one grade and fewer years spent in school. In rural South Africa and in Tanzania, children who were stunted were more likely to enrol late in school, repeat more grades(24) and complete fewer years of school(25). Alderman et al's (26) study in three resettlement areas in rural Zimbabwe showed that a 1-

SD improvement in height-for-age at age 3 was associated with an earlier age at starting school, an additional grade of schooling, and improved height in adolescence.
This study looks at the relationship between linear growth failure or stunting at birth (0-4months), early (11-17 months) and late childhood (4-7 years) on school outcomes, specifically age at enrolment in school, grade repetition in Standard 1, and progression (age-for-grade) by age 11. We also explore whether improvement in growth between early and late childhood influences school outcomes.

5.3 Methods

Continuous birth registration was set up as part of the baseline census for a demographic surveillance carried out between 2002 and 2004 in the southern part of Karonga district, in northern Malawi. Trained staff collected anthropometric data during the first visit after birth, which was usually within 2-6 weeks. Repeat anthropometry measures were collected during a follow-up visit after one year. Anthropometric data were also collected in later survey rounds on all children under the age of 10 between 2008-2011, so data were available for the 2002-4 birth cohort at ages 4-7. For those measured more than once in 2008-11 the earliest record was used. Socio-economic and schooling histories were collected in the original census and updated annually from 2007 to 2015.

Routine training was provided to staff prior to collecting anthropometric data using methods recommended by the USAID's Food and Nutrition Technical Assistance(FANTA) project(27). Informed consent to participate in the anthropometry study was sought from the head of the household. For children below age 2, recumbent length was measured using a SECA210 polyurethane plastic measuring mat (with 0.5mm increments) while weight was measured using a spring scale (100g increments). Height of children older than two years was measured using the Leicester height measure. Maternal malnutrition, measured by the mother's mid-upper arm circumference (MUAC), is a determinant of foetal growth restriction and early growth faltering (7,28). In this study, MUAC was measured using a steel tape (1mm increments) and a cut-off of <21cm was used to define maternal malnutrition, as used previously in the same setting(29).

Early and later linear growth failure or stunting was defined as the height-for-age Z score (HAZ) < -2 SD (termed as moderate/severe stunting) based on the WHO growth references for children below and above age 5(30,31). The z score represents the difference in a child's height from the median height of children within the reference population (at a given age and sex), divided by the standard deviation of the reference population. Growth

trajectories between early and late childhood were defined as being never stunted, improvers (stunted in early childhood but not stunted in late childhood), decliners (not stunted in early childhood but stunted in late childhood), or persistently stunted (stunted in early and late childhood).

With the introduction of free primary education in Malawi in 1994, enrolment is nearly universal though school quality is poor with frequent grade repetitions and students progressing slowly through school(32). Those who enrolled in school prior to or after the official age of entry of 6 were categorised as being underage or overage at enrolment. Age-for-grade is the number of years a child is ahead/behind in class based on the official age-for-grade (Age-for-Grade= Current Age-Current Grade-5) and provides a cumulative measure of school performance irrespective of the highest grade achieved. Given the follow-up time available for this cohort, the analyses focuses on age-for-grade at age 11, which is the age up until when most respondents were seen. The effects of stunting on grade repetition in Standard 1 is also examined.

Principle Component Analysis (PCA) was used to estimate relative household wealth at birth using data on dwelling characteristics (quality of walls, roof), ownership of consumer durables (clock, mosquito nets, bank account), and access to utilities (water, electricity). Categorical variables were made into dummy binary variables, while continuous variables (number of mosquito nets owned by a household) were normalised to range between 0 and 1 as PCAs assume the mean as zero and standard deviation to be 1(33,34). The first component explained 36% of the variation between households. The household wealth score was divided into tertiles (most to least poor). Data on household assets collected between 2007-2011 were also used to construct asset indices for the follow-up period (early and late childhood) using PCA. Variables selected for inclusion in the asset index (bicycle, radio, oxcart, clock, mattress, bed and chair) were based on what was consistently available across all household survey rounds.

Data on parental educational levels were collected at the time of birth registration. Missing data on parental education was imputed using self-reported data provided by parents, where available, from subsequent rounds of the socio-economic surveys under the assumption that parental education levels would not have changed since the child's birth. A few other variables, including season at birth, mother's age at birth, mother's MUAC, birth order, were initially explored but omitted from the final analysis, as they did not confound the relationships. Maternal height was not included because it can have a direct effect on

foetal growth (9) and we wanted the growth measure to include any pre-natal growth deficit. Father's height was explored as a possible confounder. Logistic regression was used to conduct the analysis for the grade repetition outcome. Multinomial logistic regression was used for the analyses on age at enrolment and age-for-grade at age 11.

5.4 Results

1,761 live births were recorded between October 2002 and December 2004 (Figure 1). Of these, 1595 (91%) respondents seen within the first four months of birth had data available on birth length. Those with missing data on birth lengths (n=45) were mostly on account of neonatal deaths (87%) and outmigration from the surveillance area. 1239 (78%) of the remaining respondents were seen in early childhood (11-17 months) within an interval not exceeding 15 months since birth. 1045 had anthropometry again between ages 4 and 8 years, of whom one had missing data in schooling (Figure 1). Complete case analysis was carried out: 5% had missing data on confounders for the school enrolment analysis, leaving 988 respondents. Data were available on grade repetition in standard 1 for 828 and on grade at age 11 for 789.

Table 1 examines the differences between groups lost to follow-up, those with incomplete data and those finally included in the analyses. Those with incomplete data were shortest at birth, were born to shorter mothers and were from poorer households in comparison to those in other groups, although there were very few with missing data on confounders (n=56 or 5.3%). Children lost to follow-up on account of re-location and those not seen at time of interview were not very different from those included in the final analysis.

Figure 2 shows the distributions of HAZ at birth, early and late childhood. The mean HAZ at birth lies closer to zero moving closer to -1SD through early and late childhood. There is an overall faltering of growth between birth and early childhood. Between early and later childhood the distribution of Z scores narrows suggesting growth improvements among those shortest in early childhood with decline in growth among the tallest children. At baseline, children who were moderate-to-severely stunted (HAZ <-2) at birth had lower birth weight, were more likely to have been born in the hot/dry season, to mothers who were younger, shorter in stature and more malnourished at birth (MUAC<21cm), than those not stunted at birth (Table 2). Stunting at birth was more prevalent among children from poorer families, with low (none or less than primary) parental education.

Figure 3 shows the distribution of the mean HAZ by age and sex. Growth faltered from birth until early childhood, improved until age 4 and then stabilised through late childhood, with fewer observations at age 7. On average, boys had lower z scores than girls at all ages. Overall stunting prevalence increased from 9% at birth to 20% in early childhood, with more boys (11% and 23%) than girls (7.7% and 15.6%) being stunted at both points. However, in late childhood, stunting prevalence fell to 15%, with boys continuing to show higher levels of stunting than girls (16% and 13%). As no evidence of interaction by sex was found on the associations between stunting and schooling outcomes, subsequent analyses are presented without disaggregating by sex.

Table 3 shows the association between stunting at different ages and schooling outcomes. Associations were weak with stunting at birth but were seen in early childhood, and were stronger and more pronounced in late childhood. Compared to those who were not stunted, those stunted in early childhood were 30% less likely (aOR=0.66) to be underage at enrolment, and about twice as likely (aOR=1.85) to be overage than on time at the point of entry, after controlling for potential confounders. Those stunted were twice as likely (aOR=2.58) to also be at least two or more years overage-for-grade than underage/on time by the age of 11, compared to those who were not stunted. These effects were further magnified in late childhood with those stunted being around half as likely (aOR=0.66) to be underage and twice (aOR=2.82) as likely to be overage than on time at enrolment. Stunting in late childhood was also associated with being 2-4 times more likely to be overage than underage/on time for grade by the age of 11, even after adjusting for other socio-economic confounders ($p<0.01$). Effects of stunting on grade repetition in Standard 1 was weak at all three time-points. Associations with repetition and age for grade at 11 persisted after further adjustment for age at enrolment (Appendix A), showing that the associations were not explained by different enrolment ages.

Compared to those who were never stunted, those stunted at some stage had worse school outcomes, with those persistently stunted facing the greatest disadvantage (Table 4).Being persistently stunted was strongly associated with later age at enrolment and being overage for grade at age 11 even after adjusting for confounders. Associations with school outcomes among those who caught-up ("improvers") and those who declined in growth status were similar in direction but showed weaker evidence of effect.

Table 5 examines the effect of persistent stunting on school outcomes, compared to those who had shown improvements in growth between early and late childhood. Compared to

'improvers', the risk of being overage for grade by the age of 11 for those persistently stunted was four-fold ($p<0.01$), even after adjusting for other confounders, including HAZ in early childhood. Effects on enrolment and grade repetition were smaller with very weak statistical evidence of association.

5.5 Discussion

Stunting at 11-17 months and 4-7 years was associated with delayed enrolments and poor progression through school. No effects on schooling were observed for those stunted at birth. Those persistently stunted through early and late childhood faced the most severe consequences of schooling. They were almost three times as likely to enrol late in school, and were 2-5 times more likely to be overage for their grade by age 11, compared to those never stunted. Even improvers and decliners were likely to face negative school outcomes, though less than those persistently stunted. Those persistently stunted were more likely to be overage for grade by age 11, than those who experienced improved growth. The stronger associations with stunting at later ages than at younger ages, and the better schooling outcomes in those whose HAZ improved is consistent with later growth having an important role in improving school performance.

Stunting in the first two years of life has for long been known to be a vital marker for growth with apparently little scope for recovery in later years (3). However, recent studies have shown that 'windows of opportunity' for catch-up growth exist beyond the age of 2 as well as in early adolescence(35) with possible effects on later school outcomes. For example, findings from the Young Lives study project in Ethiopia, Peru, India and Vietnam showed that stunting between ages 8-15 years was associated with lower grade completion and poorer performance in a language and mathematics test(15). In Guatemala, height at 36 months was associated with higher grade attainment and literacy and numeracy scores among children at 18 years of age(36). Our study findings are consistent with the evidence that shows that growth in early and later childhood are important determinants of schooling outcomes.

Two broad pathways may underpin the mechanism through which growth retardation in childhood leads to poor school outcomes: the "neural" hypothesis and the "development" hypothesis. The neural hypothesis emphasises the importance of the timely development of the brain, which if inhibited within the first two years may have deleterious, possibly irreversible effects on cognitive development. The development hypothesis stipulates that early growth retardation is linked to delays in motor-neuron development and the physical

development of the child. Children who have delayed physical mobility may experience lower stimulation from self-exploration, play and social interaction with parents and carers (11,37,38) which is predictive of verbal competency by the age of five(10,39) and poor psychological functioning in late adolescence(40). Being stunted is also associated with behavioural and conduct difficulties, being hyperactive, less vocal and attentive than non-stunted children(6,11). Children who are physically smaller in stature and appear to be less alert, articulate and ready for school, may be treated differently (by parents, society, schools) than those who are not stunted(41), explaining the later school start of stunted children in our study. Further research to examine parental and societal perceptions of school "readiness" would help understand this better.

There are a few limitations in our study. Firstly, height measurements in early childhood were only available around 11-17months, which is short of the 24 month window when growth faltering is known to reach a nadir, prior to catch-up growth taking place. This could under-estimate the extent of growth faltering in early childhood and the true extent of growth improvements that follow, with subsequent effects on school outcomes. Using height-for HAZ may also over-estimate the extent of growth improvements seen as HAZ uses age and sex-specific standard deviations of height as the denominator, which tends to increase with age. The use of absolute height-for-age differences (HAD) may be a better measure for future studies(42), though the reliability in using either measure is widely debated.

Our study may also be limited by omitted variable bias and issues of endogeneity of prior health status and schooling. Parents may equalize or exacerbate differences in investments on their children's health and schooling based on their initial perceptions of a child's heath status or their cognitive endowments. Socio-economic and behavioural factors that influence these decisions, like household allocation of resources, parents' attitudes and decisions on resource allocations (food, money for school, allocation of work vis-à-vis school), were not available. Episodes of illness, especially diarrhoea, within the household during infancy and early childhood, and measures of home environment and cleanliness may be an important determinant of children's nutritional status but may also provide a measure of vulnerability to recurrent illness and school absenteeism that has an effect on school performance over time. These factors would need to be accounted for in future studies to understand the true extent of the effect of nutrition on schooling.

The higher prevalence of male stunting is consistent with a systematic review that used DHS surveys from 10 countries in sub-Saharan Africa to confirm that stunting prevalence was indeed higher among boys than girls in the region; however, the reasons for this remain elusive(43). As our study sample was followed only to age 11, we were unable to establish the longer-term associations of stunting on adolescence and schooling, including school dropout, which is rare before age 13 in this population.

5.6 Conclusion

While policies and programmes that prioritise improvements in nutritional status of children in the first 1000 days since conception remain crucial, improving nutrition beyond age 2 may also be beneficial. Reversing growth faltering should reduce stunting in later years, with benefits that extend to not just immediate health but also schooling, economic productivity and a better life for generations to follow.

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Figure 1 Study flowchart

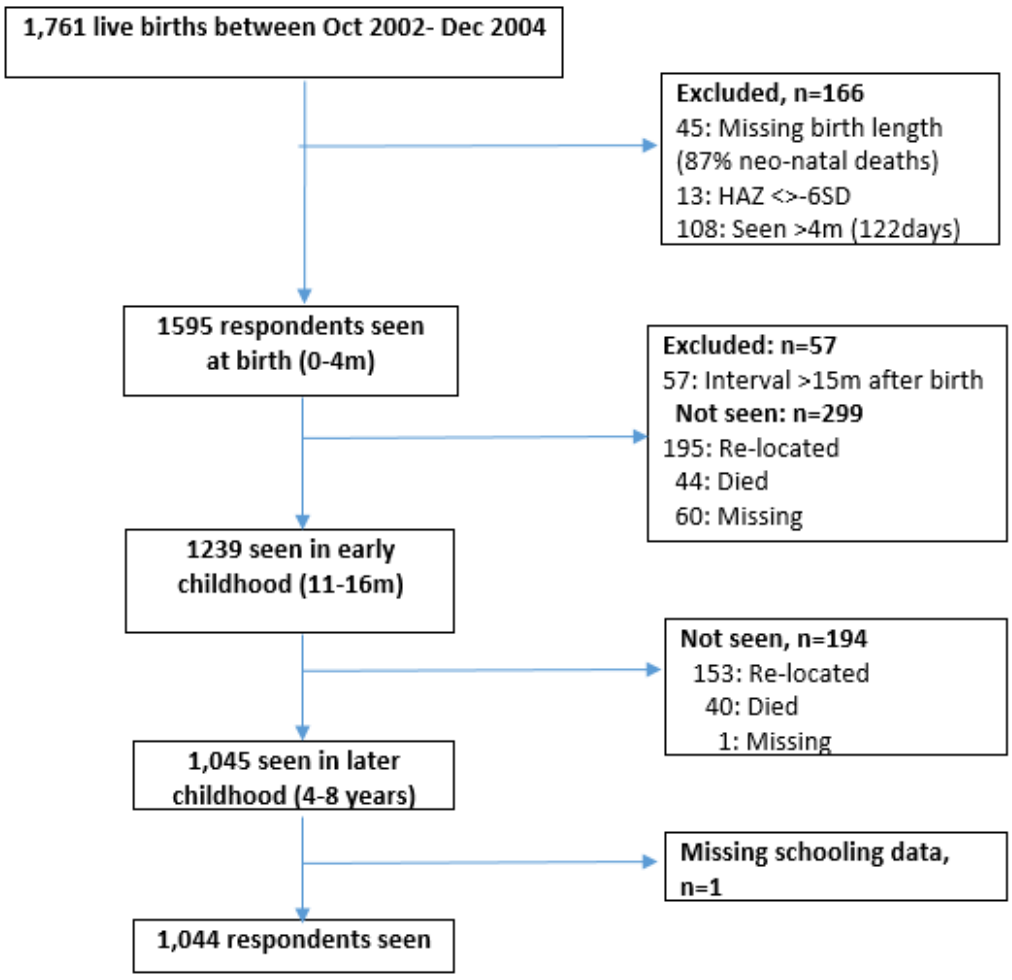

Figure 2: Distribution of HAZ at birth, early and late childhood

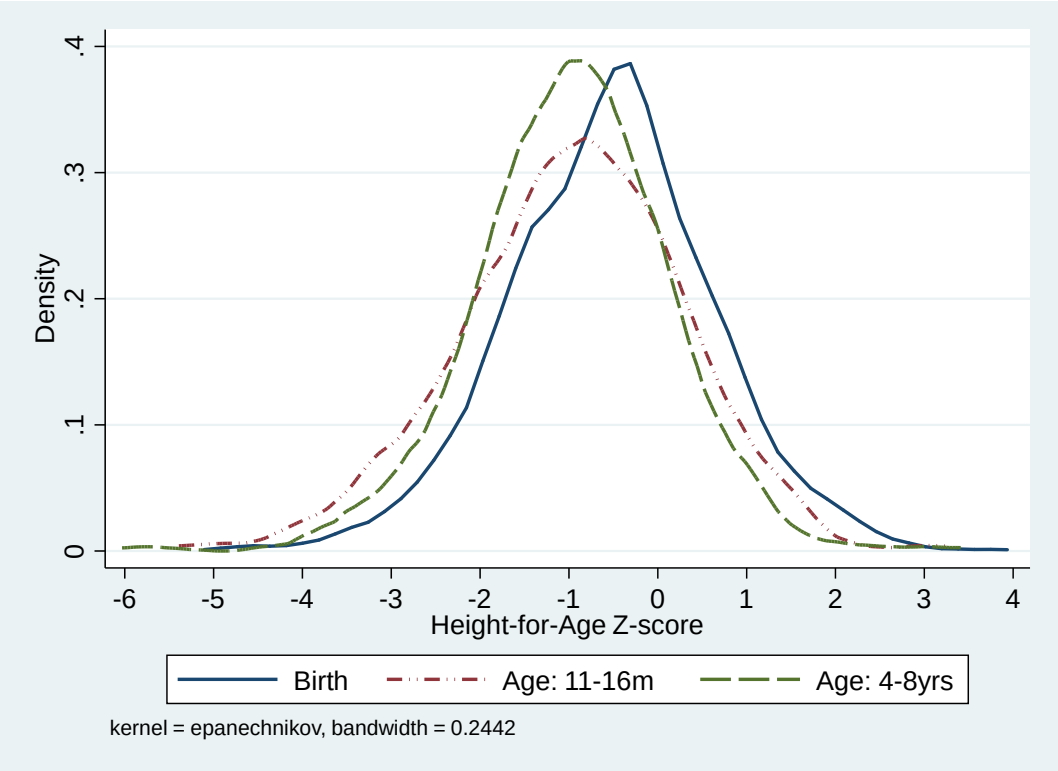

Figure 3: Distribution of the mean Height-for-Age Z-scores (and confidence intervals), by sex and age

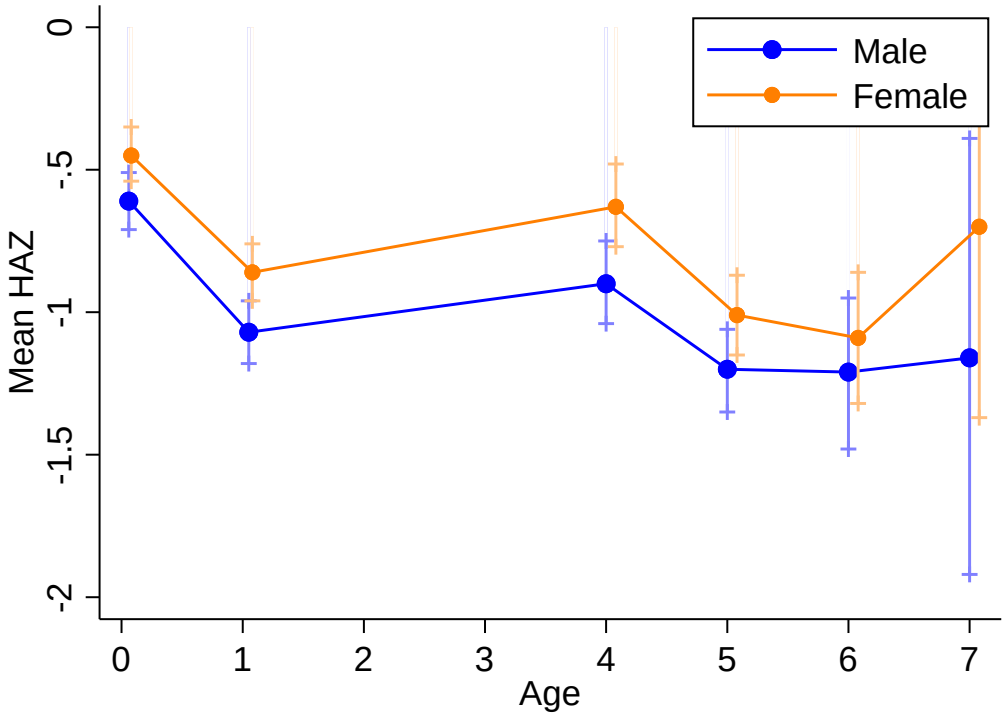

Table 1: Attrition levels and characteristics (mean, SD, median) of study participants lost to follow-up, those with incomplete data and those included in the analyses

Characteristics	Missing[1] at Year 1	Missing[1] between Years 4-7	Incomplete[2]	Included/Complete data[3]
	(n=255)	**(n=154)**	**(n=56)**	**(n=988)**
Birth HAZ (mean, SD)	-0.38(1.17)	-0.50(1.22)	-0.68(1.23)	-0.52(1.15)
Birth WAZ (mean, SD)	-0.42(1.17)	-0.46(1.17)	-0.46(1.12)	-0.47 (1.05)
Mother's height (median, IQR)	155.2(151.4-158.9)	NA	154.9(151.1-158.8)	155.7 (152-159.5)
Mother's age at birth (mean, SD)	25.10(6.29)	24.56(5.42)	25.78(6.11)	25.83(6.45)
Mother's Mid-upper arm Circumference(MUAC) at birth (median, IQR),	24.5 (23-26)	23.74(20.38-16.91)	24.91(2.49)	24.5(23.2-26)
% from poorest households (first tertile)	31.0	27.5	40.7	34.9

Note:
1. Those lost to follow-up on account of re-location or missing at survey
2. Those with missing data on confounders
3. Those included in the final analyses

Table 2: Characteristics of respondents seen at birth (0-4m)

Characteristics	N	Stunted at birth	
		n	%
Overall	**1044**	**97**	**9.3**
Sex			
Female	500	38	7.6
Male	544	59	10.8
Mother's Education			
None/<Primary	769	81	10.5
At least PSLE	275	16	5.8
Father's Education			
None/<Primary	551	59	10.7
At least PSLE	492	38	7.7
Household asset index score			
Most poor-1	356	39	10.9
2	340	38	9.2
Least poor-3	319	17	5.2
Mother's malnutrition status at birth (MUAC)			
No	1005	87	8.6
Yes	39	10	25.6
Season of birth			
Warm, rainy	412	41	9.9
Cool, dry	433	32	7.3
Hot, dry	199	24	12.0
Mother's Age at Birth			
Mean, SD	1044	23.80(5.8)	
For non-stunted, Mean, SD		26.01(6.5)	
Mother's Height			
Mean, SD	1044	153.12(4.78)	
For non-stunted, Mean, SD		155.97(6.02)	

Table 3: School outcomes associated with moderate/severe stunting at birth (0-4m), early (11-16m) and late childhood (4-8 years)

Outcomes	Birth (0-4m)					Early childhood (<18m)					Late childhood (4-8yrs)				
	n/N	OR	CI	aOR[1]	CI	n/N	OR	CI	aOR[1]	CI	n/N	OR	CI	aOR[1,2]	CI
Age at Enrolment (n=988, 476 f, 512 m)															
Underage (<6)	36/492	0.69	0.43-1.05	0.7	0.45-1.11	75/492	0.64	0.46-0.89	0.66	0.47-0.92	41/491	0.44	0.29-0.65	0.47	0.31-0.71
On time(ref)	48/455	1		1		100/455	1		1		78/453	1		1	
Overage (>6)	8/44	1.88	0.83-4.29	1.63	0.71-3.75	16/44	2.03	1.02-1.35	1.85	0.96-3.58	17/44	3.03	1.57-5.82	2.82	1.45-5.47
Test for heterogeneity			**p=0.03**		**p=0.10**			**p<0.01**		**p=0.00**			**p<0.01**		**p<0.01**
Grade Repetition in Standard 1 (n=828, 390 f, 438 m)															
None(ref)	49/465	1		1		73/454	1		1		53/453	1		1	
1+ times	31/391	0.71	0.44-1.15	0.63	0.38-1.02	81/376	1.43	1.01-2.04	1.33	0.93-1.89	60/375	1.44	0.97-2.14	1.32	0.88-1.99
Test for heterogeneity			**p=0.16**		**p=0.06**			**p=0.04**		**p=0.12**			**p=0.07**		**p=0.17**
Age-for-Grade at Age 11 (n=789, 367f, 422m)															
Underage/On time(ref)	28/388	1		1		55/388	1		1		31/388	1		1	
1yr overage	24/239	1.44	0.81-2.54	1.25	0.69-2.25	55/239	1.81	1.20-2.74	1.68	1.10-2.57	39/239	2.25	1.36-3.71	2.21	1.32-3.72
2+yrs overage	24/163	2.22	1.24-3.96	1.77	0.95-3.28	52/163	2.84	1.83-4.39	2.58	1.63-4.10	45/162	4.43	2.68-7.32	4.18	2.44-7.16
Test for heterogeneity			**p=0.03**		**p=0.20**			**p<0.01**		**p<0.01**			**p<0.01**		**p<0.01**

1. Adjusted for father's education, mother's education, and household asset index at birth 2. Adjusted for asset index around Age 4 (in late childhood only)

Table 4 Compared to those never stunted, effect on school outcomes for children with varying growth trajectories (improvers, decliners or with persistent stunting) from early to later childhood (4-8yrs)

Outcomes	Improvers					Decliners					Persistently stunted				
	n/N	OR	CI	aOR1	CI	n/N	OR	CI	aOR1	CI	n/N	OR	CI	aOR1	CI
Age at Enrolment (n=988, 734 never, 118 improvers, 64 decliners, 72 persistent)															
Underage (<6)	50/491	0.64	0.43-0.96	0.65	0.43-0.98	17/491	0.34	0.19-0.62	0.35	0.19-0.64	24/491	0.48	0.28-0.82	0.54	0.31-0.92
On time(ref)	61/453	1		1		39/453	1		1		39/453	1		1	
Overage (>6)	7/44	1.8	0.73-4.45	1.64	0.66-4.09	8/44	3.22	1.33-7.80	3.07	1.26-7.51	9/44	3.62	1.54-8.51	3.22	1.35-7.68
Test for heterogeneity: Crude OR: p<0.01, Adjusted OR: p=<0.01															
Grade Repetition in Std 1 (n=828, 620 never, 95 improvers, 55 decliners, 58 persistent)															
None(ref)	48/453	1		1		28/453	1		1		25/453	1		1	
1+times	47/375	1.29	0.83-1.98	1.19	0.77-1.85	27/375	1.27	0.73-2.20	1.19	0.68-2.09	33/375	1.73	1.01-2.99	1.54	0.89-2.67
Test for heterogeneity: Crude OR: p=0.16, Adjusted OR: p=0.41															
Age-for-Grade at Age 11 (n=789, 573 never, 101 improvers, 55 decliners, 60 persistent)															
Underage/On time(ref)	43/388	1		1		19/388	1		1		12/388	1		1	
1yr overage	36/239	1.6	0.99-2.59	1.42	0.86-2.35	20/239	2.02	1.05-3.88	1.69	0.85-3.37	19/239	3.03	1.44-6.40	2.53	1.17-5.50
2+yrs overage	22/162	1.69	0.96-2.97	1.42	0.77-2.64	16/162	2.78	1.38-5.62	1.76	0.79-3.93	29/162	7.99	3.92-16.26	5.12	2.35-11.16
Test for heterogeneity: Crude OR: p<0.01, Adjusted OR: p=0.00															

1 Adjusted for father's education, mother's education, household asset index at birth, Asset index around age 4

Table 5 Compared to improvers, effect on school outcomes for children persistently stunted between early (11-16m) and late childhood (4-8yrs)

Outcomes	Persistently stunted				
	n/N	**OR**	**CI**	**aOR1**	**CI**
Age at Enrolment (n=190, Improvers: 118, Persistently stunted: 72)					
Underage (<6)	24/74	0.76	0.40-1.41	0.73	0.37-1.45
On time(ref)	39/100	1		1	
Overage (>6)	9/16	2.01	0.69-5.84	1.75	0.56-5.51
Test for heterogeneity:		p=0.20		p=0.33	
Grade Repetition in Std 1 (n=153, Improvers: 95, Persistently stunted: 58)					
None(ref)	25/73	1		1	
1+times	33/80	1.35	0.70-2.60	1.17	0.58-2.37
Test for heterogeneity:		**p=0.37**		**p=0.66**	
Age-for-Grade at Age 11 (n=161, Improvers: 101, Persistently stunted:60)					
Underage/On time(ref)	12/55	1		1	
1yr overage	19/55	1.89	0.81-4.41	2.17	0.87-5.43
2+yrs overage	29/51	4.72	2.03-11.01	4.04	1.61-10.18
Test for heterogeneity:		**p=0.00**		**p=0.01**	

1 Adjusted for father's education, mother's education, HAZ in early childhood, household asset index at birth, Asset index around age 4

chapter 6

PAPER 2

Failing to progress or progressing to fail? Age-for-grade heterogeneity and grade repetition in primary schools in Karonga district, northern Malawi

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PLEASE NOTE THAT A COVER SHEET MUST BE COMPLETED FOR EACH RESEARCH PAPER INCLUDED IN A THESIS.

SECTION A – Student Details

Student	Bindu Sunny
Principal Supervisor	Judith Glynn
Thesis Title	Age-for-grade heterogeneity and school dropout in primary schools in Karonga district, northern Malawi: Causes & consequences

If the Research Paper has previously been published please complete Section B, if not please move to Section C

SECTION B – Paper already published

Where was the work published?	International Journal of Educational Development		
When was the work published?	2017		
If the work was published prior to registration for your research degree, give a brief rationale for its inclusion			
Have you retained the copyright for the work?*	**No**	Was the work subject to academic peer review?	**Yes**

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Where is the work intended to be published?	
Please list the paper's authors in the intended authorship order:	
Stage of publication	Choose an item.

SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I conceptualised the study design for this manuscript, with support from my supervisor Judith Glynn. I led the collation of school-level data from the Karonga District Education Office, with support from Masoyaona Munkhondya with supervisory oversight from the District Education

	Manager, Scotch Kondowe. I led on the data management with support from Estelle McLean and Keith Branson. I also led on the analysis, with support from Judith Glynn. I wrote the first draft of the manuscript and incorporated revisions suggested by co-authors in the final manuscript.

Student Signature: [redacted] **Date:** 25.10.17

Supervisor Signature: [redacted] **Date:** 25.10.17

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Chapter 6: Paper 2- Failing to progress or progressing to fail? Age-for-grade heterogeneity and grade repetition in primary schools in Karonga district, northern Malawi

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Failing to progress or progressing to fail? Age-for-grade heterogeneity and grade repetition in primary schools in Karonga district, northern Malawi

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ABSTRACT

Timely progression through school is an important measure for school performance, completion and the onset of other life transitions for adolescents. This study examines the risk factors for grade repetition and establishes the extent to which age-for-grade heterogeneity contributes to subsequent grade repetition at early and later stages of school. Using data from a demographic surveillance site in Karonga district, northern Malawi, a cohort of 8174 respondents (ages 5–24 years) in primary school was followed in 2010 and subsequent grade repetition observed in 2011. Grade repetition was more common among those at early (grades 1–3) and later (grades 7–8) stages of school, with little variation by sex. Being under-age or over-age in school has different implications on schooling outcomes, depending on the stage of schooling. After adjusting for other risk factors, boys and girls who were under-age at early stages were at least twice as likely to repeat a grade as those at the official age-for-grade (girls: adjusted OR 2.06 $p < 0.01$; boys: adjusted OR 2.37 $p < 0.01$); while those over-age at early stages were about 30% less likely to repeat (girls: adjusted OR 0.65 $p < 0.01$; boys: adjusted OR 0.72 $p < 0.01$). Being under/over-age at later grades (4–8) was not associated with subsequent repetition but being over-age was associated with dropout. Other risk factors identified that were associated with repetition included both family-level factors (living away from their mother, having young children in the household, lower paternal education) and school-level factors (higher student-teacher ratio, proportion of female teachers and schools without access to water). Reducing direct and indirect costs of schooling for households; and improving school quality and resources at early stages of school may enable timely progression at early stages for greater retention at later stages.

1. Background

Despite global efforts to universalise education, 124 million children worldwide were out of school in 2013 with a growing proportion (50%) of these children living in Sub-Saharan Africa (UIS/UNESCO, 2015, p. 11). While the introduction of free primary education in Malawi led to a significant increase in school enrolments, only 35% manage to complete primary education (World Bank, 2010). Children who drop out of school are not young and may leave school for several reasons, including poor school quality, poor performance or when schooling conflicts with transitions to adulthood (Chimombo et al., 2000; Glynn et al., 2010; Grant and Hallman, 2006; Hunt, 2008; Lloyd et al., 2008; Meekers and Ahmed, 1999; Mensch et al., 1999). In Malawi, primary education is for eight years (grades 1–8), with the official age of entry into school being 6 years. This suggests that those who enter on time and progress uninterruptedly through each grade could complete primary school by the age of 14. However, due to late entry, frequent disruptions and repetitions, children are getting over-age for their grade and may take up to 23 student years to complete eight years of primary education (World Bank, 2010). Age-for-grade heterogeneity (relative age or age "distortion" (Psacharopoulos and Nguyen, 1987) is characterised by children of

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various ages studying in the same grade in school. Delays in progression result in age heterogeneity within a class, but it is unclear what the extent of age heterogeneity is, and whether being over-age/under-age has an effect on subsequent grade repetition, potentially leading to a vicious circle with students falling further behind the official age-for-grade.

Repetition is an indicator of progress made in school and can result from "academic failure, unsatisfactory progress, insufficient examination marks to advance to the next level of instruction, age, and poor attendance or simply from lack of local educational opportunities"((UNESCO, 2012) p-17). Students in their terminal year of school may "volunteer" to repeat their grade in order to improve their performance in the final exam and increase their chances of securing a place in secondary school; or may choose to repeat a year due to unaffordability of exam fees. Repetition is often practiced in post-colonial Francophone, Anglophone and Lusophone countries in Africa and Asia, and is less common in developed countries (except France and Belgium) where automatic promotion is more prevalent (Ndaruhutse et al., 2008). A global analysis of the patterns of repetition have broadly classified countries to have: a) high repetition (>20%) in early grades, which declines over subsequent grades, till the last grade of lower secondary (like Malawi); b) low repetition in the first grade (<10%), which increases steadily till the last grade of lower secondary; or c) a mix of both, with high repetition in all grades, ranging from 10 to 49% and fluctuations between grades (UNESCO, 2012).

Students who are older at entry have higher repetitions, drop outs and lower completion rates (Wils, 2004), as the productivity of the child and the opportunity cost of being in school increases with age (Cameron, 2005; Majgaard and Mingat, 2012; UNESCO, 2012; Wils et al., 2009). A study on the factors effecting grade repetition in grade 6 in 15 countries in Southern Africa observed that boys from poorer households and under-resourced schools were twice as likely to repeat as those from better off households (Ikeda, 2005). In a study in South Africa, (Branson et al., 2014) those overage for their grade by two or more years were more likely to dropout at later stages. Data from 54 developing countries showed that a higher proportion of female teachers in school reduced repetition for boys and girls, and increased retention especially among girls (cited in (Majgaard and Mingat, 2012). Nutritional status in early years may also be associated with positive school outcomes. A five-cohort study in Brazil, Guatemala, India, Phillipines and South Africa, showed that higher birthweight was associated with a lower risk of grade repetition (Martorell et al., 2010). Recent reviews (Brophy, 2006; Ndaruhutse et al., 2008) have listed a range of individual (low motivation/ability), household (low levels of parental education, household income, participation in household work) and school-level characteristics (low instructional time, differences in mother tongue and language of instruction, high schooling costs, proximity to school, access to sanitation facilities, poor school quality and curriculum relevance) that contribute to grade repetition in school, although there is limited empirical evidence that supports these associations.

While grade repetition is one cause of age-for-grade heterogeneity, the association between age-for-grade heterogeneity and *subsequent* grade repetition is less understood. A descriptive analysis of school performance, using DHS data from 35 countries, showed that over-age students performed better than younger students at early grades, but had higher repetition and dropout at later grades (Wils et al., 2009). In 24 of the 35 countries, including Malawi, almost half of all those in primary school were two or more years over-age for their grade, with those under-age having higher repetition rates, especially in grade 1, while those over-age were at higher risk of dropping out of school.

Our study follows a cohort of primary school students in 2010 in Karonga district, northern Malawi, to understand the risk factors for grade repetition; the extent of age-for-grade heterogeneity in school; and its effects on grade repetition in the following year, after accounting for other individual, household and school-level risk factors.

2. Data and methods

2.1. Data sources

The dataset for the analysis originates from a Demographic Surveillance System (DSS), collecting data from around 34,000 individuals living in approximately 7000 households in Karonga District, northern Malawi, since 2002. The DSS area is primarily rural, with a majority of the population engaged in agriculture, fishing and petty trading (Crampin et al., 2012). The DSS collects data on births and deaths continuously through key informants within the community, with an annual census. House-to-house surveys following the census include detailed socio-economic, schooling, and demographic profiles of the population. Information on schooling includes current schooling status (in/out of school) and highest educational attainment (grade and level) for individuals above the age of 5. Questions relating to school performance (grade repetition, absenteeism) were asked of those currently in school aged 5–30 years.

Household information includes data on the quality of dwelling construction. A household is defined as a social construct of people who co-reside and acknowledge the same head of household. Interviews were conducted with verbal consent from the household head and individual household members and any reason for non-participation was recorded. GPS locations of individual households and schools (located in and within 10 km of the DSS boundary) were tracked using handheld geographic positioning systems (Garmin Etrex and Garmin Geko 201). Ethics approval for the study was received from the Health Sciences Research Committee, Malawi and the ethics committee of the London School of Hygiene and Tropical Medicine.

2.2. Study population

This study focused on respondents between ages 5–24 years, defined by the minimum age for answering the schooling survey; WHO's definition of "young people"; and the upper age limit observed for those attending primary school. The analysis is restricted to primary school students, as primary schools differ quite markedly from secondary schools, in terms of student profiles (socio-economic status, academic motivation and financial leverage to persist in school), school systems (admission/transition criterion, provision of school infrastructure and resources, funding) and teaching/learning processes (monitoring participation, performance and completion). Enrolment into primary school is free whereas secondary schools are fee-paying and highly selective based on performance at primary level and availability of places.

2.3. Dependent and independent variables

Grade repetition as reported in the following year was used as the outcome variable to explicitly delineate the effects of age-for-grade heterogeneity on *subsequent* grade repetition, and distinguish the assumed ordering between exposures and outcome. Respondents were asked about their grade repetition status ("Have you attended your current standard/form before?") and the number of times they had attended the same grade previously. Age-for-grade, the main explanatory variable, is calculated as the number of years of age a child is ahead/behind in class, based on the official age for a specific grade (i.e. Age-for-grade = Current Age-Current Grade-5). Following UNESCO definitions, respondents

were considered over-age if they were two or more years older, and under-age if they were one or more years younger than the lower limit of the official age-for-grade. For example, given the official age of entry in primary schools in Malawi is 6 years, those who are between 6 and 7yrs, > = 8years and < = 5years of age in grade 1, are considered at age, over-age and under-age, respectively (UNESCO Institute for Statistics, 2004). Grades were categorised as early (grades 1–3), mid (grades 4–6) and later stages (grades 7–8) of schooling. School absenteeism data was based on self-reports of the number of days/weeks absent within the last four weeks of being in school.

Socio-economic factors included the highest level of education attained by the father and mother (none/less than primary, at least primary). The number of children in a household below the age of six (which is the official age at school entry), was examined as a possible determinant of school participation for older children who may be responsible for providing childcare at home. Living arrangements of children were also used to establish whether parental presence or absence was associated with participation in school. The quality of dwelling was used as a proxy for long-term household wealth status. Characteristics of houses, including the quality of the roof (plastic, grass/leaves, tiles, iron sheets), floor (mud, concrete, other), glass windows and walls (burnt/unburnt brick, thick/thin mud, concrete), were ranked in ascending order of quality. An overall score was calculated and households were divided into 3 groups (bottom 45%, middle 25% and top 30%) in order of their dwelling score (1 = Worst, 3 = Best). The cut-off points classified households into broader socio-economic groups, in close conjunction with Filmer & Pritchett's (Filmer and Pritchett, 2001) household classification (i.e., lowest 40% of households as 'poor' and highest 20% as 'rich') for the construction of wealth indices.

Schools reported in the socio-economic survey were linked data from annual school returns collected by the Karonga District Education Office (DEO) since 2007. Data on school-level characteristics were collated for 24 primary schools, in and around the DSS area (covering 97% of respondents). These included school capacity (number of students, teachers), infrastructure (classrooms, toilets, water and electricity) and performance (enrolment and performance in final exams). Student-teacher ratios were categorised based on the regulation by the Malawian Ministry of Education (MoE) stipulating class sizes to not exceed 60 students(World Bank, 2004). The school performance measure was based on final Primary School Leaving Examination (PSLE), which is an external, national-level terminal exam conducted in grade 8, and is the percentage of students who passed among those entered for the exam. Euclidean distances were calculated from home to school using ArcGIS. Schools which did not have classes up to grade 8 were categorised as incomplete. Access to water (piped/borehole) and electricity (solar/grid) were categorised as binary.

2.4. Statistical analysis

The analysis investigates risk factors for grade repetition in 2011 among students in school in 2010 using mixed effects logistic regression models to account for school-level clustering. Variables that independently showed a strong association with grade repetition were selected for the multivariable analysis (Bursac et al., 2008). Age and age at enrolment were excluded from the multivariable analyses as they contribute to the cumulative measure of age-for-grade and grade, which were used instead. Father's education, number of dependents below the age of six, dwelling score and co-residence status, were identified as potential confounders using bivariate analyses. School absenteeism and school-level characteristics, such as female-teacher ratio, student-teacher ratio and school rank were retained *a priori*. Missingness patterns among the co-variates was investigated for non-random absence of data. Missing data for mother's education were not missing at random and hence excluded from the multivariable analyses to reduce bias. The model for age-for-grade and grade repetition was *a priori* stratified by gender (interaction of sex with age-for-grade was weak $p = 0.76$); and stage (early and later) of schooling (interaction of grade with age-for-grade $p < 0.01$). There were 15 (0.2%) missing observations for the outcome variable (grade repetition). Complete case analysis was conducted for 7877 respondents (96%) for the multivariable analysis.

3. Results

Of the 16,383 individuals eligible to participate (between ages 5 and 24yrs) in the survey in 2010, 109 (0.7%) had left or were not found, 4 (0.02%) had died and 8 refused to participate (0.05%). Of the remaining 16,262 participants (99.2%) who were interviewed, 1168 (7%) were not uniquely identifiable to an individual household in the DSS, as polygamous heads of households or children moving during school-term (Crampin et al., 2012) reported living in multiple households. These individuals were excluded. 11,546 respondents currently/previously in school reported primary as the highest level attended, of whom 9712 (84%) were currently enrolled in primary school in 2010 (Fig. 1).

3.1. Characteristics of study population

Table 1 shows the characteristics of these 9712 respondents, and their schooling status in the following year. Most respondents (8447 or 87%) remained in school and were followed-up in 2011 (Fig. 1); 178 had dropped out (2%), 742 had migrated or died (8%), and 345 (4%) were missed. Those who out-migrated/died or were missed had a similar distribution by age, grade and age-for-grade as those in school in the following year. Those who dropped out the following year were older, in higher grades and more likely to be overage for their grade. Being overage by two or more years was significantly associated with dropping out of school (Pearson chi-square $p < 0.01$, Table 1).

The age-for-grade distribution is shown in Fig. 2. The top figure shows the distribution of age-for-grade among those in primary school, and the lower figure shows the distribution for those out of school in 2010. Among those in school there is a greater heterogeneity of ages at higher grade levels, with a significant deviation from the official age-for-grade (the horizontal band highlighted in green), from grade 3 onwards ($p < 0.01$ Wilcoxon rank sum test). For example, inter-quartile ranges for boys in grade 1 ranged between 4 and 9 years, as compared to the distribution for boys in grade 8 which ranged between 11 and 21 years. There are higher proportions of under-age students in the early stages and higher proportions of over-age students, especially boys, at later stages. The deviation of the median age from the official age-for-grade increases with each subsequent grade, ranging from about 1 year underage in grade 1 to about 2–3 years overage in grade 8. Age-for-grade for those previously in school was calculated based on the age (or year) at leaving school and the highest grade attended and was restricted to those who reported leaving school within the last 10 years (2000–2010) to limit recall bias. Those who dropped out over the last ten years were mostly in grades 5–8 and were 2–5 years over-age for their grade in all grades ($p < 0.01$). The median age at dropout among those out of school was 16 for girls and 17 for boys.

Subsequent analyses concentrated on those respondents who were still in school the following year (as the outcome was repetition in the following year). A further 272 respondents were

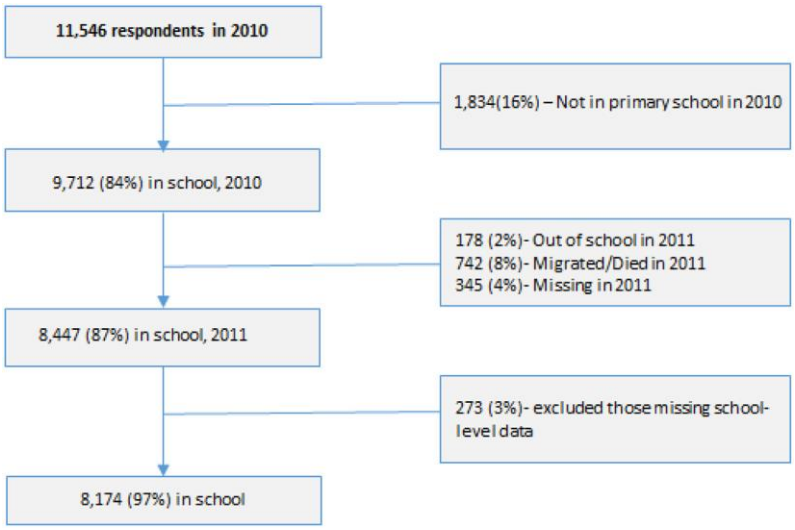

Fig. 1. School participation flowchart.

omitted due to missing school-level data. The remaining 8174 participants were enrolled in 24 primary schools in 2010 (Fig. 1). This includes those who had completed grade 8 and were out of school the following year, who were categorised as non-repeaters (n = 8), as they had performed similarly to those who progressed to secondary.

Table 2 shows their characteristics. 54% were male and nearly half were aged under 10 and in grades 1–3. While 47% were at the official age-for-grade, 12% were underage and 41% were overage. The majority of the students (Table 3) were in schools that were considered high performing (63% in schools with >75% pass rate at the grade 8 terminal exam); complete (71%); and funded by church groups (86%). More than half of the schools had fewer than 25% female teachers on staff (n = 14 or 53% students) and student-teacher ratios <60:1 (n = 15 or 53% students). Seventeen schools (84% students) had access to water (piped/borehole) but only two schools (16% students) had any electricity.

Table 1
Characteristics of respondents in 2010, by schooling status in 2011.

Characteristics	In School		Dropout		Departed/Died		Missing		Total
Age	n	%	n	%	n	%	n	%	n
5–9	3801	88.6	25	0.6	301	7.0	161	3.8	4288
10–14	3576	88.0	41	1.0	321	7.9	126	3.1	4064
15–24	1070	78.7	112	8.2	120	8.8	58	4.3	1360
Grade									
P1-3	4031	88.7	39	0.9	304	6.7	171	3.8	4545
P4-6	2979	86.2	72	2.1	282	8.2	122	3.5	3455
P7-8	1437	83.9	67	3.9	156	9.1	52	3.0	1712
Sex									
Female	3867	85.1	58	1.3	427	9.4	190	4.2	4542
Male	4580	88.6	120	2.3	315	6.1	155	3.0	5170
Age-for-Grade									
Under Age	1016	88.0	9	0.8	92	8.0	37	3.2	1154
At Official Age	3951	88.8	18	0.4	327	7.3	154	3.5	4450
Over Age-1 yr	1438	89.1	14	0.9	113	7.0	49	3.0	1614
Over Age-2 + yr	2042	81.9	137	5.5	210	8.4	105	4.2	2494
TOTAL	8447		178		742		345		9712

3.2. Grade repetition

Overall, 39% of participants reported repeating their current grade when interviewed the following year, with little variation between boys and girls. Nearly half the students in grades 1–3 (41%) had repeated their grade at least once (Fig. 2), with almost one-third of students in grade 1 having repeated twice or more. Almost half of grade 8 students had repeated at least once with 72 students (10%) having repeated twice or more. The proportion of repeaters was highest among students in schools which were smaller, incomplete,

Table 2
Characteristics of study population between ages 5–24yrs currently in school.

Characteristics	n	%
All	8174	
Sex		
Female	3733	45.7
Male	4441	54.3
Age-for-Grade		
Under Age	976	11.9
At Official Age	3823	46.8
Over Age-1 yr	1395	17.1
Over Age-2 + yr	1980	24.2
Age		
5–9	3675	45.0
10–14	3470	42.5
15–24	1029	12.6
Highest grade attended		
Early stages P1-3	3897	47.7
P 4-6	2914	35.6
Later stages P7-8	1363	16.7
Age at Enrolment		
On time (6yrs)	5356	65.5
Under Age (<6yrs)	1766	21.6
Over Age (>6 yrs)	1048	12.8
Dwelling score		
1 (Worst)	3882	47.5
2	2142	26.2
3 (Best)	2150	26.3

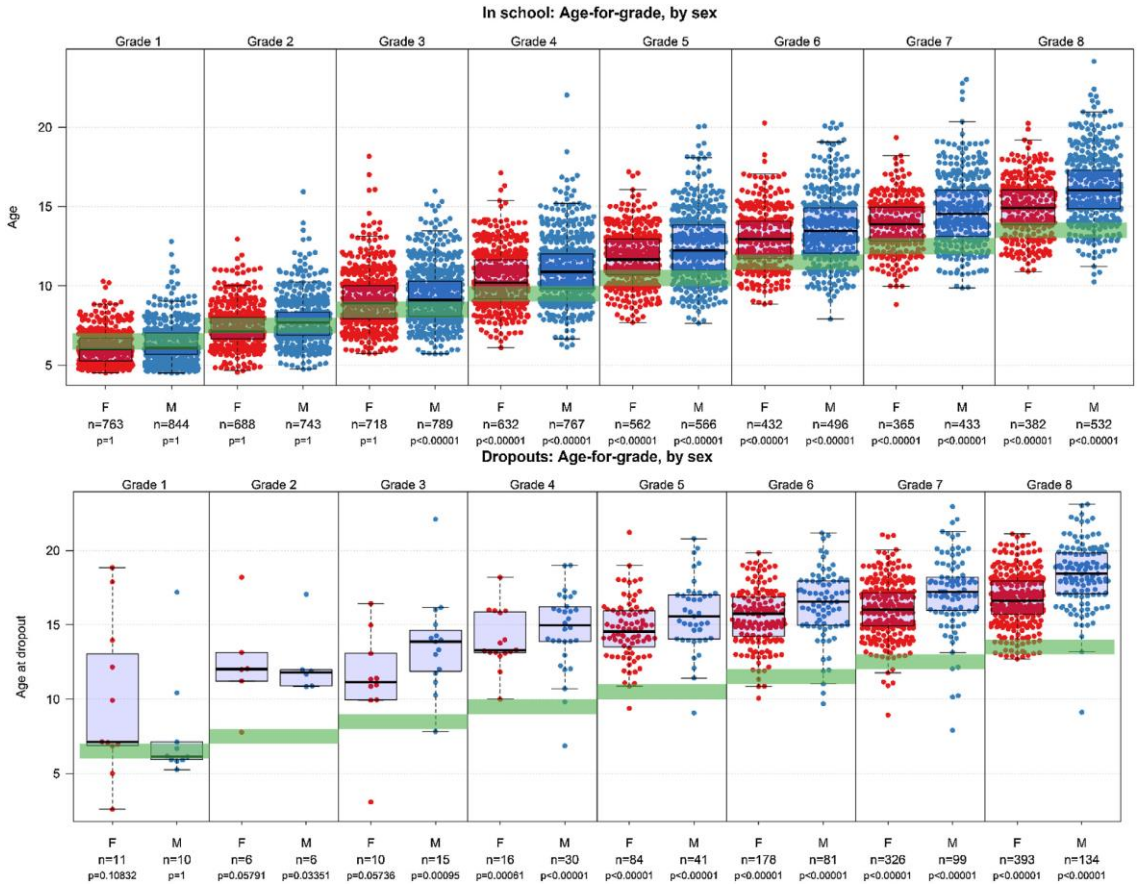

Fig. 2. Age-for-grade heterogeneity among those in and out-of-school in 2010, by sex.
The age-for-grade distributions for students in and out of primary school in 2010. Those in school in 2010 are shown in the upper panel. The age at dropout and highest grade attained among those who dropped out of primary school in the past 10 years (2000–2010), are shown in the lower panel. Females and males are shown separately. Each dot represents a student and the box plots show the median, interquartile range and outer limits of age distributions within each grade. The horizontal bar shows the official age-for-grade. The average age-for-grade increases by grade for both males and females with increasing grade and is higher among those who drop out than those who remain in school. The Wald test p-values is for the comparison of the median age-for-grade with the official age-for-grade.

with higher student-teacher ratios, no female teachers and with low school performance (Table 3). Schools that had access to water and electricity had lower proportions of repeaters.

Table 4 examines the risk factors for grade repetition in the following year, by gender showing both the univariable and multivariable analyses. Most associations were similar in the crude analysis and after adjustment for other factors. Grade repetition is more common among those under-age for their grade; and at early and later stages (grades 1–3, grades 7–8) of school. It was less common among those over-age by two or more years for their grade. Living without their mother and in lower quality dwellings increased the risk of repetition. Those whose fathers had completed at least primary education were less likely to repeat. These trends persisted after adjusting for other individual, household and school-level factors (Figs. 3 and 4).

For girls, repetition was more common among those who were absent for at least a week within the last four weeks of school. Living without their father; or with one or more children (<6years) within the same household increased their risk of repetition. Girls who studied in schools with a higher female teacher ratio (>50%); or with access to water were less likely to repeat. **For boys,** repetition was less common among those who were overage by at least one year; or living in a higher quality dwelling. The risk of repetition was higher among those who studied in schools with pupil: teacher ratio of >60:1; and was higher in high or low performing schools compared to mid performing schools.

3.3. Age-for-Grade heterogeneity and grade repetition

The association between age-for-grade and repetition varied by school grade as shown in Fig. 4. Grade repetition is highest in early (grades 1–3: 41%) and later (grades 7–8: 46%) stages of schooling; and lowest in grades 4–6 (33%). Almost 60% of under-age students in grade 1 (Fig. 4) repeated their current grade, with higher proportions of under-age repetitions at early stages ($p < 0.01$). Table 5a,b examine the association of age-for-grade heterogeneity and grade repetition, stratified by early and later (grades 4–8) stages of schooling. The majority of the risk factors for grade repetition noted above were observed at early but not later stages of schooling.

3.3.1. At early stages (Grades 1–3)

Those under-age for their grade at early stages were twice as likely to repeat a grade (girls: adj OR 2.01 $p < 0.01$; boys: adj OR 2.25 $p < 0.01$) as those at the official age-for-grade. Being over-age at early stages was associated with lower repetition (girls: adj OR

Table 3
Descriptive characteristics of 24 primary schools in Karonga district, northern Malawi.

School Characteristics		No. of schools n (%)	% of students	Repetition: No. repeating/no. of students (%)
	No. of primary schools	24		
	No. of students enrolled	8174		
School size (no. of students)				
	<=500	10(42)	24	820/1934(42)
	500–1000	12(50)	58	1838/4762(39)
	>1000	2(8)	18	531/1478(36)
Student-Teacher Ratio				
	<=60	15(62)	53	1590/4212(38)
	60–80	4(17)	30	568/1476(39)
	>80	5(21)	18	1031/2486(42)
% Female teachers				
	None	2(8)	3	113/252(45)
	<25%	12(50)	50	1648/4042(41)
	25–50%	6(25)	30	915/2410(38)
	>50%	4(17)	18	513/1470(35)
School Rank[a]				
	Low (<50%)	7(29)	11	450/895(50)
	50–75%	5(21)	26	717/2125(34)
	High (>75%)	12(50)	63	2022/5154(39)
Funding source				
	Government	4(17)	12	375/994(38)
	Religious Authority[b]	19(79)	86	2760/7037(39)
	Private	1(4)	2	54/143(38)
Complete schools[c]				
	No	7(29)	11	450/895(50)
	Yes	17(71)	89	2739/7279(38)
Access to . . .				
Water	*No*	7(29)	16	617/1326(47)
	Yes(piped/borehole)	17(71)	84	2572/6848(38)
Electricity	*No*	22(92)	84	2724/6850(40)
	Yes	2(8)	16	465/1324(35)

[a] School rank is based on the proportion of students who pass the Primary School Leaving Examination (PSLE) in Grade 8.
[b] Religious Authority schools include those funded by Roman Catholic (RC), Church of Central Africa Presbyterian (CCAP), Anglican, Seventh Day Adventist churches.
[c] Complete schools are schools that provide all eight grades of primary.

0.63 $p < 0.01$; boys: adj OR 0.67 $p < 0.01$) for both boys and girls. Repetition was less common among those whose fathers have completed at least primary. Those living without the mother or with one or more children below the age of six, within the same household, or in worse housing were at greater risk of repeating their current grade. School-level factors, like high student-teacher ratios (>60:1); more female teachers (for boys only); and access to water (girls only) were associated with higher repetition at early stages. School absenteeism showed no association with age-for-grade and grade repetition at early stages, even after adjusting for other risk factors. Repetition was lowest in mid-ranking schools, for boys.

3.3.2. At later stages (Grades 4–8)

Fewer risk factors were identified that contribute to grade repetition at later stages. There was no evidence of effect for age-for-grade heterogeneity on grade repetition at later stages, after adjusting for other risk factors, for either boys or girls. Father's education reduced the risk of repetition for both boys and girls. ***For girls at later stages,*** being absent for a week or more; or living with either parent, increased their risk of repetition. Repetition was less common among girls studying in a high-performing school and in schools with greater proportions of female teachers (>50%). ***For boys only, at later stages:*** repetition was more common for those living in a poor quality dwelling; and studying in schools with higher pupil-teacher ratios >60:1.

4. Discussion

A large proportion of school children repeat grades leading to substantial age heterogeneity in each school grade. However we found no evidence that being over-age in itself leads to repetition. Being under-age at early stages (grades 1–3) is a significant risk factor for grade repetition among boys and girls; whereas those over-age at early stages progress more quickly. The outperformance of over-age children over under-age children is probably because over-age children are motivated to perform better at early stages; are more familiar with the material and actually perform better; or are automatically advanced to the next grade by teachers in the hope that they catch up at later grades. At later stages (grades 4–8), there is no association between age-for-grade heterogeneity and grade repetition, although being over-age by 2+ years is associated with dropping out.

Our findings concur with a previous descriptive study using DHS data, which showed that countries with low overall promotion rates, like Malawi, had higher over-age progressions at early stages; while countries with higher promotion rates showed less distinct patterns of promotion by relative age (Wils

Table 4
Risk factors for grade repetition in the following year, for 8174 primary school students, by sex.

Variables		Females (N = 3733)								Males (N = 4441)							
		n/N	%	Crude OR	CI	p*	Adj OR¥	p	CI	n/N	%	Crude OR	CI	p*	Adj OR¥	p	CI
All		1402/3733	37.6							1787/4441	40.2						
Grade	P1–3	737/1834	40.2	1.44	1.23–1.67	<0.01	1.18	0.06	0.99–1.39	878/2063	42.6	1.42	1.24–1.63	<0.01	1.22	0.01	1.05–1.43
	P4–6	415/1331	31.2	1			1			535/1583	33.8	1			1		
	P7–8	250/568	44.0	1.81	1.47–2.22		1.94	0.00	1.56–2.40	374/795	47.0	1.72	1.44–2.05		1.94	0.00	1.61–2.33
Age-for-Grade																	
	Under Age	262/538	48.7	1.66	1.36–2.02	<0.01	1.76	0.00	1.43–2.17	235/438	53.7	1.76	1.42–2.18	<0.01	1.93	0.00	1.55–2.41
	At Official Age	709/1897	37.4	1			1			776/1926	40.3	1			1		
	Over Age-1 + yr	215/615	35.0	0.88	0.73–1.07		0.86	0.15	0.70–1.06	281/780	36.0	0.83	0.70–0.99		0.79	0.01	0.66–0.95
	Over Age-2 +yr	216/683	31.6	0.76	0.63–0.92		0.71	0.00	0.58–0.88	495/1297	38.2	0.9	0.77–1.04		0.81	0.01	0.68–0.96
Absenteeism																	
	0 wk	1136/3090	36.8	1		0.01	1			1473/3656	40.3	1		0.96	1		
	1 + wk	252/596	42.3	1.27	1.06–1.52		1.24	0.02	1.03–1.50	296/733	40.4	1	0.85–1.18		1.04	0.63	0.88–1.23
	Missing	14/47	29.8	0.78	0.41–1.47					18/49	36.7	0.85	0.47–1.53				
Dwelling score																	
	1 (Worst)	707/1761	40.1	1.17	0.99–1.38	0.05	1.21	0.04	1.01–1.44	921/2121	43.4	1.18	1.02–1.37	<0.01	1.21	0.02	1.04–1.41
	2	352/966	36.4	1			1			464/1176	39.5	1			1		
	3 (Best)	343/1006	34.1	0.97	0.80–1.17		0.97	0.78	0.79–1.19	402/1144	35.1	0.83	0.70–0.99		0.79	0.01	0.66–0.94
Living w/																	
	Both parents	859/2257	38.1	1		0.02	1			1122/2730	41.1	1		0.19	1		
	Father only	87/189	46.0	1.43	1.05–1.93		1.64	0.00	1.20–2.24	131/294	44.6	1.19	0.93–1.52		1.30	0.04	1.01–1.67
	Mother only	224/598	37.5	1.01	0.84–1.22		1.26	0.04	1.01–1.56	252/657	38.4	0.93	0.78–1.11		1.02	0.88	0.83–1.25
	Neither parent	232/689	33.7	0.85	0.71–1.02		1.26	0.04	1.02–1.57	282/760	37.1	0.89	0.75–1.06		1.22	0.05	1.00–1.49
Children <6yrs in hh																	
	0	344/1053	32.7	1		<0.01	1			516/1368	37.7	1		0.03	1		
	1+	1058/2680	39.5	1.34	1.15–1.56		1.28	0.00	1.08–1.51	1271/3073	41.4	1.16	1.01–1.32		1.1	0.21	0.95–1.27
Father's Ed																	
	None/ < Grade 8	697/1652	42.2	1		<0.01	1			899/2067	43.5	1		<0.01	1		
	At least Primary	666/1987	33.5	0.72	0.62–0.83		0.65	0.00	0.55–0.76	843/2257	37.4	0.80	0.71–0.91		0.75	0.00	0.64–0.87
	Missing	39/94	41.5	1.03	0.67–1.58					45/117	38.5	0.85	0.58–1.26				
Pupil-Teacher Ratio																	
	<60:1	730/1913	38.2	1		0.7	1			860/2299	37.4	1		0.22	1		
	60–80:1	225/661	34.0	0.83	0.51–1.34		1.26	0.15	0.92–1.73	343/815	42.1	1.37	0.89–2.10		1.56	0.00	1.16–2.11
	>80:1	447/1159	38.6	1.02	0.68–1.55		1.13	0.40	0.85–1.50	584/1327	44.0	1.29	0.88–1.88		1.27	0.09	0.96–1.68
Female Teacher																	
	<25%	784/1965	39.9	1		0.04	1			977/2329	41.9	1		0.46	1		
	25–50%	417/1097	38.0	0.94	0.65–1.36		1.32	0.07	0.98–1.78	498/1313	37.9	0.8	0.54–1.17		1	0.99	0.74–1.34
	>50%	201/671	30.0	0.57	0.37–0.88		0.70	0.03	0.51–0.97	312/799	39.0	0.85	0.54–1.33		1.26	0.15	0.92–1.72
School Rank																	
	Low < 50%	216/411	52.6	2.37	1.67–3.37	<0.01	1.33	0.26	0.81–2.19	234/484	48.3	1.78	1.20–2.64	0.01	2.02	0.00	1.27–3.22
	Mid < 75%	309/970	31.9	1			1			408/1155	35.3	1			1		
	High:>75%	877/2352	37.3	1.31	0.99–1.74		1.04	0.81	0.74–1.47	1145/2802	40.9	1.45	1.04–2.03		1.59	0.01	1.14–2.23

Access to water																
No	284/593	47.9	1			1			333/733	45.4	1			1		
Yes (piped/borehole)	1118/3140	35.6	0.60	0.43–0.82	<0.01	0.56	0.00	0.38–0.83	1454/3708	39.2	0.81	0.57–1.16	0.26	0.92	0.67	0.64–1.33
Mother's Ed																
None/< Primary	978/2532	38.6	1						1268/3057	41.5	1					
At least Primary	405/1165	34.8	0.88	0.76–1.02	0.08				507/1343	37.8	0.9	0.78–1.03	0.09			
Missing	19/36	52.8	1.79	0.92–3.48					12/41	29.3	0.61	0.31–1.20				
Distance to school																
<=1 km	807/2187	36.9	1						1027/2600	39.5	1					
>1 km	582/1514	38.4	1.05	0.91–1.22	0.5				740/1801	41.1	1.09	0.96–1.25	0.2			
Missing	13/32	40.6	1.04	0.42–2.60					20/40	50.0	1.53	0.67–3.49				
Access to Electricity																
No	1190/3131	38.0	1						1534/3719	41.2	1					
Yes	212/602	35.2	0.81	0.45–1.45	0.48				253/722	35.0	0.7	0.41–1.19	0.19			

* Summary p-values. Missing observations omitted from Wald test.
¥ Adjusted for individual, household and school-level factors.

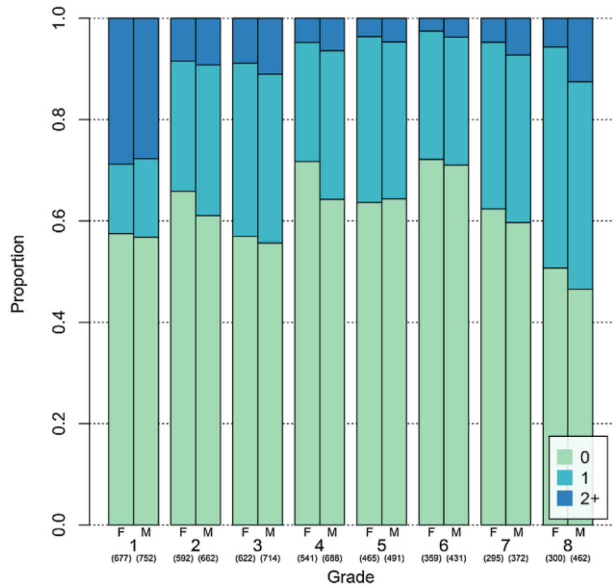

Fig. 3. Grade Repetition, by grade and sex.

Fig. 3 shows the proportions of repeaters and the extent of repetition, by grade and sex. Repetition is highest in early (grades 1–3) and later stages (grades 7–8), with almost 30% of grade 1 students repeating their current grade two or more times.

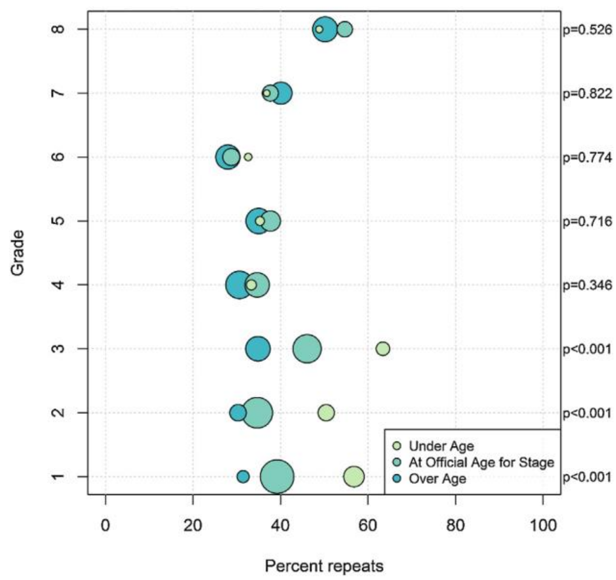

Fig. 4. Repetition by age-for-grade and grade.

Fig. 4 shows the proportion repeating in each grade in 2011 by age-for-grade in 2010. The size of the circle is proportional to the number of students within that group. The p-values (Wald test) are for the comparison of the risk of repetition by age-for-grade within each grade.

et al., 2009). In the Malawi DHS, as in our data, under-age children had higher repetition rates in the early grades, especially grade 1. Being over-age was not a risk factor for repetition, but was associated with dropping out of school. In the DHS data analysis, the effect of age-for-grade heterogeneity on grade repetition was not adjusted for other co-variates. This contrasts with earlier findings from Mozambique which showed that being over-age at school entry is a risk factor for grade repetition (Nonoyama-Tarumi et al., 2010; Wils, 2004). This is not to deny that over-age enrolment

Table 5
Association between age-for-grade heterogeneity and grade repetition for 8,174primary school students, by stage and sex.

a.		Females (N = 3733)													
		Early Stages (grades 1–3) n = 1834							Later Stages (grades 4–8) n = 1899						
Variables		n/N	%	crude OR	CI	adj OR[¥]	p	CI	n/N	%	crude OR	CI	adj OR[¥]	p	CI
All		737/1834	40.2						665/1899	35.0					
Age-for-Grade	Under Age	212/392	54.1	2.03	1.59–2.58	2.01	0.00	1.56–2.59	50/146	34.2	0.96	0.65–1.40	1.08	0.69	0.73–1.61
	At Official Age	426/1121	38.0	1		1			283/776	36.5	1		1		
	Over Age-1+ yr	99/321	30.8	0.67	0.51–0.89	0.63	0.00	0.47–0.84	332/977	34.0	0.88	0.72–1.07	0.87	0.20	0.70–1.08
Absenteeism	Not absent	592/1491	39.7	1		1			544/15997	34.0	1		1		
	1+ wk	138/317	43.5	1.15	0.90–1.48	1.16	0.26	0.89–1.51	114/279	40.9	1.39	1.07–1.82	1.39	0.02	1.05–1.83
Dwelling score	1 (Worst)	402/955	42.1	1.26	1.00–1.60	1.26	0.07	0.98–1.60	305/806	37.8	1.07	0.84–1.37	1.07	0.62	0.83–1.37
	2	177/475	37.3	1		1			175/491	35.6	1		1		
	3 (Best)	158/404	39.1	1.19	0.90–1.58	1.19	0.25	0.89–1.61	185/602	30.7	0.82	0.63–1.07	0.90	0.44	0.68–1.18
Living w/	Both parents	492/1204	40.9	1		1			367/1053	34.9	1		1		
	Father only	46/95	48.4	1.39	0.91–2.12	1.73	0.02	1.11–2.69	41/94	43.6	1.50	0.97–2.33	1.56	0.05	1.00–2.42
	Mother only	100/278	36.0	0.84	0.64–1.11	1.12	0.46	0.82–1.53	124/320	38.8	1.21	0.93–1.57	1.41	0.03	1.03–1.94
	Neither parent	99/257	38.5	0.93	0.70–1.24	1.70	0.00	1.21–2.39	133/432	30.8	0.84	0.65–1.07	1.04	0.79	0.78–1.39
Children <6yrs in hh	0	113/367	30.8	1		1			231/686	33.7	1		1		
	1+	624/1467	42.5	1.67	1.30–2.15	1.66	0.00	1.26–2.18	434/1213	35.8	1.11	0.91–1.35	1.04	0.71	0.84–1.29
Father's Ed	None/ < Primary	395/882	44.8	1		1			302/770	39.2	1		1		
	At least Primary	333/923	36.1	0.73	0.60–0.88	0.63	0.00	0.50–0.79	333/1067	31.2	0.71	0.58–0.86	0.67	0.00	0.53–0.86
Pupil-Teacher Ratio	<60:1	368/934	39.4	1		1			362/979	37.0	1		1		
	60–80:1	115/292	39.4	0.99	0.57–1.70	1.59	0.01	1.11–2.27	110/369	29.8	0.77	0.45–1.32	1.04	0.89	0.61–1.78
	>80:1	254/608	41.8	1.19	0.76–1.88	1.45	0.02	1.06–2.00	193/551	35.0	0.92	0.57–1.47	0.80	0.39	0.49–1.32
Female Teacher(%)	<25%	422/1004	42.0	1		1			362/9610	37.7	1		1		
	25–50%	224/554	40.4	0.95	0.62–1.44	1.61	0.00	1.16–2.25	193/543	35.5	0.87	0.56–1.36	0.94	0.83	0.55–1.61
	>50%	91/276	33.0	0.59	0.36–0.99	0.79	0.23	0.53–1.16	110/395	27.8	0.58	0.35–0.97	0.61	0.08	0.35–1.07
School Rank	Low < 50%	142/250	56.8	2.52	1.80–3.51	1.48	0.18	0.83–2.64	74/161	46.0	1.90	1.08–3.34	1.15	0.75	0.49–2.70
	Mid 50–75%	148/431	34.3	1		1			161/539	29.9	1		1		
	High:>75%	447/1153	38.8	1.21	0.95–1.56	0.90	0.61	0.61–1.34	430/1199	35.9	1.37	0.89–2.12	1.31	0.36	0.73–2.34
Access to water	No	158/310	51.0	1		1			126/283	44.5	1		1		
	Yes (piped/borehole)	579/1524	38.0	0.59	0.41–0.84	0.55	0.01	0.34–0.86	539/1616	33.4	0.65	0.42–1.00	0.65	0.20	0.33–1.26

b.		Males (N = 4441)													
		Early Stages (grades 1–3) n = 2063							Later Stages (grades 4–8) n = 2378						
Variables		n/N	%	crude OR	CI	adj OR[¥]	p	CI	n/N	%	crude OR	CI	adj OR[¥]	p	CI
All		878/2063	42.6						909/2378	38.2					
Age for Grade	Under Age	187/317	59.0	2.12	1.64–2.75	2.25	0.00	1.71–2.95	48/121	39.7	1.09	0.73–1.63	1.23	0.33	0.81–1.86
	At Official Age	513/1236	41.5	1		1			263/690	38.1	1		1		
	Over Age-1+ yr	178/510	34.9	0.72	0.57–0.90	0.67	0.00	0.53–0.84	598/1567	38.2	0.99	0.82–1.19	0.96	0.65	0.78–1.16
Absenteeism	Not absent	718/1686	42.6	1		1			755/1972	38.3	1		1		
	1+ wk	154/359	42.9	0.99	0.78–1.25	1.00	1.00	0.78–1.28	142/375	37.9	1.02	0.81–1.29	1.02	0.89	0.80–1.29

Dwelling score	1 (Worst)	471/1083	43.5	0.92	0.74–1.15	0.95	0.64	0.76–1.19	450/1038	43.4	1.44	1.17–1.78	1.47	0.00	1.19–1.83
	2	242/519	46.6	1		1			222/657	33.8	1		1		
	3 (Best)	165/461	35.8	0.64	0.49–0.84	0.59	0.00	0.45–0.78	237/683	34.7	1.04	0.82–1.31	1.02	0.84	0.81–1.30
Living w/	Both parents	606/1380	43.9	1		1			516/1350	38.2	1		1		
	Father only	61/117	52.1	1.41	0.96–2.08	1.59	0.02	1.07–2.37	70/177	39.5	1.11	0.81–1.54	1.09	0.59	0.79–1.52
	Mother only	107/291	36.8	0.78	0.60–1.02	0.97	0.84	0.72–1.31	145/366	39.6	1.11	0.87–1.41	1.07	0.66	0.80–1.42
	Neither parent	104/275	37.8	0.79	0.61–1.04	1.29	0.11	0.94–1.77	178/485	36.7	1.02	0.81–1.27	1.13	0.36	0.87–1.47
Children<6yrs in hh	0	156/443	35.2	1		1			360/925	38.9	1		1		
	1+	722/1620	44.6	1.45	1.16–1.81	1.30	0.03	1.02–1.66	549/1453	37.8	0.96	0.81–1.14	0.94	0.54	0.79–1.13
Father's Ed	None/ < Primary	470/1010	46.5	1		1			429/1057	40.6	1		1		
	At least Primary	397/1026	38.7	0.74	0.61–0.89	0.70	0.00	0.56–0.86	447/1234	36.2	0.87	0.73–1.04	0.82	0.06	0.66–1.01
Pupil-Teacher Ratio	<60:1	421/1073	39.2	1		1			439/1226	35.8	1		1		
	60–80:1	139/354	39.3	0.96	0.62–1.49	1.23	0.31	0.82–1.85	204/461	44.3	1.63	1.03–2.59	1.81	0.00	1.36–2.40
	>80:1	318/636	50.0	1.55	1.07–2.22	1.50	0.03	1.05–2.15	266/691	38.5	1.14	0.75–1.73	1.10	0.48	0.84–1.45
Female Teacher (%)	<25%	467/1080	43.2	1		1			510/1249	40.8	1		1		
	25–50%	266/632	42.1	0.95	0.62–1.45	1.08	0.71	0.73–1.58	232/681	34.1	0.70	0.46–1.07	0.94	0.68	0.71–1.25
	>50%	145/351	41.3	0.95	0.57–1.58	1.90	0.00	1.26–2.88	167/448	37.3	0.77	0.48–1.24	0.91	0.54	0.67–1.23
School Rank	Low < 50%	139/276	50.4	2.06	1.36–3.13	3.04	0.00	1.61–5.74	95/208	45.7	1.50	0.86–2.61	1.43	0.16	0.87–2.34
	Mid 50–75%	177/530	33.4	1		1			231/625	37.0	1		1		
	High:>75%	562/1257	44.7	1.72	1.22–2.41	1.92	0.00	1.23–3.00	583/1545	37.7	1.21	0.78–1.89	1.33	0.08	0.96–1.82
Access to water	No	168/359	46.8	1		1			165/374	44.1	1		1		
	Yes (piped/borehole)	710/1704	41.7	0.84	0.56–1.25	1.25	0.38	0.76–2.05	744/2004	37.1	0.78	0.51–1.19	0.73	0.11	0.49–1.07

[¥] Adjusted for individual, household and school-level factors.

into school has an adverse effect on schooling, but that being under-age or over-age in school has different implications on grade repetition, depending on the context of schooling (UNESCO, 2012).

Slow progression or disinterest in school at early stages may have a cumulative effect on schooling at later stages. Repetition in grades 7–8 is high although there is no detectable effect of being under-age/over-age as almost two-thirds of students are over-age at this stage. Repetition maybe high on account of "voluntary" repetitions by students who choose to repeat their grade in order to improve their performance in the terminal year exam, or due to unaffordability of exam fees (Ndaruhutse et al., 2008; Wils et al., 2009). Delays in progression at later grades leads to wider age heterogeneity in the class, which may have a "peer-effect" on performance. In South Africa, Lam et al. showed that interacting with older peers in class had an adverse influence on in-school pregnancy (Marteleto et al., 2008). Age at enrolment contributes to age-for-grade heterogeneity at early and later stages. Under-age school entry may take place to off-set the lack of adequate pre-school facilities; to ease the provision of child-care by older siblings who attend school or to provide children an early exposure to the school setting (Fentiman et al., 1999b). Late school entries take place on account of parental perceptions of the child's readiness for school (physical, social, cognitive), financial need; and distance to school (Nonoyama-Tarumi et al., 2010).

Socio-economic and school-level factors that were associated with age-for-grade heterogeneity and grade repetition were not gendered but varied by stage of schooling. The links between socio-economic status of households, school quality and schooling have been well studied (Gomes-Neto, 1991; Glick and Sahn, 2000, 2010; Patrinos and Psacharopoulos, 1992; Sackey, 2007), although less so in understanding the risk factors for grade repetition by stage of schooling. Educated fathers or living with both parents may provide a more enabling environment at home which is supportive of schooling and foster learning, especially at early stages (Booth, 1996; Glick and Sahn, 2000). Living with either parent (only father/only mother) may be a risk factor as the absence of the mother may imply greater domestic responsibilities that may conflict with schooling; and the absence of the father may imply greater financial burden on the household. This is consistent with our finding that children at early stages of school, who live with at least one child below the age of six, may experience more child-rearing and domestic duties which reduces time from school, leading to poor performance and higher repetitions in school. As the age range of those in early stages is quite wide (between 5 and 12 years) this may reflect the allocation of household duties to younger members of the household, while income-earning responsibilities are more likely to be allocated to those at older age groups (Fentiman et al., 1999b). The effect of living in a poorer quality dwelling, especially among boys at later stages, concurs with previous evidence on household economic status and school participation, especially among students who volunteer to repeat a grade due to lack of exam fees. Dwelling score is a crude measure of relative socio-economic status so we would expect a stronger correlation with more detailed measures. Despite efforts to universalise primary education, households still incur higher direct (exam fees, textbooks, transportation) and indirect costs of schooling at later stages.

Schools which have lower student-teacher ratios (<60:1), higher female teacher ratios (>50%) ratios, improved infrastructure (access to water) may reduce the risk of repetition, especially for girls at early stages. Access to water in schools and links to menstrual management may enable attendance and participation in schools for girls at later stages, though there is no clear evidence of this association (Birdthistle et al., 2011). Positive links with access to water in school and grade repetition at early stages may be related to other factors of school-quality, like proximity to roads/businesses, which may attract more qualified teachers or improve teacher attendance. School performance showed a non-linear association with repetition, especially for boys at early stages, which was high irrespective of whether they were enrolled in low or high performing schools. While the higher risk of repetition at lower performing schools is understandable, the higher risk of repetition at high performing schools may be on account of the schools' need to maintain a higher level of performance at all stages of schooling, by raising performance thresholds and compelling students to repeat.

Early academic performance is an important determinant of performance at later grades(Glick and Sahn, 2010). Higher risk of repetition among under-age students and the progression of over-age students in early grades, leads to a growing pool of over-age students at later stages who are approaching the age of adolescence. For example, the median age of students in grade 6 is around 13.5, compared to the official age-for-grade of 11–12 years. Previous studies in northern Karonga have shown that girls who reach menarche before the age of 14 are more likely to have sex, get pregnant and marry sooner; and are less likely to complete school than those who reach menarche at older ages (Glynn et al., 2010). While being overage at later stages is not a significant risk factor for repetition at later stages, academic failure when overage may lead to dropping out of school as a preferred choice over repetition. Given the low number of dropouts observed in 2011 (n = 178, 2%), which may be indicative of the dynamic nature of dropping out of school (Hunt, 2008), questions around the effect of age-for-grade heterogeneity on dropout and other competing risk factors (like first sex, pregnancy, marriage) are better explored using longitudinal data.

One of the main limitations of this study is the use of self-reported data on grade repetition, which may be prone to social desirability bias or measurement error. However, given the longitudinal nature of the KPS data, any inconsistencies or missing data were corrected using current/previous years' schooling status and repetition data, thereby minimising bias. There may also be concerns around the accuracy of age as reported by respondents, which was reported at the baseline census and only asked for those newly migrating into the DSS catchment area. Those respondents who could not provide a precise date of birth, mostly older generations, had the dates and month of birth centred for the middle of the month/year. Being part of a larger demographic surveillance site which has been collecting data on births, deaths and migrations since 2002, registration of vital events remains important and hence more accurate for the younger age-groups, who are the target group for this study. In the absence of standardized tests in schools, our study uses grade repetition as a proxy for school performance. This raises concerns about the measures of performance used in schools and how accurately a teacher's judgement on whether a student should repeat a grade or not is a true reflection of the student's ability or competency for that grade (Ndaruhutse et al., 2008). Other school-level risk factors for repetition which were not measured in this study, like instructional time, teacher attendance, teachers' motivation and self-efficacy, need to be considered for future studies.

This study further raises the issue of grade repetition as a practice, and whether it is a necessary and a sufficient condition to improve student performance. Repetition is considered beneficial in attaining homogeneity of ability within a classroom which is easier for teachers to manage (Fentiman et al., 1999a) although this assumes that the methods of choosing who should repeat are reliable which may not be the case (Bernard et al., 2005). Those in favour of repetition claim that it provides flexibility for "slow learners" or students who need more time to master the course content. It provides flexibility for students to meet their individual learning needs, especially in schools where the language of instruction differs

from their mother tongue (UNESCO, 1998). But repetition prolongs the duration of schooling, which conflicts with the period of adolescence(Glynn et al., 2010); and can affect self-esteem and motivation of students to persist (Ndaruhutse et al., 2008). The economic argument against grade repetition has revolved around increased school inefficiencies and the higher costs associated with lower/delayed entry of graduates into the work force, to contribute to the productivity of the economy. In 2004, a World Bank study assessed that a 1% reduction in repetition in Malawi would result in an annual saving of around MK 30 million (around $300,000) (World Bank, 2004). The opportunity cost of staying in school also increases with age (Fentiman et al., 1999b), especially in agrarian or subsistence economies where families perceive a higher return on adolescent's labour by working on the farm or in the household, rather than attending school.

While automatic or social promotion in school is gaining approval and implemented in several countries (like Mauritius, Seychelles, Zimbabwe), its relevance within a developing country context is still questionable, given the growing paucity of qualified teachers, teaching materials and resources for existing learners, and most importantly remedial teaching needs for those retained. While neither grade repetition nor automatic promotion have shown an impact on student performance (Ndaruhutse et al., 2008; UNESCO, 2012), repetitions will have fewer children progressing through school with higher levels of dropout at later stages; while automatic/social promotion will result in more students progressing through school, but perhaps with a minimum level of learning/mastery achieved upon completion. In Malawi, efforts to introduce less stringent, yet uniform conditions for promotion (50% pass rate in 2 subjects) between certain grades (grades 4, 6, 8) are being deliberated upon, though not yet implemented (World Bank, 2010, p. 60). The recently introduced Education Sector Implementation Plan-II (2013–2018) suggests a 10% cap on repetition in primary schools (Ravishankar et al., 2015), though the effects on performance are yet to be understood. Irrespective of whether country policies adopt a practice of grade repetition or automatic promotion, the focus needs to be directed towards school quality and meeting the diverse (age, sex, cognitive) learning needs of students to enable timely progression through school.

5. Conclusion

Timely progression through school is important, not only for school performance and completion, but also for ensuring that reasonable educational levels are reached before the onset of other life transitions for adolescents. Although we did not find that being over age was a risk factor for repetition, it results from repetition and leads to increased drop out. Most students are not dropping out at young ages, but they are dropping out undereducated. The levels of repetition were extremely high at all stages, implying poor learning. Many risk factors were similar for boys and girls. From a policy perspective, it is critical to address the varied learning needs of children, through greater investments in managing multi-age teaching, quality resource allocations (timely provision of textbooks, infrastructure and qualified teachers), remedial learning and focus on reading, writing and numeracy skills at early stages that equip students to progress through each grade on time.

Ethics

This study is part of the Karonga Prevention Study (KPS), a demographic surveillance site primarily funded by the Wellcome Trust. Ethics approval was granted by the National Health Sciences Research Committee, Malawi and the ethics committee of the London School of Hygiene and Tropical Medicine. Prior to the start of the study, the team consulted and gained consent from traditional authorities, village headmen and traditional advisers in the catchment area. The aims, objectives, risks and benefits of the study were discussed and verbal consent obtained to carry out the study. Interviews at household-level were conducted based on verbal consent given by heads of households. Individual consents and refusals to participate were recorded in the field register. School-level data was collated with permission from the District Education Office, Karonga.

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chapter 7

PAPER 3

Understanding the timing and determinants of primary school dropout in Karonga district, northern Malawi: A large population-based cohort study

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SECTION A – Student Details

Student	Bindu Sunny
Principal Supervisor	Prof. Judith Glynn
Thesis Title	Age-for-grade heterogeneity and school dropout in primary schools in Karonga district, northern Malawi: Causes & consequences

If the Research Paper has previously been published please complete Section B, if not please move to Section C

SECTION B – Paper already published

Where was the work published?			
When was the work published?			
If the work was published prior to registration for your research degree, give a brief rationale for its inclusion			
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SECTION C – Prepared for publication, but not yet published

Where is the work intended to be published?	Journal of Biosocial Sciences
Please list the paper's authors in the intended authorship order:	Bindu Sunny, Bianca DeStavola, Albert Dube, Levie Gondwe, Allan Kaonga, Scotch Kondowe, Estelle McLean, Keith Branson, Amelia C Crampin, Judith R Glynn
Stage of publication	**Not yet submitted**

SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I conceptualised the study design for this manuscript, with support from my supervisor Judith Glynn. I led the collation of school-level data from the Karonga District Education Office, with support from Allan Kaonga with supervisory oversight from the

	District Education Manager, Scotch Kondowe. I led on the data management with support from Estelle McLean and Keith Branson. I also led on the analysis, with support from Judith Glynn. I wrote the first draft of the manuscript and incorporated revisions suggested by co-authors in the final manuscript.

Student Signature: [redacted] **Date:** 25.10.17

Supervisor Signature: [redacted] **Date:** 25.10.17

7

CHAPTER 7: Paper 3- Understanding the timing and determinants of primary school dropout in Karonga district, northern Malawi: A large population-based cohort study

7.1 Abstract

Introduction

Being overage-for-grade is a marker of poor school performance and a likely driver of school dropout.

Methods

Using longitudinal data from a demographic surveillance site in northern Malawi, we examine the timing, incidence and risk factors for primary school dropout among 8,426 primary school students, with age-for-grade heterogeneity as our main predictor.

Results

Those who dropped out of school were not young, but were overage and undereducated. By the age of 15, 90% of participants were still enrolled in school. The median age of dropout for girls was 19. By this age, one-third of all boys had dropped out of school, 45% of girls and boys had completed school and 25% of boys compared to only 5% of girls were still enrolled. Those who were 2 years overage for their grade were more likely to drop out than those at the correct age: twice as likely for girls and three times as likely for boys. Several individual, household and school-level risk factors, including household wealth status, parental education levels, and household living arrangements, female-teacher ratios and access to water in school, were also associated with dropout for both boys and girls.

Conclusion

Being overage in school increases the risk of school dropout for both boys and girls, though the pathways to dropout may be more gendered. Investing in school quality, timely progression and learning needs to be prioritised to ensure children complete school on time.

7.2 Introduction

Over the last thirty years, the universalisation of primary education in Sub-Saharan Africa has resulted in surging school enrolments and a narrowing of the gender gap, with girls' enrolment in school approaching that of boys(1). The rise in enrolments was not met by improved school quality, resulting in an over-burdened school system unable to keep up with this demand(2). Higher school enrolments also meant that children of different ages and abilities were enrolled together in the same class. Those who were enrolled were not all attending, those who were attending were not all learning, and those who failed to learn progressed very slowly through school with the risk of dropping out prior to completion(1,3,4).

Age-for-grade heterogeneity, caused by children being overage or underage for their grade is characterised by children of various ages studying in the same grade. As a cumulative measure of enrolment, progression and disruptions through school, age-for-grade provides a proxy for school performance. Analysis of age-for-grade patterns across five countries in sub-Saharan Africa, showed that the extent of age heterogeneity in early grades of primary school was quite large, with age gaps extending up to 7 years within a grade, though diminishing at higher grades (1). These variations in ages within grade can prove difficult for teachers to teach and for learners to stay engaged thereby relying on improved school quality to cater to different learner needs(5). Prolonged stay in school does not guarantee better learning outcomes, with only one-third of children in Malawi reported to have gained a basic level of mastery in reading and numeracy skills at the end of Grade 6 (6,7).

Late enrolment in school may contribute to age-for-grade heterogeneity in schools in some settings(8,9). DHS surveys from eight sub-Saharan African countries showed that 34% of children who enrolled in Standard 1 were at least two years overage for grade. Most children who enrolled late in school came from rural areas, represented the poorest 20% of the population and had uneducated mothers. In five of the eight countries, boys were most likely to be overage than girls at the time of enrolment. Age-for-grade is also caused by grade repetitions, which are usually the highest in the first and last grades of primary school(10). In early grades, overage students were more likely to perform better than underage students, but had higher repetition and dropout at higher grades. This was consistent with our findings in Karonga district, in northern Malawi(11).

Age-for-grade is also considered to influence school dropout (3,10,12–15), though findings of this association have been mostly descriptive, based on cross-sectional data, and does not

account for socio-economic factors that may also explain this relationship. Two studies that have examined this empirically show that age-for-grade is associated with dropout, though one uses cross-sectional data (16); and the other is a longitudinal study in South Africa, where school enrolment and attrition is high, which limits comparability to other countries in the region(17). Other risk factors for school dropout are also known(14) and extend from the individual (age, sex), household (household income, size and structure, education and employment status of household members), school (direct and indirect costs of schooling, location, student-teacher ratios, sanitation facilities); peer effects, which will be further examined in this study.

In Malawi, primary school is for eight years (Standards 1-8) with the official age at entry being 6 years. Almost half of all those in primary school were two or more years overage for their grade (10). Though heterogeneity in age-for-grade is wide, the extent of overage enrolments in schools in Malawi have been on the decline from 76% in 1991 to 56% in 2004 (4). School dropout is high: only 52% completed six years of primary school compared to an average of 61% for sub-Saharan Africa(6), while dropout rates for girls in the final three years of primary school are at least seven times higher than that of boys(18). In Karonga district, in northern Malawi, which is the setting for this study, almost 39% of students repeated their current grade, with high repetitions across all grades of primary school, especially in Standards 1 and 8(11). Grade repetition is similar for boys and girls, though varied by stage of school and the extent to which students were underage or overage in school.

Using eight years of event-history data on schooling from the demographic surveillance site in Karonga district, northern Malawi, this study aims to understand the timing, incidence and broader contextual determinants (individual, household, school, peer effects) of school dropout in relation to school completion, looking particularly at age-for-grade as our main predictor.

7.3 Data and Methods

The demographic surveillance site of the Karonga Prevention Study(19), in Karonga district, northern Malawi has been collecting routine data on birth, death and migrations from around 43,000 individuals living in 9,000 households since 2002. Eight rounds of socio-economic data, including schooling histories, were collected annually from 2007-2015. Current school performance data, including age at school entry, timing (age and stage) of dropout and grade repetition, and reasons for dropout were collected annually from household members (or their proxies) between ages 5-30 years at the time of the interview. Data on schooling status, highest grade attended and qualifications attained were collected for individual household members of all ages. Household-level data on ownership of assets and dwellings, and access to utilities and

services, were also collected annually between 2007-2011 and 2013-2015. Consent to participate in the household surveys was collected from household heads and individual household members as part of the demographic surveillance. All refusals to participate and loss-to-follow up because of death or migration out of the surveillance site were also documented. Ethics approval was received from the Health Sciences Research committee, Malawi and the London School of Hygiene and Tropical Medicine, UK.

School-level characteristics for 28 primary schools within the study area were collated from the Karonga District Education Office (DEO) for the period of analysis (2007-2015). School-level data were collected annually by the DEO from school head-teachers and included information on student-teacher ratios, proportion of female teachers, access to water and electricity in the school and school performance in the Primary School Leaving Examination (PSLE) undertaken by students in their terminal year of primary school (Standard 8). GPS locations of individual households, schools and markets were tracked using handheld geographic positioning systems which were used to estimate point-to-point distances.

Outcome: Definition of Dropout, Data Management and Set-up

This study examines the timing, incidence and determinants of primary school dropout, while treating primary school completion as a competing event. In our analyses, dropout is defined to have occurred when a respondent reported having left school for the first time during the follow-up period, without completing primary school (repeat dropout was ignored: 101 participants (<0.1%) reported dropping out two or more times). Dropout is conditional on being enrolled in school the previous year. Completion of primary school was determined on the basis of reported data on completion of PSLE or inference from subsequent enrolment into secondary school. The study targets those between ages 5-24 years who had attended at least some primary school. Given the official age of completion is 14 years, the upper age limit would allow the inclusion of those who take longer to complete primary education; none reported primary school completion after the age of 24.

Dropout and school completion are interdependent as dropout makes subsequent completion unlikely; and school completion precludes dropout. Given the nature of this interplay, a standard survival analysis would only produce estimates of cause-specific hazards of dropout or completion (20). For this reason, the Fine and Gray (21) approach was used to deal with competing events as it directly models the cumulative probability of dropping out (or completing). The hazard ratios estimated for the Fine and Gray model however do not have the same interpretation as those obtained by fitting a cause-specific hazards model as they refer to

how the explanatory variables influence the cumulative incidence of each competing event. This influence is expressed on the sub-hazard scale [27]. The model assumes that explanatory variables have a proportional effect on this scale, with the effect measures called the sub-hazard ratios (20), which will be referred to as the hazard ratio (HR) in the analysis, for simplicity.

Given the importance of age as a potential confounder, all analyses were carried out on the age time scale, with the age at enrolment into the study as the time of origin. As data on schooling histories were collected annually, the timing of dropout (or completion) were based on the age when participants reported being out of school and the interview date when either event of interest (dropout/completion) was reported. Duration enrolled in school, and the timing of primary school completion were established using the precise end and start dates of the primary and secondary school calendars, respectively. Cumulative incidence probabilities of dropout and school completion (expressed in terms of age) were estimated using the Nelson-Aalen method(20). The distributions of age-for-grade and grade last attended among dropouts, in the year in which they dropped out, were also examined separately for boys and girls. These distributions were also compared with those in school i.e., when individuals were last observed to be in school and not having experienced either event (dropout or completion).

For those with gaps in the data that were longer than expected from annual survey data but shorter than two years, the information on school progression or dropout/completion date was inferred if possible from the nearest available rounds (preceding and subsequent). If it was not possible then the information for that individual was censored at the beginning of the gap. Observations were censored at grade > standard 8, the date of the last survey in which the participant was seen, or the end of the study (survey round 2015-6).

Risk factors

Age-for-grade is calculated as the number of years a participant is ahead/behind their current grade (i.e. Age-for-grade=Current Age- Current Grade-5) based on the official age of entry into primary school(22). Age-for-grade for those out of school was estimated using the age of leaving school and the highest grade attended when last enrolled. For parental education, we used the reports of the parents themselves, if they were included as part of the study. If these were not available (20% for mothers and 30% for fathers), we used a question on education of parents asked of all individuals. Data on household composition, such as living arrangements of respondents (with father, mother, both parents, neither parent) and the number of children below the age of six living in the same household, were derived for each round.

Data on household ownership of consumer durables, assets, dwelling characteristics, and access to utilities, like water and electricity, were collected to create a composite wealth index of households using principal components analysis(23–25). Selection of variables on asset ownership (ownership of bed, mattress, car, radio) and service utilisation (access to water and electricity) was based on what was consistently available across all rounds of the schooling data. Categorical variables were re-coded as binary dummy variables and continuous variables were normalized to range between the values of 0 and 1. The first component was used to create a wealth index score split by quintiles across all households. Missing values for household wealth indices were imputed with scores from the most recent round.

Peer-effects were measured for each participant by calculating the proportion of same-sex peers who were overage by two or more years within the same class and school, for each study round. This was further categorised into three groups at around the 30^{th} and 60^{th} percentiles. Student-teacher proportions were categorised based on the recently mandated Ministry of Education student-teacher ratio policy of 60:1(26). Proportion of female teachers; and school access to basic utilities (water and electricity), were also included as potentially important determinants of school participation. All risk factors, except for parental education, were updated at each round.

Statistical Analysis

The analysis was split into two steps. The first was descriptive and the second, analytical. The first focussed on participants who were between ages 5-24 years when first observed (baseline), to explore the overall distribution of age, grade and age-for-grade at dropout, and the overall rates of dropout and completion. Findings from the descriptive analysis determined the target age group (12-24 year olds) for the second analytical step, as they were most likely to experience dropout (and completion) in primary school.

The Fine and Gray approach to modelling the cumulative probability (incidence) of dropping out and the cumulative probability of school completion was then implemented to identify the most important risk factors for each of these outcomes, expressed on the age time-scale, and accounting for clustering at school-level. Age-for-grade was included *a priori* into the model as a key marker of school progression. All variables that vary with study wave were lagged by one wave before inclusion in each model to reflect the assumed (potential) causal ordering between exposures and outcomes. The assumption of proportionality of effects on the sub-hazard scale was examined separately for each of these variables using Schoenfeld's residuals (21). The proportional hazards assumption was found to be met for all covariates except for sex, so all analyses are reported separately by sex.

Uni-variable and bi-variable analyses were carried out to explore individual and combined effects on the two competing events. Inclusion of variables in the multivariable model was based on findings from the school dropout literature rather than to merely achieve statistical parsimony, as lack of evidence of an association is also important. We fitted a multivariable model that included all the risk factors.

7.4 Results

Of 20,031 respondents who were between ages 5-24 years and eligible to participate at baseline, 24(0.1 %) relocated households or left the study site; 5(<0.1%) were missing or not found at the time of the survey; and 3(<0.1%) refused to participate. A further 289(1.5%) participated only once through all eight rounds of the study and 947(5%) respondents who did not have data on school-level characteristics were excluded from the analysis. In total therefore 18,283 (91%) individuals between ages 5-24 years at baseline were included in the descriptive analyses. Information on those <12years was provided mostly by parents (75%) and grandparents (21%), with low levels of self-reported data. Self-reported data were higher for those older than 12 years (16%), though parents (60%) and grandparents (25%) remained the primary informants.

For the risk factor analysis 8,426 respondents between ages 12-24 years were eligible, either because they were already in this age group at baseline or because they aged into the cohort during follow-up. Only 313 or 3.7% of the 8,426 participants had missing data on one or more variables, so complete record analysis was carried out for 8,113 participants.

Descriptive characteristics of target population at baseline (5-24 years)

Of 18,283 participants (Table 1), 51% were male, 76% were 5-11 years old, 77% were in the early stages of school (Standard 1-4), and overall 19% were more than one year overage for their grade. 93% enrolled in school at/under the official age of 6 years with only 6% enrolled at age 7. Most participants lived in male-headed (80%), medium-to-large sized (64% living with >five residents) households; and lived more than 1km from the nearest market (68%). Almost half of all respondents lived with both parents and three quarters co-resided with at least one child below the age of six. Parental education was low for most participants, with wide discrepancies in attainment between parents. Only 33% of participants' mothers had completed at least primary, as compared to 55% of fathers. In this broad age group, 12% of participants had high exposure (>50%) to overage classmates of the same sex. About half of all participants were enrolled in schools which were poor-to-medium performing (54% in schools with <75% pass rate in the PSLE); and located within 1km of their homes (60%). Most participants were enrolled in schools

that had predominantly male teachers (74% with <50% female teacher ratios), high student-teacher ratios (68% in schools with >60:1 student-teacher ratios), with access to water (77%) and no access to electricity (93%).

Cumulative Incidence of Dropout and Completion- Fig. 1a, shows the cumulative probability of school dropout by age, where completion was treated as a competing event (and vice-versa for completion, Fig.1b).

At the age of 15, 90% of participants remained enrolled in primary school. The median age of dropout for girls was 19. By this age, one-third of all boys had dropped out of school, 45% of girls and boys had completed primary and 25% of boys compared to only 5% of girls were still enrolled in school. By the age of 23, almost all those in school either had dropped out or completed primary school, with higher cumulative incidence of dropouts among girls (52%) than among boys (42%) and higher cumulative incidence of completion among boys (58%) than among girls (48%).

Characteristics at Time of Dropout

***Grade at dropout*:** Figure 2, shows the distribution by grade and sex of those who had dropped out before the end of primary. Pupils drop out at all grades, with increasing proportions of dropouts at higher grades. The distribution of grade at drop out is similar for boys and girls.

Age-for-Grade and Grade among dropouts and those in school

The age-for-grade distribution among those in and out of school (Fig 3) differs quite markedly by grade and sex. Among those in school, 60% of boys and girls were at the right age/underage in Std 1. However, this distribution changed by the end of Std 8: more boys than girls prolonged their stay in school, with almost half being overage by 3 or more years, compared to 20% of girls overage by 3 or more years. While the number of dropouts at early stages (Standards 1-3) were small in comparison to that at later stages (Standards 4-8), the proportion of male dropouts overage by 3 or more years exceeds that of girls at every grade except Standard 1. At least 90% of male dropouts at later stages were overage by 3 or more years. In contrast, the proportion of female dropouts overage by 3 or more years at later stages declined with every increment in grade.

Only 28 respondents dropped out before the age of 12, of whom 18 (64%) were girls. Reasons for dropping out were reported by 21 participants. 4 boys and 4 girls dropped out due to poor

school performance; 3 boys and 3 girls due to household instability or household chores, and 4 girls and 1 boy due to illness.

Among the 1,901 dropouts aged 12-24, 53% were girls with more than half reporting marriage (45%) or pregnancy (18%) as the primary reasons for dropping out of school. 22% of girl dropouts mentioned school-related reasons, such as poor performance in exams, poor school quality, suspension from school; and 3.1% reported household economic reasons, such as helping with household chores, caring for other household members, and lack of fees. In contrast, half of boys (53%) reported school-related reasons, 15% reported household-related reasons and 8% reported marriage or pregnancy of girlfriend as the primary reasons for dropping out of school.

Risk factors for school dropout

The analysis of risk factors for dropout is restricted to those between 12-24yrs because of the small number of dropouts under 12 years. The characteristics of the participants at study baseline (when they were first seen or when they first aged into this cohort) are shown in Table 1. Of the 8,426 respondents in the analytical sample, 80% were between ages 12-14 years, at later stages of school (Standard 5-8). Almost half of the respondents were overage by at least 2 years for their grade, with 33% exposed to >50% overage same-sex classmates. Table 2 reports rates and HRs of dropout prior to completing primary school for all the presumed risk factors, separately by sex.

Rates of dropout are higher for girls than for boys in each category of these variables. Several factors were found to be important risk factors for school dropout for both boys and girls when examined individually, in particular age-for-grade, household wealth status, parents' education, household living arrangements, exposure to over-age classmates, distance to school, female-teacher ratios and access to water in school. Most of these effects remained significant and with similar estimated HRs after adjusting for other co-variates. Household-level risk factors like household size, the number of children below the age of six, were only strongly associated with dropout for boys; while school-level risk factors, like distance from market to school, student-teacher ratios, PSLE pass ratios and access to electricity in school were only significantly associated with dropout for girls.

At the ***individual-level,*** being overage for grade increased the hazard of dropout but with different strength of effect by sex. Girls who were 2 years overage for their grade were almost twice as likely to drop out of school (crude HR 2.0 $p<0.01$) while boys were at least three times

as likely to drop out (crude HR 3.5 p<0.01). This association remained after adjusting for other covariates. The increased hazard of dropout with increasing levels of being overage was more marked for boys, with a higher proportion of boys than of girls being overage by 3 or more years, but within each stratum of age-for-grade, girls had higher dropout rates than boys.

At the ***household level,*** there was a strong trend (p<0.01) of increasing risk of dropout going from the least poor to the poorest households. After adjusting for other co-variates, this effect remained but was weaker for boys than for girls. For both girls and boys, those whose mothers or fathers had received at least primary education were less likely to drop out. For both girls and boys, those living with both parents were the least likely to drop out, with the largest HRs for those living just with their fathers and, for girls, for those living with neither parent. For boys, but not girls, living in smaller households and in households with more children under 6 years old were associated with increased HR of dropout; while boys living in close proximity to the market were less likely to drop out. There was no association between sex of the household head and the hazard of school dropout.

Among the physical aspects of the ***school,*** proximity of the school to home for girls and boys, and proximity of the school to the market for girls only, were associated with higher hazards of dropout. Access to water at school was associated with reduced hazard of dropout similarly for boys and girls, whereas access to electricity was weakly associated with reduced dropout for girls, with no association seen for boys. Higher female teacher ratios were associated with reduced hazard of dropout for both boys and girls, while there was a weaker effect of student-teacher ratios. Girls studying in high-performing schools were less likely to dropout, but with little association seen for boys.

A higher proportion of overage same-sex pupils in the class reduced the hazard of dropout for both boys and girls, with a stronger trend for boys. Boys in classes where more than half of their male classmates were overage by 3 or more years were 60% less likely to drop out of school compared to those with fewer than 40% overage classmates. Since this peer effect may be more important among those who were themselves overage, interactions between age-for-grade and peer exposure were examined (Table 1 in the Appendix). This showed that the effects of being overage on dropout within each stratum of exposure to overage peers were generally similar, although there was an inflationary effect on dropout among girls overage by 3 or more years who had a higher exposure (>50%) to overage class-mates. Fewer girls within this sub-stratum (who were overage by 3 or more years, with a high exposure to overage classmates) makes it difficult to explore this further. The tests for interaction showed p-values of <0.01 for girls; 0.17 for boys.

Determinants of School Completion

Table 2, in the Appendix, shows the results of the analysis using school completion as the outcome. The results were very similar, showing an almost inverse relationship with risk factors for school dropout.

7.5 Discussion

School participation was similar in boys and girls till around age 14, but then diverged with rates of dropout from primary school rising faster for girls. Rates of primary school completion are higher for girls initially, while boys are more likely to prolong their stay in school getting increasingly overage but with higher ultimate completion rates. Overall, 90% of participants remained enrolled in primary school at age 15, but by the age of 19, almost all girls (95%) either drop out or complete school, compared to only 75% of boys.

A key finding was the strong association between being over-age for grade and dropout. This has been noted previously (8–10). Being over-age-for-grade is both a marker of poor school performance and a likely driver of dropout as students become increasingly bored with repetition and disaffected by studying with much younger children. Interestingly, although having a high proportion of over-age students in the class was associated with lower rates of dropout, it did not mitigate the effect of being over-age on dropout. Overage enrolments may be a possible reason for age-for-grade heterogeneity and subsequent dropout(8,9). However in our study, we find that most students enrol underage or on time which suggests that high, frequent and cumulative repetitions (including other disruptions, like school absenteeism) leads to a growing over-age population in school who are soon inclined to drop out.

Although we identified several household and school level risk factors associated with dropping out of school, it seems that they only lead to high levels of drop out after 15. Perhaps at older ages the cumulative effects of poor school quality, poor performance and repetition, together with the opportunity cost of school, and societal and increasing peer pressures associated with adolescence, precipitate dropout, especially for girls (27).

Slow progression through school suggests poor school quality. The only direct measure of school quality we had was the PSLE pass rate, which was associated with lower dropout. Student teacher ratios had a surprisingly small effect, but do not reflect the variations in grade-specific ratios (with lower grades having higher STRs), levels of teacher qualifications or absenteeism. Interestingly a high proportion of female teachers was associated with reduced dropout for boys as well as girls.

Gender equality and the treatment of girls in schools by their teachers and peers was a critical determinant of school dropout in Kenya(28). Access to water reduced the risk of dropping out similarly for both boys and girls, which questions the earlier assumptions (29) around the specific protective effect of the provision of toilets and water in schools for girls in relation to menstrual hygiene.

We identified associations with measures of poor household socio-economic status such as low levels of household wealth, parental education, living with a single or neither parent, which have all previously been shown as risk factors for dropout (30–33). These suggest that the direct and indirect costs of schooling contribute to school dropout. While the introduction of free primary education in 1994 eliminated the payment of fees and reduced the opportunity cost for families to send their children to school(2), households in Malawi are still responsible for other out-of-pocket school-related expenses, like the provision of textbooks, stationery and examination fees, which are not all mandatory but still pose a significant economic burden on households(2). We had hypothesised that the presence of young children in the house would lead to increased dropout for girls due to domestic responsibilities, but an association was only seen for boys.

Schools' proximity to markets increased the probability of dropout, especially for girls. This is consistent with anecdotal evidence from head teachers in this population who mentioned proximity to markets as a reason for frequent absenteeism. The finding that students living closer to school were at a higher risk of dropping out is surprising, though the majority of children attend schools within a 2km radius (only 7% attend schools >2km radius at baseline). We used point-to-point distance measures, which may vary greatly from distances measured by actual walking pathways used by children to get to school and are much harder to measure. Using DHS data from 21 countries, Filmer's study on proximity to school and school participation showed that reducing distance to school is a necessary but not a sufficient condition for improving school participation. Over time, any further increase in the provision of new schools within the same area has a diminishing marginal utility on school participation, and may be more dependent on other aspects of school quality and the community's value and demand for education (34).

A limitation of this paper is the exclusion of critical life events, like marriage and pregnancy, which were reported as the main reasons for school dropout among girls. Unfortunately, this information was only available for a minority of adolescents so could not be included in the analysis. Future studies would need to delineate the timing and sequence of these events (pregnancy, marriage) in relation to dropout, as a way to validate the reasons reported by participants for dropping out of school. We also had to rely on proxy respondents (mostly

parents) in collecting schooling histories of participants. However, the use of longitudinal data on schooling histories allowed us to validate and select the most reliable estimate for the analysis. Several other factors specific to school quality that could account for dropout in primary school, which were not accounted for in this study, include access to teaching and learning resources in school, teacher absenteeism, and the practice of corporal punishment in the classroom. Detailed information on peer influences; participation in economic activity; and time spent in school versus work could also shed more light on factors that influence dropout.

7.6 Conclusion

Improving school retention and completion is critical to leverage better health, education and economic outcomes for current and future generations (35).Our study shows that more girls drop out of primary school than boys, with boys prolonging their stay and completing school, or dropping out, at older ages. Almost all children are in school until at least 15 but with poor progression so that they are overage for their grade, and being overage-for-grade is a key risk factor for dropping out of school. They are not dropping out young, but they are dropping out under-educated. This suggests that investment in school quality to allow children to progress on time would give children a stronger foundation education before transitioning into the competing social and economic pressures of adolescence.

7.7 References

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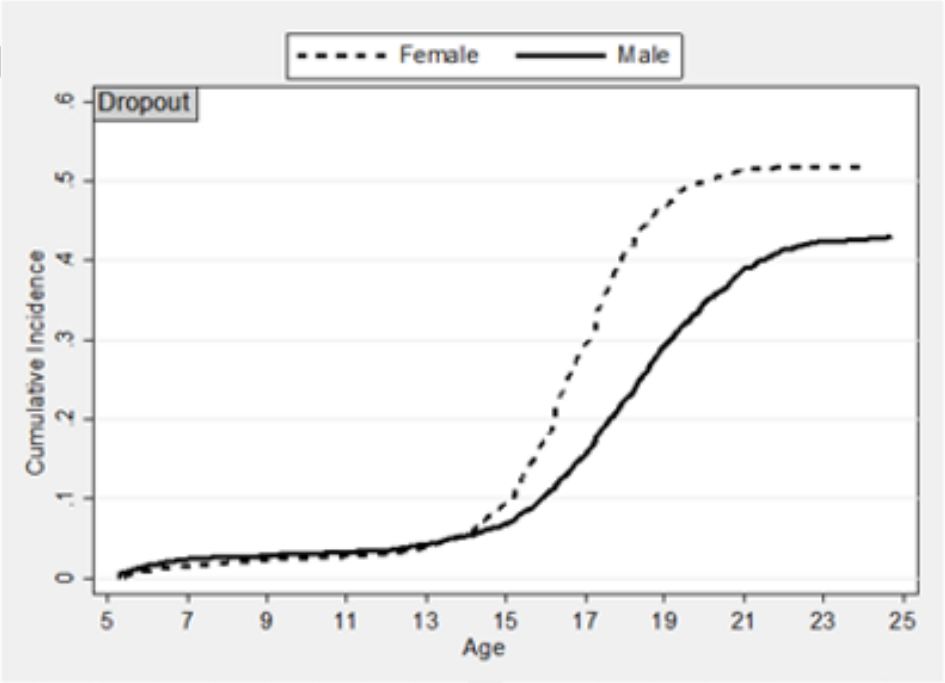
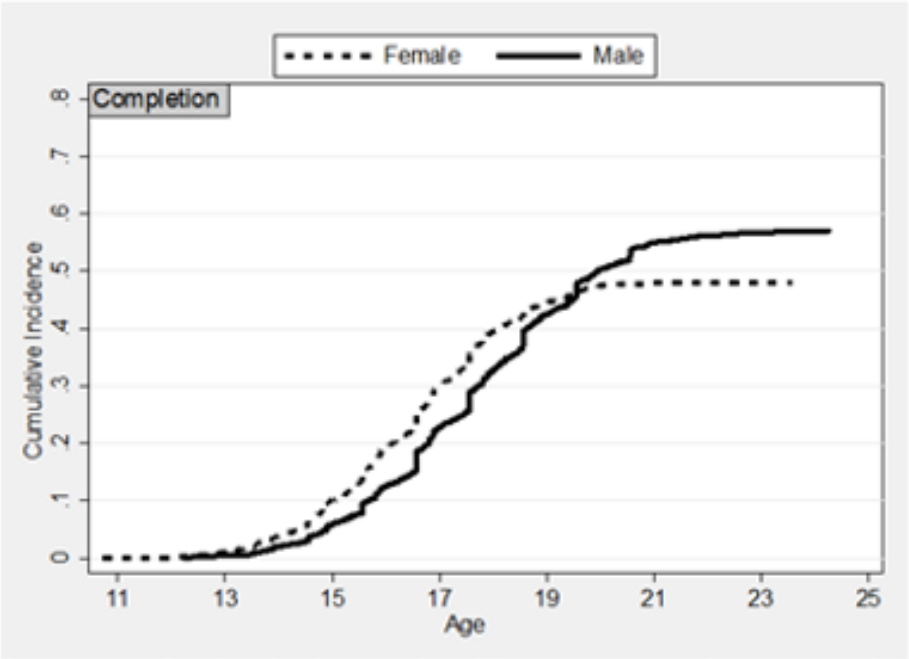
Table 1: Characteristics for those between ages 5-24 & 12-24 years at base-line/as they age into the cohort

		5-24yrs (n=18,283)		12-24 years (n=8,426)	
Characteristics	Categories	n	%	n	%
Sex	Female	8895	48.7	3,880	46.0
	Male	9388	51.4	4,546	54.0
Age	5-11	13952	76.3		
	12-14	2686	14.7	6,727	79.8
	15-24	1645	9.0	1,699	20.2
Highest grade attended	P1-4	1445	76.7	1,745	20.7
	P5-6	2399	13.1	3,941	46.8
	P7-8	1,839	10.1	2,740	32.5
Age at Enrolment	Underage- <6	6359	34.8	1,899	22.5
	At age- 6 years	10,726	58.7	5,794	68.8
	Overage->6 years	1,198	6.5	733	9.7
Age for Grade	Under/Atage/Overage 1yr	14,816	81.0	3,888	46.1
	Overage 2yr	1,526	8.4	2,037	24.2
	Overage 3+yr	1,941	10.6	2,501	30.0
Household Effects					
Household Wealth Index	1 (Poorest)	4,249	23.2	1,859	22.1
	2	2,152	11.8	1,116	13.2
	3	5,034	27.5	2,399	28.5
	4	2,612	14.3	1,216	14.4
	5 (Richest)	3,241	17.7	1,527	18.1
	Missing	995	5.4	309	3.7
Mother's Education	None/<Primary	12,188	66.7	5,703	67.7
	At least PSLE	6,061	33.2	2,702	32.1
	Missing	34	0.2	21	0.3
Father's Education	None/<Primary	8,143	44.5	3,805	45.2
	At least PSLE	9,998	54.7	4,548	54.0
	Missing	142	0.8	73	0.9
Living arrangements	Both parents	8,892	48.6	3,437	40.8
	Father only	1,086	6.0	617	7.3
	Mother only	4,407	24.1	2,130	25.3
	Neither parent	3,879	21.2	2,227	26.4
	Missing	19	0.1	15	0.2
Distance to nearest market	<=1 km	5,820	31.8	2,620	31.1
	>1 km	12,450	68.1	5,797	68.8
	Missing	13	0.1	9	0.1
Household size	1-5	6,553	36.0	2,563	30.4
	6-8	8,901	48.7	4,366	51.8
	9+	2,810	15.4	1,482	17.6
	Missing	19	0.1	15	0.2
Sex of Household head	Female	3,465	19.0	1,874	22.2
	Male	14,799	81.0	6,537	77.6
	Missing	19	0.1	15	0.2
Children <6yr in hh	None	4,491	24.6	3,303	39.2
	1	5,994	32.8	2,636	31.3
	2+	7,779	42.6	2,472	29.3
	Missing	19	0.1	15	0.2
School effects					
Distance to school	<=1 km	11,041	60.4	4,818	57.2
	>1km	7,194	39.4	3,582	42.5
	Missing	48	0.3	26	0.3
Distance to nearest market	<=1 km	7,109	38.9	3,262	38.7
	>1km	11,135	60.9	5,146	61.1
	Missing	39	0.2	18	0.2
Access to Electricity	No	17,069	93.4	7,600	90.2
	Yes	1,214	6.6	826	9.8
Access to Water	No	4,242	23.2	1,573	18.7
	Yes	14,041	76.8	6,853	81.3
% Female Teacher	<20%	5,736	31.4	2,287	27.1
	20-50%	7,805	42.7	3,680	43.7
	>50%	4,742	26.0	2,459	29.2
Student-Teacher Ratio	<60:1	5,934	32.5	2,739	32.5
	60-80:1	6,574	36.0	2,987	35.5
	>80:1	5,775	31.6	2,700	32.0
PSLE Pass Ratio	<60%	3,273	17.9	1,431	17.0
	60-75	6,580	36.0	3,053	36.2
	>75%	6,048	33.1	3,208	38.1
	Incomplete schools	2,382	13.0	734	8.7
Percentage of overage same-sex classmates (within same class and school)					
	<40%	14,597	80.0	3,741	44.4
	40-50%	1,550	8.5	1928	22.9
	>50%	2,136	11.7	2,757	32.7



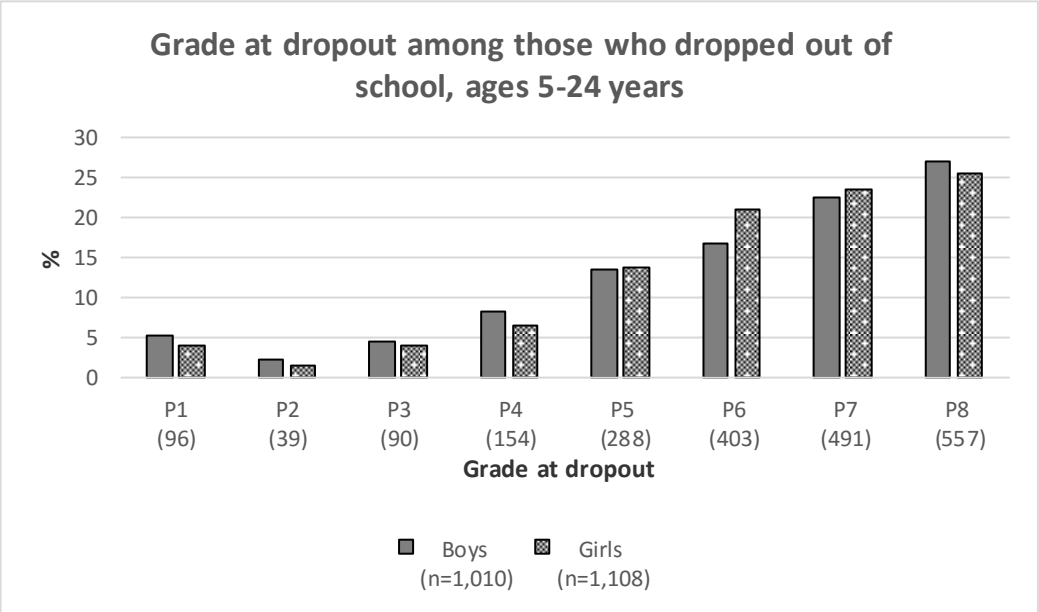
Dropout	5	7	9	11	13	15	17	19	21
Females									
Dropout	24	24	18	30	151	454	320	74	13
Censored	249	1367	1478	1432	1512	1301	513	61	6
Risk set	9047	8774	7383	5887	4425	2762	1007	174	19
Males									
Dropout	30	15	15	30	76	233	329	202	79
Censored	194	1269	1428	1430	1393	1367	956	409	70
Risk set	9525	9301	8017	6574	5114	3845	2045	760	149

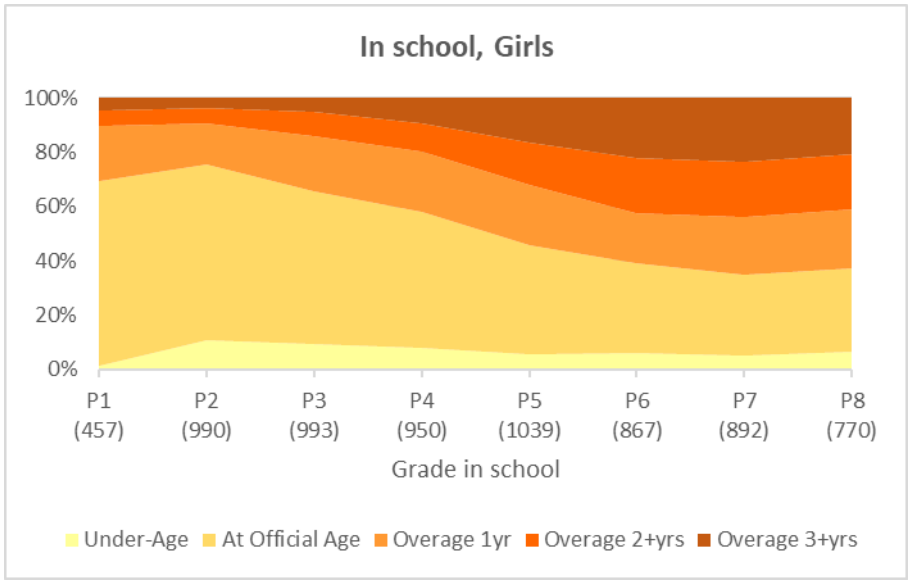


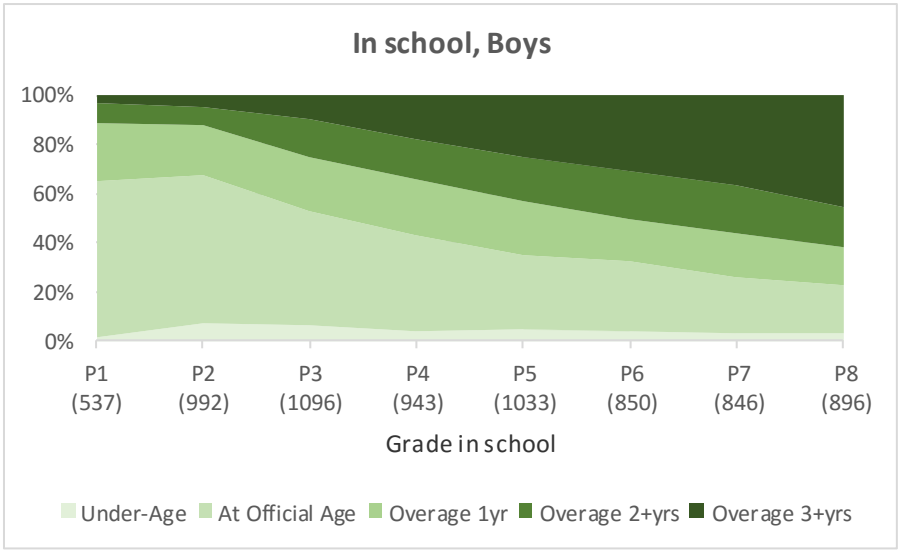
Completion	11	13	15	17	19	21	23	25
Females								
Completed	25	246	448	268	55	2	1	0
Censored	1450	1426	1309	570	104	13	2	1
Risk set	5920	4445	2773	1016	178	19	4	1
Males								
Completed	12	171	469	472	267	35	4	0
Censored	1450	1294	1135	821	355	94	17	2
Risk set	6598	5136	3871	2067	774	152	23	2

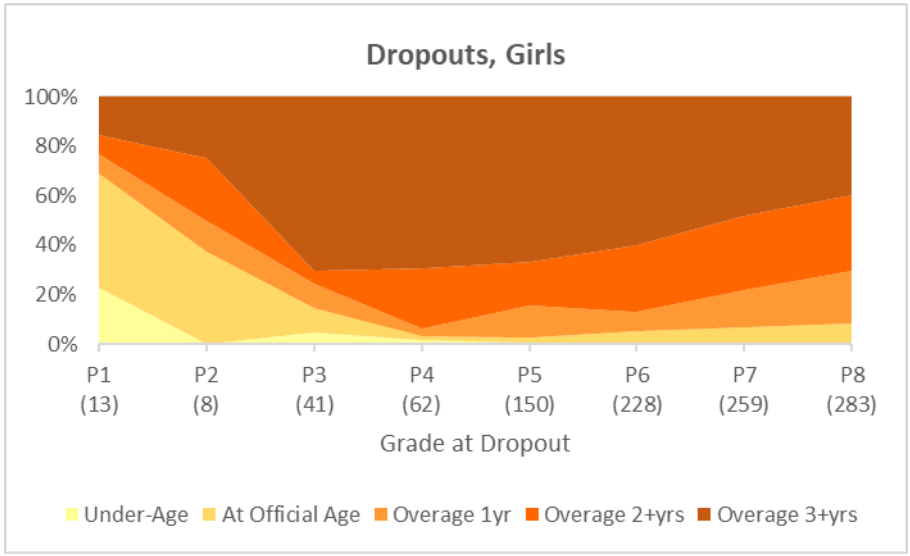
Figures 1a,1b: Age at dropout and school completion, with school completion and dropout modelled separately as competing risks, respectively. The numbers at risk and the number of events are shown.

Figure 2: Distribution of grade at dropout among those who dropped out, by grade and sex (5-24yrs)









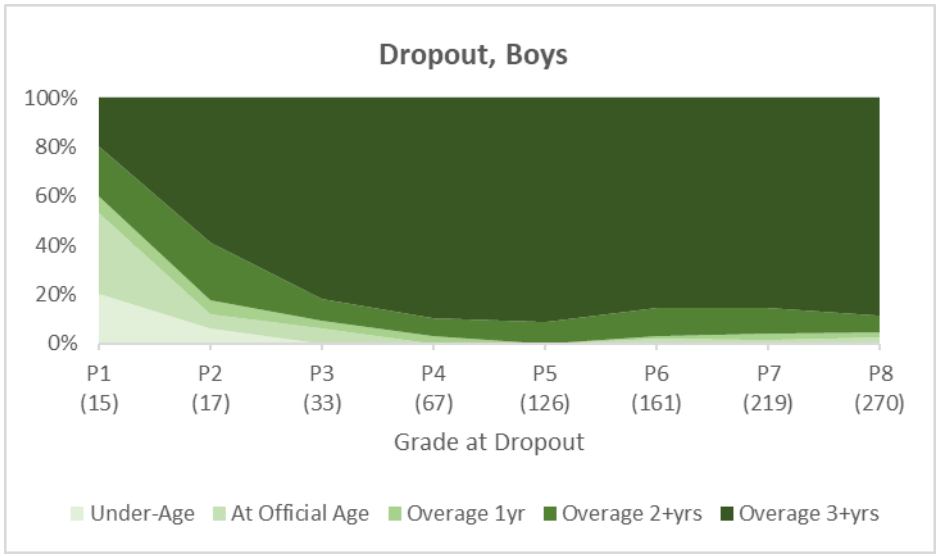


Figure 3: Grade and Age-for-grade among those in and out of school, by sex (5-24yrs)

Table 2: Risk factors for school drop-out among 8,113 primary school students between ages 12-24 years, with primary school completion as a competing risk

Variables	Girls (n=3,717)							Boys (n=4,396)						
	Drop-outs	Person years (1000s)	Rate /1000py	Crude HR	p	Adj HR¥	CI	Drop-outs	Person years (1000s)	Rate /1000py	Crude HR	p	Adj HR¥	CI
Overall	932	9.7	95.6					879	13.7	63.9				
Age-for-grade														
Under/At/Overage 1yr	172	3.9	43.6	1		1		28	3.6	7.7	1		1	
Overage 2yr	242	2.5	95.5	2.03***	<0.01	1.79***	1.49 - 2.16	77	3.0	25.3	3.47***	<0.01	3.19***	2.08 - 4.89
Overage 3+yr	518	3.3	158.6	2.86***		2.19***	1.75 - 2.75	774	7.1	109.7	11.33***		8.31***	5.29 - 13.04
Household effects														
Household wealth index														
1 (Poorest)	274	2.1	130.6	2.68***		2.03***	1.62 - 2.55	264	3.1	85.3	2.52***		1.54**	1.04 - 2.29
2	155	1.4	107.9	2.03***		1.64***	1.27 - 2.13	158	2.3	68.9	1.89***		1.35*	0.96 - 1.90
3	242	2.6	92.1	1.58***	<0.01	1.36***	1.09 - 1.70	229	3.8	60.0	1.48*	<0.01	1.09	0.75 - 1.59
4	132	1.7	76.4	1.33**		1.16	0.93 - 1.45	127	2.3	54.8	1.44*		1.16	0.87 - 1.54
5 (Richest)	129	1.9	69.4	1		1		101	2.2	45.8	1		1	
Mother's education														
None/<PSLE	693	7.0	98.5	1	0.03	1		660	9.9	66.8	1	<0.01	1	
At least PSLE	239	2.7	88.2	0.82**		0.81**	0.66 - 0.98	219	3.9	56.7	0.73***		0.82	0.65 - 1.05
Father's education														
None/<PSLE	490	4.6	106.5	1	<0.01	1		525	7.0	74.8	1	<0.01	1	
At least PSLE	442	5.1	85.9	0.69***		0.77***	0.71 - 0.84	354	6.7	52.6	0.60***		0.68***	0.59 - 0.80
Household size:														
1-5	296	3.0	98.2	1		1		309	4.2	73.8	1		1	
6-8	467	5.0	92.6	0.91	0.54	0.95	0.78 - 1.16	413	7.1	58.4	0.81***	<0.01	0.74***	0.64 - 0.86
9+	169	1.7	99.8	0.91		0.87	0.66 - 1.14	157	2.5	63.1	0.84		0.67**	0.49 - 0.91
No. of children <6yrs in														
0	399	4.1	97.1	1		1		412	6.2	66.8	1		1	
1	287	3.2	88.7	0.95	0.19	1.02	0.90 - 1.16	237	4.3	55.0	0.88*	<0.01	1.05	0.90 - 1.24
2+	246	2.4	102.4	1.19*		1.19	0.95 - 1.51	230	3.3	70.4	1.26***		1.50***	1.22 - 1.84
Household head sex														
Female	231	2.3	102.3	1	0.86	1		219	3.1	71.2	1	0.63	1	
Male	701	7.5	93.6	0.99		0.95	0.82 - 1.09	660	10.7	61.8	0.97		0.93	0.78 - 1.09
Living with														
both parents	350	4.2	84.3	1		1		345	6.0	57.5	1		1	
father only	73	0.6	124.9	1.58***	<0.01	1.79***	1.37 - 2.34	92	1.1	81.6	1.35***	<0.01	1.26**	1.01 - 1.58
mother only	262	2.6	102.3	1.19**		1.20*	1.00 - 1.44	241	3.4	70.0	1.15**		1.15	0.94 - 1.40
neither parent	247	2.5	100.7	1.20**		1.55***	1.24 - 1.94	201	3.2	63.2	0.97		1.14	0.91 - 1.43
Distance to nearest market														
<=1km	267	2.9	90.6	0.82	0.18	0.81	0.54 - 1.24	213	4.0	53.7	0.76**	0.01	0.82	0.62 - 1.07
>1km	665	6.8	97.8	1		1		666	9.8	68.1	1		1	

Variables	Girls (n=3,717)							Boys (n=4,396)						
	Dropouts	Person years (1000s)	Rate /1000py	Crude HR	p	Adj HR¥	CI	Dropouts	Person years (1000s)	Rate /1000 py	Crude HR	p	Adj HR¥	CI
(continued)														
School Effects														
Distance to School														
<=1km	497	5.4	92.6	1.46*	<0.01	1.38***	1.14 - 1.67	438	7.2	60.7	1.63***	<0.01	1.56***	1.15 - 2.11
>1km	435	4.4	99.3	1		1		441	6.5	67.5	1		1	
Distance market-school														
<=1km	361	3.6	98.9	0.99	0.93	1.38**	1.08 - 1.76	319	5.1	62.5	0.92	0.67	1.24	0.77 - 2.00
>1km	571	6.1	93.6	1		1		560	8.6	64.8	1		1	
Access to water														
No	161	1.3	127.	1	<0.01	1		160	1.8	89.3	1	<0.01	1	
Yes	771	8.5	90.9	0.61*		0.74***	0.60 - 0.91	719	12.0	60.1	0.65		0.72**	0.54 - 0.98
Access to electricity														
No	834	8.3	100.	1	0.07	1		788	11.8	66.9	1	0.05	1	
Yes	98	1.4	69.8	0.73*		0.73*	0.53 - 1.02	91	2.0	46.1	0.71**		0.90	0.63 - 1.28
Student: teacher ratio														
<60:1	307	3.7	82.0	1		1		316	5.4	58.1	1		1	
60-80:1	297	3.1	96.9	1.05	0.37	1.31**	1.02 - 1.67	263	4.2	62.7	0.94	0.27	1.21	0.96 - 1.51
>80:1	328	2.9	111.	1.24		1.20	0.95 - 1.52	300	4.1	73.0	1.22		1.24	0.91 - 1.69
Female: male teacher ratio														
<20%	256	2.1	123.	1	<0.01	1		250	2.9	87.0	1	<0.01	1	
20-50%	396	4.0	98.3	0.72*		0.80*	0.62 - 1.03	364	5.8	62.3	0.64***		0.74*	0.53 - 1.02
>50%	280	3.6	76.9	0.53*		0.64***	0.51 - 0.81	265	5.0	52.6	0.57***		0.70**	0.50 - 0.99
PSLE pass rate														
<60%	173	1.3	133.	1		1		143	1.7	82.4	1		1	
60-75%	297	3.4	88.6	0.58*	<0.01	0.63***	0.46 - 0.86	281	4.7	60.0	0.73*	<0.01	0.80	0.54 - 1.16
>75%	411	4.6	89.8	0.63*		0.71**	0.53 - 0.95	396	6.6	60.0	0.71*		0.76	0.49 - 1.16
Incomplete schools¶	51	0.5	98.7	1.31		0.97	0.60 - 1.55	59	0.7	81.9	1.59*		0.97	0.61 - 1.54
Percentage of overage classmates														
<40%	545	5.7	96	1	0.20	1		151	2.4	63.7	1	<0.01	1	
40-50%	235	2.5	94	0.78		0.71***	0.57 - 0.88	190	3.0	63.0	0.64*		0.68***	0.52 - 0.89
>50%	152	1.6	96	0.73*		0.61***	0.48 - 0.77	538	8.4	64.3	0.38***		0.41***	0.29 - 0.59

***p<0.01, ** p<0.05, * p<0.1 ¶ Incomplete schools are those that stop before standard 8; ¥ Adjusted for individual, household and school effects

chapter 8

PAPER 4

Lusting, learning and lasting in school: Sexual debut, school performance and dropout among adolescents in primary schools in Karonga district, northern Malawi

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RESEARCH PAPER COVER SHEET

PLEASE NOTE THAT A COVER SHEET MUST BE COMPLETED FOR EACH RESEARCH PAPER INCLUDED IN A THESIS.

SECTION A – Student Details

Student	Bindu Sunny
Principal Supervisor	Prof. Judith Glynn
Thesis Title	Age-for-grade heterogeneity and school dropout in primary schools in Karonga district, northern Malawi: Causes & consequences

If the Research Paper has previously been published please complete Section B, if not please move to Section C

SECTION B – Paper already published

Where was the work published?			
When was the work published?			
If the work was published prior to registration for your research degree, give a brief rationale for its inclusion			
Have you retained the copyright for the work?*	Choose an item.	Was the work subject to academic peer review?	Choose an item.

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SECTION C – Prepared for publication, but not yet published

Where is the work intended to be published?	PLOS ONE
Please list the paper's authors in the intended authorship order:	Bindu Sunny, Bianca DeStavola, Allan Kaonga, Scotch Kondowe, Chandiwira Nyirenda, Alison Price, Albert Dube, Amelia C Crampin, Judith R Glynn
Stage of publication	**Not yet submitted**

SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I conceptualised the study design for this manuscript, with support from my supervisor Judith Glynn. I led the collation of school-level data from the Karonga District Education Office, with support from Allan Kaonga with supervisory oversight from the

	District Education Manager, Scotch Kondowe and Chandiwira Nyirenda at the MoE Planning Office. I led on the data management and analysis and the first draft of the manuscript. I responded and incorporated revisions suggested by co-authors in the final mansucript.

Student Signature: [redacted] **Date:** 25.10.17

Supervisor Signature: [redacted] **Date:** 25.10.17

8

CHAPTER 8: Paper 4- Lusting, learning and lasting in school: Sexual debut, school performance and dropout among adolescents in primary schools in Karonga district, northern Malawi

8.1 Abstract

Introduction

Age at sexual debut is known to have implications on future sexual behaviours and health outcomes (including HIV infection, early pregnancy and maternal mortality), but may also predict educational outcomes.

Methods

Longitudinal data on schooling and sexual behaviour from a demographic surveillance site in Karonga district, in northern Malawi, were analysed for 3,153 respondents between ages 12-25 years to examine the association between sexual debut and primary school dropout, and the role of prior school performance. Time to dropout was modelled using the Fine and Gray survival model to account for the competing event of primary school completion. To deal with the time-varying nature of age at sexual debut and school performance, models were fitted using the landmark analyses.

Results

Sexual debut was associated with a five-fold increased rate of dropout for girls and a two-fold increased dropout rate for boys (adjusted hazard ratio: 5.27, CI: 4.22-6.57 and 2.19, CI: 1.77-2.7, respectively). For girls who were sexually active by 16 only 16% ultimately completed primary, compared to 70% with sexual debut at 18 or older. Prior to sexual debut girls had completion levels similar to boys. The association between sexual debut and dropout was not explained by prior poor performance: the effect of sexual debut on dropout was as strong among those who were not behind in school as among those who were overage. Girls who were sexually active were more likely to repeat a grade, with no effect seen for boys.

Conclusion

Pathways to dropout are complex and may differ for boys and girls. Interventions are needed to improve school progression so children complete primary school before sexual debut, as well as sex education to delay debut, and contraception provision.

8.2 Introduction

Sexual initiation is a key point of transition from childhood to adulthood. Early sexual debut increases exposure to risky sexual activity(1), including having older and multiple sexual partners, low use of contraceptives and condoms, and contracting sexually transmitted infections, including HIV, especially for girls (2,3). Early sexual debut also increases the risk of unplanned pregnancy, early childbearing and adverse reproductive and health outcomes for adolescents and their offspring.

Few studies have examined the effect of sexual debut on schooling, except indirectly in studies on pregnancy and marriage as causes of dropout(4). Using cross-sectional data from the 2004 National Survey on Adolescents among 12-19 year olds in Ghana, Burkina Faso, Malawi and Uganda, Biddlecom et al (5) found that girls who had experienced sexual debut were 2-5 times more likely to drop out prior to completing primary school, compared to those who had not initiated sex. The association between sexual debut and dropout among boys was negligible. Similar findings were observed among secondary school students in southern Malawi, where sexual activity among girls, and not boys, was associated with dropout (6). Longitudinal data from the Cape Area Panel Study (CAPS) in South Africa, showed that those who engaged in early sex were less likely to complete secondary school (7). In Kenya, girls' perceptions of gender equality and how they were treated in school influenced their decision to engage in premarital sex, although no such association was seen among boys (8). In southern Malawi, girls with strong future-oriented goals for schooling, pregnancy and marriage were more likely to abstain from sex; while those already sexually active were interested in fulfilling short-term, and specifically, financial needs (9–11) which may lead to dropout.

Sexual activity and dropout may both be higher among adolescents who have delayed progression through school or are disaffected with school (11). In South Africa, Grant and Hallman (12) used longitudinal adolescent survey data to show that those with delayed enrolment were more likely to become pregnant in school, than those who started on time, while those who repeated a grade prior to becoming pregnant were twice as likely to drop out of school. In another study in South Africa, Marteleto et al, found that those with higher repetitions were more likely to get pregnant and less likely to re-enrol in school after the pregnancy(13), while those who performed better on literacy and numeracy tests were less likely to become sexually active and drop out(14). In Kenya, students reported having sexual relationships with teachers, either forcibly, as they feared school authority, or in

exchange for money or better grades(15), to continue staying in school. Despite girls performing better than boys in school in southern Malawi, parents' perceptions and fears of the possibility of schoolgirl pregnancy and their daughters' inability to "resist the temptations of sex" and "focus on school if they are in a sexual relationship" may also result in their early withdrawal from school (16).

The introduction of free primary education in Malawi in 1994 led to high enrolments and a narrowing of the gender gap in schools(17). The increase in demand for education was unmet by improvements in school quality. Poor school quality and the resultant failure to teach and learn lead to high repetitions and slow progression through school. Delayed enrolments and poor progression defined the growing population of overage children who were most likely to reach adolescence and experience first sex while in primary school. While pre-marital sex is not socially sanctioned in the northern region of Malawi, which is the setting for this study, it is common, with first sex experienced at a median age of 17.5 for girls and 18.8 years for boys(18). Higher enrolments and educational attainment were considered to have delayed the age of marriage, but with no change in the age at sexual debut which previously coincided with marriage(19). Earlier puberty also widened the period between puberty and marriage, increasing the likelihood of sexual debut taking place prior to marriage(3) while adolescents are more likely to be in school.

This study uses longitudinal data from an open cohort of adolescents in Karonga district, in northern Malawi, to understand if sexual initiation while enrolled in school is associated with subsequent dropout from primary school, and the extent to which school performance influences this relationship.

8.3 Methods

Data for this study originate from a demographic surveillance site (DSS) established in 2002, in a population of around 43,000 individuals from 9,000 households in Karonga district, northern Malawi. The surveillance uses key informants to collect data on births and deaths continuously, with an annual census also tracking migration of participants (20). Socio-economic data, including schooling, were collected from household members (or their proxies) since 2007. Schooling histories were collected for those between ages 5-30 years, including data on attendance, age (or year) at leaving school, highest level of schooling attended and qualifications attained. Those who had dropped out of school were asked the reason for dropping out and the first reason reported was used as the primary reason. Age (or year) at sexual debut and menarche were asked for those 15 years and older

in 3 sexual behaviour survey rounds between 2008-2010(18). Early onset of menarche was defined as <14yrs, at the 25th centile. Consent to participate in the study was collected from household heads and individual household members as part of the demographic surveillance. For the sexual behaviour survey, individual written informed consent was sought and interviews were conducted in private to ensure confidentiality. Ethics approval was received from the Health Sciences Research Committee, Malawi, and the London School of Hygiene and Tropical Medicine, UK.

This analysis aims to understand the association of sexual debut and subsequent primary school dropout, and to examine the extent to which school performance explains this association. In Malawi, primary schools are free; there are eight grades, with the official age of entry being 6 years. Progression from grade to grade depends on satisfactory performance. At the end of primary, students have to pass an external examination to gain admission into secondary school, which is highly selective, as secondary schools are fewer and fee-paying.

Dropout here is defined as the first observation of leaving school without completing primary education during the follow-up period. Dropout is conditional on being enrolled in school the previous year. Repeat dropouts are rare and ignored in the analysis. Data on completion was based on self-reports of completing the PSLE (Primary School Leaving Examination) or inferred from subsequent enrolment into secondary school.

Nelson-Aalen estimation of cumulative incidence and the Fine and Gray competing risks model were used to account for school completion as a competing risk of dropout. Competing risks are events that preclude the occurrence of the main event of interest (school dropout), and cannot be treated as independent censoring events, as dropout and completion are likely to share common causes. Application of traditional survival analysis methods, such as Kaplan–Meier survival curves and Cox regression models would censor observations when they experience the competing event and lead to the estimation of the cause-specific probability and hazard ratios of dropping out, respectively. Such estimates cannot be used to obtain the cumulative probability (incidence) of each competing event because the selective depletion of the at-risk population would bias the estimated incidence upwards. Instead, the Nelson-Aalen method and the Fine and Gray model lead to unbiased estimates of the cumulative incidence function, with the latter assuming that the effects of its explanatory variables are proportional on the sub-hazard scale(21). These effects are

expressed in terms of sub-hazard ratios (21), or referred to as the hazard ratio (HR), for the purpose of this analysis.

Age at school enrolment is the point of origin for the analyses. Interview dates from annual survey rounds were used to establish the start and end dates for events reported (dropout, completion; and repetition, explained below). Primary and secondary school calendars were used to establish the precise dates for time in school and completion. Observations were censored once dropout/completion was first observed; or at the earliest grade seen beyond grade 8 (end of primary); or when last observed. Schooling status for those with missing data was inferred using the nearest available rounds of schooling data.

The main exposure of interest is sexual debut. Since participants were seen annually, sexual debut was included in the model as a time-varying covariate with a one-year lag, where the sexual debut status of an individual in one year was examined for associations with school dropout the following year. Similar lagged values were used for other time-varying covariates. As this approach may not appropriately control for time-varying confounders(22), we also used landmark analysis with the Fine and Gray model to deal with the competing event of school completion. Landmark analysis involves repeating the analyses on overlapping periods of time, starting from different 'landmark' ages and including the one-year lagged values of sexual debut as the base-line exposure variable.

At each landmark point, those who have already experienced the event (dropout/completion) are excluded, and sexual debut and other characteristics at the landmark time are assumed time-invariant, irrespective of any changes subsequently. Dropout and sexual debut are rare prior to the age of 13 so analyses are presented from 13 onwards. Girls are censored after the age of 19 and boys after the age of 22, after which no outcomes were observed.

Age-for-grade is used as a proxy for school performance. It is calculated as the number of years ahead/behind the current grade and is a cumulative measure of enrolment and progression through school, including intermittent disruptions or prolonged periods of absence from school. To assess whether school performance (age-for-grade) modified the relationship between sexual debut and dropout, as well as adjusting for age-for-grade, we stratified the landmark analysis by age-for-grade (those who were <= 1 year, 2 years or 3 or more years overage for their grade). We hypothesised that there is a synergic relationship

between school failure and sexual debut and that sexual debut when failing leads to dropout, while if not failing does not influence dropout.

To examine whether sexual debut is associated with school performance, we used time to grade repetition as an additional outcome, and adjusted for age-for-grade, using values with a one-year lag, as above. For this analysis we excluded those in Standard 8, where repetitions are high, as students may choose to repeat the final grade in order to improve their chance of gaining admission into secondary school(23). Because of the exclusion of Standard 8, completion is not any more a competing event. Hence we have used standard Cox regression model to study the effect of sexual debut on grade repetition adjusted for age-for-grade. The proportionality assumption was tested for all covariates using Schoenfeld residuals with some deviation from proportionality observed for age-for-grade and sexual debut. As a result, the hazard ratios reported will be assumed to be averages of time-varying hazard ratios over the follow-up period.

The multivariable analyses assessed the effects of sexual debut, adjusting for wider socio-economic determinants at the individual, household and school level. Data on household assets, including ownership of consumer durables and access to utilities/services, were collected between 2007-2011 and 2013-2016. These were used to construct an index for household socio-economic status using principle components analysis (PCA) (24). Variables selected for inclusion in the asset index (bicycle, radio, oxcart, clock, mattress, bed and chair) were based on what was consistently available across survey rounds. School-level characteristics were collated for 25 schools, covering 90% of children enrolled within the DSS, from the annual school returns submitted by school head teachers to the Karonga District Education Office from 2007 onwards. This included data on enrolment, student-teacher ratios, female teacher proportions and schools' access to water and electricity. Student-teacher ratio categories were based on Malawi Ministry of Education recommended classroom thresholds of 60:1(25). Schools were considered to have access to water if they had a borehole or piped water connection in the school. Access to electricity was assumed if schools reported having solar electricity or connection to the main power grid (ESCOM).

Analyses were carried out with and without adjusting for confounders. Age-for-grade, age at menarche, student-teacher ratio and female teacher proportions confounded the relationship between sexual debut and dropout so were included in the multi-variable analyses. Other variables that were included *a priori* based on previous literature on school

dropout, were household asset index, father's education, household structure (size, number of children below age 6) and living arrangements. Mother's education status was collinear with father's education status, hence omitted. Variables that were initially explored but excluded from the multivariable analysis, as they were not associated with dropout for either boys or girls, were sex of the household head, school access to water and electricity. Complete case analysis was carried out and 8% of pupils with missing data were excluded. Given the sample size, we were unable to cluster the analysis by school.

8.4 Results

23,098 participants from ages 12-25 years were seen at baseline in this open cohort, of whom 10,943 (47.4%) were enrolled in primary school when first seen and were interviewed more than once across all nine survey rounds. Of these, only a minority were eligible to participate in the sexual behaviour survey (ie age ≥15 in 2008-10): 3153 (28.8%) who had reported their sexual debut status ("Have you ever had sexual intercourse? Y/N") and age at sexual debut, were included in the analysis.

Within the Karonga DSS, the mean age of school entry is 5.9 for both girls and boys, with entry as early as 4, and as late as 10 for girls and 13 for boys. Most children (72%) start school at the official age of entry of age 6, with 18% starting early (<6years) and 9% starting at age 7. Respondents were mostly <17 years, sexually inactive and at least a year or more overage for their grade when first seen (Table 1). Socio-economic background characteristics were similar for girls and boys. Most participants lived with at least their mother, came from households with more than five members, and studied in schools with high student-teacher ratios (>60:1) and low proportions of female teachers (<50%).

Figures 1 and 2, shows the Nelson-Aalen estimates of the cumulative incidence of dropout and completion by prior sexual debut status. Sexual debut is associated with dropout for both boys and girls. For girls, those sexually active had a much higher cumulative incidence (probability) of dropping out and a lower cumulative incidence of completing school, as compared to those who were not sexually active. For boys dropout was later, less common, and less strongly associated with sexual debut. Most of the difference in dropout and completion between girls and boys was among those who were sexually active. Completion levels among sexually inactive girls were similar to that of sexually inactive boys (Fig 2).

Table 2 shows the association between prior sexual debut status and dropout for girls and boys, with and without adjusting for the wider socio-economic determinants of school

dropout, obtained by fitting the Fine and Gray model. Sexual debut was associated with a 6.4-fold increased hazard of dropout for girls and a 2.6-fold increased hazard for boys. After adjusting for confounders (including age at menarche for girls), this relationship was slightly attenuated for both girls (aHR: 5.27, CI: 4.22-6.57) and boys (aHR: 2.19, CI: 1.77-2.7).

The adjusted results also show that being overage for their current grade was an important risk factor for dropout, with boys being on average 3.4 years overage for their grade, compared to girls who were 2.3 years overage for their grade. Every additional year of being overage increased the rate of dropout by 30% for girls and 68% for boys in the adjusted model. Those from better-off households, who were living with both parents, and whose fathers had at least completed primary education, were least likely to drop out of school.

Girls with early menarche (<14yrs) were more likely to dropout. None of the school-level factors were associated with dropout for girls after accounting for sexual debut and other confounders. For boys, living in households with two or more children below the age of six, and studying in schools with low proportions of female teachers were more likely to drop out.

The landmark analysis (Table 3) shows that being sexually active increased the later risk of dropout from landmark age 14 for girls and age 15 for boys. In the crude analysis for girls, the association is stronger at younger ages. But after adjusting for age-for-grade and other confounders, there was no consistent pattern by age, with sexually active girls 3-6 times as likely to drop out of school as their sexually inactive peers at all ages. For boys, those who were sexually active were twice as likely to drop out of school, as those who were sexually inactive, and this was constant from age 15.

In Table 4, the relationship between sexual debut and dropout is stratified by age-for-grade and sex for landmark ages 14-16 (the ages for which there were sufficient numbers in the sub-groups). There was no indication that the association between sexual debut and dropout was stronger among those who were more behind in school: in fact, the hazard ratios were lower in this group, but confidence intervals were wide.

Table 5 looks at the association between sexual debut and grade repetition for girls and boys. Girls who were sexually active had a higher hazard of subsequently repeating a grade,

compared to girls who were not sexually active. This effect remained even after adjusting for prior school performance (age-for-grade in the previous year) and other socio-economic variables, with no effect seen among boys.

Among those who dropped out before the end of primary, pregnancy (15%) and marriage (45%) were reported as the most common reasons for dropping out among girls (Table 6), irrespective of their sexual debut status the previous year. In contrast, boys mostly reported school (47%) and household-related reasons (14%) for dropping out of school, with no differences seen between those sexually active and sexually inactive.

To assess the role of sexual debut on schooling in the wider context, including children who were out of school when first seen, and those already in secondary, the landmark approach was used to descriptively examine the schooling outcomes achieved by age 20, by age at sexual debut. The results are shown in Figure 4. Those who were still sexually inactive at each landmark age had a higher chance of primary school completion than those who were sexually active, and this is much more striking for girls than for boys. For example, for girls who were sexually active by age 16, only 16% completed primary, compared to 70% who were still sexually inactive at 18. For boys the equivalent figures were 55% and 60%, with some still in school.

8.5 Discussion

Sexual activity while still in primary school is a key risk factor for school dropout, with a five-fold risk for girls and a two-fold risk for boys. Falling behind in school was also a strong risk factor for dropout, but did not interact with the association between sexual debut and dropout in the way we had predicted. The association between sexual activity and dropout was as strong or stronger among girls who were on track/a year overage as compared to those two or more years overage for their grade. This suggests that poor school performance does not drive the association between sexual activity and dropout. However, for girls, being sexually active was associated with subsequent grade repetition with no effect on performance seen among sexually active boys.

The pathways to dropout are myriad, complex and gendered, with pathways for girls being different to those for boys. Unlike previous studies(5), we found that being sexually active is a risk factor for dropout not only for girls, but also for boys, though the risk was far higher for girls. Once sexually active, girls more than boys are likely to perform poorly, which leads to school disaffection and dropout; or pregnancy or imminent marriage. On

the contrary, boys face no immediate consequences of poor school performance, either as a cause or as a consequence of sexual activity although marriage and responsibility for school girl pregnancy can be reasons for boys to withdraw/be expelled from school. Sexually active boys are just as likely as sexually inactive boys to complete school. School performance does not elucidate the association between sexual activity and dropout, for either boys or girls, which runs contrary to previous findings(11–14). Although this may be on account of age-for-grade being a cruder measure of performance than those used elsewhere.

Reasons for these gendered differences in sexual behaviour and school dropout may also be explained by understanding the attitudes and perceptions around adolescent sexual activity among teachers and parents. Studies in southern Malawi have shown that despite girls performing better than boys (16) and more boys being sexually active than girls at earlier ages (26,27), girls experienced moral policing in schools and were more likely to repeat a grade, face disciplinary action or be suspended by school authorities for being in a relationship or getting pregnant(6). Parents who feared the possibility of school girl pregnancy may also withdraw their daughters from school as a pre-emptive measure(16). In contrast, boys were subjected to less severe scrutiny and consequences. Frye's study in southern Malawi(6) found that this incompatibility between sex and schooling was attributed to a pervasive culture within schools and communities that over-emphasised the perception of female vulnerability to sexual relationships and overlooked the role and responsibility of males involved in these partnerships. This was inferred from interviews with teachers, students and parents; and content analysis of school regulations (enforcing disciplinary action on girls who got pregnant), school curricula, and media/posters disseminated in schools ("A real woman puts her future ahead of sexual relationships"; "A real woman waits"). Teachers' attitudes and perceptions of girls' vulnerability to sexual relationships and the subsequent link to school failure was also prominent. Marriage and pregnancy may also be reasons for leaving school among boys, though only 11% of sexually active boys reported these as reasons for dropout. School suspension because of pregnancy has different implications for boys who may still find it easier to re-enrol in school with fewer consequences, compared to girls who have to bear the social stigma of pregnancy in school, possible withdrawal of parental support and the implications of child-care.

Adolescents' decisions on schooling may also conflict with their aspirations and genuine desires for marriage and childbearing, which are natural life-course options for girls to

transition into after leaving school(28), outweighing the need to perform well in school. Sexual debut is considered a part of the socio-cultural process of finding the right marital partner(10), with marriage seen as a means to elevate social status and attain "independence, influence, motherhood and respect"(28)(29). Poulin's qualitative study in Malawi examines the social processes and the contractual nature of sexual relationships among school-going adolescents(11), where the process of courtship helps realise marital aspirations of young people. Entering into a pre-marital relationship with a Chibwenze (casual partner) is a common process for young people to identify a Chitomelo or a suitable partner for marriage. Chibwenze partnerships involve a transfer of gifts or money from the man to the woman in anticipation of, during or right after sex, and is an expression of trust and love in the relationship(29) and considered a routine aspect of dating(30). Engaging in premarital sex is paramount to the relationship, though it is difficult to differentiate relationships that stem from being purely transactional and therefore more risky from those that are not. Irrespective of the intent of sexual relationships, our findings show that sexual activity itself is a risk factor for school dropout.

Girls who were sexually inactive also reported pregnancy and marriage as reasons for dropout, which may reflect their desire or plans to marry or get pregnant in the near future or be due to under-reporting of sexual activity. Limitations around reporting of sexual behaviour data are well known(19,31), with girls more likely to under-report the onset of sexual activity. While access to contraceptives (mainly injectables and condoms) is limited, with a third of adolescents between ages 15-19 years reportedly getting contraceptives from a government facility, the knowledge and use of contraceptives is on the rise with 27% (from 15% in 2000) of unmarried, sexually active girls in the same age group using some form of contraception(32,33) in 2010. In Karonga, contraceptive prevalence among women between ages 15-49 years was 35%(34), with condom use at first sex among those between 15-20 years reported at 41.2% among girls and 53.5% among boys(18), which is higher than national-level estimates. Early menarche, which increases exposure to early sexual debut among girls has also been previously shown to be a risk factor for early dropout, pregnancy and marriage(18). Lack of data on male puberty in our study, which may be a potential confounder similar to menarche for girls, may explain the effect seen for boys in our study which was not seen in previous studies that included data on male puberty(5). Qualitative data on the aspirations and intentions of schooling and sexual partnerships may also help us understand the context in which decisions on schooling and sexual relationships operate. In addition, data on peer groups and networks could enhance our

understanding of how peer perceptions and behaviour may influence decisions on schooling and sexual behaviour.

Although school performance was not a driving force in the association between sexual debut and dropout, improving the quality of schooling and enabling students to progress and complete school on time would stem the flow of overage students in schools and the conflicts they face when the period of adolescence overlaps with schooling. The preponderance on sexual activity being a risk factor for schooling reinforces the negative messaging to adolescents from parents and school administrators. This should not be construed as a debarment for young people to engage in sexual activity altogether. On the contrary, provision of age-appropriate, accurate and relevant sex education to school children and access to contraception remains critical. Sex education was introduced in the life skills curriculum in primary and secondary schools in Malawi in 2002. However, a recent review of curricula in ten eastern and southern African countries, including Malawi, cited concerns around the negative and fear-based content on sexual relationships(35). The review recommended the need to prioritise issues of safe sex (risk of sexually transmitted infections, HIV, unintended pregnancy, use of condoms and contraceptives), safe school environments (free of sexual violence, homophobia) and building critical life skills of young people to negotiate decisions on sex. This would better prepare young people to be "ready for sex" while in school and effectively navigate through other life transitions in the future.

8.6 Conclusion

Sexual activity conflicts with schooling, with sexually active girls more than boys bearing a greater risk of dropping out of school prior to completion. Interventions in schools should prioritise the need to improve the quality of schooling to ensure timely progression, the provision of sex education in the curriculum and ensure contraception access for young people.

Table 1: Base-line characteristics of respondents in school from ages 12-25yrs when first seen

Base-line characteristics	Female		Male	
	N	%	N	%
Total	1283	41	1870	59
Sexual debut status				
No	1142	89	1406	75
Yes	141	11	464	25
Age				
12-16	1165	91	1484	79
17-25	118	9	386	21
Grade				
P1-6	746	58	1082	58
P7-8	537	42	788	42
Age-for-Grade				
Underage/At Official Age	235	18	230	12
1 yr overage	323	25	286	15
2 yrs overage	307	24	369	20
3+ yrs overage	418	33	985	53
Father's Education				
None/<Primary	577	45	896	48
At least PSLE	699	55	964	52
Household Asset Score				
Poorest(1)	281	22	454	24
2	445	35	612	33
Less poor (3)	555	43	798	43
Household size				
1-5	349	27	542	29
6-8	664	52	964	52
9+	270	21	364	19
Living Arrangements				
With neither parent	335	26	494	26
With father only	75	6	168	9
With mother only	364	28	461	25
With both parents	509	40	747	40
No. of children <6yrs				
None	442	35	733	39
1	415	32	559	30
2+	426	33	578	31
Student-teacher ratio				
<60:1	263	21	376	20
60-80:1	537	42	816	44
>80:1	388	30	564	30
Female-teacher ratio				
<20%	468	37	695	37
20-50%	542	42	813	44
>50%	178	14	248	13

Figure 1: Cumulative incidence of school dropout (with completion as a competing event) by 1-year lagged sexual debut status for girls and boys (left-side); and by sex, for sexually inactive and sexually active respondents (right-side)

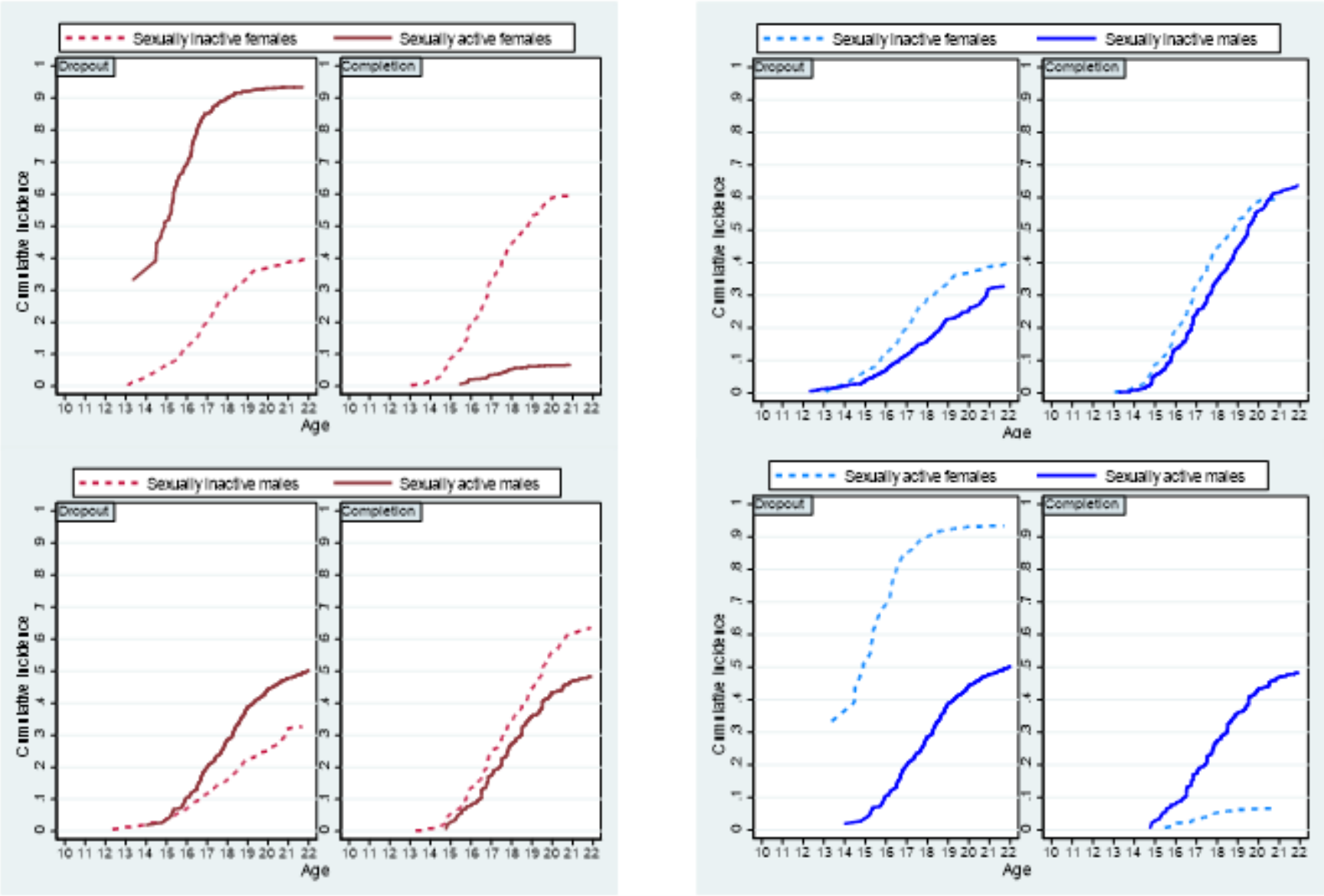

Table 2: Sexual debut status in the previous year and subsequent dropout for 3,153 primary school students aged 12-25 years

	Girls (n=1,282)							Boys (n=1,871)						
Variables	**Dropouts**	**PY***	**Rate**	**HR**	**CI**	**aHR[1]**	**CI**	**Dropout**	**PY**	**Rate**	**HR**	**CI**	**aHR[1]**	**CI**
Overall	379	2.85	133.01					497	4.97	99.91				
Sexual debut status lagged														
No	202	0.77	261.1	1		1		164	0.91	180.9	1		1	
Yes	160	0.12	1319.4	6.37	5.17-8.01	5.27	4.22 - 6.57	306)	0.37	828.5	2.66	2.18-3.25	2.19	1.77 - 2.70
Age-for-Grade	Mean: 2.3; SD:1.6			1.45	1.36-1.55	1.30	1.20 - 1.40	Mean: 3.4; SD:2.0			1.59	1.50-1.68	1.68	1.59 - 1.78
Age at Menarche														
<14	120	0.22	555.3	1.42	1.12-1.77	1.43	1.15 - 1.78							
14+	237	0.6	396.3	1		1								
Household asset index														
Poorest (1)	103	0.22	461.3	1.79	1.38-2.31	1.50	1.14 - 1.97	144	0.32	443.4	1.97	1.55-2.51	1.07	0.83 - 1.38
2	134	0.34	397	1.30	1.02-1.65	1.06	0.84 - 1.35	195	0.48	402.8	1.72	1.36-2.15	1.35	1.07 - 1.69
Less Poor (3)	125	0.33	374.1	1		1		131	0.47	280.3	1		1	
Father's Education														
None/<Primary	184	0.39	470.2	1		1		258	0.62	417.8	1		1	
At least PSLE	178	0.5	353.4	0.79	0.64-0.96	0.68	0.54 - 0.86	212	0.66	321.8	0.77	0.64-0.93	0.76	0.60 - 0.95
Living arrangements														
Neither parent	101	0.24	417	1.50	1.15-1.95	1.44	1.07 - 1.95	118	0.34	350.7	1.14	0.89-1.44	1.16	0.86 - 1.54
With father only	26	0.05	553.3	1.60	1.06-2.42	1.62	1.06 - 2.45	48	0.11	425.1	1.34	0.97-1.85	1.10	0.78 - 1.53
With mother	115	0.26	442.7	1.47	1.12-1.88	1.64	1.25 - 2.15	141	0.31	449.7	1.32	1.05-1.66	1.38	1.06 - 1.80
Both parents	120	0.35	346.9	1		1		163	0.51	317.6	1		1	
Household size														
1-5	100	0.26	386.5	1		1		166	0.38	445.1	1		1	
6-8	190	0.46	416.8	0.95	0.74-1.20	1.05	0.81 - 1.37	221	0.66	335.6	0.83	0.67-1.01	0.81	0.64 - 1.02
9+	72	0.18	399.2	0.91	0.68-1.23	0.90	0.62 - 1.29	82	0.24	337.3	0.73	0.57-0.97	0.70	0.50 - 0.96
No. of children <6														
0	133	0.34	389.8	1		1		218	0.54	405	1		1	
1	119	0.31	387.6	1.0	0.78-1.28	1.09	0.84 - 1.41	117	0.4	287.8	0.80	0.64-1.01	0.94	0.73 - 1.20
2+	110	0.25	445.9	1.15	0.90-1.48	1.07	0.79 - 1.45	134	0.33	406.1	1.09	0.88-1.36	1.32	1.02 - 1.72
Student-Teacher Ratio(STR)														
<60:1	116	0.29	404.7	1		1		207	0.46	325.9	1		1	
60-80:1	122	0.32	387.1	0.84	0.65-1.09	0.82	0.63 - 1.07	108	0.39	354.5	0.79	0.62-1.00	0.89	0.71 - 1.12
>80:1	124	0.29	423	1.19	0.92-1.54	0.98	0.75 - 1.29	154	0.42	427.8	1.27	1.00-1.58	1.14	0.91 - 1.43
Female Teacher Ratio (FTR)														
<20%	140	0.24	515.2	1.45	1.05-1.99	1.25	0.90 - 1.74	144	0.43	448.5	1.81	1.35-2.42	1.48	1.10 - 1.98
20-50%	164	0.45	371.1	1.07	0.77-1.44	0.96	0.70 - 1.31	227	0.6	349.8	1.22	0.92-1.63	1.12	0.84 - 1.47
>50%	57	0.21	346.4	1		1		98	0.25	275.9	1		1	

Note: PY: Person-years(1000s); Rate/1000py:HR: Hazard Ratio; aHR: Adjusted Hazard Ratio; CI: Confidence Interval [1]Analyses adjusted for age-for-grade, age at menarche(for girls), household asset index, father's education, living arrangements,. household size, number of children below age 6 in the same household, Student-teacher ratio(STR) and Female-teacher Ratio (FTR)

Table 3: HR of school dropout by whether respondents had ever been sexually active by each landmark age, with completion as a competing event

Landmark Age	Females: Sexual debut status (Y/N)							Males: Sexual debut status (Y/N)						
	N	n(%) sexually active	Dropouts (D)	HR	CI	aHR	CI	N	n(%) sexually active	Dropouts (D)	HR	CI	aHR	CI
13	549	7(1)	111	7.5	4.01-14.02	3.27	0.80-13.43	658	42(6)	96	1.4	0.78-2.54	1.18	0.54-2.60
14	749	39(5)	168	5.3	3.32-8.44	4.45	2.65-7.47	920	139(15)	148	1.67	1.18-2.36	1.45	0.96-2.18
15	769	90(12)	185	5.8	4.16- 8.03	6.33	4.48-8.97	1045	264(25)	179	2.1	1.56-2.82	2.05	1.51-2.78
16	542	84(15)	134	4.3	3.01-6.04	4.80	3.3-6.97	946	331(35)	198	2.1	1.56-2.84	2.12	1.53-2.95
17	274	56(21)	67	2.4	1.48-3.79	3.30	1.92-5.69	710	328(46)	176	2.1	1.45-2.89	2.40	1.63-3.40
18	116	31(27)	32	2.7	1.44-5.66	6.60	1.95-22.4	472	260(55)	148	2.1	1.41-3.1	2.13	1.43-3.15
19	35	10(31)	13	1.67	0.63-4.45	NA		283	177(63)	97	1.58	0.96-2.59	2.23	1.28-3.9
20	12	4(33)	6	1.54	0.36-6.58	NA		126	91(72)	63	1.06	0.54-2.09	1.52	0.56-4.13
21	NA-No completers							54	37(69)	32	2.62	1.04-6.58	10.81	0.86-135.4
22	NA-No outcomes							18	11(61)	11	3.20	0.63-15.96	NA	

* adjusted for age-for-grade, age at menarche(for girls), household asset score, father's education, co-residence status, no. of children <6yrs in the same household, household size, Student-teacher ratio(STR) and Female teacher ratio(FTR)

Table 4: HR of school dropout by prior sexual debut status at each landmark age, by age-for-grade and sex (with school completion as a competing event)

Landmark Age	Age for Grade- Up to 1 year overage													
	Females: Sexual debut status (Y/N)							Males: Sexual debut status (Y/N)						
	N	n(%) sexually active	Dropout (%)	HR	CI	aHR	CI	N	n(%) sexually active	Dropout (%)	HR	CI	aHR	CI
14	387	14(4)	52(13)	6.30	2.95-13.43	8.8	3.17-24.43	353	53(15)	19(5)	2.13	0.84-5.43	1.86	0.48-7.25
15	289	30(10)	45(16)	7.22	4.02-12.93	13.35	5.84-30.49	281	71(25)	13(5)	2.7	0.91-7.95	2.73	0.59-12.49
Landmark Age	**Age for Grade- 2 years overage**													
	Females: Sexual debut status (Y/N)							**Males: Sexual debut status (Y/N)**						
	N	**n(%) sexually active**	**Dropout (%)**	**HR**	**CI**	**aHR**	**CI**	**N**	**n(%) sexually active**	**Dropout (%)**	**HR**	**CI**	**aHR**	**CI**
14	182	9(5)	47(26)	3.80	1.02-14.06	8.82	2.07-37.58	215	34(16)	31(14)	2.32	1.07-5.01	2.93	1.11-7.75
15	239	24(10)	51(21)	6.30	3.11-12.72	6.99	3.25-15.00	261	67(26)	32(12)	3.85	1.72-8.60	2.53	1.02-6.26
16	263	35(13)	44(17)	4.04	2.22-7.33	4.57	2.11-9.89	330	120(36)	24(7)	3.33	1.26-8.80	2.41	0.91-6.42
Landmark Age	**Age for Grade- 3+ years overage**													
	Females: Sexual debut status (Y/N)							**Males: Sexual debut status (Y/N)**						
	N	**n(%) sexually active**	**Dropout (%)**	**HR**	**CI**	**aHR**	**CI**	**N**	**n(%) sexually active**	**Dropout (%)**	**HR**	**CI**	**aHR**	**CI**
14	182	17(9)	71(39)	5.00	2.92- 8.57	3.73	1.51-9.20	356	52(15)	98(28)	1.24	0.78-1.98	1.08	0.64-1.84
15	246	36(15)	91(37)	4.93	3.01-8.08	5.13	2.98-8.85	509	128(25)	134(26)	1.59	1.12-2.26	1.78	1.23-2.57
16	282	49(17)	91(32)	4.47	2.85-6.99	5.38	3.28-8.81	618	212(34)	175(28)	2.03	1.47- 2.79	2.05	1.45-2.90

*Analysis restricted to age 14+ as sexual activity is rare prior to that, especially among girls. Adjusted for age-for-grade, age at menarche (for girls), household asset score, father's education, co-residence status, no. of children <6yrs in the same household, household size, STR and FTR.

Table 5: Association between prior sexual debut and grade repetition- excluding those in standard 8

Girls (n=1,015)				Boys (n=1,439)			
HR	**CI**	**aHR***	**CI**	**HR**	**CI**	**aHR**	**CI**
1.44	1.17-1.77	1.56	1.25-1.96	1.01	0.90-1.13	0.99	0.88-1.11
*Adjusted for lagged (from the previous year) estimates of age-for-grade, household asset index, co-residence pattern, number of children below age 6 in the same household, household size, age at menarche, STR and FTR; and time-invariant covariates, including age at menarche, father's education							

Table 6: Self-reported reasons for dropout, by lagged sexual debut status and sex

Reasons for leaving school	Females (N=1283)				Males (N=1870)			
	Sexually inactive	%	Sexually active	%	Sexually inactive	%	Sexually active	%
	n=207		n=172		n=167		n=329	
Marriage	**86**	**42**	**86**	**50**	**5**	**3**	**26**	**8**
Pregnancy/girlfriend's pregnancy	**23**	**11**	**34**	**20**	**1**	**1**	**10**	**3**
School-related reasons	**52**	**25**	**25**	**15**	**73**	**44**	**159**	**48**
No money for fees/transport/uniform	10		8		13		27	
Long journey to school	1				1		1	
Failed exams, non-admission in secondary, grade	21		10		33		83	
Being overage/Too old to continue	4		1		4		4	
Poor school quality					2			
Lost interest in school	12		6		17		30	
Suspended	2				3		14	
"Finished school"	2							
Sickness	**17**	**8**	**4**	**2**	**17**	**10**	**20**	**6**
Own	16		4		11		14	
Parental sickness/death	1		0		6		6	
Household-related reasons	**6**	**3**	**9**	**5**	**30**	**18**	**39**	**12**
Helping with household economic activities	3		5		24		25	
Household chores	1						1	
Looking after relatives/siblings	1						2	
Household instability	1		4		6		11	
Other/Unknown	**23**	**10**	**14**	**8**	**41**	**25**	**75**	**23**

Figure 4: Sexual debut and school outcomes by age 20, including those out of school and in secondary school

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chapter 9

PAPER 5

Early school failure predicts teenage pregnancy and marriage: A large population-based cohort study in Northern Malawi

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PLEASE NOTE THAT A COVER SHEET MUST BE COMPLETED FOR EACH RESEARCH PAPER INCLUDED IN A THESIS.

SECTION A – Student Details

Student	Bindu Sunny
Principal Supervisor	Prof. Judith Glynn
Thesis Title	Age-for-grade heterogeneity and school dropout in primary schools in Karonga district, northern Malawi: Causes & consequences

If the Research Paper has previously been published please complete Section B, if not please move to Section C

SECTION B – Paper already published

Where was the work published?			
When was the work published?			
If the work was published prior to registration for your research degree, give a brief rationale for its inclusion			
Have you retained the copyright for the work?*	Choose an item.	Was the work subject to academic peer review?	Choose an item.

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SECTION C – Prepared for publication, but not yet published

Where is the work intended to be published?	The Lancet Global Health
Please list the paper's authors in the intended authorship order:	Judith Glynn, Bindu Sunny, Bianca DeStavola, Albert Dube, Menard Chihana, Alison Price, Amelia Crampin
Stage of publication	**Submitted**

SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	This analyses was conducted as part of a larger, ESRC-funded comparative study on the risk factors for school dropout in two sites in northern and southern Malawi. I have contributed to the conceptualisation and design of the overall study, along with my supervisor, Prof. Judith R Glynn who was the

	lead author for this paper; and Bianca De Stavola, who provided overall statistical guidance. I took primary responsibility in the data management for the northern site, which included data cleaning, linking data from various surveys and construction of variables. Data linkages included nine survey rounds of socio-economic, schooling, marital histories; three survey rounds of the sexual debut and reports of first pregnancy. I was involved in discussions on the methodology to be used and contributed to aspects of the analyses and write-up, including providing early drafts of the background and literature review, which was used in the final paper.

Student Signature: [redacted] **Date:** 25.10.17

Supervisor Signature: [redacted] **Date:** 25.10.17

9

CHAPTER 9: Paper 5- Early school failure predicts teenage pregnancy and marriage: A large population-based cohort study in Northern Malawi

9.1 Abstract

Introduction

School dropout is known to be linked to early pregnancy and marriage. Less is known about the effect of school performance and from what age life trajectories diverge.

Methods

Data from 2007-2016 from a demographic surveillance site in northern Malawi with annual updating of schooling status and grades, and linked sexual behaviour surveys, were analysed to assess the associations of age-specific school performance and status on subsequent age at sexual debut, pregnancy and marriage. Age-for-grade was used as a proxy of school performance. Landmark analysis with Cox regression was used to estimate hazard ratios of sexual debut, pregnancy and marriage by schooling at selected (landmark) ages, controlling for socio-economic factors.

Results

Information on at least one outcome was available for >16,000 children seen at ages 10-18. Sexual debut was available on a subset aged ≥15 by 2011. For girls, being out of school was strongly associated with earlier sexual debut, pregnancy and marriage. For boys, the association with sexual debut was less marked, but that with marriage was similar, although boys married later. Being overage-for-grade was not associated with sexual debut for girls or boys. For girls, being overage-for-grade from age 10 was associated with earlier pregnancy and marriage. For boys, overage-for-grade from age 12 was associated with earlier marriage.

Conclusion

School progression at ages as young as 10 can predict teenage pregnancy and marriage, even after adjusting for socio-economic factors. Early education interventions may reduce teenage pregnancy and marriage as well as improving learning.

9.2 Introduction

Improving education is one of the Sustainable Development Goals, and underlies others: increasing education improves health, reduces poverty and helps gender equality.[1] For girls there are also major benefits for the next generation: half of the reduction in under-5 mortality achieved in the last 30 years may be attributable to increased maternal education.[2] There are also strong links to sexual health: education level is associated with age at first sex, condom use and HIV risk.[3,4] [5]

Initial primary school enrolment is high in most countries, and often similar for boys and girls, but increasing dropout of girls in adolescence is a major and wide-spread problem.[6] Since schooling often starts late and grades are repeated, dropout in adolescence frequently means dropout before the end of primary school, as well as the loss of opportunities for secondary schooling and tertiary education.

The relationship between sexual behaviour and school dropout is complex. Most data on the association between schooling and sexual behaviour come from cross-sectional studies, making it difficult to distinguish cause and effect.[5,7] Being out of school can lead to risky sexual behaviour, pregnancy and marriage, but unintended pregnancies and early marriage can lead to school dropout.[6,8] Compared to out of school adolescents, those in school are less likely to have sex, have multiple life partners or have frequent sex.[5] Adolescents in school and performing better at school may have a higher perception of risk associated with early sexual debut, and higher aspirations for their future than their non-school going peers.[7,8] For those in school, sexual activity poses a high opportunity cost, with unintended pregnancies and marriage as a deterrent to achieving educational goals. Those out of school may consider sexual activity desirable, potentially bringing marriage and financial security for the future.

Both school dropout and early pregnancy and marriage are influenced by the same underlying factors, including poverty, poor school performance, absenteeism and peer, family and community pressures and expectations.[9-12] High costs of schooling, lack of school infrastructure (from toilets to textbooks), and poor school performance may precipitate disinterest in school, which promotes risky sexual behaviour,[13] and early school exit. Randomised trials in Kenya[14] and southern Malawi[15] suggest uniform provision and cash transfer can reduce school dropout, pregnancy and sexually transmitted infection

rates, strengthening evidence that poverty underlies both outcomes, and that being in school is "protective".[8]

A review of determinants of adolescent sexual health in developing countries showed that school performance (high grade-point averages) and high levels of motivation to continue schooling provided protective effects for adolescents.[16] In South Africa, falling behind in school was the strongest risk factor for giving birth within the following two years.[17] The few longitudinal studies generally involve teenagers,[12,14,15,17] and it is unclear from what age school failure predicts subsequent life trajectories.

In Malawi school dropout is high and learning outcomes poor: the 2010 World Bank report on the education system estimated that only 52% of children completed 6 years of primary school compared to an average of 61% for sub-Saharan Africa, and test scores for English and Maths were among the lowest in the region.[18] A quarter of young adults do not have even basic literacy skills.[19] Malawi also has high rates of child marriage: the constitution was amended to raise the age of marriage from 15 (with parental consent) to 18 in February 2017.[21]

In Karonga district, northern Malawi, the site of the current study, the proportions completing primary are better than the national average but still poor.[20] We have previously shown that girls drop out of school earlier than boys, and half of girls (and 8% of boys) reported pregnancy or marriage as the main reason for leaving school.[20] We have also shown that falling behind in school, measured by being increasingly overage for the school grade, is common, and is strongly associated with dropout.[22] In this paper we examine the associations between falling behind in school (age-for-grade) and school dropout with subsequent sexual debut, teenage pregnancy and marriage. We use a landmark approach (detailed below) and show that school performance at ages as young as 10 years predicts age at pregnancy and marriage.

9.3 Methods

The Karonga Prevention Study Demographic Surveillance Site in northern Malawi covers a rural population of 35,000 people, collecting data, since 2002, on births and deaths monthly, with annual censuses to update migrations.[23] Linked surveys collect detailed household and individual socio-economic, schooling, demographic and behavioural data. Schooling data, including grade attainment, have been collected annually since 2007. Household-level socioeconomic data were collected annually between 2007-2011, and

2013-2016. Sexual behaviour data including age at first sex were collected on those aged 15 and over in three survey rounds between 2008 and 2011.[24] Age at first pregnancy and marriage was collected in the sexual behaviour surveys and, from October 2013, with the demographic data for those aged 12 and over.[23]

Ethics approval for the demographic surveillance and sexual behaviour studies was obtained from the National Health Sciences Research Committee in Malawi (#419) and Research Ethics Committee of the London School of Hygiene and Tropical Medicine. For the demographic surveillance verbal consent was given by the head of household. For the sexual behaviour surveys individual written informed consent was sought.

In this analysis we assessed the association of schooling performance and status at different ages on the subsequent risk of sexual debut, pregnancy and marriage. Exposures were defined as: current age-for-grade (the number of years a child is overage for their grade), and current schooling status (in primary, in secondary, dropped out during primary, dropped out after primary). In Malawi primary school has 8 grades and secondary school 4 forms. Schooling starts, theoretically, at age 6, so a child progressing optimally would spend one year at each level and finish primary at age 14 and secondary at 18. Children with poor performance are required to repeat the year. Some children start late, and many repeat levels, so they become increasingly over-age for their grade.[22] Primary school has no fees. Secondary school has fees, and places are restricted so there is a bottle-neck at the end of primary[25] and children may repeat the final year to improve their results. As academic failure and under-achievement are major causes for repetition, age-for-grade is a marker of school progress.

We used a landmark approach[26] because both exposures and risks change quickly with age and we aimed to examine the effect of earlier schooling on life transitions (sexual debut, pregnancy and marriage). With this method, using yearly landmarks, the situation for each participant is taken at each single year of age and the subsequent rate of the outcomes examined. For each landmark analysis, the rates measured are conditional on the exposure (e.g. age-for-grade) and confounders (e.g. living arrangements) at the landmark age, ignoring any change of status thereafter. Because age at sexual debut, pregnancy and marriage were reported by year, a random fraction of a year was added to the ages to convert them to dates.

Survival analysis with Cox regression models was used to estimate hazard ratios for each of the outcomes (sexual debut, pregnancy and marriage). For each landmark analysis, those who had already experienced the event by the landmark age were excluded, and individuals were included from the date at which they were first seen at that landmark age. Individuals were kept in the analysis until they experienced the event of interest, or the last date at which they were asked about the outcome (the date of the last interview at which the relevant data were recorded), or they reached age 20 or 25. For girls all analyses were censored at age 20 as the interest was in early pregnancy and marriage. For boys marriage is rare under 20 years so the time period was extended to age 25.

Analyses were done with and without adjusting for confounders. For clarity the same set of confounders were included in all analyses. These were: education of parents, vital status of parents, living arrangements (household size, number of children aged 0-5 years in household, living with parents), sex of head of household, socioeconomic status (as five levels from principal component analysis of household assets), year of interview. The proportion with missing values for these confounders was very low (<1%) for all except asset score (~7%). Complete case analysis was used for the Cox regression analyses, thereby excluding those with missing data. Other possible confounders were examined: dwelling score (which was only available until 2011), age of parents at birth, and first born or subsequent child. Further adjustment for these variables did not affect results and because they would have added to the proportion with missing values they are not included. We also assessed whether associations with age-for-grade were explained by the age at starting school by adding this variable as a possible confounder.

There was some evidence of departure from proportionality for analyses with age-for-grade (girls age 12-14 and boys at age 13 only), and a larger departure from proportionality for analyses with schooling status at all ages, with the hazard ratios of the outcomes decreasing with age due to the high initial hazard of the outcomes after school dropout. For simplicity of comparison across landmark analyses, we report the estimated hazard ratios obtained under the proportional hazards assumption, noting that these estimates are averages of time-varying hazard ratios over the follow-up time.

9.4 Results

In this open cohort, information on at least one outcome (age at sexual debut, first pregnancy or first marriage) was available for more than 16,000 children with schooling information at ages 10-18 years. Few children were two or more years over-age for their

grade when younger than 10 years, and very few children dropped out of school before age 13, so the analyses of school progression and schooling status were restricted to those aged 10 and over and 13 and over, respectively.

Information on age at first marriage was available for 8576 girls and 7751 boys, on pregnancy for 6999 girls, and on sexual debut (which was only asked for those aged ≥15 between 2008 and 2011) for 2361 girls and 2207 boys. The numbers available for each landmark age analysis are different: those who had already had the outcome are excluded; there are almost no data on sexual debut for those with schooling data at age <12 years; and data on pregnancy and marriage are missing for some individuals, due to age eligibility, timing of the surveys or lack of time for follow-up surveys for those seen in the last year.

For example, for girls, there were 4592 seen at age 10, 3811 at age 14, and 3258 at age 18. At age 14: 890 (23%) girls had data on sexual debut and 56 had already had sex. After excluding those with missing data on confounders, 817 were included in the school status analysis, and 777 in the age-for-grade analysis (which excluded those who had already left school). Similarly, for girls at age 14, 2703 (71%) had data on first pregnancy, 40, had already been pregnant, 2508 were included in the schooling status analysis and 2408 in the age-for-grade analysis; and 2978 (78%) had data on marriage, 67 had already been married, 2744 were included in the school status analysis and 2644 in the age-for-grade analysis.

The rates of sexual debut, first pregnancy and first marriage by schooling status, age-for-grade and the potential confounders are shown in **Appendix Table S1** for landmark age 14 for girls. At this age very few children had reached secondary school, and few had already experienced any of the outcomes (as described above). As well as associations with schooling status and age-for-grade, discussed below, sexual debut, pregnancy and marriage tended to be later (shown as lower rates) in those with higher socio-economic status, living with their parents, and with more educated parents (for pregnancy and marriage only). Although some children started school young, because of early repetitions few children were underage for their grade (5% by age 10, 2% by age 14), so they are included with those at the correct age-for-grade for the analyses.

Figures 1-4 show the cumulative proportion of study participants with sexual debut, first pregnancy and first marriage by schooling status and age-for-grade at landmark age 14, separately for girls and boys. Similar figures for landmark ages 10-18 are in the Appendix.

Tables 1-4 show the Cox regression analyses, with and without adjustment for confounders.

For girls, rates of first sex, pregnancy and marriage were all much higher for those out of school than those in school, and the associations with schooling status were only slightly less strong after adjusting for confounders **(Table 1).** The proportion sexually active increased rapidly among those out of school at each age **(Figures 1, S1).** The proportions pregnant and married also increased quickly in the out of school population, though not as dramatically as the proportion sexually active. **(Figure 1, S2, S3).**

For boys there was an increased hazard of sexual debut among those out of school from age 14 **(Figures 2, S1, Table 2),** with or without adjusting for confounders, although with lower hazard ratios than for girls. Fewer boys than girls were out of school at the younger ages. Marriage for boys was much later than for girls, and occurred at a lower rate, but the relative hazard of marriage among those who dropped out of primary compared to those still in primary was similar to that for girls for most landmark ages **(Table 2, Figures 2, S3).** At each landmark age, rates of pregnancy and, for both boys and girls, marriage, were lower among those in secondary school than among those still in primary school **(Tables 1, 2).**

There was no association between age-for-grade and sexual debut for girls or boys, except for boys at landmark age 12, among whom those not overage had a higher rate of sexual debut than those overage for their grade **(Figures 3, 4, S4, Tables 3, 4).** There were strong associations between age-for-grade and pregnancy and, for both boys and girls, between age-for-grade and marriage **(Figures 3, 4, S5, S6, Tables 3, 4).** The associations with pregnancy and marriage were only slightly attenuated by adjusting for confounders. Additional adjustment for age at start of school made no difference to the results (not shown). The associations with pregnancy and marriage were similar at all ages and were apparent for girls from landmark age 10 onwards, although there were few pregnancies or marriages under 14. The proportion of girls pregnant before age 18 by age-for-grade is summarised in **Figure 5a** for different landmark ages. For example, of those ≥3 years behind at age 14, 39% were pregnant before they were 18, compared to 18% of those who were at or above the appropriate grade. The pattern for marriage was similar **(Figure 5b).** For boys there was insufficient follow-up time at the youngest ages to assess marriage rates accurately, since few boys marry under age 20, but an association between being overage for grade and earlier marriage was seen from the age of 12 onwards **(Table 4).**

9.5 Discussion

In this large longitudinal population-based study, age-for-grade for those in school, as well as school drop-out, predicted age of pregnancy and marriage. Being out of school, but not age-for-grade, predicted sexual debut in girls, and, weakly, in boys.

A key insight from the landmark approach is that it allows us to see at what age being in or out of school or falling behind begins to impact on later life events. Up to age 13, almost all children were still in school so it was not possible to examine the effect of earlier dropout. For girls, associations of dropout with sex, pregnancy and marriage were already strong by age 13. For boys the association of dropout with marriage was strong by age 14. Many children were overage-for-grade, by age 10. By this age, girls who were three or more years behind were more likely to get pregnant or married early, even though these events were not imminent. For boys age-for-grade by age 12 was predictive of age at marriage: it was not possible to assess this at younger ages as the follow-up was not long enough.

The associations between being out of school and sexual activity, pregnancy and marriage are well recognised.[8,16,25,27] The influence of age-for-grade on pregnancy and marriage may be because falling behind increases dropout. But, for girls, the rapidity with which sexual debut, pregnancy and marriage occur among those who are out of school at each age suggests that events leading to dropout may be important as well as actually being out of school. It is interesting that the associations with marriage were seen for boys as well as girls, albeit at older ages. Common factors underlie school progression, dropout and early sex, pregnancy and marriage.[9] We adjusted the analyses for available confounders and this had surprisingly little effect on the associations, but we were restricted by what was available. For example, academic aspirations of children and/or of their parents, which both influence and are influenced by performance,[28] may be associated with dropout, pregnancy and marriage. We could only adjust for this indirectly through parental education level.

Children may be old for their grade because of late starts, temporary withdrawal, or grade repetition. In this population temporary withdrawal and late starts are rare. For example, among the girls in the analysis at landmark age 14, 92.2% had started at 6 years or younger, 6.6% started at 7 years and only 1.2% started at older than 7 years (Table S1). Adjusting for starting age made no difference to the results. As most children were overage because of repetition, it is a reasonable proxy of performance, especially at primary school, which is

free, so repetition is not caused by lack of money for school fees (although there may be other financial barriers). In this population repetition is common in all grades.[22]

The lack of association between age-for-grade and sexual debut at most ages may partly be due to the small sample size for this analysis, as information on sexual debut was only collected for a limited period and age group. Also, age at sexual debut may be more liable to problems of recall and reporting[24] than ages of pregnancy and marriage, which may have diluted any association. The higher risk of sexual debut at landmark age 12 for boys who were at or underage-for-grade may be due to chance, but could be explained by them mixing with older classmates,[10] as most children are already below the expected grade by this age.[22]

Because landmark analysis defines exposures (and confounders) at a single point of time, it is different from looking at associations with the final education level or total years of schooling achieved.[27,29] An alternative analytical approach would have involved a single Cox regression analysis where the exposure (school drop-out or age-for-grade) is treated as a time-varying variable. The confounders too would have to be time-varying, in particular vital status of parents, living arrangements, and household socioeconomic status. The interpretation of the estimated hazard ratios from such a model would rely on its implicit assumption of no feedback between time-varying exposure and time-varying confounders. As this is hard to justify, we have preferred the landmark approach as this breaks the analysis into overlapping time periods with time-fixed exposure and confounders, leading to more easily interpretable estimates of effects.

The landmark analyses performed at different ages are not independent, as individuals contribute to the analysis at each age at which they are seen and are still at risk of the outcome. The younger landmark ages, when few individuals will already have experienced the outcome, are more informative for the whole population than the older ages, which are applicable to the increasingly select group who have not yet experienced the outcome. However the similar hazard ratios at different landmark ages is striking. At each age, being in or out of school or the grade reached are important determinants of future life transitions.

9.6 Conclusion

Even though it was not possible totally to disentangle the effects of poor progression from its underlying causes, or to determine the extent to which poor progression influences the outcomes directly rather than through dropout and the loss of the "protective" effect of being in school, the results suggest that children at high risk of dropout and teenage pregnancy and marriage might be identified within the first few years of school. The solutions may correspondingly lie in the early childhood years. Teacher training and other pedagogic interventions can improve learning and school progression for some,[30,31] though evidence for an effect on dropout or school completion is limited.[30] They may also reduce teenage pregnancy and marriage.

9.7 References

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Figure 1 Cumulative proportion ever (a) sexually active (b) pregnant (c) married by schooling status of girls at landmark age 14

(Restricted to those who had not yet had the outcome in question)

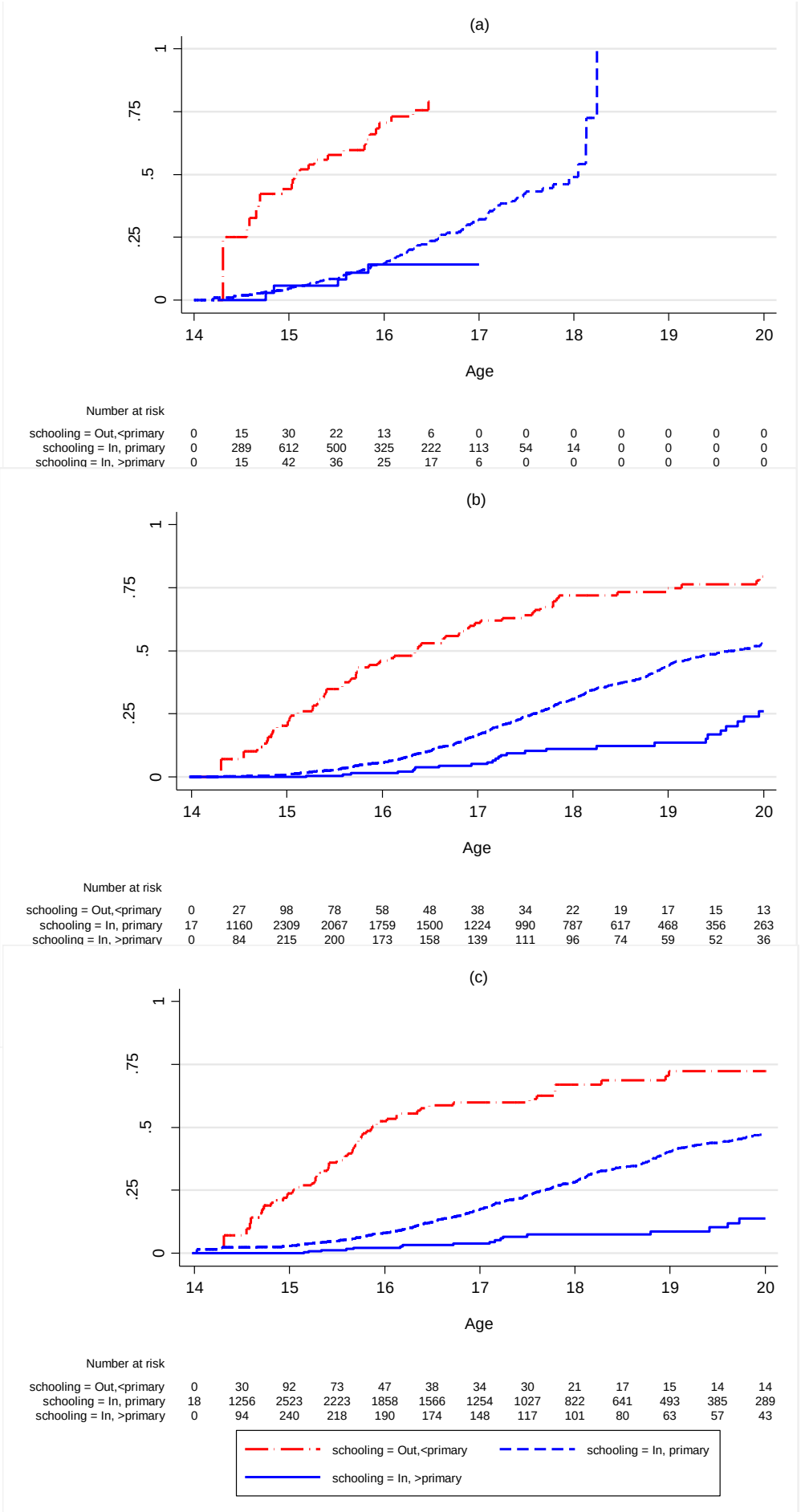


Figure 2: Cumulative proportion ever (a) sexually active (b) married by schooling status of boys at landmark age 14.

(Restricted to those who had not yet had the outcome in question)

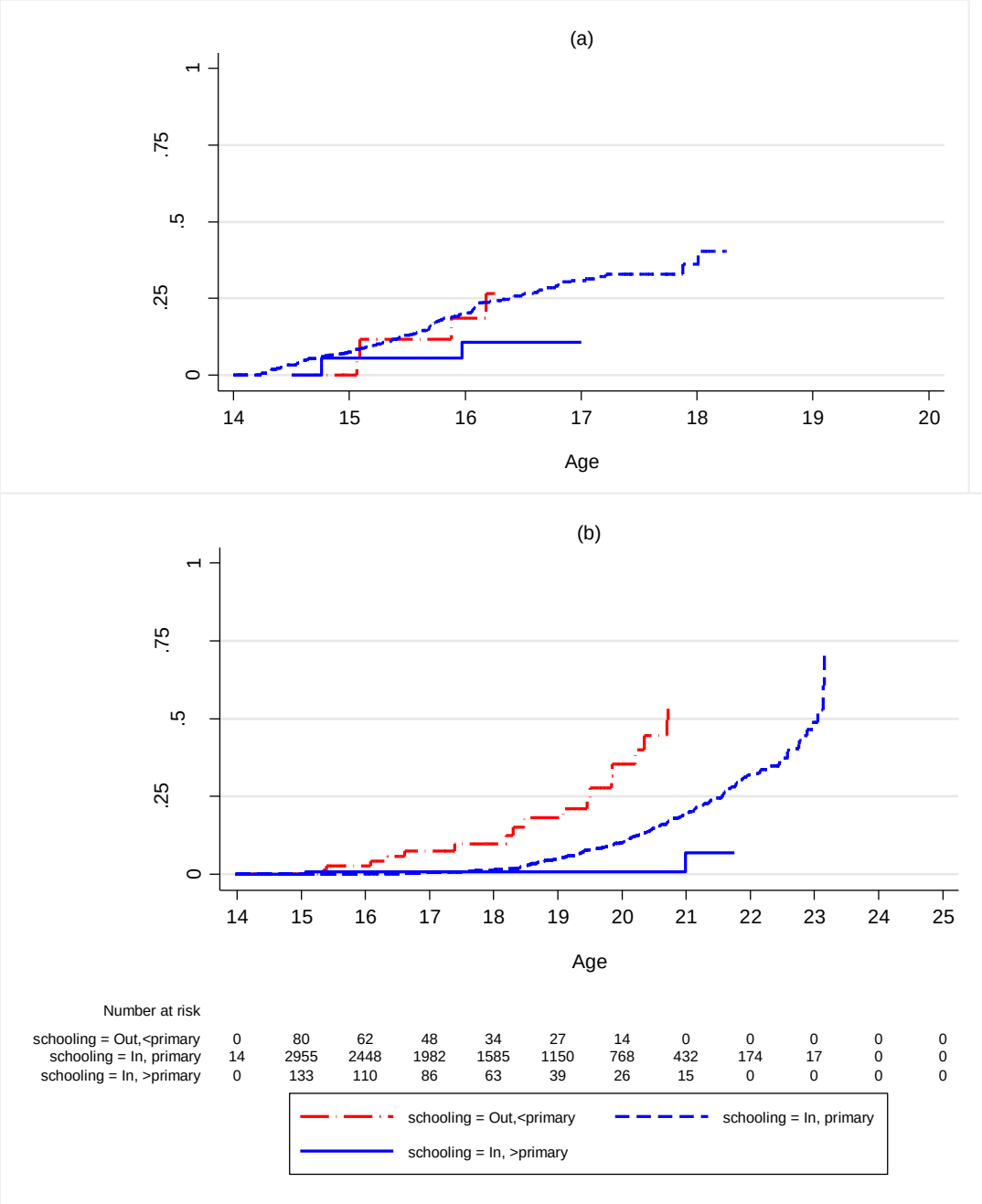


Figure 3: Cumulative proportion ever (a) sexually active (b) pregnant or (c) married by age for grade of girls at landmark age 14

(Restricted to those who were in school at age 14 and not yet had the outcome in question)

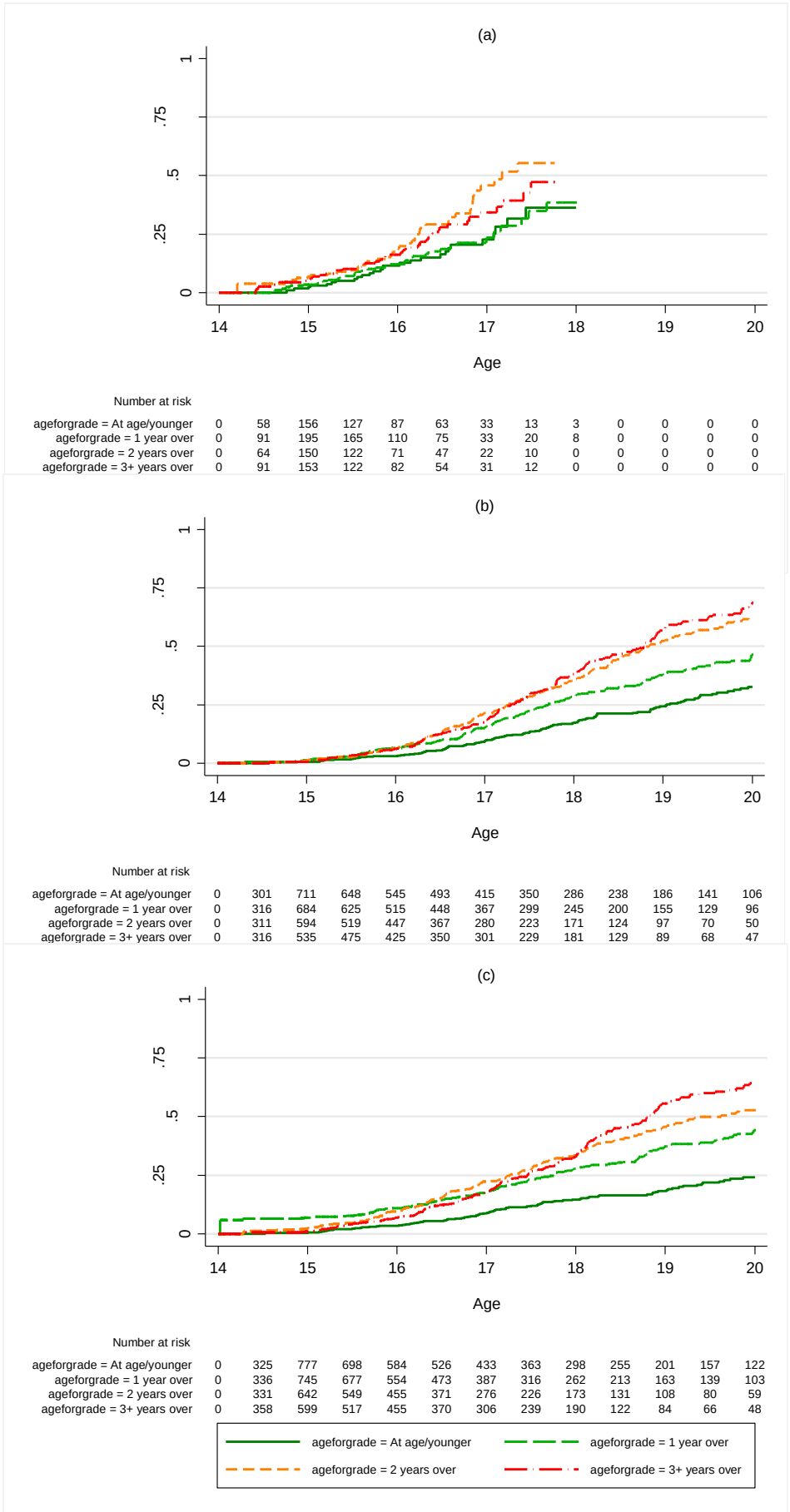


Figure 4: Cumulative proportion ever (a) sexually active (b) married, by age for grade of boys at landmark age 14

(Restricted to those who were in school at age 14 and not yet had the outcome in question)

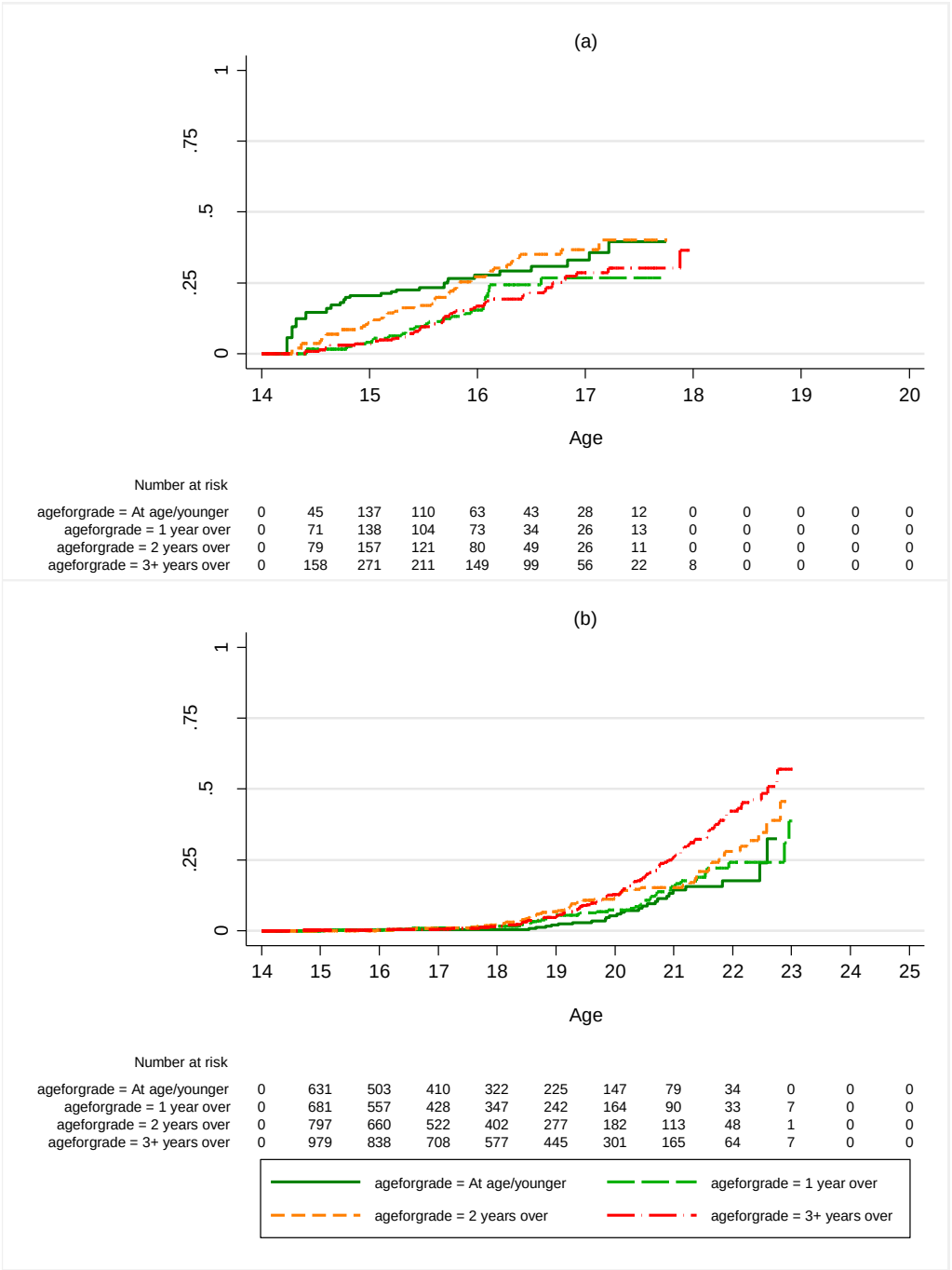


Table 1: Associations between schooling status and time to sexual debut, pregnancy and marriage for girls at different landmark ages. Hazard ratio(HR) and 95% confidence intervals (CIs) are shown, compared to those in primary school

		Crude HR (95%CI)				Adjusted HR (95%CI)[1]			
Landmark age	**Event/ No. at risk**	**Dropped out in primary**	**Dropped out beyond primary**	**In secondary**	***P* (LRT)**	**Dropped out in primary**	**Dropped out beyond primary**	**In secondary**	***P* (LRT)**
Sexual Debut									
13	101/577	6.33 (3.5-11.6)	NA	0.40 (0.06-2.87)	<0.000	6.29 (3.0-13.1)	NA	0.50 (0.07-.78)	0.0001
14	167/817	5.07 (3.27-7.85)	17.4 (2.39-127.1)	0.70 (0.31-1.59)	<0.000	5.39(3.27-8.86)	27.6 (3.45-21.0)	0.75 (0.32-.74)	<0.000
15	169/812	5.96 (4.07-8.73)	9.19(1.26-67.1) [1]	0.74 (0.44-1.23)	<0.000	3.50(2.22-5.52)	6.30 (0.74-53.6)	0.85 (0.50-.45)	<0.000
16	147/633	5.87 (4.02-8.56)	4.92 (0.68-35.7)	0.74 (0.48-1.15)	<0.000	3.61(2.21-5.87)	1.5 (0.19-11.9)	0.79 (0.49-.26)	<0.000
17	116/461	6.47 (4.07-10.28)	3.98 (1.66-9.52)	0.95 (0.58-1.54)	<0.000	3.39(1.90-6.07)	2.41 (0.92-6.32)	1.01 (0.60-.68)	0.0002
18	66/295	9.88 (4.48-21.8)	8.41 (3.42-20.6)	0.66 (0.28-1.57)	<0.000	8.32 (3.2-21.6)	6.62 (2.32-18.9)	0.63 (0.24-.67)	<0.000
Pregnancy									
13	645/2680	1.79 (1.21-2.65)	NA	0.28 (0.13-0.64)	<0.000	1.52(1.01-2.28)	NA	0.43 (0.19-.96)	0.01
14	743/2508	2.85 (2.20-3.69)	37.1 (5.14-267.2)	0.35 (0.23-0.52)	<0.000	2.39(1.82-3.12)	55.9 (7.58-11.9)	0.42 (0.28-.63)	<0.000
15	770/2196	3.95 (3.27-4.76)	4.11 (1.95-8.66)	0.44 (0.34-0.57)	<0.000	2.89(2.35-3.46)	3.94 (1.82-8.52)	0.52 (0.40-.67)	<0.000
16	690/1827	4.08 (3.44-4.84)	5.24 (2.95-9.33)	0.46 (0.37-0.58)	<0.000	2.84(2.33-3.47)	4.80 (2.63-8.76)	0.52 (0.42-.65)	<0.000
17	500/1423	4.38 (3.54-5.43)	3.62 (2.46-5.32)	0.55 (0.43-0.70)	<0.000	2.87(2.23-3.69)	3.06 (2.04-4.61)	0.60 (0.46-.77)	<0.000
18	325/1064	5.59 (3.82-8.19)	5.53 (3.60-8.51)	0.75 (0.50-1.13)	<0.000	3.87(2.58-5.83)	4.28 (2.72-6.71)	0.75 (0.49-.13)	<0.000
Marriage									
13	604/2989	2.13 (1.46-3.12)	NA	0.21 (0.08-0.56)	<0.000	1.79(1.20-2.66)	NA	0.31 (0.12-.84)	0.002
14	669/2744	3.06 (2.32-4.05)	NA	0.26 (0.16-0.41)	<0.000	2.76(2.08-3.67)	NA	0.31 (0.19-.51)	<0.000
15	658/2325	3.75 (3.04-4.63)	1.21 (0.39-3.75)	0.33 (0.25-0.44)	<0.000	3.32(2.67-4.12)	1.56 (0.49-4.89)	0.40 (0.30-.55)	<0.000
16	556/1913	3.67 (3.01-4.46)	1.70 (0.81-3.61)	0.39 (0.30-0.49)	<0.000	2.99(2.43-3.67)	2.30 (1.07-4.92)	0.44 (0.34-.56)	<0.000
17	373/1502	3.82 (2.99-4.87)	2.49 (1.62-3.82)	0.42 (0.32-0.56)	<0.000	3.09(2.38-4.02)	2.75 (1.74-4.33)	0.49 (0.37-.64)	<0.000
18	232/1133	6.55 (4.26-10.1)	4.03 (2.48-6.55)	0.61 (0.39-0.97)	<0.000	4.67(2.98-7.32)	3.58 (2.17-5.90)	0.72 (0.45-.15)	<0.000

Restricted to those with no missing data. NA – Not available (insufficient data); LRT – Likelihood ratio test

[1] Adjusted for education of parents, vital status of parents, living arrangements (household size, number of children aged 0-5 years in household, living with parents), sex of head of household, socioeconomic status (as five levels from principal component analysis of household assets), year of interview

Table 2: Associations between schooling status and time to sexual debut and marriage for boys at different landmark ages. Hazard ratios (HR) and 95% confidence intervals (CIs) are shown compared to those in primary school.

Landmark age	Event/ No. at risk	Crude HR (95% CI) Dropped out in primary	Dropped out beyond primary	In secondary	*P* LRT	Adjusted HR (95% CI) [1] Dropped out in primary	Dropped out beyond primary	In secondary	*P* LRT
Sexual debut									
13	125/636	1.36 (0.56-3.34)[5]	NA	NA	0.27	0.97(0.38-2.49)	NA	NA	0.96
14	150/858	1.64 (0.73-3.74	NA	0.47 (0.15-1.48)	0.18	1.92(0.81-4.55)	NA	0.43 (0.13-1.41)	0.12
15	139/835	2.38 (1.25-4.54)	1.66 (0.23-11.92)	0.78 (0.40-1.54)	0.092	2.26(1.16-4.43)	1.44 (0.18-11.42)	0.82 (0.40-1.69)	0.15
16	120/673	1.53 (0.80-2.93)	NA	0.69 (0.40-1.19)	0.16	1.35(0.67-2.70)	NA	0.73 (0.41-1.30)	0.42
17	95/525	2.50 (1.49-4.19)	1.07 (0.15-7.74)	1.10 (0.67-1.79)	0.015	2.48(1.39-4.42)	1.77 (0.23-13.76)	1.21 (0.72-2.04)	0.03
18	59/403	4.4 (1.78-6.50)	1.89 (0.44-8.14)	1.19 (0.63-2.23)	0.0030	3.80(1.90-7.62)	2.01 (0.41-9.86)	1.16 (0.60-2.27)	0.0026
Marriage									
13	186/3209	2.03 (1.00-4.12)	NA	NA	0.20	1.72(0.82-3.61)	NA	NA	0.097
14	279/3029	3.46 (2.17-5.140	NA	0.21 (0.053-0.86)	<0.000	3.74(2.28-6.11)	NA	0.26 (0.064-1.04)	<0.000
15	382/2857	2.88 (2.09-3.96)	NA	0.29 (0.16-0.52)	<0.000	3.08(2.22-4.28)	NA	0.35 (0.19-0.64)	<0.000
16	493/2661	2.60 (2.04-3.32)	3.45 (0.48-24.62)	0.47 (0.39-0.64)	<0.000	2.67(2.08-3.43)	7.08 (0.95-52.68)	0.56 (0.41-0.77)	<0.000
17	574/2492	2.30 (1.89-2.79)	0.78 (0.25-2.430	0.47 (0.37-0.60)	<0.000	2.35(1.92-2.87)	0.95 (0.30-3.01)	0.50 (0.39-0.64)	<0.000
18	597/2227	2.35 (1.95-2.84)	0.76 (0.42-1.40)	0.62 (0.50-0.76)	<0.000	2.40(1.98-2.91)	0.86 (0.46-1.58)	0.68 (0.55-0.84)	<0.000

Restricted to those with no missing data

NA* Not available (insufficient data); LRT – Likelihood ratio test

[1] Adjusted for education of parents, vital status of parents, living arrangements (household size, number of children aged 0-5 years in household, living with parents), sex of head of household, socioeconomic status (as five levels from principal component analysis of household assets), year of interview

Table 3: Associations between age-for-grade and time to sexual debut, pregnancy and marriage for girls at different landmark ages. Hazard Ratios(HR) and 95%

		Crude HR (95% CI)				Adjusted HR (95% CI) [1]			
Landmark age	**Event/No.**	**1 year overage**	**2 years overage**	**3+ years**	**P**	**1 year overage**	**2 years overage**	**3+ years**	**P**
Sexual debut									
12	41/309	0.82 (0.38-1.81)	1.19 (0.52-2.74)	1.26 (0.48-3.32)	0.79	0.95 (0.41-2.20)	1.39 (0.57-3.39)	1.00 (0.32-3.10)	0.84
13	89/557	1.05 (0.58-1.91)	1.40 (0.78-2.50)	1.82 (1.00-3.34)	0.19	0.97 (0.53-1.80)	1.14 (0.61-2.13)	1.42 (0.73-2.77)	0.66
14	142/777	1.01 (0.62-1.65)	1.66 (1.02-2.71)	1.46 (0.90-2.38)	0.077	1.07 (0.65-1.77)	1.68 (1.01-2.79)	1.50 (0.89-2.52)	0.12
15	133/757	1.29 (0.71-2.35)	1.28 (0.68-2.36)	1.55 (0.86-2.77)	0.49	1.32 (0.72-2.45)	1.08 (0.56-2.11)	1.28 (0.68-2.42)	0.72
16	100/575	0.73 (0.34-1.59)	1.50 (0.84-2.70)	1.31 (0.74-2.32)	0.16	0.75 (0.33-1.72)	1.44 (0.76-2.72)	1.26 (0.66-2.42)	0.31
17	66/385	2.15 (0.76-6.03)	2.41 (0.88-6.58)	1.86 (0.72-4.78)	0.31	1.99 (0.69-5.77)	1.87 (0.66-5.34)	1.46 (0.54-3.94)	0.51
18	23/235	NA*	NA*	NA*		NA*	NA*	NA*	
Pregnancy									
10	235/2608	1.72 (1.29-2.30)	1.55 (1.06-2.26)	3.00 (1.46-6.17)	0.0002	1.54 (1.14-2.08)	1.32 (0.87-2.01)	2.84 (1.32-6.17)	0.0077
11	387/2937	1.61 (1.26-2.06)	1.79 (1.37-2.34)	2.04 (1.34-3.10)	<0.000	1.42 (1.10-1.84)	1.58 (1.19-2.10)	1.58 (1.02-2.47)	0.0069
12	518/2789	1.28 (1.02-1.61)	1.85 (1.47-2.32)	1.93 (1.45-2.56)	<0.000	1.15 (0.91-1.45)	1.55 (1.22-1.97)	1.59 (1.18-2.15)	0.0008
13	619/2622	1.39 (1.11-1.74)	1.88 (1.51-2.35)	2.07 (1.64-2.62)	<0.000	1.26 (1.01-1.58)	1.56 (1.24-1.95)	1.68 (1.31-2.15)	0.0003
14	679/2408	1.62 (1.28-2.05)	2.39 (1.90-3.02)	2.68 (2.13-3.36)	<0.000	1.52 (1.19-1.92)	2.19 (1.73-2.78)	2.28 (1.79-2.89)	<0.000
15	627/2016	1.66 (1.24-2.21)	2.42 (1.82-3.21)	3.01 (2.29-3.96)	<0.000	1.56 (1.16-2.08)	2.09 (1.56-2.79)	2.48 (1.86-3.31)	<0.000
16	463/1547	1.08 (0.73-1.59)	1.95 (1.45-2.61)	2.59 (1.95-3.44)	<0.000	1.06 (0.72-1.57)	1.78 (1.32-2.40)	2.16 (1.60-2.91)	<0.000
17	258/1107	1.39 (0.86-2.26)	1.72 (1.06-2.77)	2.63 (1.74-3.96)	<0.000	1.31 (0.80-2.14)	1.55 (0.95-2.53)	2.24 (1.46-3.44)	0.0002
18	117/759	1.55 (0.68-3.55)	2.11 (1.05-4.25)	2.70 (1.38-5.29)	0.0082	1.56 (0.67-3.61)	2.02 (0.99-4.12)	2.50 (1.23-5.06)	0.04
Marriage									
10	211/2805	1.77 (1.31-2.39)	1.50 (1.00-2.25)	3.55 (1.72-7.32)	0.0002	1.52 (1.10-2.08)	1.15 (0.74-1.79)	3.19 (1.47-6.94)	0.008
11	345/3219	1.73 (1.33-2.23)	1.72 (1.29-2.29)	2.39 (1.56-3.65)	<0.000	1.49 (1.14-1.96)	1.44 (1.06-1.96)	1.80 (1.15-2.84)	0.0095
12	473/3073	1.38 (1.08-1.75)	1.91 (1.49-2.43)	2.00 (1.48-2.70)	<0.000	1.2 (0.94-1.55)	1.54 (1.20-1.99)	1.57 (1.14-2.15)	0.003
13	576/2921	1.49 (1.18-1.88)	2.09 (1.66-2.63)	2.19 (1.71-2.80)	<0.000	1.32 (1.04-1.67)	1.70 (1.34-2.15)	1.68 (1.30-2.19)	0.0001
14	615/2644	1.70 (1.32-2.20)	2.63 (2.05-3.38)	3.07 (2.41-3.92)	<0.000	1.57 (1.21-2.03)	2.38 (1.84-3.07)	2.62 (2.02-3.39)	<0.000
15	550/2199	2.17 (1.56-3.03)	3.22 (2.31-4.47)	4.12 (2.99-5.68)	<0.000	2.01 (1.43-2.81)	2.75 (1.96-3.85)	3.33 (2.38-4.65)	<0.000
16	401/1681	1.31 (0.84-2.03)	2.77 (1.97-3.88)	3.48 (2.50-4.84)	<0.000	1.22 (0.78-1.90)	2.44 (1.73-3.44)	2.81 (1.99-3.99)	<0.000
17	213/1241	1.61 (0.90-2.90)	2.28 (1.30-4.00)	4.04 (2.47-6.62)	<0.000	1.51 (0.84-2.74)	2.05 (1.16-3.63)	3.40 (2.04-5.69)	<0.000
18	84/861	1.17 (0.41-3.33)	2.65 (0.16-6.03)	2.81 (1.26-6.27)	0.0061	1.13 (0.39-3.28)	2.50 (1.08-5.78)	2.58 (1.11-6.03)	0.024

Restricted to those with no missing data

NA* Not available (zero events in baseline category)

[1] Adjusted for education of parents, vital status of parents, living arrangements (household size, number of children aged 0-5 years in household, living with parents), sex of head of household, socioeconomic status (as five levels from principal component analysis of household assets), year of interview

Table 4: Associations between age-for-grade and time to sexual debut and marriage for boys at different landmark age. Hazard ratios(HR) and 95% confidence intervals (CIs) are shown, compared to those at age or younger

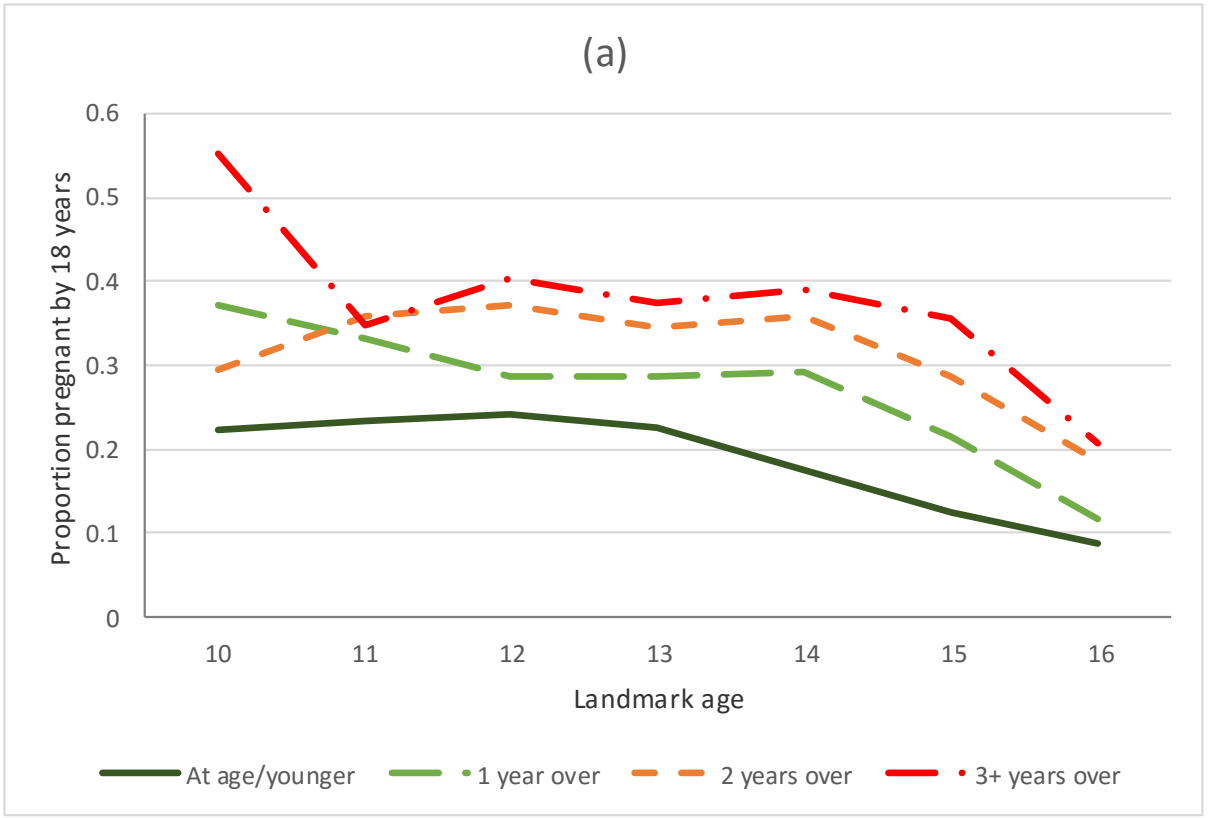
		Crude HR (95% CI)				Adjusted HR (95% CI) [1]			
Landmark age	Event/No. at risk	1 year overage	2 years overage	3+ years overage	P (trend)	1 year overage	2 years overage	3+ years overage	P (trend)
Sexual debut									
12	75/388	0.55 (0.29-1.05)	0.98 (0.56-1.71)	0.54 (0.26-1.09)	0.098	0.41 (0.21-0.82)	0.54 (0.28-1.02)	0.24 (0.11-0.55)	0.0026
13	120/618	1.15 (0.68-1.96)	1.14 (0.69-1.89)	0.94 (0.57-1.55)	0.82	1.25 (0.72-2.19)	1.06 (0.62-1.81)	1.01 (0.59-1.74)	0.85
14	144/836	1.00 (0.57-1.74)	1.51 (0.91-2.49)	0.94 (0.58-1.54)	0.13	1.06 (0.60-1.87)	1.49 (0.88-2.51)	0.94 (0.56-1.58)	0.18
15	128/801	1.49 (0.65-3.43)	1.85 (0.82-4.18)	1.46 (0.67-3.20)	0.44	1.52 (0.64-3.59)	1.77 (0.75-4.15)	1.32 (0.57-3.07)	0.43
16	110/637	1.41 (0.51-3.90)	1.50 (0.65-3.45)	1.69 (0.77-3.68)	0.54	1.53 ((0.54-4.33)	1.40 (0.59-3.31)	1.61 (0.71-3.64)	0.66
17	74/468	0.45 (0.15-1.34)	0.70 (0.28-1.73)	0.61 (0.30-1.25)	0.48	0.40 (0.13-1.25)	0.68 (0.26-1.80)	0.54 (0.24-1.20)	0.37
18	39/335	1.11 (0.20-6.09)	1.32 (0.28-6.25)	0.93 (0.22-3.92)	0.86	1.02 (0.17-6.16)	0.97 (0.19-4.97)	0.89 (0.19-4.18)	0.99
Marriage									
10	22/3041	0.54 (0.19-1.55)	1.10 (0.39-3.12)	NA	0.42	0.49 (0.16-1.52)	0.89 (0.29-2.74)	NA	0.23
11	44/3497	1.02 (0.50-2.06)	0.99 (0.47-2.09)	0.30 (0.040-2.25)	0.54	0.92 (0.44-1.90)	0.92 (0.42-2.05)	0.26 (0.033-2.03)	0.48
12	111/3357	0.60 (0.32-1.15)	1.92 (1.20-3.09)	1.44 (0.83-2.52)	0.0003	0.60 (0.32-1.16)	1.83 (1.12-2.98)	1.30 (0.72-2.35)	0.0030
13	178/3145	0.90 (0.52-1.57)	2.23 (1.43-3.49)	2.06 (1.32-3.20)	<0.0001	0.85 (0.49-1.49)	1.98 (1.25-3.13)	1.94 (1.22-3.09)	0.0001
14	260/2950	1.34 (0.83-2.19)	1.80 (1.14-2.83)	2.50 (1.65-3.79)	<0.0001	1.33 (0.81-2.17)	1.74 (1.10-2.76)	2.41 (1.56-3.70)	<0.0001
15	339/2730	2.89 (1.31-6.34)	5.35 (2.47-11.59)	5.77 (2.71-12.26)	<0.0001	2.57 (1.17-5.67)	4.64 (2.13-10.10)	4.64 (2.16-9.97)	<0.0001
16	414/2448	1.86 (1.01-3.45)	2.22 (1.31-3.77)	3.50 (2.11-5.80)	<0.0001	1.79 (0.97-3.33)	1.90 (1.11-3.25)	2.90 (1.72-4.86)	<0.0001
17	425/2166	1.89 (1.01-3.52)	2.04 (1.12-3.72)	3.49 (2.08-5.85)	<0.0001	1.93 (1.03-3.61)	1.91 (1.04-3.50)	3.12 (1.84-5.31)	<0.0001
18	390/1780	1.60 (0.85-3.00)	1.52 (0.85-2.71)	2.59 (1.54-4.35)	<0.0001	1.50 (0.80-2.84)	1.37 (0.76-2.47)	2.36 (1.39-4.02)	<0.0001

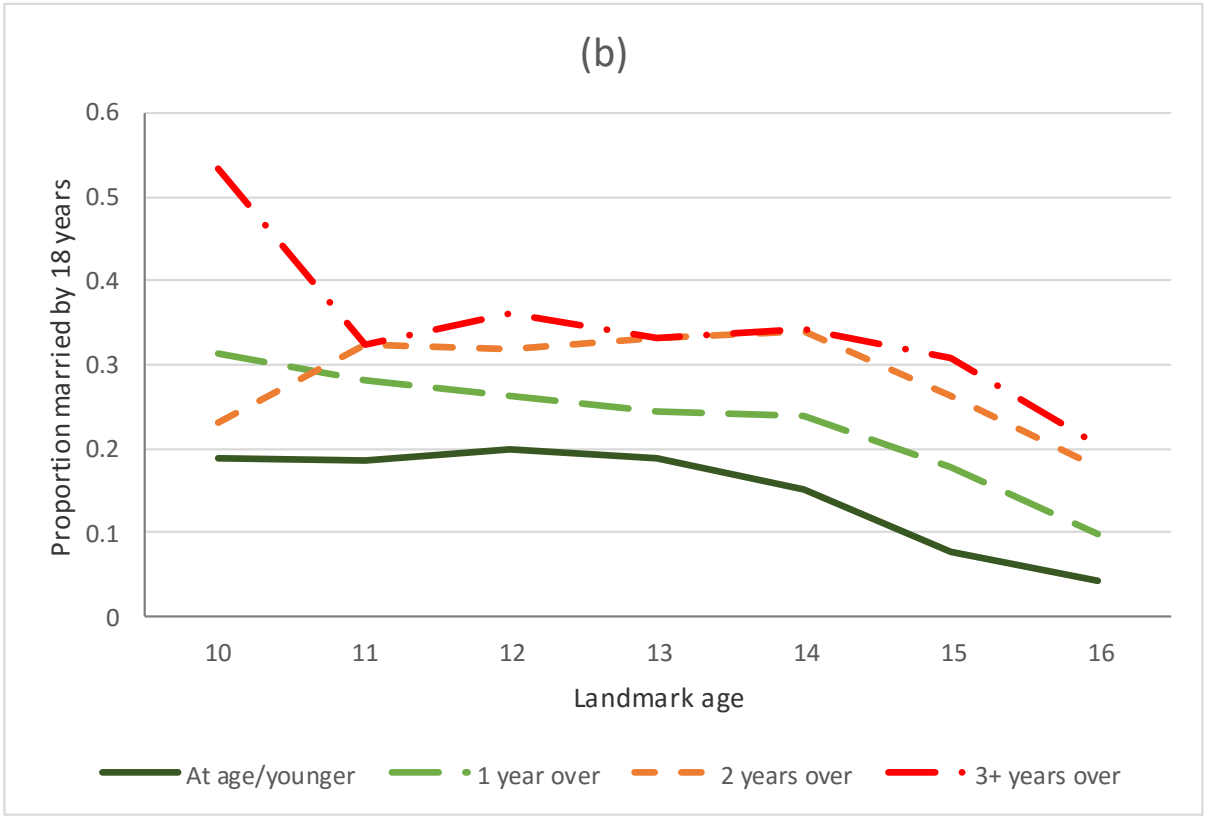
Restricted to those with no missing data

NA - Not available (insufficient data)

[1] Adjusted for education of parents, vital status of parents, living arrangements (household size, number of children aged 0-5 years in household, living with parents), sex of head of household, socioeconomic status (as five levels from principal component analysis of household assets), year of interview

Figure 5: Proportion (a) pregnant and (b) married before age 18, conditional on being in school and on school grade at different landmark ages





chapter 10

DISCUSSION & CONCLUSIONS

10

CHAPTER 10: DISCUSSION AND CONCLUSIONS

10.1 Introduction

This chapter presents a discussion of the key findings from my research, including the strengths and limitations across the different papers. I will also discuss the implications of these findings for future research and recommendations for future education interventions and policies in Malawi.

10.2 Key Findings

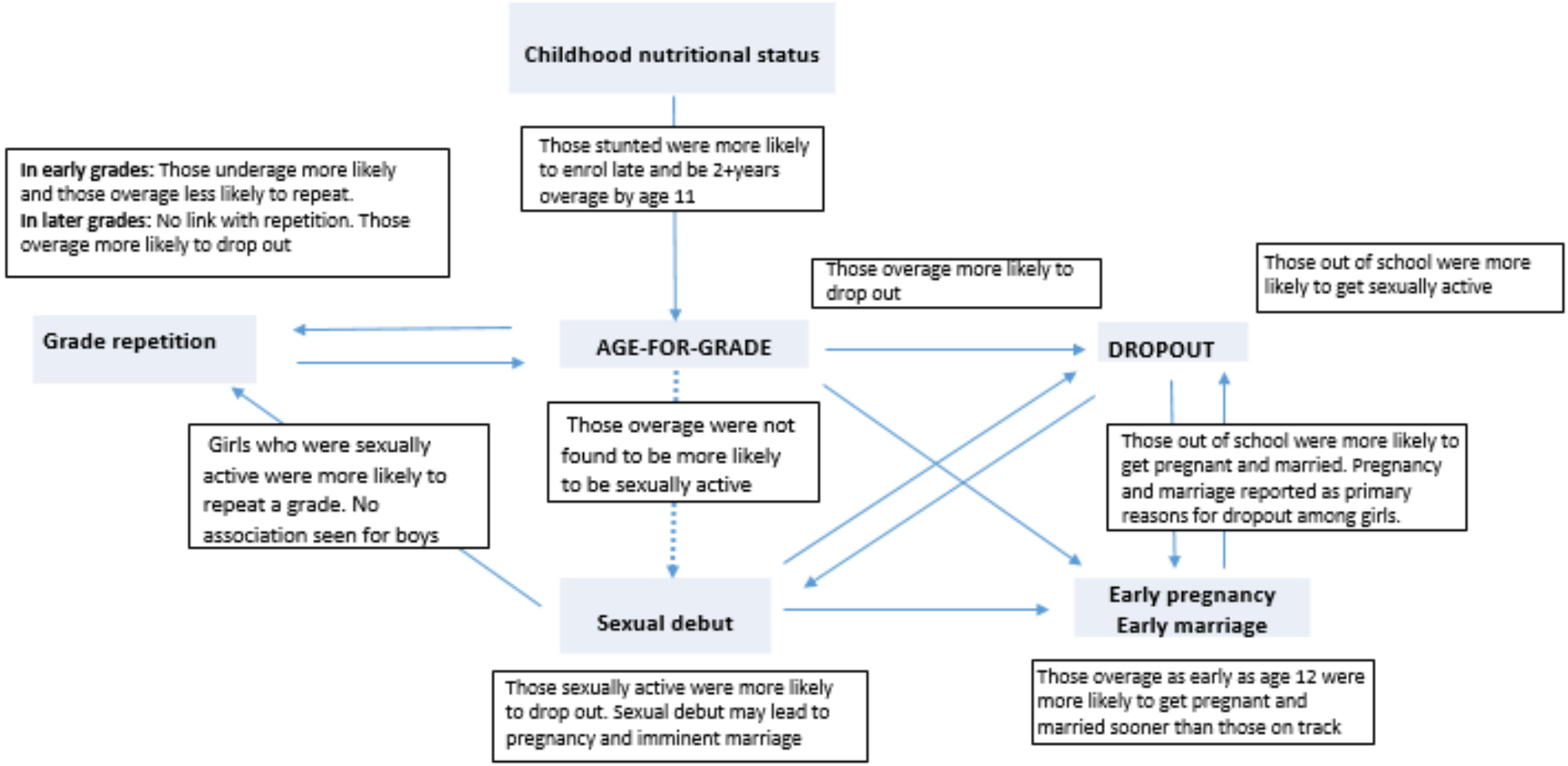
Dropping out of school is the result of a complex, dynamic interaction of events and influences. and cannot be determined just by one single cause(1). Figure **1** provides a summative overview of the research findings in the form of a causal diagram.

The causes of age-for-grade heterogeneity may be traced back to the first few years of life, when chronic childhood malnutrition, measured by stunting, is shown to be associated with delayed enrolment and being two or more years behind in school by the age of 11 (Paper 1). Unlike enrolment patterns seen for much of sub-Saharan Africa, most children in Karonga enrol underage or at the official age of six (93%) with only 1% entering after age 7. Despite this early start in school, high and frequent repetitions among those underage in early grades fuels the growing population of overage children in primary school (Paper 2). There is no clear advantage of enrolling earlier than mandated as those who started young were more likely than those who started on time to repeat, often more than once. This may be because those underage were perceived as, or were genuinely, not "ready" for school. In this setting being overage was largely driven by frequent repetitions, and not by being overage at entry as reported elsewhere(2,3).

Poor progression in school was associated with dropout, with those who were two or more years overage for their grade being more likely to drop out of school than those at the correct age. Schooling trajectories were similar for boys and girls up to the age of 15, when almost 90% reported being still in school. After this point, girls' schooling diverged quite dramatically from that of boys. The median age of dropout among girls was 19, by which age only one-third of boys had dropped out. By this time, 45% of girls and boys had completed primary with 25% of boys compared to only 5% of girls remaining enrolled in school (Paper 3).

Those who were sexually active were more likely to drop out of school, although this association was stronger for girls than for boys (Paper 4). The effect of sexual debut on dropout was just as strong for those who were overage as among those who were not behind in school. 60% of girls reported pregnancy/marriage as the primary reason for dropout, compared to 12% of boys. Being sexually active in school disadvantages girls more than boys in terms of school outcomes (repetition, dropout). Sexually active girls were more likely to repeat and get overage, with no similar associations seen for boys (Paper 4).

Figure 1 Overview of research findings



Associations between schooling and age-for-grade and later life transitions were also demonstrated. Dropout was associated with sexual debut, pregnancy and marriage, and being overage was associated with earlier pregnancy and marriage. Among girls who were 3 or more years behind at age 14, 39% were pregnant by the age of 18, compared to 18% of those who were on track at 14.

10.3 Strengths and limitations

Strengths

A few of the strengths of this research are highlighted below:

In this thesis, I have attempted to bring together different elements determining school dropout and the interaction with sexual behaviour, concentrating on the key role of age-for-grade heterogeneity. This has been possible because of the rich, unique, longitudinal datasets made available by the Karonga Prevention Study in Karonga district, northern Malawi over the last 15 years.

A unique aspect of this thesis is the examination of this relationship among boys as well as girls, and hence the ability to compare associations and influences.

With the long established structure of the demographic surveillance site, tracking participants within the catchment area was very systematic and reliable, thereby reducing the level of attrition on account of migration. Loss to follow-up was low; the extent is reported within each of the papers.

Collecting birth registration data is also key to the DSS and has been collected since 2002, therefore known directly for the younger children who are the focus of my analyses. For children not seen at birth, dates of birth have been collected and checked annually through household visits and do not rely on self-reports by the child. This makes data on respondents' ages highly reliable and not subject to the lack of birth registration systems found in other remote, rural areas. This assures the quality and reliability of the data that are used, especially for analyses of age-for-grade heterogeneity.

As part of this research, collation of secondary data on school-level characteristics and its integration with socio-economic surveys, allowed me to synchronise schooling histories

with the attributes of schools attended. This provides a more complete picture of the wider influences on school dropout

This thesis is an attempt to bring together socio-demographic data and epidemiological methods to analyse a social science phenomenon. Methods range from the use of ordinary and multinomial logistic regression to the use of methods in survival analysis, including the Fine and Gray competing risks model and landmark analysis.

Most longitudinal research that has examined the issue of dropout and sexual behaviour (pregnancy, marriage) has focussed on girls. A unique strength of this research is that it is one of very few longitudinal studies on school dropout that has included both boys and girls.

Limitations

The limitations of the research are described in each of the papers, but four over-arching limitations are outlined below.

Use of age-for-grade heterogeneity as a measure of school performance

Due to the lack of standardised assessment measures (literacy, numeracy scores) in schools, I relied on the use of age-for-grade as a simple, yet crude, measure of school performance. Similar to grade repetition, the underlying premise of this measure is that school progression is synonymous with school performance and how well children are actually doing in school. However, our understanding of how teachers (and parents) make decisions on enrolment or progression is unclear.

Schools may rely on teachers' perceptions or judgement of how well a child is prepared to enrol or progress to the next grade, rather than on academic performance. My findings show that those who were stunted in early and late childhood were more likely to delay enrolment in school (Paper 1). I also find that in the early grades of school, children who were underage were more likely to repeat a grade, while those who were overage were more likely to be promoted (Paper 2). Delays in enrolment on account of being physically smaller in stature may be because of delayed cognitive development, although no base-line measures of performance are used by schools to determine eligibility to enrol. However, it could also reflect an assumption that stunted children are not ready for school.

Establishing the timing of dropout with annual data collection

Dropout is a dynamic process with children leaving school at any point through the school academic year for a variety of reasons. The data on dropout was collected annually in conjunction with the school calendar, along with other school participation questions on enrolment and grade repetition. Given the intervals between annual survey rounds, it is difficult to determine the exact timing of when children leave school; and if withdrawals were temporary or permanent. However, given the longitudinal nature of our dataset and the availability of up to nine rounds of data for each respondent, data management strategies were set up to establish the best estimate of when children dropped out using data from the nearest rounds. Participants were also asked about the age when they dropped out of school, which was used to triangulate earlier responses on school participation.

Understanding adolescent sexual behaviour and other risky behaviour

Determinants of sexual debut, like characteristics of sexual partner, contraceptive use, were not included as they had already been examined using cross-sectional data previously (4) and this was not the focus of my research question. My research is also limited in addressing heterosexual penetrative sexual intercourse, hence unable to elaborate on other forms of sexual practices. There is currently no data on other risky behaviours, like substance abuse, smoking and alcohol use, which is not as prevalent in rural areas as in urban areas, but could be a possible determinant of sexual initiation and/or poor performance and non-attendance in school, especially while considering the effects of peer influence among boys. The problems of validity in reported sexual behaviour data are addressed in papers 4 and 5.

Reliability of school-level data

The use of administrative school-level data has previously been critiqued for concerns around data quality and discrepancies, missingness and incorrect data capturing (5,6) with issues around non-standardisation of data management and reporting from schools and district-level Education Management Information Systems (EMIS). To effectively account for the influences of schools in this analysis, I have deliberately focused on using tangible aspects of school characteristics, which are easily verifiable and less likely to be falsified or misreported.

10.4 Future research

The findings from my studies lead me to suggest the following priorities for future research and action.

Understanding the learning crisis in Malawi

School completion does not guarantee literacy, with 70% of children in Malawi being illiterate even after spending four years in primary school(7) and only one-third of children who complete grade 6 having acquired basic numeracy and reading skills(8) in the northern region. This is indicative of the learning crisis and the ever-widening repercussions of poor school progression on dropout, pregnancy and marriage that I find in my thesis.

One of the possible barriers to learning may be slow and poor reading acquisition skills in the early grades which inhibits children from following written instructions, comprehending textbook content or developing writing skills(9). Countries whose school systems privilege the use of the native language, instead of multiple or colonial languages, in school had higher literacy rates among adults completing at least five years of schooling(10). The implementation of the mother tongue policy in Malawi in 1996 required schools to teach in the local language (Chitumbuka in Karonga) in the first four grades of school with English and Chichewa(national language) as subjects and English used as the medium of instruction in school after Standard 4(11). The languages used in textbooks were Chichewa and English prior and subsequent to Standard 4[6]. The effective acquisition and transferability of decoding skills from one language to the other may determine success in overall reading acquisition and future learning (12).

In order to explore this pathway of learning, it would be important to expand our understanding on how teachers enable transitions from one language to another in schools in Karonga? Are they suitably trained to do so? How do grade-specific learning outcomes (literacy and numeracy skills) compare with those of children from monolingual schools in the south? Can the cognitive and linguistic skills gained (prior to and subsequent to this transition) predict their reading acquisition and overall school outcomes (grade repetition, progression, dropout)?

[6] *Based on correspondence with the MoEST, Malawi*

Why do children progress slowly through school?

There is also a need to gain a deeper understanding of why exactly children repeat in schools? How is repetition defined? How do teachers assess children? Is repetition indicative of school performance? This could help develop context-specific interventions that may help improve performance and accelerate progression through school.

Understanding the links between early nutrition, sexual maturation and schooling

A previous analysis using cross-sectional data from Karonga showed that early menarche is associated with early drop out, sexual debut, pregnancy and marriage(4). My research shows that childhood malnutrition and poor growth (stunting) is associated with later enrolment and poor progression. It would be interesting to examine the extent to which improvements in nutrition may lower the age at menarche and undo any gains on school progression and completion.

Qualitative research on the experiences of schooling and sexual behaviour

The study could have benefitted from the use of qualitative data to decipher the gendered experiences, context and aspirations of schooling and sexual behaviour; to disentangle notions of the value for education, how/who makes decisions on schooling and sex. This was outside the scope of my work but is something to consider in future studies. For the purpose of my research I have used qualitative findings from other studies in southern Malawi(13–15) to interpret my findings.

10.5 Future education programmes and policies

Based on the findings from my thesis, improving school quality and learning outcomes is imperative for children to progress through school on time. The gendered effect of schooling found in my research is validated by findings from qualitative studies from southern Malawi(13–17) which attributes these differences to a deeply entrenched and accepted culture of gender discrimination in schools, households and the wider community, which disadvantages girls over boys in school. Cultural and schooling contexts in the south vary from the north, with the south having lower levels of education, a matriarchal rather than patriarchal system of kinship and the practice of initiation ceremonies at puberty. Specific recommendations on reducing gender disparities in schools

in the north would need to follow from further qualitative explorations of young people's experiences and decision-making on schooling and sex (mentioned earlier).

Here are some recommendations I would like to make:

Prioritising provision of pre-school education to promote school readiness

Ensuring access to quality pre-primary education is one of the Sustainable Development Goals (Goal 4). The proportion of children enrolling overage by two or more years in schools in Malawi is on the decline (18). In Karonga, almost one-third of children enrol underage in primary school. The high presence of underage children over-crowds classrooms probably affecting teaching, learning and overall performance. One way to address this would be to increase access to affordable pre-school education (possibly enforcing stringent regulations on the age at entry done also in Tanzania(19)). This could reduce the pressure on primary schools to enrol underage children, fulfil parents' child-care needs while they work and help children be more prepared to seamlessly transition and attend primary school at the official age of entry (age 6). A review of studies from low-income countries have shown that exposure to pre-primary education is advantageous in overcoming early growth-related setbacks through improvements in cognitive development, social development, school preparedness and performance in the early years of school(20–24). Exposure to playgroups and kindergartens among 12,976 children between ages 3-4 in rural Indonesia increased language and numeracy scores at later ages (ages 6-9), compared to those who had no early education exposure or were exposed to either playgroups or kindergarten only.

Improving learning outcomes in the early years of school

Despite poor progression through school, most children remain enrolled up to the age of 15, which is the official age of primary school completion. This implies that there is plenty of time in which to teach children. A key window of opportunity to intervene is in the early years, and focusing on improving learning outcomes in school could help children progress and complete school on time, prior to the period of adolescence.

Promoting accelerated reading acquisition in the early years may be a possible pathway to improve learning outcomes and enable timely progression through school. Children who are unable to read early on may struggle to effectively engage with the curriculum and are more likely to fall behind in class(9,12). Customising learning and effective transition of

content from the child's mother-tongue to the local, dominant languages (Chichewa) may enable faster acquisition of reading skills and improved learning outcomes (12).

Merit-based scholarships have also been shown to improve learning outcomes (mathematics scores and cognitive outcomes), with scholarships for a group of students found to be more effective than to specific individuals(25). For example, in China, offering group incentives to high and low achieving students who were paired on a bench saw significant improvements in learning outcomes for low achievers, without harming the performance of high achievers(26). Widely popular cash transfer programmes have been shown to be effective in improving school enrolment and the overall demand for education(25,27,28), though they are more costly to implement, unsustainable to replicate with no evidence of its effect on improving learning outcomes. Two reviews found no evidence on the effect of CCTs on improving learning outcomes(25,27); while one showed negligible effect(28).

Global commitment to prioritise learning have also been expressed through the formation of the Global Alliance to Monitor Learning (GAL) and the Assessment for Learning Initiative(A4L) which are international platforms to consolidate support for national learning assessment systems in low and middle-income countries to formulate policies and track progress to improve learning outcomes to fulfil Sustainable development Goal 4.

Nutrition interventions to improve later school outcomes

Similar to my findings in Karonga, several other studies(29–32) have also shown that childhood malnutrition is associated with poor school outcomes. Timely growth enables the development of cognitive functions in early years and school outcomes in later years. Implementation of school feeding programs have shown to be effective in improving school enrolment, attendance(27) and learning outcomes(25), though its effect on reducing school dropout is unclear. The programmes typically provide children a hot meal at school or to take home. School-feeding programmes that were implemented by communities in areas of high food insecurity and with high prevalence of malnutrition were the most effective in achieving higher learner outcomes. Improvements in infant and child nutrition through complementary feeding promotion between 6-24months and supplementation (multiple micronutrient, zinc, vitamin A, iron) can reduce stunting and overall development(33).

Improving school quality

Structured pedagogical programmes have been found to be effective in improving learning outcomes in schools(25,27). This includes the combination of providing tangible inputs (buildings, books) along with pedagogical training and mentoring (curriculum-development, setting lesson plans, improving lesson delivery, monitoring and mentoring of teachers) in schools.

Provision of basic inputs like textbooks, blackboards, notebooks, are essential for learning and may increase school participation, but there is no evidence to show the effect on learning outcomes(25). However, the lack of evidence for the provision of textbooks was mostly attributed to difficulties in distribution and lack of age-appropriate curriculum for learners to adequately engage(25,27) so would need to be explored further.

The pros and cons of implementing a grade repetition policy versus an automatic promotion policy has been discussed in Chapter 6, with neither showing improvements in student performance(3,34). One way to improve learning outcomes is through the implementation of remedial instruction programmes(25,27) in schools. These programmes provide supplementary teaching/learning material to help children who are lagging behind to catch up with their peers. Hiring contract teachers to reducing class sizes (or pupil-teacher ratios) have also been shown to also be effective in improving learning (25,27).

10.6 Conclusions

Improving nutritional and learning outcomes in the early years of life and school is imperative for ensuring timely progression and completion of school; and successful transitions into adulthood, for both boys and girls. Provision of affordable quality pre-school education will allow children to better prepare for school and reduce pressure on primary schools to meet their learning needs. Issues of school quality should emphasise resource allocations towards the early years including provision of structured pedagogy, reading acquisition skills and remedial education which may help children to learn, progress and complete school on time, while reducing early sexual debut, pregnancy and marriage in the future.

10.7 References

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chapter 11

APPENDIX

11

CHAPTER 11: APPENDIX

This section includes all the appendices referred to in the previous chapters.

APPENDIX: PAPER 1

Table 1: School outcomes associated with moderate/severe stunting at birth (0-4m), early (11-16m) and ate childhood (4-8 years), including age at enrolment as a mediator

Outcomes	Birth (0-4m)					Early childhood (<18m)					Late childhood (4-8yrs)				
	n/N	aOR1	CI	aOR1,3	CI	n/N	aOR1	CI	aOR3	CI	n/N	aOR1,2	CI	aOR1,2,3	CI
Grade Repetition in Std 1 (n=828, 390 f, 438 m)															
None(ref)	49/465	1		1		73/454	1		1		53/453	1		1	
1+ times	31/391	0.63	0.38-1.02	0.67	0.41-1.10	81/376	1.33	0.93-1.89	1.44	1.00-2.07	60/375	1.32	0.88-1.99	1.55	1.02-2.38
Test for heterogeneity	**p=0.06**			**p=0.11**		**p=0.12**			**p=0.05**		**p=0.06**			**p=0.04**	
Age-for-Grade at Age 11 (n=789, 367f, 422m)															
Underage/On time(ref)	28/388	1		1		55/388	1		1		31/388	1		1	
1yr overage	24/239	1.25	0.69-2.25	1.21	0.66-2.20	55/239	1.68	1.10-2.57	1.6	1.04-2.47	39/239	2.21	1.32-3.72	1.92	1.13-3.25
2+yrs overage	24/163	1.77	0.95-3.28	1.55	0.80-2.98	52/163	2.58	1.63-4.10	2.3	1.42-3.72	45/162	4.18	2.44-7.16	2.95	1.68-5.18
Test for heterogeneity	**p=0.20**			**p=0.42**		**p<0.01**			**p=0.001**		**p<0.01**			**p=0.001**	

1. Adjusted for father's education, mother's education, and household asset index at birth; 2. Adjusted for asset index around Age 4 (in late childhood only); 3. Age at Enrolment

APPENDIX: PAPER 3

ANNEX Table 1: The effect of age-for-grade and school dropout by varying levels of overage peer-exposures

GIRLS						
Age for Grade	Peer exposure levels	Dropouts	Person years (1000s)	Rate	Lower CI	Upper CI
Underage/At age/Overage 1 yr	<40%	96	1.34	71.77	58.76	87.67
Overage 2 years	<40%	138	1	137.46	116.33	162.41
Overage 3+yrs	<40%	279	1.55	180.21	160.26	202.65
Underage/At age/Overage 1 yr	40-50%	37	0.62	59.72	43.27	82.43
Overage 2 years	40-50%	56	0.52	108.64	83.6	141.16
Overage 3+yrs	40-50%	129	0.8	160.4	134.98	190.61
Underage/At age/Overage 1 yr	>50%	17	0.36	47.65	29.62	76.66
Overage 2 years	>50%	35	0.4	88	63.18	122.56
Overage 3+yrs	>50%	98	0.51	191.97	157.49	234
BOYS						
Age for Grade	Peer exposure levels	Dropouts	Person years (1000s)	Rate	Lower CI	Upper CI
Underage/At age/Overage 1 yr	<40%	5	0.21	23.37	9.73	56.15
Overage 2 years	<40%	12	0.27	44.19	25.09	77.8
Overage 3+yrs	<40%	117	1.01	115.73	96.55	138.73
Underage/At age/Overage 1 yr	40-50%	4	0.42	9.47	3.55	25.23
Overage 2 years	40-50%	18	0.53	34.27	21.59	54.41
Overage 3+yrs	40-50%	160	1.34	119.47	102.32	139.49
Underage/At age/Overage 1 yr	>50%	14	1.52	9.21	5.46	15.56
Overage 2 years	>50%	37	1.46	25.26	18.3	34.86
Overage 3+yrs	>50%	475	3.99	118.91	108.68	130.1

Appendix- Table 2: Determinants of school completion for 8,113 primary school students between ages 12-24 years, with school dropout as a competing risk

Variables	Girls (n=3,717)							Boys (n=4,396)						
	Completers	Person years (1000s)	Rate /1000py	Crude HR	p	Adj HR¥	CI	Completers	Person years (1000s)	Rate /1000py	Crude HR	p	Adj HR¥	CI
Overall	966	9.8	98.8					1354	13.8	97.8				
Age-for-grade:														
Under/At/Overage 1yr	565	4.0	143.1	1	<0.01	1		501	3.6	137.4	1	<0.01	1	
Overage 2yr	206	2.5	81.3	0.25***		0.27***	0.23 - 0.31	263	3.1	86.1	0.18***		0.16***	0.12 - 0.22
Overage 3+yr	195	3.3	59.3	0.12***		0.13***	0.11 - 0.16	590	7.1	82.6	0.04***		0.04***	0.03 - 0.05
Household effects														
Household wealth Index:														
1 (Poorest)	116	2.1	55.2	0.29***	<0.01	0.46***	0.33 - 0.64	208	3.1	66.5	0.38***	<0.01	0.57***	0.46 - 0.70
2	103	1.4	71.5	0.38***		0.52***	0.38 - 0.71	188	2.3	81.6	0.49***		0.67***	0.53 - 0.85
3	288	2.6	109.5	0.64***		0.78***	0.65 - 0.93	409	3.9	105.8	0.66***		0.86*	0.72 - 1.02
4	165	1.7	95.0	0.56***		0.73***	0.59 - 0.89	226	2.3	96.9	0.64***		0.73***	0.59 - 0.90
5 (Richest)	294	1.9	157.9	1		1		323	2.2	146.2	1		1	
Mother's Education														
None/<PSLE	626	7.1	88.8	1	<0.01	1		882	10.0	88.6	1	<0.01	1	
At least PSLE	340	2.7	124.9	1.51***		1.59***	1.21 - 2.10	472	3.9	121.5	1.42***		1.42***	1.20 - 1.69
Father's Education														
None/<PSLE	339	4.6	73.4	1	<0.01	1		537	7.1	76.0	1	<0.01		
At least PSLE	627	5.2	121.6	1.79***		1.48***	1.35 - 1.63	817	6.8	120.6	1.79***		1.69***	1.51 - 1.89
Household size														
1-5	278	3.0	92.0	1	0.27	1		403	4.2	95.5	1	0.06	1	
6-8	498	5.1	98.5	1.10		1.08	0.87 - 1.33	700	7.1	98.4	1.17**		1.23**	1.03 - 1.46
9+	190	1.7	112.0	1.20		1.30*	0.96 - 1.76	251	2.5	100.4	1.10		1.32*	0.98 - 1.78
No. of children <6yrs in hh														
None	417	4.1	101.2	1	0.17	1		641	6.2	103.1	1	<0.01	0.95	0.82 - 1.09
1	341	3.3	104.9	1.10		1.06	0.90 - 1.23	442	4.3	101.9	1.12**		0.79***	0.67 - 0.94
2+	208	2.4	86.5	0.88		0.83	0.65 - 1.06	271	3.3	82.5	0.88**		1	
Household Head Sex														
Female	234	2.3	103.2	1	0.79	1		339	3.1	109.4	1	0.36	1	
Male	732	7.5	97.5	1.02		1.11	0.84 - 1.47	1015	10.7	94.5	0.95		1.08	0.96 - 1.22
Living w/														
Father only	46	0.6	77.8	0.65***	<0.01	0.53***	0.39 - 0.72	96	1.1	84.9	0.74***	<0.01	0.59***	0.47 - 0.74
mother only	253	2.6	98.7	0.87		0.83	0.66 - 1.05	349	3.5	100.5	0.95		0.74***	0.64 - 0.87
both parents	430	4.2	103.4	1		1		571	6.0	94.6	1		1	
neither parent	237	2.5	96.3	0.86		0.59***	0.43 - 0.82	338	3.2	105.6	0.99		0.67***	0.56 - 0.79
Distance to nearest market														
<=1km	369	3.0	124.9	1.45***	<0.01	1.31	0.88 - 1.96	451	4.0	112.6	1.37***	<0.01	1.31*	1.00 - 1.72
>1km	597	6.8	87.5	1		1		903	9.8	91.8	1		1	

***p<0.01, ** p<0.05, * p<0.1

Variables		Girls (n=3,717)							Boys (n=4,396)						
		Completers	Person years (1000s)	Rate /1000py	Crude HR	p	Adj HR¥	CI	Completers	Person years (1000s)	Rate /1000py	Crude HR	p	Adj HR¥	CI
(continued)															
School Effects															
Distance to School															
	<1km	277	5.4	51.5	0.36***	<0.01	0.33***	0.22 - 0.49	332	7.3	45.7	0.35***	<0.01	0.32***	0.21 - 0.51
	>1km	689	4.4	156.8	1		1		1022	6.6	155.6	1		1	
Distance market-school															
	<1km	417	3.7	114.1	1.24	0.22	1.08	0.84 - 1.40	566	5.1	110.0	1.26	0.14	1.19*	0.97 - 1.47
	>1km	549	6.1	90.0	1		1		788	8.7	90.7	1		1	
Access to water															
	No	99	1.3	77.8	1	0.14	1		172	1.8	95.3	1	0.58	1	
	Yes	867	8.5	102.0	1.32		1.17	0.88 - 1.56	1182	12.0	98.2	1.09		0.98	0.83 - 1.15
Access to electricity															
	No	839	8.4	100.3	1	0.81	1		1165	11.8	98.3	1	0.81	1	
	Yes	127	1.4	90.3	0.96		0.85	0.70 - 1.04	189	2.0	95.0	1.04		0.87	0.73 - 1.03
Student: teacher ratio															
	<60:1	327	3.8	87.1	1	0.32	1		486	5.5	88.7	1	0.19	1	
	60-80:1	341	3.1	111.0	1.16		0.88*	0.76 - 1.02	483	4.2	114.6	1.21*		1.07	0.88 - 1.29
	>80:1	298	2.9	101.2	1.01		0.94	0.73 - 1.21	385	4.1	92.9	0.96		0.95	0.73 - 1.23
Female teacher Ratio															
	<20%	165	2.1	79.3	1	0.19	1		243	2.9	84.1	1	0.08	1	
	20-50%	391	4.0	96.8	1.30		1.12	0.83 - 1.50	608	5.8	103.4	1.29**		1.21	0.88 - 1.68
	>50%	410	3.7	112.1	1.58*		1.36	0.90 - 2.05	503	5.1	99.1	1.30		1.16	0.84 - 1.61
PSLE pass ratio															
	<60%	109	1.3	83.6	1		1		167	1.7	95.6	1		1	
	60-75%	388	3.4	115.4	1.51***	<0.01	1.39**	1.03 - 1.87	468	4.7	99.2	1.15	0.15	1.11	0.85 - 1.44
	>75%	455	4.6	99.1	1.29		1.24	0.91 - 1.69	691	6.6	103.9	1.19		1.23	0.89 - 1.71
	Incomplete schools¶	14	0.5	27.0	0.41*		0.70	0.28 - 1.74	28	0.7	38.6	0.49*		0.90	0.41 - 1.98
Percentage of overage classmates															
	<40%	487	5.7	85.6	1	0.61	1		82	2.4	34.3	1	<0.01	1	
	40-50%	284	2.5	113.7	1.18		1.27	0.91 - 1.77	176	3.0	58.0	1.28		1.67	0.70 - 3.98
	>50%	195	1.6	123.1	1.22		1.42	0.90 - 2.22	1096	8.4	130.3	2.32*		2.44***	1.27 - 4.67

***p<0.01, ** p<0.05, * p<0.1 ¶ Incomplete schools are those that stop before standard 8; ¥Adjusted for individual, household and school effects

APPENDIX: PAPER 5

Table 1: Rates of outcomes by different exposures and potential confounders at landmark age 14 in girls

		Sexual debut		Pregnancy		Marriage	
		n	Rate/100PYAR	n	Rate/100PYAR	n	Rate/100PYAR
Schooling							
	Out < primary	26	60.8 (41.4-89.4)	71	30.8 (24.4-38.9)	60	28.6 (22.2-36.9)
	Out ≥ primary	1	144.5 (20.4-1000)	1	144.5 (20.4-1000)	0	
	In primary	139	13.2 (11.2-15.6)	677	10.1 (9.4-10.9)	616	8.7 (8.0-9.4)
	In > primary	6	8.6 (3.8-19.1)	26	3.8 (2.6-5.6)	17	2.3 (1.4-3.6)
Age for grade							
	At age	28	10.6 (7.3-15.3)	121	5.6 (4.7-6.6)	100	4.3 (3.5-5.2)
	I year over	37	10.8 (7.8-14.9)	177	8.8 (7.6-10.2)	155	7.2 (6.-8.4)
	2 years over	41	16.9 (12.4-22.9)	194	12.0 (10.4-13.8)	179	10.6 (9.2-12.3)
	3+ years over	39	14.2 (10.4-19.4)	211	15.6 (11.8-15.4)	199	11.9 (10.4-13.7)
SES asset score							
	1Poorest	25	16.9 (11.4-25.0)	123	14.4 (12.0-17.1)	115	12.9 (10.7-15.4)
	2	33	17.0 (12.1-23.9)	149	11.1 (9.5-13.1)	121	8.4 (7.0-10.0)
	3	35	22.2 (16.0-31.0)	134	11.7 (9.8-13.8)	123	10.3 (8.7-12.3)
	4	37	14.0 (10.1-19.3)	157	8.8 (7.5-10.3)	145	7.6 (6.4-8.9)
	5 Richest	41	10.2 (7.5-13.9)	187	8.3 (7.2-9.6)	169	7.1 (6.1-8.2)
Living with							
	Father only	10	11.9 (6.4-22.1)	52	12.0 (9.1-15.7)	45	9.4 (7.0-12.6)
	Mother only	53	14.2 (10.8-18.5)	216	10.2 (8.9-11.7)	188	8.4 (7.3-9.7)
	Both parents	53	11.8 (9.0-15.5)	285	8.6 (7.7-9.7)	265	7.7 (6.8-8.7)
	Neither parent	56	21.4 (16.5-27.8)	222	12.7 (11.1-14.5)	195	10.3 (8.9-11.8)
Mother's education							
	None/<primary	115	13.9 (11.6-16.7)	570	10.6 (9.7-11.5)	519	9.2 (8.4-10.0)
	≥ primary	56	16.5 (12.7-21.4)	203	9.2 (8.0-10.5)	174	7.2 (6.2-8.3)
Father's education							
	None/<primary	71	13.8 (11.0-17.5)	378	11.5 (10.4-12.7)	350	10.2 (9.2-11.4)
	≥ primary	100	15.4 (12.7-18.7)	394	9.1 (8.3-10.1)	342	7.4 (6.6-8.2)
Mother alive							
	No	23	25.3 (16.8-38.1)	69	13.0 (10.3-16.5)	58	10.2 (7.9-13.2)
	Yes	149	13.8 (11.8-16.2)	706	10.0 (9.3-10.7)	635	8.5 (7.8-9.2)
Father alive							
	No	35	14.5 (10.4-20.1)	138	9.7 (8.2-11.5)	113	7.4 (6.1-8.9)
	Yes	135	14.6 (12.3-17.3)	634	10.3 (9.5-11.1)	577	8.8 (8.2-9.6)
Sex head household							
	Female	40	14.4 (10.6-19.7)	177	9.7 (8.4-11.3)	158	8.1 (7.0-9.5)
	Male	132	14.8 (12.5-17.6)	598	10.3 (9.5-11.2)	535	8.7 (8.0-9.5)
House hold size							
	1-5	60	17.6 (13.7-22.7)	282	12.2 (10.8-13.7)	246	10.1 (8.9-11.4)
	6-8	83	14.3 (11.5-17.7)	365	9.2 (8.3-10.2)	335	7.9 (7.1-8.8)
	9+	29	11.8 (8.2-16.9)	128	9.7 (8.1-11.5)	112	7.9 (6.6-9.5)
Children < 6 in households							
	0	67	16.0 (12.6-20.3)	319	10.4 (9.3-11.6)	288	9.0 (8.0-10.1)
	1	57	14.6 (11.2-18.9)	260	9.7(8.6-11.0)	220	7.6 (6.7-8.7)
	≥2	48	13.4 (10.1-17.8)	196	10.6 (9.2-12.1)	185	9.3 (8.0-10.7)

(continued)		Sexual debut		Pregnancy		Marriage	
		n	Rate/1000PYR	n	Rate/1000PYR	n	Rate/1000PYR
Age of mother at birth							
	<20	36	18.8 (13.6-26.1)	153	11.8 (10.1-13.9)	130	9.4 (7.9-11.1)
	20-34	99	13.7 (11.2-16.7)	464	9.5 (8.6-10.4)	429	8.3 (7.6-9.1)
	35+	17	10.5 (6.6-17.0)	89	10.6 (8.6-13.1)	73	8.2 (6.5-10.4)
Age of father at birth							
	<25	25	16.4 (11.1-24.3)	135	11.9 (10.1-14.1)	129	11.0 (9.2-13.0)
	25-34	63	15.1 (11.8-19.3)	262	9.5 (8.4-10.7)	245	8.5 (7.5-9.6)
	35+	44	12.0 (8.9-16.1)	228	9.9 (8.7-11.2)	200	8.1 (7.1-9.3)
Firstborn							
	No	94	11.9 (9.7-14.6)	498	9.7 (8.9-10.6)	453	8.4 (7.7-9.2)
	Yes	58	20.3 (15.7-26.3)	208	10.9 (9.5-12.4)	179	8.8 (7.6-10.1)
Dwelling score							
	1Poorest	25	20.1 (13.6-29.7)	79	17.1 (23.7-21.3)	67	13.5 (10.6-17.1)
	2	41	13.6 (10.0-18.5)	133	14.0 (11.8-16.5)	128	12.7 (10.7-15.1)
	3	30	18.3 (12.8-26.1)	81	12.9 (10.3-16.0)	73	10.5 (8.3-13.2)
	4	23	14.2 (9.5-21.4)	67	12.3 (9.7-15.6)	58	9.5 (7.4-12.3)
	5 Richest	25	12.3 (8.3-18.1)	82	9.3 (7.5-11.5)	64	6.4 (5.0-8.2)
Age at school start							
	<6	33	13.0 (9.2-18.2)	170	8.4 (7.2-9.7)	148	6.9 (5.9-8.1)
	6	130	15.6 (13.1-18.5)	543	10.9 (10.0-11.8)	488	9.2 (8.4-10.1)
	7	9	12.0 (6.2-23.1)	55	11.4 (8.8-14.9)	49	9.6 (7.2-12.6)
	8+	0		7	11.9 (5.7-25.0)	8	13.0 (6.5-26.0)

N= number of events; SES=socio-economic status

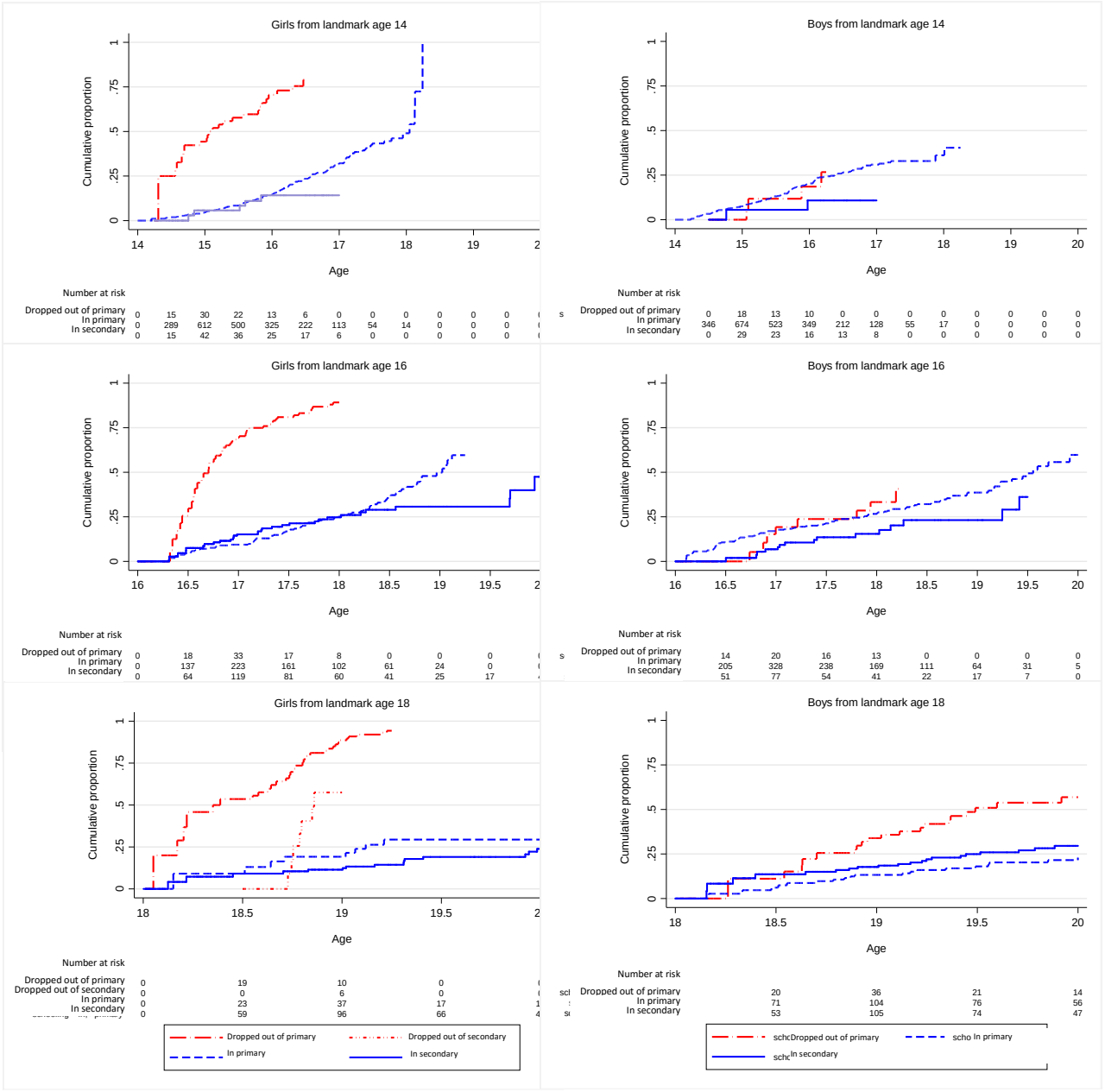

Figure S1: Cumulative proportion ever sexually active, conditional on schooling status at landmark age. By landmark age and sex.

The numbers at risk are shown under each graph. Note different scales on the x-axes.

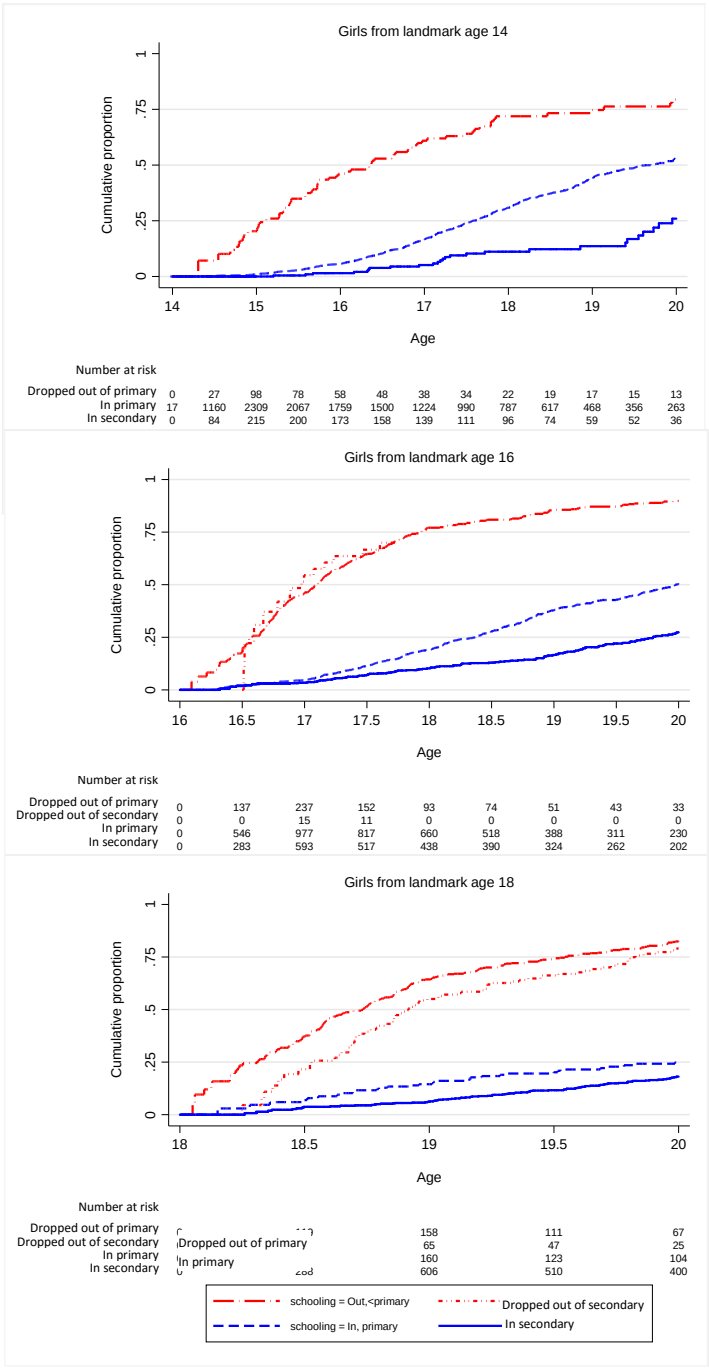

Figure S2: Cumulative proportion ever pregnant, conditional on schooling status at landmark age. By landmark age.

The numbers at risk are shown under each graph. Note different scales on the x-axes.

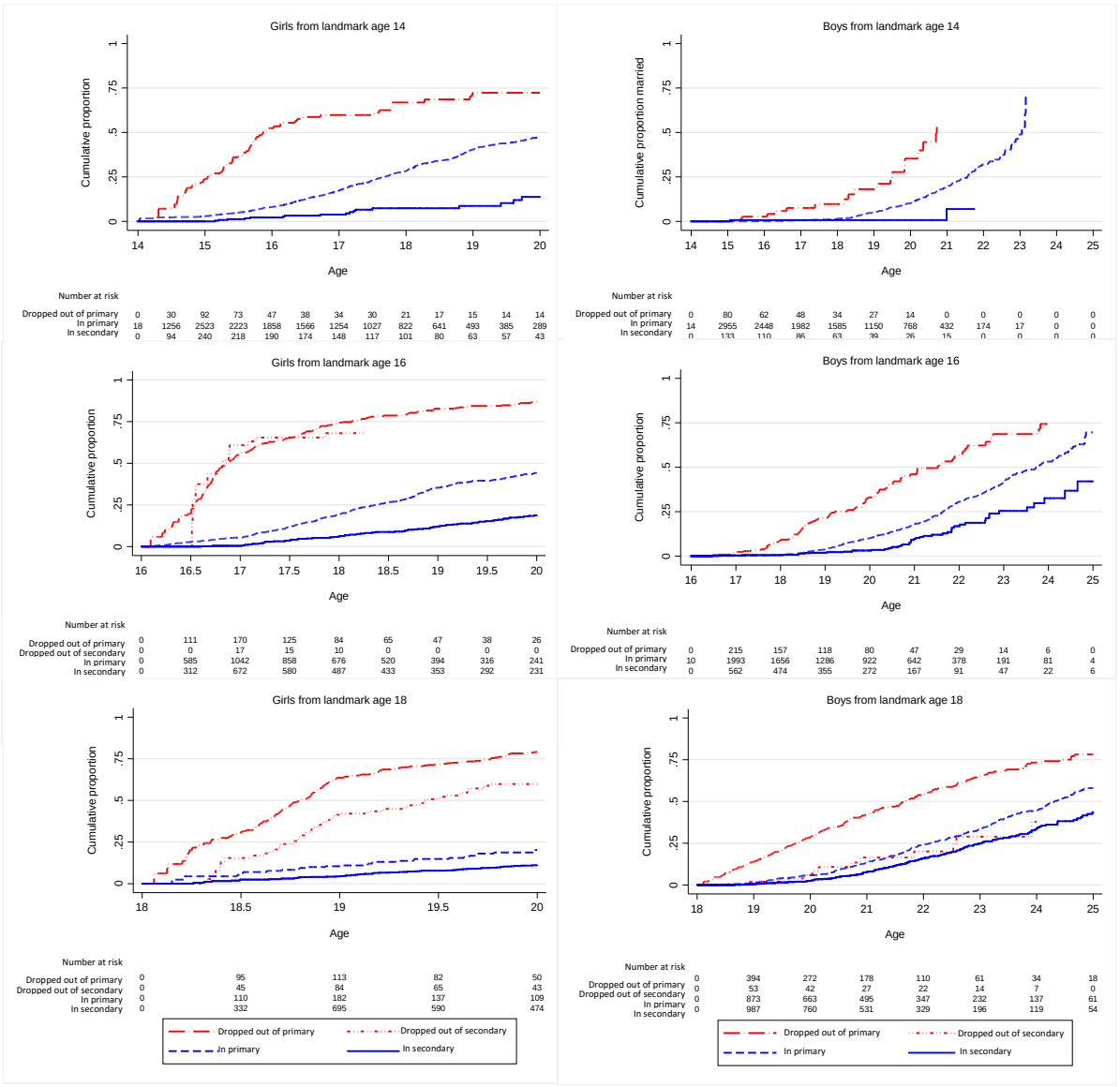

Figure S6: Cumulative proportion ever married, conditional on schooling status at landmark age. By landmark age and sex.

The numbers at risk are shown under each graph. Note different scales on the x-axes.

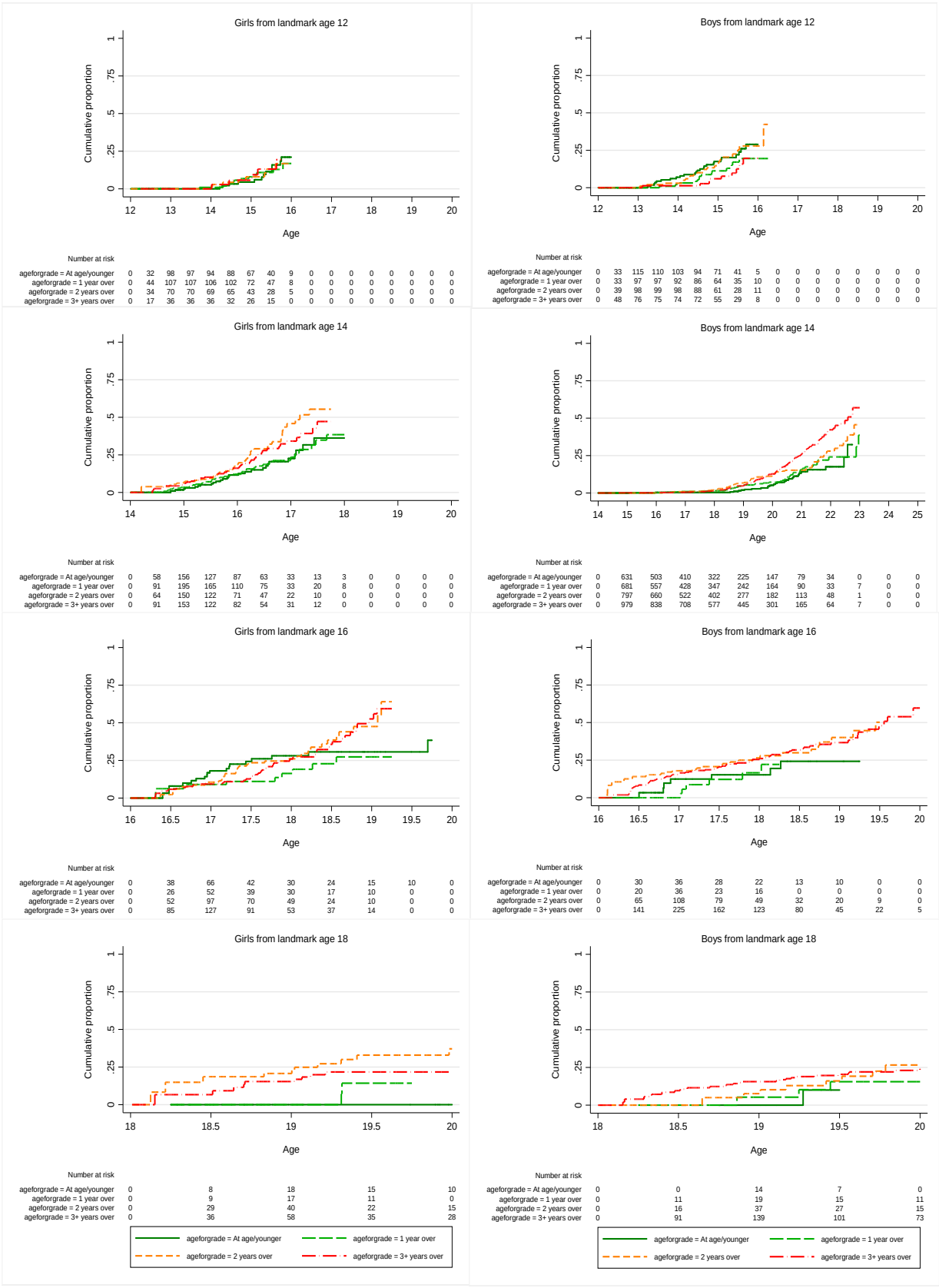

Figure S4: Cumulative proportion ever sexually active, conditional on age-for-grade at landmark age. By landmark age and sex.

The numbers at risk are shown under each graph. Note different scales on the x-axes.

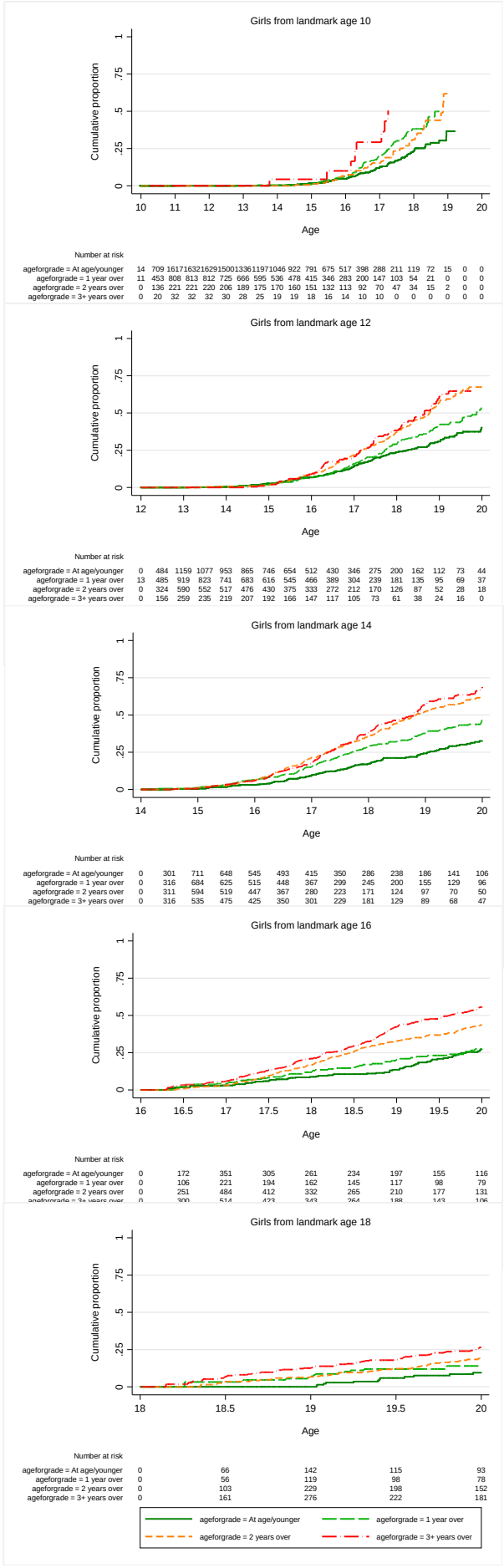

Figure S5: Cumulative proportion ever pregnant, conditional on age-for-grade at landmark age. By landmark age.
The numbers at risk are shown under each graph. Note different scales on the x-axes.

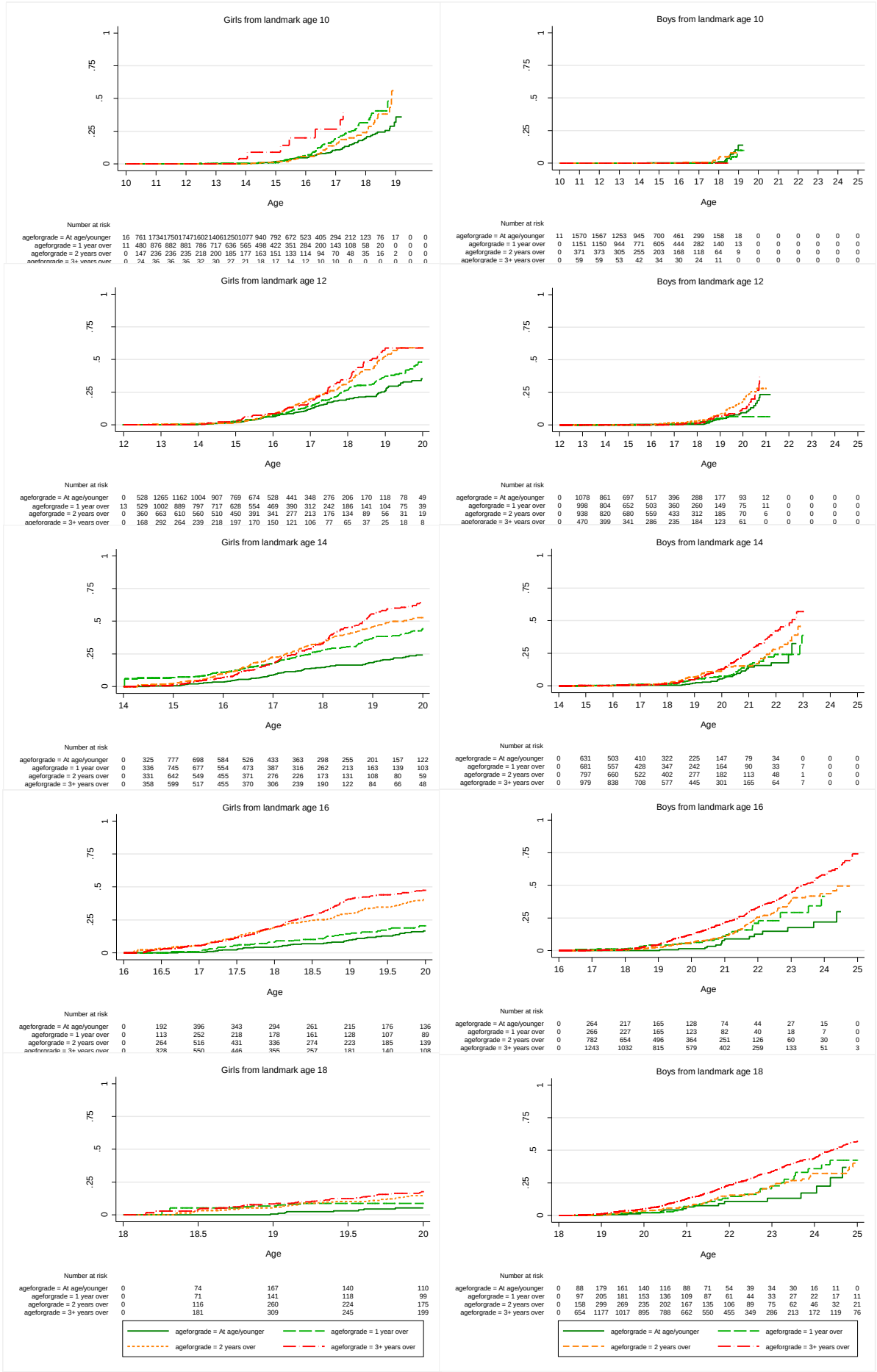

Figure S6: Cumulative proportion ever married, conditional on age-for-grade at landmark age. By landmark age and sex.

The numbers at risk are shown under each graph. Note different scales on the x-axes.

SEI – INDIVIDUAL SOCIO-ECONOMIC SURVEY – KPS

1.	**Round**	**9**	**Interview Date (DD/MM/YYYY)**		

Identity

2.	GHHID				
3.	CRS number			«cn» «mh»	
4.	Subject's name: «nametag»			«identtag»	
5.	Sex	«sex»	Birth date	«birthest»«dobtag»	
6.	**Informant type**	**1** self **2** spouse **3** child **4** grand-child **5** niece/nephew **6** sibling **7** cousin **8** parent **9** aunt/uncle **10** family friend **11** other relative **12** other non-relative **13** step-child **14** step grand-child **15** parent-in-law **16** grandparent **17** stepfather **18** stepmother			
7.	**Name of informant** (If Self, write Self)				
8.	**CRS no. of informant**				

Current household

9.	Relationship to household head	**1** self **2** spouse **3** child **4** grand-child **5** niece/nephew **6** sibling **7** cousin **8** parent **9** aunt/uncle **10** family friend **11** other relative **12** other non-relative **13** step-child **14** step grand-child **15** parent-in-law **16** grandparent **17** stepfather **18** stepmother					
10.	Was subject seen?						1 2 N
11.	When was the subject last here?	**0** today	**1** yesterda	**2** in last 7 days	**3** in last 4 wks	**4** more than 4 wks ago	

Parents survival status and education (ask only of individuals aged ≤30 years old)

12.	Is the subject's father alive?	«FV»	Is the subject's mother alive?	«MV»	
13.	**If no**, what year did he die?	Year died «FY»	**If no**, what year did she die?	Year died «MY»	
14.	How many live or still births did the subject's mother have before the subject?				
15.	Did the subject's father go to school? **What was the** highest level attended?	«FS»	Did the subject's mother go to school? What was the highest level attended?	«MS»	

What is the subject's current marital status (ask only if aged 12+ years old)

NB. Check again with the respondent if they report 'Never married' and there are any pre-printed spouse data overleaf

16.	N never married M married D divorced/septd W widowed If never married skip→ **Q24**		
17.	If ever married (Q15= M or D or W), age at first marriage?	Age__«A1M» or Year_«Y1M»	
18.	How many spouses does the subject have now?		

Spouses

For individuals who are currently married, use Columns 1-4 to contain information on current spouses.
For individuals who are divorced/separated, use Column 1 for the most recently divorced/separated spouse.
For individuals who are widow(er)s, use Column 1 for the spouse who died most recently.
For individuals who are divorced/separated, or widowed, fill Q19 (name), Q20 (NA if widowed), and Q22. Fill Q21 (the spouse CRS number) only if the spouse was previously seen in the CRS in this household.

		Column 1		Column 2		Column 3		Column 4		Column 5	
19.	Name			«SP1»		«SP2»		«SP3»		«SP4»	
20.	Residency in CRS	Y N DK NA		Y N DK		Y N DK		Y N DK		Y N DK	
21.	crsno			«CR1»		«CR2»		«CR3»		«CR4»	
22.	Year marriage start end	Start	End	Start «MST1»	End «MEN1»	Start «MST2»	End «MEN2»	Start «MST3»	End «MEN3»	Start «MST4»	End «MEN4»
23.	ident			«ID1»		«ID2»		«ID3»		«ID4»	

Fill spouse ident in office - use GP form for current spouse if not co-resident and not in CRS area, and attach (tick) ☐

Education and Occupation and Economic activities

24.	Has the subject ever been to school?	«N»«M» «E»«F» «C»«D»			
25.	What is the highest level of education attended?	«P»«Q» «S»«R» «T»«U»		form/standard	«schstd»

For individuals >30 years old, skip → Q40 ***For individuals who have never been to school (Never), skip →Q40***
For individuals who have been to school, but are not currently enrolled in school (Ever) , →Q26
For individuals who are currently enrolled in school, skip → Q27 and then continue with Q28-40

26.	What was the reason for leaving school? (record the two most important reasons, in order of importance) *Do not read out possible answers. Record the reasons given, without "prompting".*				rsn1	rsn2
27.	What is the highest educational qualification acquired?					
28.	Age, or year, first started primary school	«SA» (age)	«SY» (year)	don't know		
29.	Age, or year, left school (Z if still in school)	«LA» (age)	«LY» (year)	don't know	Z	

Now ask Q30- 40 if individual is currently enrolled in school. If not currently enrolled in school, skip →Q40

30.	Name of school				
31.	Did the subject attend school on the last day that school was in session?				Y N
32.	**If no**: What was the main reason for missing school on that day?				rsn
33.	Did the subject attend school during the last 4 weeks that the school was in session?	Y	N >>35		
34.	**If yes**: During the last 4 weeks that the school was in session, how many school days / weeks were missed? ***(now skip → Q36 if 0 days missed or if has not attended school in last 4 weeks)***				
35.	What was the main reason for missing school during the last 4 weeks that the school was in session?				rsn
36.	At any time in the last 12 months, did the subject ever miss >2 weeks of school at one time (consecutive)?				Y N
37.	Has the subject attended your current standard/form before? If yes, how many times (including this year)?	Y N			
38.	**If yes** : Why is the current standard/form being repeated (use codes sheet)				
39.	Did the subject ever leave school for at least 12 months, and later return?				Y N

If yes :	Age first left		Form / Standard when first left: Number of years absent:	P S T _____ (years)	Reason first left	

(blue)

For all subjects aged 5 years or over

40	What is the subject's main occupation? (Specify occupation with a salary or if unsalaried the occupation with most income)	Emp	Occ	emp occ

For individuals aged 5-20

41.	During the last 4 weeks, did the subject participate in any economic activities? For example farming, fishing, gathering natural products, piece work, preparing and selling food or beverages, selling goods manufactured by this household, providing a service?	Y N		hhec
42.	If yes, which ones? (record the two most important activities, in order of importance)	ec1	ec2	ecac ecac

Mobile phone questions for adults aged 15+. If <15 years skip →*Q45*

43	Does the subject have access to a working mobile phone? Yes No If Yes, enter code: , My own Spouse Parent SiBling Relative Visitor Child Other if No skip→ q45	Y	N	Mobile
44	Does the subject have a working mobile phone for their personal use [not used by anyone else]? Yes No If No, enter code; No personal phone, Share phone with others In Household, Share with others Outside Household	Y	N	mobile

TB case finding - all

45	If individual is seen: does the subject have a cough?	Y N	Duration of cough (weeks)			cough couwe
46	Haemoptysis?	Y N	*If cough >2 weeks / haemoptysis / TB suspect on other grounds fill GP form and collect sputum*	tbsuapect Y N		haem tbsus

Pregnancy

47.	If Sex =Female and 12+ years, has the subject ever been pregnant? If N or U skip→ q53	«EP»			Everp
48.	Age at first pregnancy?	Age___«A1P» or Year_«Y1P»			Age1s 1stpr
49.	Is the subject currently pregnant?	Yes No Unk			pregn
50.	Total number of previous pregnancies (*Note total pregnancies can be less than total outcomes if multiple births)*				Totalp
51.	What were outcomes of previous pregnancies (*exclude any current pregnancy – give numbers of each type*	livebirths:	stillbirths:	miscarriages:	Liveb /still /misc
52.	The number of times she had a multiple birth (e.g. twins) 0=never 1= once 2 = twice , etc				numm

NB. If the subject is female, aged over 50, has ever had a live birth and is the informant: fill breast-feeding form

Disability questions (To be asked to individuals who are 18+ years old who are seen)

53.	Does the subject have difficulty seeing, even if wearing glasses? A. None B. Some C. A lot D. Cannot do U. Unk/refused	A	B	C	D	U	Disse
54.	Does the subject have difficulty hearing, even if using a hearing aid? A. None B. Some C. A lot D. Cannot do U. Unk/refused	A	B	C	D	U	Dishe
55.	Does the subject have difficulty walking or climbing steps? A. None B. Some C. A lot D. Cannot do U. Unk/refused	A	B	C	D	U	Disw

56.	Does the subject have difficulty remembering or concentrating? A. None B. Some C. A lot D. Cannot do U. Unk/refused	A B C D U	Disrem
57.	Does the subject have difficulty (with self-care such as) washing all over or dressing? A. None B. Some C. A lot D. Cannot do U. Unk/refused	A B C D U	Discare
58.	Using your usual (customary) language, does the subject have difficulty communicating, for example understanding or being understood? A. None B. Some C. A lot D. Cannot do U. Unk/refused	A B C D U	Discom

Vaccine history (children under 5 years)

59.	**Health passport reviewed?**											Y	N	cardseen
			date			date			date		date	Vaccination HC		
60.	BCG	1.Y 0..N	dd/mm/yy	Polio0	1.Y 0..N		PCV	1.Y 0..N		RV1	1.Y 0..N		bcgdate	p0date
61.	Penta1	1.Y 0..N		Polio	1.Y 0..N		PCV	1.Y 0..N		RV2	1.Y 0..N		dpthh1date p1date	pcv1date rv1date
62.	Penta2	1.Y 0..N		Polio 2	1.Y 0..N		PCV	1.Y 0..N					dpthh2date p2date	pcv2date rv2date
63.	Penta3	1.Y 0..N		Polio 3	1.Y 0..N		PCV	1.Y 0..N					dpthh3date p3date	pcv3date
64.	Measles	1.Y 0..N											measdate	
65.	Measles 2	1.Y 0..N											meas2date	
66.	No of doses Vit A			Record dates of the first two doses vit A					1st			2nd	vitadoses	vitadat1 vitadat2

Stroke. To be asked to individuals 18 years and over

67.	Has the subject ever had weakness down one side of the body?	Y N	bweakness
68.	Has the subject ever had a stroke?	Y N	estroke

Anthropometry. To be taken from all individuals who are seen

69.	Body weight [no shoes]	kg	weight
70.	Body height [no shoes] pre-filled for individuals >=25 years	«HEIGHT» cm	height
71.	Mid-upper arm circumference	cm	muac
72.	Waist circumference for individuals >=11 years	cm	Waisc
73.	Hip circumference for individuals >=11 years	cm	Hipcu

Field staff code		CODR	CHCKR

SEH – HOUSEHOLD SOCIO-ECONOMIC SURVEY – KPS

Version 09 30/05/2017

1.	Round		Start time		Interview date (DD/MM/YYYY)	intdate FU1 starttim
2.	GHHID			Household number		GHHID house
3.	CRS house number					resp cluster hnumno
4.	Name of head of house:				(Ident)	idhdnw

	Livestock owned now	A	B	C	D	E		A	B	C	D	E	
5.	Cattle	0	1-2	3-5	6-9	≥10	Pigs	0	1-2	3-5	6-9	≥10	cattleown pigown
6.	Chickens	0	1-2	3-5	6-9	≥10	Goats	0	1-2	3-5	6-9	≥10	chickown goatown
7.	Ducks and guineafowl	0	1-2	3-5	6-9	≥10	Sheep	0	1-2	3-5	6-9	≥10	duckown sheepown
8.	*For chickens, ducks, guineafowl, and doves – count only if at least 2 months old*						Doves	0	1-2	3-5	6-9	≥10	doveown

Type of construction of best dwelling in household

9.	Ownership of dwelling	O Owned	R Rented	T Other:			rent
10.	Total number of sleeping dwellings and sleeping rooms (dwellings / rooms)	dwellings		rooms			dwelltot roomtot
11.	Walls	1 burnt brick 2 unburnt brick 3 pounded thick mud	4 plastered thin mud 5 bamboo 6 grass or no walls	7 iron sheets 8 concrete blocks 0 other:			walls
11b	Glass windows				Y N		glasswin
12.	Roof	1 grass or leaves	3 grass+iron sheets	6 grass+plastic sheet	7 iron sheets or tiles		roof
13.	Floor	1 mud	2 concrete	3 other	4 tiles		floor
14.	Number of sleeping rooms that have cement floor:						cement
15.	Toilet facilities	0 none	1 simple pit latr	2 VIP	3 Water toilet		lattype
16.	Source of electricity	Escom	Solar	None			electric
17.	Water used for drinking	Tap to hse	Shared comm. tap	Bore hole	Covered well	Open well	Lake/river	water

Sources of income

	How does this household bring in income? (over the last 12 months)? *List activities of all members: 1) tick boxes 2) specify the activity 3) rank by importance*			rank order	
18.					
19.	through regular employment (salary/wage)		Y N		employ
20.	through casual employment / piecework		Y N		piecew
21.	selling own agricultural produce (crops and livestock)		Y N		Farm
22.	selling own fish (locally or with transport?)		Y N		Fish
23.	Preparing & selling food or beverages		Y N		snacks
24.	selling own manufactured goods		Y N		manuf
25.	buying & selling other peoples product		Y N		trade
26.	Gathering natural products (grass, wood,...)		Y N		gather
27.	letting of property/ land/ houses/ oxcarts		Y N		letting
28.	providing a service		Y N		service
29.	from outside relatives		Y N		supportf
30.	from outside organisation or non-relative		Y N		supporto
31.	Unclassifiable		Y N		othinc

Possessions. Does anyone in the household possess the following? (this is to know about living standards)

32.	working watch or clock	Y N		Mattress	Y N		watchclock mattress
33.	working radio	Y N		Bed	Y N		radio bed
34.	bank account (or bank book)	Y N		Bicycle	Y N		bankbook bike
35.	charcoal iron	Y N		Canoe	Y N		ciron canoe
36.	working sewing machine	Y N		Oxcart	Y N		sewing oxcart
37.	Mobile phone	Y N		Motorbike	Y N		Phone motorbike
38.	mosquito net (number)	Y N	Number	Car	Y N		mosnetyn mosnetnum car
39.	**Does anyone in the household possess something that requires electricity?** **If yes, any of the following? C** Tape/CD player **E** Fan **I** Electric Iron **T** TV **F** Fridge **O** Other **(Circle for each item owned by the household. Only count if working)**				Y N		elecitem tape fan eiron tv fridge eother

Food and nutrition security, and availability of soap for bathing

40.	Since this time last year, has there been a time when there was not enough food for the household to have its normal meals? (fewer meals per day, and/or smaller meals, and/or less variety of foods)		Y N	foodenough
41.	Have there been times when the household did not have money to buy bathing soap?	Last 4 wks Y N	Last 12 mths Y N	soap4wk soap12mon
42.	End time	Field - staff code	Coder / L1 checker	rcdr codr chkr

ABS1 SHORT – ADULT BEHAVIOUR SURVEY FORM – WOMEN – KPS

ENGLISH

(WOMEN AGED 15-59 YEARS)

V8(03/05/11) — Version

1a	Interview date (DD/MM/YYYY)		1b	Study id	Yellow — intdate stid
1c	Round		1d	Contact no.	Orange — rd cno

MARRIAGE

2	Are you currently married or living with a man as if married?	Y → Q4 N — Curmar
3	Have you ever been married? IF NO, Have you ever lived with a man as though married?	Y N — Evermar Y N → Q17 — evercoheb
4	How old were you when you first got married, or lived with a man like you were married?	Agefirstmar
5	How many husbands have you had in total, in your whole life? (including current husband) Think of all husbands you ever had, even if you lived together for a short time, or even if they went home or died.	Nummar
6	How many of your marriages have ended over the last 12 months? (00 if none) **If 00 Skip to Q9**	Endymar

SEXUAL RELATIONSHIP WITH EX-HUSBAND / HUSBAND OVER THE LAST 12 MONTHS

Complete for marriages that have ended during the 12 months prior to the survey (Q6>0) -

	Marriages that ended most recently first (XX if not known) Initials	1 most recently divorced /deceased ex-husband (S2)	2 ex-husband divorced /deceased before that (S3)	
7	Have you had sex with him in the past 12 months?	Y N	Y N	Sexdshyr
8	When was the LAST TIME you had sex with him?	D W M ago	D W M ago	Lastsexcat Lastsexnum
		If another, fill in Column 2	If another, fill in cont form (tick)	

CURRENT MARRIAGE (Complete this section only if currently married)

If Q2 = Y: **Now I am going to ask you questions about your current husband ...** If Q2 = N, **then skip to Q17.**

		s1	Sno
	(XX if not known) Initials:	1 current husband	
9	a. When did you marry?(MM/YYYY)		Determarmth determaryr
	b. How old were you when you married him?		Agemar
10a	How did you get married? (Circle ONE) "Eloped": 1=Both agreed 2=Parents 3=Woman 4=Man P Sent while pregnant C Church / traditional S He came to my house I Inherited O Other (specify):	1 2 3 4 P C S I O	Howmar
10b	Has your husband paid bride wealth?	N No P Partial F Full	bridewealth
11	Did he have any other wives at the time you got married? How many?	Y N — Number:	Poly1mar Poly1marnum
12	Did he marry any other wives during your marriage? How many?	Y N — Number	Poly2mar Poly2marnum
13	How old is he now or what year was he born? OR	(age) (year)	Agespmar Yearspmar
	Is he older / younger than you? *(Interviewer: Do not ask this part of the question if respondent knows exact age or year of birth)*	Same Older Younger By: L < 5 Years B 5-10 Years M >10 Years	Agespmarrel Agespmardiff
14	Where does he usually live? S Same crshse V Same village C Same Compound K Elsewhere in Karonga (specify village) E Outside Karonga U Unknown	S C V K E U K: _____ Village Code:	Ressprmar Villspmar
15	Have you had sex with him in the past 12 months?	Y N	Sexdshyr
16	When was the LAST TIME you had sex with him?	D W M ago	Lastsexcat Lastsexnum

SEXUAL HISTORY: Now I would like to ask you questions about your sexual activity. I know you may feel embarrassed about discussing this, but let me assure you that everything you tell us will be kept strictly confidential.

17	Have you ever had sexual intercourse? Think carefully. This includes a spouse. Maybe it was a man you had sex with only once, maybe it was with someone who was just a friend, with someone you had just met. Even someone who you didn't want to have sex with or who may have forced you to have sex, or someone who gave you gifts/money in order to have sex.	Y N→ Q27
18a	How old were you when you first had sexual intercourse?	
18b	Was that before you started menstruating?	
18c	Were you still attending school when you first had sexual intercourse?	Y N Can't remember

Now I will ask you about the total number of men you have had sex with in your lifetime, including those you married or didn't. Please include men whom you have had sex only once or those who forced you to have sex with.

19a	You have told me that you have (X) husbands? Is that right? *Record the corrected number (00 if none)*	
19b	How many ***other*** men have you had sex with in your life?	
	Interviewer: If participant is unsure: Is it probably (read out)…	L <5 B 5-10 M >10 Refused to answer Unknown
19c	So in total, you have had sex with XX men. Is that right? (→ Q22 if partnum==1) ***Interviewer to total 19a and 19b, check with participant and record total number*** ***Interviewer: If participant is unsure:*** **Is it probably (read out)…**	L <5 B 5-10 M >10 Refused to answer Unknown
20	How old were you when you had sex with the **SECOND** person you ever had sex with? (Record X if NO second sex partner)	
21	How long was this after you first had sex?	____Days____Wks___Months____Years
	Interviewer: If participant is unsure: Is it probably (read out)…	S < 1yr M 1-5 yr L 5-10 yr V >10 yr
22a	How many men have you had sex with during the last 12 months, in total (including current spouse)?	
22b	Have you had sex in the last month?	Y N

SEX IN THE PAST 12 MONTHS WITH MEN SHE HAS NEVER MARRIED: Now I will ask about men you have had sexual intercourse with in the last 12 months, apart from your husband(s). Think carefully. It can include boyfriends, men you had sex with once, men who gave you money or gifts for sex, or men you did not want to have sex with or who forced you to have sex.

23	How many men [apart from husbands] have you had sex with in the past twelve months?			L <5 B 5-10 M >10
		x1	x2	x3
	Most recent man had sex with first (XX if not known) Initials:	**1 Most recent man** — —	**2 Most recent man** — —	**3 Most recent man** — —
24	Is the sexual relationship still going on?	Y N Unknown	Y N Unknown	Y N Unknown
25	When was the FIRST TIME you had sex with him?	D W M Y ago	D W M Y ago	D W M Y ago
26	When was the LAST TIME you had sex with him?	D W M ago	D W M ago	D W M ago
		If another, fill in Column 2	If another, fill in Column 3	If another, fill in cont form (tick)

FERTILITY HISTORY

27	Have you started your monthly period? If YES, How old were you when you started your monthly period?	Y N →29a
28a	Were you still attending school at the age when your monthly period started?	Y N Can't remember
28b	When was your last monthly period? **1**. Less than a month ago **2**. 1-2 months ago **3**. 2-3 months ago **4** more than 4 months ago. **5** Not returned since last birth	1 2 3 4 5
29a	Have you ever been pregnant? (This includes pregnancies that do not go to term) If YES, How old were you at the time of your first pregnancy? (YYYY)	Y N →Q42 Age_____ Year_____
29b	Were you attending school at the age when you first got pregnant?	Y N
30	Did this pregnancy end in a live birth? Y Yes N No C Current 1st pregnancy	Y N C

31a	How many children have you had in total (including those who later died)?	☐ If=0→Q38	totalchi
31b	When was your last child born? DD/MM/YYYY	...../...../.....	deterbi
32	Is this child still alive?	Y N	chialive
33	Was this child one of a multiple birth? IF MULTIPLE BIRTH is one or both/all of these children still alive?	Y N Y N	multiple multialive

	Check Q2	Currently Married	Currently Unmarried	
34	At the time you were pregnant with this child were you married to your current husband?	Y N		Marlast
35	Is your current husband the father of this child?	Y N		Husfa
36	After the last birth, did you have any miscarriages? If YES, when was the last one? MM/YYYY	Y N→ Q38 -------/-------		termis termmm termyear
37	Is your current husband the father of the child you miscarried?	Y N		Husmis
38	Are you currently pregnant? If YES, how many months gestation? M	Y N→40 Unsure ☐		pregnant mmgest
39	If YES, is your current husband the father of the child you are carrying?	Y N		Huspre

GO TO Q40 IF PREGNANT OR HAD A CHILD IN THE LAST 12 MONTHS
GO TO Q42 IF NOT PREGNANT AND NO CHILD IN THE LAST 12 MONTHS

	RETROSPECTIVE – (Complete for women who are CURRENTLY PREGNANT *Q38=Y* AND/OR HAD A CHILD IN THE LAST12 Months) Ex: today date is the 20th of November 2010. If she had a child in October 2009 we DO NOT ask this question, if she had it in November 2009 we DO.		
40	In the month that you became pregnant with your last child (born in the last 3 years) or in your current pregnancy were you using a method of contraception? If YES, Which method were you mainly using? **1.** Injections **2.** Pill **3.** Condom **4.** Norplant 5. LOOP (IUD) **6.** Other modern methods **7.** Withdrawn 8. Traditional methods	Y N 1 2 3 4 5 6 7	contrmeth
41	At the time you become pregnant with your last child (born in the last 3 years) or in the current pregnancy, did you 1. Want to become pregnant 2. Want to wait until later 3. Want no (more) children at all?	1 2 3	Wantpre
	(COMPLETE FOR ALL WOMEN 15-49)		
42	Are you currently using any method to avoid getting pregnant? If YES, which main method are you currently using?(2 options apply if 1st Answer is CONDOM) **1.** Injections **2.** Pill **3.** Condom **4.** Norplant **5.** LOOP (IUD) **6.** Close of the tube "BTL". **7.** Other modern methods **8.** Withdrawn 9. Traditional methods	Y N 1 2 3 4 5 6 7 8	Avoidpre Cumeth 1 Cumeth 2
	PROSPECTIVE - (Complete if NOT currently pregnant)	Currently Married / Currently Unmarried	
43	Do you want to have any (more) children any time in the future?	Y N→ Q45 U→ Q45	Anymo
44	If YES, How long would you like to wait before having another child? **1.** Within this year **2.** 1-2 yrs **3.** 2 -3 yrs **4.** 3+ yrs **Unsure**	1→ Q46 2 3 4 U	Waitano
45	What are your reasons for wanting no more children/unsure OR wanting to wait? **(2 options allowed)** **1.** Financial reasons **2.** Woman's health **3.** Children's health **4.** HIV positive/ Unsure HIV status **5.** Own education **6.** Children's education **7.** Child Spacing **8.** Husband away **9.** Marital stability/instability **10.** DK	1 2 3 4 5 6 7 8 9 10	Prorea1 Prorea2
46	Does your husband want any (more) children? **If YES, how long would he like to wait?** **1.** Within this year **2.** 1-2 yrs **3.** 2 -3 yrs **4.** 3+ yrs **5.** Husband not sure **6.** Respondent DK	Y N 1 2 3 4 5 6	Dischus Huswait

END: Thank you for answering these questions. Your answers will be kept secret, and your name will not be kept with them.

Field-Staff code ☐ **Coder/Checker** ☐☐