

# Impact of the DREAMS Partnership on social support and general self-efficacy among adolescent girls and young women: causal analysis of population-based cohorts in Kenya and South Africa

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## ABSTRACT

**Introduction** The Determined, Resilient, Empowered, AIDS-free, Mentored and Safe (DREAMS) Partnership aimed to influence psychosocial processes that promote empowerment among adolescent girls and young women (AGYW), and reduce HIV incidence. We estimated the impact of DREAMS on aspects of AGYW's collective and individual agency (specifically, social support and self-efficacy), in three settings where DREAMS was implemented from 2016 until at least end 2018.

**Methods** Research cohorts of ~1500 AGYW aged 13–22 were randomly selected from demographic platforms in Kenya (Nairobi; Gem) and South Africa (uMkhanyakude) and followed up from 2017 to 2019. Social support was based on questions about female networks and access to safe places to meet with peers; general self-efficacy was measured using a scale previously validated in other settings. We conducted multivariable logistic regression, and estimated the causal effect of invitation to DREAMS on each outcome in 2018 and 2019 by comparing counter-factual scenarios in which all, vs no, AGYW were DREAMS invitees.

**Results** In Nairobi, Gem and uMkhanyakude, respectively, 74%, 57% and 53% were invited to DREAMS by 2018. Social support was higher among DREAMS invitees versus non-invitees (eg, adjusted OR 2.0 (95% CI 1.6 to 2.6), Gem, 2018). In 2018, DREAMS increased social support in all settings and age groups, for example, from 28% if none were DREAMS invitees to 43% if all were invitees (+15% (95% CI 10% to 20%)) in Gem. Effects were strongest in Kenya, but weakened in 2019, particularly among older AGYW. In uMkhanyakude, DREAMS invitees had greater self-efficacy compared with non-invitees in 2018 (+9% (95% CI 3% to 13%), 2018) but less so in 2019. In Kenyan settings, there was weak evidence for impact

## Key questions

### What is already known?

- Determined, Resilient, Empowered, AIDS-free, Mentored and Safe (DREAMS) is a multicomponent intervention that seeks to address the underlying causes of vulnerability to HIV infection, including by empowering adolescent girls and young women (AGYW).
- In theoretical frameworks developed to conceptualise women's empowerment, there are three closely related dimensions: resources, agency and achievements. Agency is the ability to make and act on choices, it is enabled by access to resources, and achievements are the outcomes of people's choices and efforts. In the process of empowerment, changes in one dimension can lead to changes in others.
- Agency may be enacted individually or collectively, and is likely to be facilitated by high self-efficacy as well as resources in the form of social support and social connectedness.
- There is some evidence that interventions have the potential to improve adolescents' agency, although evidence from complex interventions implemented in 'real-world' settings is lacking.

on self-efficacy among younger AGYW in Gem (+6% (95% CI 0% to 13%)) and older AGYW in Nairobi (+9% (95% CI –3% to +20%)) in 2019.

**Conclusions** DREAMS impacted on social support and, less consistently, on self-efficacy. Weakening effects over time may reflect changes in access to safe spaces and social networks as AGYW age and change circumstances, and withdrawal of DREAMS from uMkhanyakude in 2018, highlighting the importance of programme sustainability and improving programming for older participants.

## key questions

**What are the new findings?**

- ▶ DREAMS increased social support among AGYW across diverse rural and urban settings in southern and eastern Africa, after 2–3 years of implementation.
- ▶ There was some impact of DREAMS on self-efficacy in the same time frame, with evidence of a positive impact in rural KwaZulu-Natal, South Africa and among younger AGYW in rural Kenya and older AGYW in Nairobi.

**What do the new findings imply?**

- ▶ Our findings support sustaining and expanding DREAMS, including safe spaces and mentoring, and suggest that holistic, multicomponent interventions can be implemented to improve aspects of AGYW's empowerment.
- ▶ Enhancements to programming are needed for older AGYW, while increased engagement with communities is needed to ensure sustainability and adaptation to context.

**BACKGROUND**

Despite significant advances in HIV prevention, adolescent girls and young women (AGYW) aged 15–24 years are at considerably greater risk of HIV than their male peers throughout sub-Saharan Africa, accounting for one in four of all new HIV infections in the region in 2019.<sup>1</sup> This is due, in part, to social and structural factors<sup>1,2</sup> that perpetuate gender inequities and stifle the health and empowerment of young women. These social and structural factors include fewer years of schooling than male peers, food insecurity, engagement in ‘transactional’ sex for gifts or money, disparity in age with older male sexual partners, early marriage and gender-based violence.<sup>2,3</sup>

Women's empowerment has been defined by Kabeer as ‘the processes by which those who have been denied the ability to make strategic life choices acquire such an ability’.<sup>4</sup> Life choices include years of schooling, marriage, number of children, livelihoods, friends and networks, as well as choice around HIV prevention options including safer sex practices (eg, condom use, refusal of unwanted sex, pre-exposure prophylaxis).<sup>4–6</sup> In this conceptual framing of empowerment, there are three dimensions and changes in one can lead to changes in others.<sup>4,7</sup> A central dimension is agency, which describes ‘the ability to define one's goals and act on them’ and may be exercised through reflection, decision making and negotiation.<sup>4,7</sup> Women can exercise agency as individuals, and collectively with other women through formal and informal networks.<sup>4,6,7</sup> A second dimension is resources, access to which can influence or determine what choices are made as well as how effectively they can be acted upon.<sup>4,7</sup> The third dimension is achievements, which are the outcomes of people's choices and also their efforts.<sup>4,7</sup>

Self-efficacy is described as a core property of human agency in social-cognitive theory,<sup>8,9</sup> with one definition being ‘an optimistic sense of personal competence...

accounting for motivation and accomplishments’.<sup>10</sup> Individuals with high self-efficacy are thought to remain resilient in the face of adversity,<sup>8</sup> to be able to initiate coping behaviour when needed,<sup>11,12</sup> and to have belief in their ability to accomplish tasks, though this resilience and belief may not be sufficient to achieve a defined goal; the achievements that are possible may be limited by socio-structural factors, including societal norms and control exerted by partners and/or family members.<sup>4,6,7,13</sup> The utility of measuring general self-efficacy, capturing a broad sense of personal competence, is widely acknowledged, though it can also be defined in relation to specific situations or domains, for example, condom use.<sup>10,11,14–16</sup>

In Kabeer's framework, women's empowerment is facilitated by, and may require, collective agency and solidarity.<sup>4,7</sup> This is particularly the case in contexts where cultural norms may constrain women's decision making and their ability to make their own life choices. For example, by standing together through mutual support and social networks, women may strengthen their voice, and gain greater control over their decisions and life choices.<sup>4,6,7</sup> Social support, including social connectedness, is therefore an important element in increasing empowerment of AGYW.<sup>17</sup> It can also be seen as a resource on which women may draw when making and acting on choices individually.

Together, self-efficacy, social support and social connectedness contribute to different dimensions of empowerment: ‘power within’ that drives individuals' sense of agency and self-esteem, ‘power with’ other women that facilitates both individual and collective agency, and in combination the ‘power to’ make and act on decisions.<sup>4,6,7</sup>

The DREAMS (Determined, Resilient, Empowered, AIDS-free, Mentored and Safe) Partnership aims to reduce HIV incidence among AGYW through a holistic approach that addresses the complex underlying causes of vulnerability to HIV infection.<sup>18</sup> The ‘core package’ includes evidence-based interventions that aim to enhance AGYW's individual agency to access HIV prevention and sexual and reproductive health services.<sup>19</sup> DREAMS also includes interventions to improve the social context in which AGYW live, for example, strengthening families of AGYW economically, enhancing parent-adolescent relationships, and mobilising communities, to elicit norms change. A fundamental component of the core package is social asset building, to strengthen both the individual and collective agency of AGYW (online supplemental file 1). Social asset building approaches enhance social networks of AGYW with female peers and mentors, through meetings in ‘safe spaces’, aiming to increase emotional and material support, resilience and self-esteem.<sup>19</sup> Safe spaces typically refer to private, girl-only spaces established in, for example, community and church halls or schools, where AGYW can receive support and curriculum-based programmes, and be linked to other services. In a theory of change guiding analyses of DREAMS' impact, these approaches are hypothesised

to increase the agency of AGYW, and through this, contribute to reducing their vulnerability to HIV.<sup>19</sup>

While there is some evidence that interventions can increase adolescents' agency, self-efficacy or social support, most previously reported studies were done under trial conditions, in specific settings such as schools and in high-income settings.<sup>3 20–36</sup> For example, a career development curriculum for adolescent girls in high schools in the UA, including activities around self-awareness, decision making and gender identity, was reported to increase perceptions of social support and self-efficacy among other social cognitive and self-determination outcomes.<sup>24</sup> In contrast, DREAMS was a complex intervention delivered at individual, family and community level, and in a 'real-world' context.

Here, we evaluate the impact of the combined DREAMS core package on social support and self-efficacy among population-based cohorts of AGYW in Kenya and South Africa, after 3 years of intervention delivery. We also sought to describe background levels of aspirations and expectations around important life milestones such as education and employment, to provide context to our findings.

## METHODS

### Research settings

The research was carried out in three diverse settings, each capitalising on long-standing demographic surveillance platforms: in Kenya, the Nairobi Urban Health and Demographic Surveillance System (HDSS), established in 2002 in two informal settlements, and the Kenya Medical Research Institute/Centers for Disease Control and Prevention HDSS, established in 2001 in Gem, rural Siaya County; in South Africa, the Africa Health Research Institute HDSS, established in 1998 in rural, KwaZulu-Natal.<sup>37–39</sup> The settings are characterised by a large youth population, and have historically high HIV prevalence and incidence.<sup>40–44</sup>

### DREAMS implementation context

Kenya and South Africa were identified by the US President's Emergency Plan for AIDS Relief (PEPFAR) as priority countries for the implementation of DREAMS.<sup>18</sup> Interventions were rolled out by DREAMS implementers from early 2016 in each country.<sup>45</sup> Funding for DREAMS was stopped in uMkhanyakude in late 2018<sup>46</sup> (because it was not among districts identified as 'high-priority' in the PEPFAR country operational plan) and continued in Kenya through 2019–2021. Models of delivery and ways of reaching AGYW in need varied by setting, described in detail previously.<sup>45</sup> In South Africa, uMkhanyakude was selected following a geographical mapping exercise to identify DREAMS districts. AGYW were selected for DREAMS interventions by community-based organisations, from among the vulnerable children and families they worked with, and also through schools and social workers.<sup>45 46</sup> In Kenyan settings, AGYW were invited to

participate in DREAMS based on their risk characteristics such as being pregnant, or out-of-school or socio-economically vulnerable, and were identified using the Girl Roster census method.<sup>45 47</sup> The Girl Roster method enables rapid segmentation of AGYW into risk profile groups including those considered at particularly high risk, using a tool that collects information on age, marital status, childbearing, schooling and living arrangements. AGYW identified as vulnerable were invited to participate in DREAMS by implementing partners through door-to-door home visits followed by enrolment interviews.

### Evaluation study design and procedures

As part of an independent evaluation of the impact of DREAMS, described in detail previously,<sup>48</sup> age-stratified, prospective, observational cohort studies of AGYW were conducted. AGYW aged 13–17 years (15–17 in Nairobi) and 18–22 years, residing in the HDSS area for each setting, were eligible and randomly selected for research cohort inclusion (therefore, capturing a random sample of those who had and had not been invited by implementing partners to participate in DREAMS interventions). Cohorts were enrolled in 2017 in Nairobi and uMkhanyakude, and 2018 in Gem, with annual follow-up until 2019; three rounds of data collection in total in Nairobi and uMkhanyakude and two rounds in Gem. At each round, participants were interviewed by trained data collectors to collect information on topics including sociodemographic and socioeconomic circumstances, sexual and pregnancy history, invitation to participate in DREAMS, self-efficacy beliefs and access to social support.

### Exposure measure

Our primary exposure measure was defined using self-reported data on invitation to participate in DREAMS (yes or no) that were collected using the research cohort study interview tool in all rounds of data collection. From this, we generated a binary variable that distinguished AGYW who were invited to DREAMS by 2018 from those who were not. Those invited to DREAMS by 2018 were considered DREAMS 'beneficiaries'. 'Non-beneficiaries'—those not invited by 2018—represent those who were not targeted or invited by implementing partners to participate in DREAMS interventions.

### Outcome measures

A binary, composite variable summarising social support, including social connectedness, was created using four questions on female networks and access to safe social spaces to meet<sup>47 49</sup> (online supplemental file 2). A high level of social support was defined as a 'yes' response to three or more of the four questions, vs lower levels defined as 'yes' to between 0 and 2 questions. These decisions were guided by descriptive analyses for each setting that included the distribution of the number of 'yes' responses, overall and within age group strata and cross-tabulation of all pairs of component questions.

Ten questions comprising a general self-efficacy scale were used to create a binary self-efficacy outcome variable, measuring an overall coping ability, and competence to solve problems and meet goals<sup>14</sup> (online supplemental file 3). The scale has been validated and used in numerous settings internationally.<sup>10 50</sup> Responses to each scale question ranged from 1 (not at all true) to 4 (exactly true), with 'not sure' responses coded as zero (Nairobi only).<sup>10</sup> Scores were summed across the 10 scale questions and an overall mean score calculated for each individual. Distributions were summarised and histograms plotted for visual inspection separately for each setting, overall, by age group, and by invitation to DREAMS. A cut-off value of  $\geq 3.5$ , was used to define higher self-efficacy, with mean scores  $< 3.5$  indicating lower self-efficacy. This cut-off was selected as it lay, conceptually, between moderately and exactly true (scores of 3 and 4), was consistent with the literature,<sup>51 52</sup> and was considered achievable, that is, a sizeable proportion of AGYW would fall into the higher self-efficacy category.

Questions on aspirations (phrased as 'how important are the following things to you?') and expectations ('what are the chances that you will...?') covered important life milestones such as education, employment, marriage and having children.

### Confounding factors

We constructed directed acyclic graphs (DAGs) using DAGitty<sup>53 54</sup> to conceptualise and represent underlying causal structures, and identify a minimum set of confounders of the association between DREAMS exposure and each outcome, for inclusion in our statistical models. Factors potentially associated with the exposure and/or outcome were included in the DAGs based on local knowledge and related literature.

Confounding factors identified were measured at enrolment and included age group, geographic area or subsite, religion, ethnic group, educational attainment, currently attending school, socioeconomic status (wealth index), food insecurity, self-assessed household poverty, migration, sexual and pregnancy history, violence and orphanhood.

### Statistical analysis

Proportions reporting social support and self-efficacy in 2018 and 2019 were summarised overall, by age group, and by invitation to participate in DREAMS, separately for each setting. Results in 2018 were analysed among AGYW followed up in 2018, while results in 2019 were analysed among those followed up in 2019. Aspirations and expectations were also summarised by age group and invitation to DREAMS, for context.

We summarised associations between each characteristic at enrolment in 2017, guided by the minimal confounding set identified in the DAG, and invitation to DREAMS by 2018. We then conducted univariable logistic regression analyses for the association between each characteristic and the outcome. After adjusting

for age and (for Nairobi and uMkhanyakude) area of residence a priori, we conducted multivariable logistic regression analyses of the effect of DREAMS invitation on social support/self-efficacy, adjusting for all characteristics in the minimum confounding set for each setting and outcome, plus those that were strong predictors of the outcome or considered potentially important in a particular context a priori (eg, migration for uMkhanyakude). Analyses were done overall, and separately for younger AGYW aged 13/15–17 years at cohort enrolment and older AGYW aged 18–22 years.

Next, using a causal inference framework, we estimated the causal effect of DREAMS on social support and self-efficacy by comparing the two counter-factual scenarios in which all, vs no, AGYW were DREAMS beneficiaries. Our primary analysis used propensity-score regression adjustment. The propensity score (PS)—the probability of being a DREAMS beneficiary given a set of characteristics—was predicted using a logistic regression model in which invitation to DREAMS by 2018 (yes/no) was specified as the 'outcome', and explanatory variables were confounders identified in the DAGs plus independent predictors of social support/self-efficacy. We then fitted a logistic regression model to predict the probability of social support/self-efficacy, restricted to AGYW who were DREAMS beneficiaries; age group and the PS were explanatory variables. From this model we predicted the probability of the outcome for *all* AGYW, irrespective of whether they were DREAMS beneficiaries. The average value of these probabilities was used to estimate the percentage of AGYW with the outcome under the counterfactual scenario that all AGYW were DREAMS beneficiaries. We repeated this approach for AGYW who were not DREAMS beneficiaries, to estimate the percentage of AGYW with the outcome under the counterfactual scenario that no AGYW were DREAMS beneficiaries. We present these average predictions overall, and separately for older and younger AGYW.

Sensitivity analyses were also done to check consistency of findings across different methodological approaches to control for confounding within the same framework (PS-stratification; PS-inverse-probability-of-treatment weighting; and using a multivariable logistic regression model of the outcome variable on the explanatory variables that were included in the PS model). We used bootstrapping on 1000 samples drawn with replacement to obtain confidence intervals for our predicted percentages with the outcome, and for the difference in the percentages between the two counterfactual scenarios for an absolute difference attributable to DREAMS.

### Patient and public involvement

Study findings were shared with the research participants and their communities, as well as health officials and programme implementers.

**RESULTS**
**Participants**

In Nairobi, out of 1770 AGYW aged 15–22 years, residing in the study area and eligible to participate, 1081 (61%) were enrolled into a study cohort in 2017 (online supplemental file 4). Of these, 836 (77%) were followed up in 2018. In 2019, 117 AGYW not seen in 2018 were re-traced, while 101 dropped out, giving a total of 852 (79%) followed up at end-line. In Gem, out of 1258 eligible, 1171 were enrolled in 2018 (93%) and 1018 (87%) were followed up in 2019; in uMkhanyakude, 2527 were eligible, 2184 (86%) were enrolled in

2017, 1853 (85%) were followed up in 2018 and 1712 (78%) in 2019.

Patterns of loss to follow-up by participant characteristics at enrolment are presented in online supplemental file 5 and in detail elsewhere.<sup>55</sup> Briefly, those not invited to participate in DREAMS, older, sexually active, out of school and food secure were less likely to be retained in the study.

Table 1 displays characteristics at cohort enrolment of participants followed up in 2019. Across the three settings, slightly higher proportions of AGYW aged 13/15–17

**Table 1** Sociodemographic characteristics of DREAMS beneficiaries and non-beneficiaries at the time of cohort enrolment in Gem (2018), Nairobi and uMkhanyakude (2017), among those followed up in 2019

Characteristics at enrolment	Gem			Nairobi			uMkhanyakude		
	Overall (N=1018) % (col)	Never invited (N=436) % (col)	Invited in 2018 (N=582) % (col)	Overall (N=852) % (col)	Never invited (N=224) % (col)	Invited by 2018 (N=628) % (col)	Overall (N=1712) % (col)	Never invited (N=809) % (col)	Invited by 2018 (N=903) % (col)
<b>Age</b>									
13/15–17	61.1	59.9	62.0	54.5	42.4	58.8	56.8	45.0	67.3
18–22	38.9	40.1	38.0	45.5	57.6	41.2	43.2	55.0	32.7
<b>Currently in school</b>									
No				36.6	48.7	32.3	21.0	30.7	12.3
Yes				63.4	51.3	67.7	79.0	69.3	87.7
<b>Education completed</b>									
None/primary	42.7	40.1	44.7						
Secondary/tertiary	36.5	32.8	39.3						
Unknown	20.7	27.1	16.0						
<b>Education completed</b>									
None/some primary				10.8	13.4	9.9	10.3	8.3	12.1
Primary/some secondary				68.1	58.0	71.7	77.3	73.1	81.1
Secondary/tertiary				21.1	28.6	18.5	12.4	18.6	6.8
<b>Food insecure</b>									
No	77.5	82.6	73.7	66.2	74.1	63.4	68.8	65.4	71.9
Yes	22.5	17.4	26.3	33.8	25.9	36.6	31.2	34.6	28.1
<b>Socioeconomic status</b>									
Low	41.7	36.0	45.9	35.6	34.4	36.0	35.9	32.2	39.3
Medium	19.2	19.0	19.2	32.5	35.3	31.5	35.0	36.1	34.0
High	39.2	45.0	34.9	31.9	30.4	32.5	29.1	31.8	26.7
<b>Ever had sex</b>									
No	68.9	64.0	72.5	65.4	55.8	68.8	63.4	54.2	71.4
Yes	31.1	36.0	27.5	34.6	44.2	31.2	36.7	45.8	28.6
<b>Ever pregnant</b>									
No	84.4	81.4	86.6	75.9	67.4	79.0	75.2	67.8	81.8
yes	15.6	18.6	13.4	24.1	32.6	21.0	24.8	32.2	18.2

DREAMS, Determined, Resilient, Empowered, AIDS-free, Mentored and Safe.

were enrolled than older AGYW aged 18–22. Proportions reporting food insecurity ranged from 23% to 34%. Most adolescents aged <18 years had never had sex, and among older AGYW, over 60% were sexually active and over 30% had been pregnant (online supplemental file 6). Proportions in school were high, particularly among the younger cohorts, and most AGYW aged  $\geq 18$  had progressed to secondary education. The overall proportions invited to participate in DREAMS by 2018 were 57% in Gem, 74% in Nairobi and 53% in uMkhanyakude. Higher proportions of those invited to DREAMS by 2018 were younger, in school, never had sex, food insecure and from lower SES households, compared with those never invited. Further details, including factors independently associated with invitation to participate in DREAMS, are published elsewhere.<sup>55 56</sup>

### Descriptive summary of aspirations and expectations

Aspirations around education, employment and home ownership were high (across settings in 2019,  $\geq 88\%$  considered important for each statement), with few differences by age group, DREAMS invitation status or year (online supplemental file 7). An exception was educational aspirations in Kenya where among younger AGYW in Nairobi in 2019, 94% of DREAMS-invitees thought finishing secondary school was very important vs 86% of non-invitees, and among older AGYW in Gem, 89% of DREAMS invitees thought accessing tertiary education was very important vs 81% of non-invitees. The majority considered children and marriage/partnerships as important, with a much higher proportion in Kenya (eg, Nairobi: 95% and 88%, respectively) than in uMkhanyakude (56% and 57%), and more among AGYW aged  $\geq 18$  vs younger adolescents (eg, Gem: 85% vs 74% for having children).

Expectations around similar life milestones were slightly lower than aspirations (online supplemental file 7). In both Kenyan settings and among older AGYW in uMkhanyakude, higher expectations were reported for education, employment and health-related expectations among AGYW invited to DREAMS versus those never invited, though differences were modest, for example, within  $\pm 5\%$  in absolute terms, for most statements.

### Patterns of social support by setting, year, age and DREAMS exposure

Levels of social support were highest in Nairobi (56% overall, 2019) and lowest in Gem (40%), with a small increase from 2018 to 2019 in both Kenyan settings and no change in uMkhanyakude (table 2). In all settings, both age groups, and in both years of follow-up, proportions with high social support were greater among DREAMS beneficiaries versus non-beneficiaries. For example, in Gem in 2018 the percentage of younger AGYW with social support was 39% among DREAMS beneficiaries vs 27% among non-beneficiaries. Comparing responses for the component questions comprising our social support measure, the

greatest differences between beneficiaries and non-beneficiaries were for having a 'safe and private place to meet', particularly in Kenyan settings (eg, 59% vs 40%, Nairobi, 2019) (online supplemental file 2).

### Estimated impact of DREAMS on social support

The odds of having high social support in 2018 were greater among DREAMS beneficiaries vs non-beneficiaries in all settings (eg, adjusted OR (aOR) 1.5 (95% CI 1.1 to 2.1), Nairobi) (table 2; online supplemental file 8), in younger AGYW, and in older AGYW in Gem and uMkhanyakude. In 2019, evidence for an association with DREAMS weakened, particularly in uMkhanyakude (aOR 1.1 (95% CI 0.9 to 1.3) overall) and in the older cohorts of AGYW (eg, aOR 1.1 (95% CI 0.7 to 1.7), Gem). However, in Kenya, evidence remained for greater odds of social support in 2019 among DREAMS beneficiaries vs non-beneficiaries overall (eg, aOR 1.4 (95% CI 1.0 to 1.8),  $p=0.02$ , Gem) and in the younger cohorts (eg, aOR 1.7 (95% CI 1.0 to 2.8),  $p=0.03$ , Nairobi).

In 2018, we estimated that the percentage of AGYW with social support would increase from 28% if none were DREAMS beneficiaries to 43% if all were beneficiaries (+15% (95% CI +10% to 20%)) in Gem, with corresponding figures of 40% and 53% in Nairobi (+13% (95% CI +4% to 21%)) and 42% and 49% in uMkhanyakude (+8% (95% CI +3% to 12%)) (table 3, figure 1). Increases were estimated among younger AGYW in all settings, and among older AGYW in Gem and uMkhanyakude, with the exception being older AGYW in Nairobi where there was no evidence for a difference in predicted percentages with social support between the scenarios that no, vs all AGYW were DREAMS beneficiaries (+2% (95% CI -10% to +13%)). Differences attributable to DREAMS were largest in Kenya (eg, +21% (95% CI +10% to 32%) among 15–17 year-olds, Nairobi, 2018), and weakened in 2019, particularly among older AGYW (eg, +5% (95% CI -5% to +14%), Gem) and overall in uMkhanyakude (+2% (95% CI -3% to +7%)). Results were similar in sensitivity analyses that used alternative approaches to control for confounding (online supplemental file 9).

### Patterns of self-efficacy by setting, year, age and DREAMS exposure

Proportions with high self-efficacy were greater in Nairobi (eg, 54%, 2018) than in uMkhanyakude (42%, 2018) or Gem (37%, 2018), and higher among older versus younger AGYW (eg, 41% vs 30% in Gem, 2019) (table 2, online supplemental file 3). Levels did not change by 2019 in Kenyan settings, although self-efficacy rose to 48% in uMkhanyakude. Overall, proportions with high self-efficacy were similar or slightly greater among those invited to DREAMS compared with those never invited, with greater differences by subgroups of age, for example, 59% vs 50% among older AGYW in Nairobi in 2019.

**Table 2** Crude and multivariable analyses for associations between invitation to participate in DREAMS and outcomes (social support; self-efficacy) in 2018/2019

Outcome	Setting	Age group	All			Never invited			Invited by 2018			Unadjusted OR (95% CI)	Age and area adjusted OR (95% CI)	Fully adjusted* OR (95% CI)	P value (LRT)
			N	n (%) with outcome	N	n (%) with outcome	N	n (%) with outcome	N	n (%) with outcome					
Social support, 2018	Nairobi	Overall	831	421 (50.7)	210	90 (42.9)	621	331 (53.3)	1.5 (1.1 to 2.1)	1.5 (1.1 to 2.1)	1.5 (1.1 to 2.1)	0.01			
		15–17	466	240 (51.5)	94	33 (35.1)	372	207 (55.7)	2.3 (1.4 to 3.7)	2.2 (1.4 to 3.5)	2.4 (1.5 to 3.9)	<0.001			
		18–22	365	181 (49.6)	116	57 (49.1)	249	124 (49.8)	1.0 (0.7 to 1.6)	1.1 (0.7 to 1.7)	1.0 (0.6 to 1.7)	0.9			
		Overall	1171	424 (36.2)	514	145 (28.2)	657	279 (42.5)	1.9 (1.5 to 2.4)	2.0 (1.5 to 2.5)	2.0 (1.6 to 2.6)	<0.001			
		13–17	684	231 (33.8)	285	76 (26.7)	399	155 (38.8)	1.8 (1.3 to 2.4)	1.8 (1.3 to 2.5)	2.0 (1.4 to 2.8)	<0.001			
		18–22	487	193 (39.6)	229	69 (30.1)	258	124 (48.1)	2.2 (1.5 to 3.1)	2.3 (1.6 to 3.4)	2.4 (1.6 to 3.6)	<0.001			
	uMkhanyakude	Overall	1852	847 (45.7)	886	373 (42.1)	966	474 (49.1)	1.3 (1.1 to 1.6)	1.4 (1.1 to 1.6)	1.4 (1.1 to 1.7)	0.002			
		13–17	1040	490 (47.1)	389	170 (43.7)	651	320 (49.2)	1.2 (1.0 to 1.6)	1.3 (1.0 to 1.7)	1.3 (1.0 to 1.7)	0.03			
		18–22	812	357 (44.0)	497	203 (40.9)	315	154 (48.9)	1.4 (1.0 to 1.8)	1.4 (1.1 to 1.9)	1.4 (1.1 to 1.9)	0.02			
		Overall	852	480 (56.3)	224	111 (49.6)	628	369 (58.8)	1.4 (1.1 to 2.0)	1.4 (1.0 to 1.9)	1.4 (1.0 to 1.9)	0.04			
		15–17	464	266 (57.3)	95	43 (45.3)	369	223 (60.4)	1.8 (1.2 to 2.9)	1.7 (1.1 to 2.8)	1.7 (1.0 to 2.8)	0.03			
		18–22	388	214 (55.2)	129	68 (52.7)	259	146 (56.4)	1.2 (0.8 to 1.8)	1.2 (0.8 to 1.8)	1.2 (0.8 to 1.9)	0.4			
Social support, 2019	Nairobi	Overall	1018	411 (40.1)	436	156 (35.8)	582	255 (43.8)	1.4 (1.1 to 1.8)	1.4 (1.1 to 1.8)	1.4 (1.0 to 1.8)	0.02			
		13–17	622	229 (37.0)	261	81 (31.0)	361	148 (41.0)	1.5 (1.1 to 2.2)	1.5 (1.1 to 2.2)	1.6 (1.1 to 2.3)	0.008			
		18–22	396	182 (46.0)	175	75 (42.9)	221	107 (48.4)	1.3 (0.8 to 1.9)	1.3 (0.8 to 1.9)	1.1 (0.7 to 1.7)	0.6			
		Overall	1712	778 (45.4)	809	358 (44.3)	903	420 (46.5)	1.1 (0.9 to 1.3)	1.1 (0.9 to 1.3)	1.1 (0.9 to 1.3)	0.5			
		13–17	972	441 (45.4)	364	157 (43.1)	608	284 (46.7)	1.2 (0.9 to 1.5)	1.1 (0.9 to 1.5)	1.2 (0.9 to 1.5)	0.2			
		18–22	740	337 (45.5)	445	201 (45.2)	295	136 (46.1)	1.0 (0.8 to 1.4)	1.0 (0.8 to 1.4)	0.9 (0.7 to 1.3)	0.7			
	uMkhanyakude	Overall	836	449 (53.7)	212	109 (51.4)	624	340 (54.5)	1.1 (0.8 to 1.6)	1.2 (0.8 to 1.6)	1.1 (0.8 to 1.6)	0.5			
		15–17	466	243 (52.1)	94	49 (52.1)	372	194 (52.2)	1.0 (0.6 to 1.6)	1.0 (0.6 to 1.6)	1.0 (0.6 to 1.6)	0.9			
		18–22	370	206 (55.7)	118	60 (50.8)	252	146 (57.9)	1.3 (0.9 to 2.1)	1.4 (0.9 to 2.1)	1.2 (0.8 to 2.0)	0.4			
		Overall	1171	436 (37.2)	514	193 (37.5)	657	243 (37.0)	1.0 (0.8 to 1.2)	1.0 (0.8 to 1.3)	1.1 (0.9 to 1.5)	0.4			
		15–17	684	224 (32.7)	285	93 (32.6)	399	131 (32.8)	1.0 (0.7 to 1.4)	1.0 (0.7 to 1.4)	1.1 (0.8 to 1.5)	0.6			
		18–22	487	212 (43.5)	229	100 (43.7)	258	112 (43.4)	1.0 (0.7 to 1.4)	1.0 (0.7 to 1.4)	1.1 (0.7 to 1.6)	0.7			
Self efficacy, 2018	uMkhanyakude	Overall	1853	771 (41.6)	886	348 (39.3)	967	423 (43.7)	1.2 (1.0 to 1.4)	1.4 (1.1 to 1.7)	1.4 (1.2 to 1.8)	<0.001			
		15–17	1041	379 (36.4)	389	125 (32.1)	652	254 (39.0)	1.3 (1.0 to 1.8)	1.3 (1.0 to 1.7)	1.4 (1.0 to 1.8)	0.03			
		18–22	812	392 (48.3)	497	223 (44.9)	315	169 (53.7)	1.4 (1.1 to 1.9)	1.5 (1.1 to 2.0)	1.5 (1.1 to 2.1)	0.004			
		Overall	836	449 (53.7)	212	109 (51.4)	624	340 (54.5)	1.1 (0.8 to 1.6)	1.2 (0.8 to 1.6)	1.1 (0.8 to 1.6)	0.5			
		15–17	466	243 (52.1)	94	49 (52.1)	372	194 (52.2)	1.0 (0.6 to 1.6)	1.0 (0.6 to 1.6)	1.0 (0.6 to 1.6)	0.9			
		18–22	370	206 (55.7)	118	60 (50.8)	252	146 (57.9)	1.3 (0.9 to 2.1)	1.4 (0.9 to 2.1)	1.2 (0.8 to 2.0)	0.4			

Continued

Table 2 Continued

Outcome	Setting	All		Never invited		Invited by 2018		Age and area adjusted OR (95% CI)		P value (LRT)	
		Age group	N	n (%) with outcome	N	n (%) with outcome	n (%) with outcome	Unadjusted OR (95% CI)	Fully adjusted* OR (95% CI)		
Self efficacy, Nairobi 2019	Overall		852	465 (54.6)	224	113 (50.5)	628	352 (56.1)	1.3 (0.9 to 1.7)	1.3 (0.9 to 1.8)	0.1
	15–17		464	247 (53.2)	95	48 (50.5)	369	199 (54.0)	1.2 (0.7 to 1.8)	1.1 (0.7 to 1.7)	0.8
	18–22		388	218 (56.2)	129	65 (50.4)	259	153 (59.1)	1.4 (0.9 to 2.2)	1.6 (1.0 to 2.6)	0.04
Gem	Overall		1018	351 (34.5)	436	145 (33.3)	582	206 (35.4)	1.1 (0.9 to 1.4)	1.2 (0.9 to 1.5)	0.2
	15–17		622	187 (30.1)	261	71 (27.2)	361	116 (32.1)	1.3 (0.9 to 1.8)	1.5 (1.0 to 2.2)	0.04
	18–22		396	164 (41.4)	175	74 (42.3)	221	90 (40.7)	0.9 (0.6 to 1.4)	1.0 (0.6 to 1.5)	0.8
uMkhanyakude	Overall		1712	829 (48.4)	809	384 (47.5)	903	445 (49.3)	1.1 (0.9 to 1.3)	1.3 (1.0 to 1.5)	0.03
	15–17		972	414 (42.6)	364	140 (38.5)	608	274 (45.1)	1.3 (1.0 to 1.7)	1.3 (1.0 to 1.7)	0.04
	18–22		740	415 (56.1)	445	244 (54.8)	295	171 (58.0)	1.1 (0.8 to 1.5)	1.2 (0.8 to 1.6)	0.4

Row percentages are presented.

Outcome definition for social support: Binary outcome variable constructed where a high level of social support was defined as a 'yes' response to at least three out of four questions: 'Is there a female in your community from whom you can borrow money in an emergency?'; 'Do you have at least one trusted female friend?'; 'Do you know a woman in your community, other than a mother or guardian, whom you could turn to if you had a serious problem?'; 'Do you have a safe and private place to meet with girls and young women who are like you?'. Outcome definition for self-efficacy: Binary outcome variable constructed based on a series of 10 questions comprising a general self-efficacy scale, where a cut-off value of  $\geq 3.5$  was used to define higher self-efficacy (yes).

\*Adjusted for the following variables: Gem: Social support: age group (categorised as 13–17/18–22), education (none or primary/secondary and above/ unknown), socioeconomic status (wealth index derived using principal component analysis with input variables including, for example, individual or household assets and household structure; categorised as low/medium/high), orphanhood (no/maternal/paternal/double orphan/unknown based on self-reports of mother or father having died), food insecurity (AGYW or household member went to sleep at night hungry because there was not enough food in the past 4 weeks; yes/no) and sexual and pregnancy history (never had sex/had sex never pregnant/ever pregnant); Self-efficacy: age group, education, socioeconomic status, orphanhood, food insecurity and sexual and pregnancy history (variable definitions the same as for social support analyses).

Nairobi: Social support: age group and education (composite variable combining age 15–17/18–22, in school/not in school, no/primary/secondary/tertiary education attainment), Demographic Surveillance System (DSS) study site (Korogocho/Viwandani settlements), marital status (never married/previously married or living with partner/currently married or living with partner), sexual and pregnancy history (never had sex/had sex never pregnant/ever pregnant), socioeconomic status (wealth index derived using principal component analysis with input variables including for example, individual or household assets and household structure; categorised as low/medium/high), food insecurity (AGYW or household member went to sleep at night hungry because there was not enough food in the past 4 weeks; yes/no), poverty perception (self-assessment of household economic situation currently as very poor/moderately poor/not poor), orphanhood (single or double orphan/ not orphan, based on self-reports of mother or father having died); Self-efficacy: DSS study site, food insecurity, orphanhood, sexual and pregnancy history, socioeconomic status, poverty perception (variable definitions the same as for social support analyses), age group (15–17/18–22), in/out of school (yes/no), birth history (ever given birth yes/no), ethnic group (Somali, Kamba, Kikuyu, Kisii, Luhya, Luo, other), religion (Catholic/other Christian/Muslim/no or other religion), gender of the household head (male/female), AGYW was the household head (yes/no).

uMkhanyakude: Social support: age group (13–14/15–17/18–19/20–22), age and education (composite and dummy variables comparing age groups 13–17/18–22, in school/not in school, incomplete/complete secondary education), area (rural/ periurban or urban), sexual and pregnancy history (never had sex/had sex never pregnant/ever pregnant), socioeconomic status (wealth index derived using principal component analysis with input variables including for example, individual or household assets and household structure; categorised as low/medium/high), food insecurity (any report of reducing the size of food portions or skipping meals by any member of a household because there was not enough money to buy food in the past 12 months), migration (any movement within or outside the surveillance area since age 13); Self-efficacy: age group, age and education, area, sexual and pregnancy history, socioeconomic status, food insecurity, migration (variable definitions the same as for social support analyses), violence (experience of any act of violence by a man in the 12 months preceding the survey).

AGYW, adolescent girls and young women; DREAMS, Determined, Resilient, Empowered, AIDS-free, Mentored and Safe; LRT, likelihood ratio test; OR, odds ratio.

**Table 3** Estimated causal effect of DREAMS on social support and self-efficacy in 2018 and in 2019

Outcome and year	Setting	Age group	% with outcome in total study population	Estimated % with outcome if none benefit from DREAMS	Estimated % with outcome if all benefit from DREAMS	Difference in estimated %
				% (95% CI)	% (95% CI)	% (95% CI)
Social support, 2018	Nairobi	Overall	50.7	40.2 (33.1 to 47.6)	52.7 (48.5 to 56.7)	12.5 (4.2 to 20.9)
		15–17	51.5	34.4 (24.8 to 44.3)	55.5 (50.4 to 60.8)	21.1 (9.6 to 31.8)
		18–22	49.6	47.6 (38.4 to 56.6)	49.2 (42.8 to 55.6)	1.6 (-10.1 to 13.3)
	Gem	Overall	36.2	27.9 (23.9 to 32.9)	43.3 (39.6 to 46.8)	15.4 (10.2 to 19.8)
		13–17	33.8	26.9 (22.0 to 35.2)	39.7 (35.4 to 43.6)	12.8 (4.0 to 19.8)
		18–22	39.6	28.8 (22.5 to 35.5)	47.8 (42.9 to 53.4)	19.0 (10.6 to 27.1)
	uMkhanyakude	Overall	45.7	41.7 (38.4 to 45.4)	49.4 (46.1 to 52.8)	7.7 (2.5 to 12.0)
		13–17	47.1	42.8 (38.2 to 47.9)	49.6 (45.6 to 53.3)	6.8 (-0.3 to 12.9)
		18–22	44.0	40.4 (35.9 to 45.1)	49.2 (43.2 to 55.0)	8.8 (1.6 to 15.8)
Social support, 2019	Nairobi	Overall	56.3	49.4 (42.6 to 56.2)	58.2 (54.1 to 62.3)	8.8 (1.2 to 16.7)
		15–17	57.3	46.1 (36.2 to 55.6)	60.0 (54.6 to 65.0)	14.0 (3.0 to 25.0)
		18–22	55.2	53.3 (43.9 to 61.3)	56.0 (49.5 to 62.5)	2.6 (-7.3 to 14.1)
	Gem	Overall	40.4	35.5 (31.1 to 39.6)	43.3 (39.3 to 47.3)	7.8 (2.1 to 14.0)
		13–17	37.0	31.2 (26.0 to 37.3)	40.7 (35.7 to 46.3)	9.5 (1.9 to 17.3)
		18–22	44.9	43.5 (35.7 to 51.1)	48.2 (41.6 to 55.0)	4.7 (-4.5 to 14.1)
	uMkhanyakude	Overall	45.4	44.2 (40.5 to 47.7)	46.0 (42.5 to 49.5)	1.8 (-3.2 to 6.6)
		13–17	45.4	43.2 (38.0 to 48.1)	46.7 (42.7 to 50.7)	3.6 (-2.6 to 10.2)
		18–22	45.5	45.6 (41.2 to 50.4)	44.9 (39.1 to 50.4)	-0.6 (-7.5 to 6.6)
Self-efficacy, 2018	Nairobi	Overall	53.7	54.7 (46.4 to 60.7)	54.9 (51.2 to 59.2)	1.2 (-6.9 to 10.0)
		15–17	52.1	53.7 (43.3 to 64.5)	52.1 (47.4 to 57.3)	-1.6 (-13.7 to 9.9)
		18–22	55.7	53.6 (43.8 to 63.2)	58.4 (52.8 to 64.5)	4.8 (-6.4 to 16.6)
	Gem	Overall	37.2	36.1 (30.9 to 40.6)	38.5 (35.3 to 41.8)	2.4 (-4.1 to 8.5)
		13–17	32.8	32.7 (27.1 to 37.7)	34.7 (29.8 to 38.9)	2.0 (-4.3 to 9.6)
		18–22	43.5	40.3 (34.5 to 46.0)	43.4 (36.7 to 48.9)	3.2 (-3.9 to 9.7)
	uMkhanyakude	Overall	41.6	37.9 (34.5 to 41.4)	46.4 (42.9 to 49.6)	8.6 (3.4 to 13.1)
		13–17	36.4	32.4 (27.6 to 37.3)	39.4 (35.6 to 43.3)	7.0 (0.9 to 12.9)
		18–22	48.3	44.9 (40.6 to 49.8)	55.5 (50.0 to 61.4)	10.6 (3.2 to 17.8)
Self-efficacy, 2019	Nairobi	Overall	54.6	50.5 (43.8 to 58.2)	56.3 (52.2 to 60.2)	5.7 (-2.7 to 13.9)
		15–17	53.2	50.6 (41.3 to 61.2)	53.9 (49.0 to 59.0)	3.3 (-8.7 to 14.3)
		18–22	56.2	50.5 (41.9 to 59.5)	59.1 (53.2 to 65.5)	8.6 (-3.0 to 19.8)
	Gem	Overall	34.5	31.8 (27.3 to 36.0)	35.6 (31.1 to 39.0)	3.8 (-4.0 to 9.1)
		13–17	30.1	27 (21.6 to 31.7)	32.8 (28.2 to 37.8)	5.7 (-0.1 to 13.4)
		18–22	41.4	41 (33.6 to 49.8)	41.2 (34.2 to 46.6)	0.2 (-11.7 to 9.6)
	uMkhanyakude	Overall	48.4	45.5 (42.1 to 49.3)	51.0 (47.4 to 54.4)	5.4 (0.5 to 10.1)
		13–17	42.6	38.7 (33.6 to 44.1)	45.3 (41.4 to 49.7)	6.7 (0.3 to 12.6)
		18–22	56.1	54.5 (49.9 to 59.4)	58.3 (52.2 to 64.0)	3.8 (-3.6 to 11.2)

2018 denominator: AGYW followed up in 2018 (Overall totals: Gem 1171; Nairobi 836; uMkhanyakude 1853).

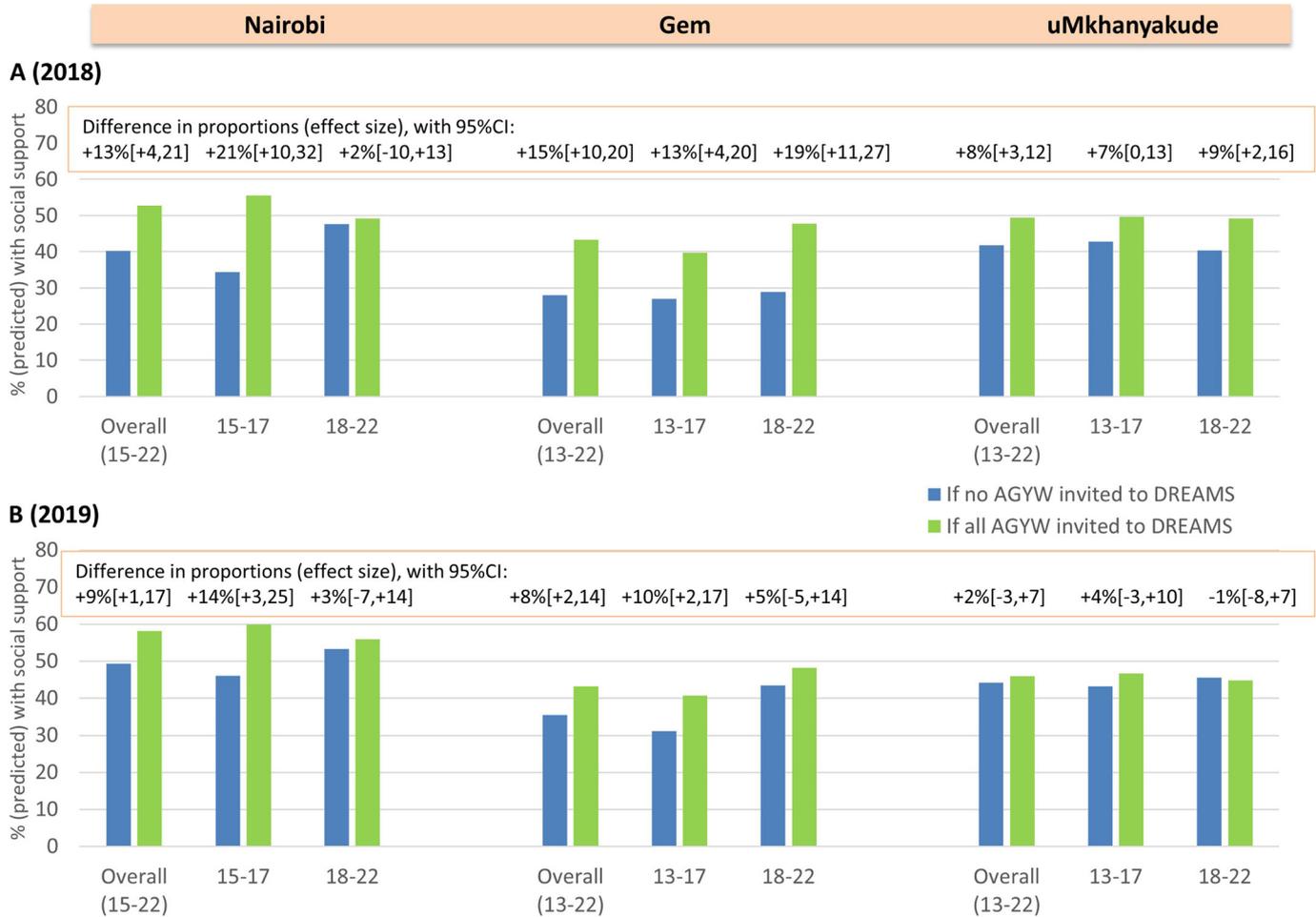
2019 denominator: AGYW followed up in 2019 (Overall totals: Gem 1018; Nairobi 852; uMkhanyakude 1712).

Method: Propensity-score regression adjustment.

Outcome definition social support: Binary outcome variable constructed where a high level of social support was defined as a 'yes' response to at least three out of four questions: 'Is there a female in your community from whom you can borrow money in an emergency?'; 'Do you have at least one trusted female friend?'; 'Do you know a woman in your community, other than a mother or guardian, whom you could turn to if you had a serious problem?'; 'Do you have a safe and private place to meet with girls and young women who are like you?'

Outcome definition self-efficacy: Binary outcome variable constructed based on a series of ten questions comprising a general self-efficacy scale, where a cut-off value of  $\geq 3.5$  was used to define higher self-efficacy (yes).

AGYW, adolescent girls and young women; DREAMS, Determined, Resilient, Empowered, AIDS-free, Mentored and Safe.



**Figure 1** Predicted proportions who have social support in 2018 (A) and in 2019 (B) if no AGYW versus all AGYW were invited to DREAMS, overall and by age group at enrolment in three settings. AGYW, adolescent girls and young women; DREAMS, Determined, Resilient, Empowered, AIDS-free, Mentored and Safe.

**Estimated impact of DREAMS on self-efficacy**

Overall, there was no evidence for an effect of DREAMS on self-efficacy in Kenyan settings in either year (eg, aOR 1.2 (95% CI 0.9 to 1.5), Gem, 2019) (table 2; online supplemental file 8). However, a modest effect was observed in 2019 among younger AGYW in Gem (aOR 1.5 (95% CI 1.0 to 2.2)) and older AGYW in Nairobi (aOR 1.6 (95% CI 1.0 to 2.6)). In uMkhanyakude, DREAMS beneficiaries had greater odds of high self-efficacy compared with non-beneficiaries overall (aOR 1.4 (95% CI 1.2 to 1.8), 2018; 1.3 (1.0 to 1.5), 2019), and aORs were similar in subgroup analyses by age group.

In uMkhanyakude, we estimated that DREAMS would increase self-efficacy in 2018 from 38% if no AGYW were DREAMS beneficiaries to 46% if all AGYW were beneficiaries (+9% (95% CI +3% to 13%)). The predicted increase was slightly weaker in 2019, particularly among older AGYW (+4% (95% CI -4% to +11%)) (table 3, figure 2). In Kenyan settings, there was no evidence for an effect of DREAMS in 2018, while in 2019 there was weak evidence for a positive impact of DREAMS among younger AGYW in Gem (+6% (95% CI 0% to 13%)) and among older AGYW in Nairobi (+9% (95% CI -3% to

+20%)). Results were similar in sensitivity analyses (online supplemental file 9).

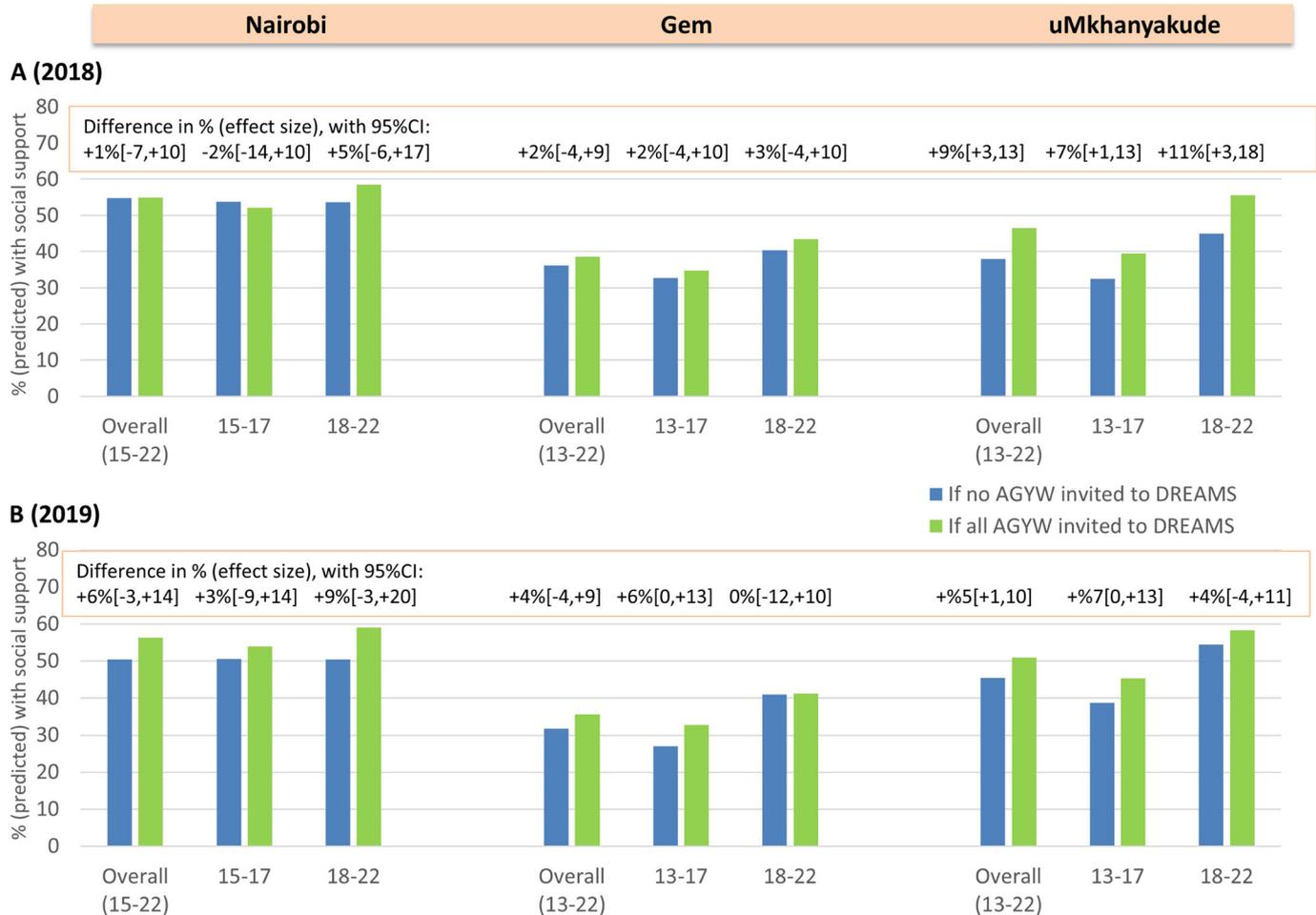
**DISCUSSION**

**Key findings**

DREAMS increased social support among AGYW across diverse rural and urban settings in southern and eastern Africa. We also found some impact of DREAMS on self-efficacy, with evidence of a positive impact in rural KwaZulu-Natal, and among younger AGYW in rural Kenya and older AGYW in Nairobi. Aspirations and expectations were high, and there were examples of modestly elevated expectations for education, employment and health-related milestones among DREAMS beneficiaries compared with non-beneficiaries.

**Interpretation of social support findings**

The DREAMS package aimed to create an enabling environment through interventions that strengthen families and elicit community-wide norms change. Social asset building approaches were specifically included to strengthen networks of AGYW with peers and female



**Figure 2** Predicted proportions who have self efficacy in 2018 (A) and in 2019 (B) if no AGYW versus all AGYW were invited to DREAMS, overall and by age group at enrolment in three settings. AGYW, adolescent girls and young women; DREAMS, Determined, Resilient, Empowered, AIDS-free, Mentored and Safe.

mentors, helping AGYW to feel socially supported with a collective and connected identity.<sup>4 6 7 19</sup> We previously reported good uptake of the DREAMS package over the same time frame (2017–2019), with almost all AGYW invited to DREAMS participating in at least one intervention, and many accessing multiple (eg, 3+) interventions.<sup>55–57</sup> Social asset building interventions in particular, including safe spaces,<sup>19 55–57</sup> were highly accessed (particularly by younger AGYW), so the observed impacts of DREAMS on social support are plausible from an implementation perspective, and could reflect exposure to valuable social resources as conceptualised in Kabeer’s empowerment framework.<sup>4</sup> As our definition of social support captured access to a safe and private place, as well as connectedness and support from other females, it is likely that the impacts due to DREAMS primarily reflect participation in social asset building interventions, and to a lesser extent participation in DREAMS school-based and social protection curricula which may also have enhanced opportunities for social networking.

### Interpretation of self-efficacy findings

The enabling, supportive environment created through the DREAMS package of interventions was also

hypothesised to boost individual agency and general self-efficacy, facilitating decisions around access to HIV prevention and sexual and reproductive health services including testing, condoms and family planning. While impacts of DREAMS on social support may occur relatively quickly, it may take longer and more sustained intervention<sup>45</sup> to achieve impacts on self-efficacy beliefs. This is one possible explanation for the relatively weak effects of DREAMS on self-efficacy by 2019, and for the heterogeneity across settings. Longer-term follow-up, after interventions have become embedded and then sustained with sufficient intensity, might show a larger change in attitudes and beliefs.

Broader societal influences, including poverty, economic circumstances, family, male partners and cultural norms, are also thought to affect what choices are considered possible and the extent to which choice can be exercised.<sup>4 6 7 13 45 58</sup> These wider issues may have limited the impact of DREAMS interventions on the individual agency of AGYW and their self-efficacy beliefs. For instance, uptake of DREAMS community norms-change interventions was low in the general populations in our study settings,<sup>56</sup> and DREAMS may not have influenced

these broader contextual factors very much. Another reason for the modest levels of self-efficacy observed and weak effects of DREAMS could be the fairly stringent cut-off used to define self-efficacy.

There may be differences between Kenya and South Africa, and between settings in Kenya, in AGYW's perceptions around access to resources (including HIV prevention tools), which will in turn influence their perceived choices and decision-making. This may offer another explanation for the heterogeneity in self-efficacy findings, and further qualitative research would be valuable for better understanding.

### Findings in context

Impacts of DREAMS specifically on social support and general self-efficacy have not been reported elsewhere. However, complementing our findings, implementation science research conducted in Zambia and Kenya found that high proportions of DREAMS beneficiaries felt comfortable with their mentors and that mentors were 'readily available when an issue arose'.<sup>59 60</sup> The impacts seen in our study support the continued expansion of safe social spaces where AGYW can meet, engage in transformative communications and learning, and initiate collective action, through peer-networking and peer mentorship, as part of a holistic approach to combination HIV prevention.<sup>61–64</sup>

Cohort studies with DREAMS beneficiaries in Zambia and Kenya reported high levels of self-efficacy for HIV testing, and self-perceptions of reduced HIV risk,<sup>59 60</sup> but the absence of a comparison group of non-beneficiaries in the research hinders interpretation of impact. Several Africa-based studies assessing educational, health promotion or economic empowerment interventions have also reported positive effects on specific forms of self-efficacy, though these findings were generally from trial contexts or pre-/post-intervention comparisons that may be confounded by other contributing factors.<sup>32–34 36</sup> For example, a cohort study with young people living with HIV in Uganda who participated in a peer-led intervention package of HIV and sexual and reproductive health services reported increases in self-efficacy 'to engage in healthy behaviours' after 9 months of the intervention.<sup>31</sup> Our study, therefore, makes an important contribution to understanding whether complex interventions can be implemented to impact on self-efficacy among young people in real-world contexts.

### Impacts by age group

On the whole, stronger impacts on social support and self-efficacy were seen among younger vs older AGYW. We also observed that uptake of relevant interventions, including social asset building, and 'layering' of interventions across the DREAMS core package, were generally greater in this age group.<sup>31 55–57</sup> Weaker impacts among older AGYW may also reflect challenges engaging them in the programme over a sustained period, for example, due to competing priorities to care for family, or short-term

migration to earn a living, and consequently less freedom and choice about how to spend their time.<sup>45 46</sup> Completion of curricula or programme disengagement are also possible explanations for weakening effects of DREAMS in 2019 among the older cohorts, as well as ageing of the cohorts, again indicating that adaptation and/or new ways to sustain social support would be valuable as AGYW age and their life circumstances (including relationships and marriage) evolve. Involving older AGYW in the adaptation and refinement of DREAMS interventions will be essential to ensure that curricula are useful and stimulating and offered in a way that is compatible with competing demands on their time, so as to contribute to strengthening their social networks and support, self-efficacy beliefs and ultimately their agency.

### Impacts over time

Impacts on social support were weaker in 2019 than in 2018 across all settings, particularly in uMkhanyakude, where impacts on self-efficacy also weakened over time. In uMkhanyakude, this likely reflects the withdrawal of DREAMS funding in late 2018, and corresponding evidence of weakening participation in DREAMS interventions, particularly social asset building.<sup>46 55 57</sup> This emphasises the importance of sustainability, including ongoing support for safe social spaces and continued opportunities for communication with mentors and/or peer-networks and of further engaging communities in leadership.<sup>46 55 57</sup> In Kenyan settings, background levels of social support also rose among non-beneficiaries between 2018 and 2019, perhaps indicating some spill-over effects and that such support can increase as individuals age, and this diluted the effects observed compared with beneficiaries.

### Aspirations and expectations

It was encouraging that aspirations and, although to a lesser extent, expectations, were high. This suggests that intervention approaches should focus on helping AGYW to realise their goals, through strengthening of individual and collective agency and access to relevant resources. Given the high levels of aspiration, it was not surprising that there was little difference by DREAMS invitation. Nonetheless, differences by DREAMS invitation status for some expectations related to education, employment and health, as well as qualitative research conducted in the same/similar settings,<sup>58 65 66</sup> support the potential of DREAMS, and other interventions, to make a positive contribution to change.

The heterogeneity observed by setting mirrored the different cultural contexts. For example, aspirations around marriage were seen as more important in Kenya compared with uMkhanyakude, where marriage is now uncommon in the Zulu population.<sup>67</sup> A context-specific understanding of aspirations and how they shape social identities will be important for guiding both DREAMS and wider sexual and reproductive health programming.<sup>68</sup>

## Study strengths and limitations

Representative samples of AGYW drawn from established demographic platforms, high cohort retention and detailed data collection on exposure to DREAMS and social outcome measures that was harmonised across settings, were key strengths of this study. We also used a range of robust, analytical approaches to control for confounding, with consistency in findings.

Limitations included differential loss to follow-up by AGYW characteristics, potentially contributing to selection bias. High cohort retention suggests the extent of any bias would be small, and our estimates of the impact of DREAMS were controlled for confounding variables measured at enrolment. Nevertheless, it is possible that outcomes among one or both of DREAMS invitees and non-invitees were different among individuals who were not followed up compared with those who were, even after controlling for characteristics at baseline. Differential reporting bias is also possible, if DREAMS beneficiaries were aware of programme aims and more likely to report favourable responses to questions on support networks, self-efficacy beliefs and aspirations, although use of independent (not part of DREAMS implementation) interviewers and assurances of confidentiality should have limited this bias. Misclassification of exposure and outcome may have occurred due to reliance on self-reported data. For example, the proportion defined as beneficiaries may be underestimated if AGYW did not self-identify as DREAMS invitees. This is relatively unlikely in Kenyan settings where invitation to DREAMS was coordinated by a single implementing partner, but could plausibly have occurred in uMkhanyakude.

Composite measures of social support and self-efficacy were informed by detailed exploratory analyses, prior to conducting the impact analyses, and based on established scale items or questions relevant to programming, although choice of cut-offs may have influenced findings. Our outcome measures were intended to capture important aspects of individual and collective agency, but we did not assess others such as self-esteem, reflection, decision-making processes or the ability to negotiate or take on a leadership role. Nor did we assess the broader contextual factors—institutional and social structures, and access to resources beyond health services—that shape AGYW choices and actions, and are included in models of empowerment,<sup>4 6 7 13</sup> although parallel analyses are being conducted on the impact of DREAMS on gender norms in our study population.<sup>69</sup> Measurement of these constructs through structured questionnaires is challenging, for example, measuring ‘resources’ beyond simple access indicators,<sup>4</sup> and further research is needed to develop and apply context-appropriate measures to more fully assess the impacts of DREAMS on AGYW empowerment. This includes further development of context-specific measures of self-efficacy, social support and aspirations. Further qualitative research to more thoroughly explore how DREAMS may have contributed to and influenced the process of empowerment,

including how AGYW navigated challenges and societal structures, is also underway.

Our results may not be generalisable to all DREAMS districts, but represent diverse implementation contexts and can contribute important insights for other settings implementing DREAMS.

## CONCLUSION

We have identified encouraging impacts of the real-world implementation of the DREAMS package on aspects of AGYW empowerment, particularly social support and connectedness, in a range of contexts. Such outcomes are important in their own right to the well-being of young women in sub-Saharan Africa, and contribute to accelerating sustainable development goals.<sup>70</sup> Weaker and more heterogeneous findings for self-efficacy and for impacts among older AGYW, highlight that opportunities remain to strengthen and sustain DREAMS programming to increase empowerment, particularly among young women.

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## Supplementary file 1. DREAMS Core Package

	Package level	Package category	Target group(s)	Description of intervention activities, with examples
Individual level	Empower AGYW and reduce their risk	HIV Testing Services	AGYW & male partners	HIV testing; linkage to care & ART if positive, or linkage to other DREAMS prevention if negative
		Social asset building	AGYW	Build social skills and networks; connect AGYW with peers & adults, for information, emotional & material support
		Expand contraceptive mix	AGYW	Promote use of modern contraception, dual methods alongside condoms, to reduce unplanned pregnancy and school drop-out
		Condom promotion & provision	AGYW & male partners	Increasing consistent use & availability, e.g. through condom distribution, adolescent-friendly SRH services
		Post-violence care	AGYW experienced/ at risk for violence	Youth-friendly screening & care for intimate partner violence/ violence against children, PEP
		PrEP <i>*selected countries</i>	AGYW at highest risk of acquiring HIV	Education on and targeted provision of PrEP (e.g. sex workers in South Africa), linkage to support services
Contextual level	Strengthen families	Social protection	AGYW & parents/guardians	Educational subsidies, combination socio-economic approaches e.g. savings groups
		Parenting/caregiver programmes	AGYW & parents / care-givers of AGYW	Parenting programmes on adolescent sexual/risk behaviours & protection from violence
	Mobilise community for change	School-based HIV prevention	AGYW & boys in schools	HIV & sex education, violence prevention education in schools
		Community mobilisation & norms change	AGYW, boys & men, broader communities	Community-based HIV and violence prevention programmes, social/gender norms change & gender-related messaging
	Reduce risk in male sex partners	Characterisation of male sex partners to target interventions	Sexual partners of AGYW	Target highly effective HIV prevention, care and treatment interventions. Develop services men are more likely to use. Research & characterise 'typical' partners of AGYW.

**Supplementary file 2. Proportions with different aspects of social support\* in 2019, by invitation to DREAMS and age group, among those followed-up in 2019**

**a(i).Gem**

	Age 13-22		Age 13-17		Age 18-22	
	Never invited (N=436) % (col)	Invited in 2018 (N=582) % (col)	Never invited (N=261) % (col)	Invited in 2018 (N=361) % (col)	Never invited (N=175) % (col)	Invited in 2018 (N=221) % (col)
<b>a) Is there a female in your community from whom you can borrow money in an emergency</b>						
Yes	32.1	38.0	27.6	34.1	38.9	44.3
No	67.9	62.0	72.4	65.9	61.1	55.7
Don't know	0.0	0.0	0.0	0.0	0.0	0.0
<b>b) Do you have a safe and private place to meet with girls and young women who are like you</b>						
Yes	34.2	55.3	33.7	54.3	34.9	57.0
No	64.9	44.3	65.1	45.2	64.6	43.0
Don't know	0.9	0.2	1.1	0.3	0.6	0.0
<b>d) Do you have at least one trusted female friend?</b>						
Yes	77.3	79.6	75.9	80.3	79.4	78.3
No	22.7	20.3	24.1	19.4	20.6	21.7
Don't know	0.0	0.0	0.0	0.0	0.0	0.0
<b>e) Do you know a woman in your community, other than a mother or guardian, whom you could turn to if you had a serious problem</b>						
Yes	50.2	52.4	46.7	50.4	55.4	55.7
No	49.8	47.3	53.3	49.3	44.6	43.9
Don't know	0.0	0.3	0.0	0.3	0.0	0.5

\*Responses combined into composite social support binary outcome

**Supplementary file 2. Proportions with different aspects of social support\* in 2018, by invitation to DREAMS and age group, among those followed-up in 2018**

**a(ii).Gem**

	Age 13-22		Age 13-17		Age 18-22	
	Never Invited (N=514) % (col)	Invited (N=657) % (col)	Never invited (N=285) % (col)	Invited (N=399) % (col)	Never invited (N=229) % (col)	Invited (N=258) % (col)
<b>a) Is there a female in your community from whom you can borrow money in an emergency</b>						
Yes	28.0	32.1	25.6	28.1	31.0	38.4
No	72.0	67.6	74.4	71.7	69.0	61.2
Don't know	0.0	0.0	0.0	0.0	0.0	0.0
<b>b) Do you have a safe and private place to meet with girls and young women who are like you</b>						
Yes	28.0	65.0	28.1	64.4	27.9	65.9
No	68.7	34.1	67.7	34.8	69.9	32.9
Don't know	3.3	0.9	4.2	0.8	2.2	1.2
<b>d) Do you have at least one trusted female friend?</b>						
Yes	75.1	78.2	75.1	78.2	75.1	78.3
No	24.7	21.5	24.6	21.6	24.9	21.3
Don't know	0.2	0.3	0.4	0.3	0.0	0.4
<b>e) Do you know a woman in your community, other than a mother or guardian, whom you could turn to if you had a serious problem</b>						
Yes	47.7	49.3	44.9	46.1	51.1	54.3
No	51.8	50.1	54.4	53.4	48.5	45.0
Don't know	0.6	0.6	0.7	0.5	0.4	0.8

**Supplementary file 2. Proportions with different aspects of social support\* in 2019, by invitation to DREAMS and age group, among those followed-up in 2019**

	Age 15-22		Age 15-17		Age 18-22	
	Never invited (N=224) % (col)	Invited by 2018 (N=628) % (col)	Never invited (N=95) % (col)	Invited by 2018 (N=369) % (col)	Never invited (N=129) % (col)	Invited by 2018 (N=259) % (col)
<b>a) Is there a female in your community from whom you can borrow money in an emergency?</b>						
Yes	50.4	56.8	47.4	57.2	52.7	56.4
No	49.1	43.2	51.6	42.8	47.3	43.6
Don't know	0.4	0.0	1.1	0.0	0.0	0.0
<b>b) Do you have a safe and private place to meet with girls and young women who are like you?</b>						
Yes	40.2	59.2	42.1	59.3	38.8	59.1
No	58.5	40.4	56.8	40.7	59.7	40.2
Don't know	1.3	0.3	1.1	0.0	1.6	0.8
<b>d) Do you have at least one trusted female friend?</b>						
Yes	76.8	82.6	75.8	87.0	77.5	76.4
No	22.8	17.2	23.2	13.0	22.5	23.2
Don't know	0.4	0.2	1.1	0.0	0.0	0.4
<b>e) Do you know a woman in your community, other than a mother or guardian, whom you could turn to if you had a serious problem?</b>						
Yes	62.1	65.8	56.8	66.1	65.9	65.3
No	37.9	34.2	43.2	33.9	34.1	34.7
Don't know	0.0	0.0	0.0	0.0	0.0	0.0

\*Responses to each of the questions shown were combined into composite social support binary outcome

**Supplementary file 2. Proportions with different aspects of social support\* in 2018, by invitation to DREAMS and age group, among those followed-up in 2018**

**b(ii). Nairobi**

	Age 15-22		Age 15-17		Age 18-22	
	Never invited (N=212) % (col)	Invited by 2018 (N=624) % (col)	Never invited (N=94) % (col)	Invited by 2018 (N=370) % (col)	Never invited (N=118) % (col)	Invited by 2018 (N=252) % (col)
<b>a) Is there a female in your community from whom you can borrow money in an emergency?</b>						
Yes	51.9	57.8	51.1	57.8	52.6	57.8
No	47.6	41.7	47.9	41.4	47.4	42.2
Don't know	0.5	0.5	1.1	0.8	0.0	0.0
<b>b) Do you have a safe and private place to meet with girls and young women who are like you?</b>						
Yes	33.3	54.6	25.5	56.5	39.7	51.8
No	66.7	45.3	74.5	43.3	60.3	48.2
Don't know	0.0	0.2	0.0	0.3	0.0	0.0
<b>d) Do you have at least one trusted female friend?</b>						
Yes	72.4	77.9	77.7	80.9	68.1	73.5
No	27.6	22.1	22.3	19.1	31.9	26.5
Don't know	0.0	0.0	0.0	0.0	0.0	0.0
<b>e) Do you know a woman in your community, other than a mother or guardian, whom you could turn to if you had a serious problem?</b>						
Yes	52.9	61.0	46.8	60.2	57.8	62.3
No	47.1	39.0	53.2	39.8	42.2	37.8
Don't know	0.0	0.0	0.0	0.0	0.0	0.0

**Supplementary file 2. Proportions with different aspects of social support\* in 2019, by invitation to DREAMS and age group, among those followed-up in 2019**

**c(i).uMkhanyakude**

	Age 13-22		Age 13-17		Age 18-22	
	Never invited (N=809) % (col)	Invited by 2018 (N=903) % (col)	Never invited (N=364) % (col)	Invited by 2018 (N=608) % (col)	Never invited (N=445) % (col)	Invited by 2018 (N=295) % (col)
<b>a) Is there a female in your community from whom you can borrow money in an emergency?</b>						
Yes	56.5	54.6	48.6	50.3	62.9	63.4
No	43.4	45.3	51.4	49.5	36.9	36.6
Don't know/prefer not to answer	0.1	0.1	0.0	0.2	0.2	0.0
<b>b) Do you have a safe and private place to meet with girls and young women who are like you?</b>						
Yes	21.1	27.1	26.1	31.4	17.1	18.3
No	78.0	72.6	73.1	68.4	82.0	81.4
Don't know/prefer not to answer	0.9	0.2	0.8	0.2	0.9	0.3
<b>d) Do you have at least one trusted female friend?</b>						
Yes	78.1	82.5	83.0	87.3	74.2	72.5
No	21.8	17.2	17.0	12.5	25.6	26.8
Don't know/prefer not to answer	0.1	0.3	0.0	0.2	0.2	0.7
<b>e) Do you know a woman in your community, other than a mother or guardian, whom you could turn to if you had a serious problem?</b>						
Yes	69.2	68.5	69.2	68.4	69.2	68.8
No	30.7	30.9	30.5	31.1	30.8	30.5
Don't know/prefer not to answer	0.1	0.6	0.3	0.5	0.0	0.7

\*Responses to each of the questions shown were combined into composite social support binary outcome

**Supplementary file 2. Proportions with different aspects of social support\* in 2018, by invitation to DREAMS and age group, among those followed-up in 2018**

**c(ii).uMkhanyakude**

	Age 13-22		Age 13-17		Age 18-22	
	Never invited (N=886) % (col)	Invited by 2018 (N=966) % (col)	Never invited (N=389) % (col)	Invited by 2018 (N=651) % (col)	Never invited (N=497) % (col)	Invited by 2018 (N=315) % (col)
<b>a) Is there a female in your community from whom you can borrow money in an emergency?</b>						
Yes	56.7	51.3	53.2	47.6	59.4	59.0
No	42.8	48.3	46.3	52.1	40.0	40.6
Don't know/prefer not to answer	0.6	0.3	0.5	0.3	0.6	0.3
<b>b) Do you have a safe and private place to meet with girls and young women who are like you?</b>						
Yes	14.1	34.8	17.7	41.3	11.3	21.3
No	85.7	65.1	82.3	58.5	88.3	78.7
Don't know/prefer not to answer	0.2	0.1	0.0	0.2	0.4	0.0
<b>d) Do you have at least one trusted female friend?</b>						
Yes	79.0	81.7	84.6	83.9	74.6	77.1
No	20.8	18.3	15.4	16.1	24.9	22.9
Don't know/prefer not to answer	0.2	0.0	0.0	0.0	0.4	0.0
<b>e) Do you know a woman in your community, other than a mother or guardian, whom you could turn to if you had a serious problem?</b>						
Yes	66.1	64.5	68.1	64.4	64.6	64.8
No	33.7	35.5	31.9	35.6	35.2	35.2
Don't know/prefer not to answer	0.1	0.0	0.0	0.0	0.2	0.0

**Supplementary file 3. Distribution of responses to each statement from the general self efficacy scale in 2018, by age group and invitation to participate in DREAMS, among AGYW followed up in 2019.**

**a(i). Gem**

	Overall	Age group at cohort enrolment		Invited to DREAMS in 2018	
	Total (N=1171) %	13-17 (N=684) %	18-22 (N=487) %	Never invited (N=514) %	Invited in 2018 (N=657) %
<b>I can always solve difficult problems if I try hard enough</b>					
Not at all true	14.2	17.3	9.9	12.5	15.5
Hardly true	12.5	14.2	10.1	13	12
Moderately true	22.5	21.8	23.4	24.9	20.5
Exactly sure	50.9	46.8	56.7	49.6	51.9
<b>If someone is against me (opposes me), I can find the means and ways to get what I want</b>					
Not at all true	14.8	17.1	11.5	15.8	14
Hardly true	13.7	15.5	11.1	13.4	13.9
Moderately true	22.7	22.4	23.2	25.7	20.4
Exactly sure	48.8	45	54.2	45.1	51.8
<b>It is easy for me to stick to my aims and accomplish my goals</b>					
Not at all true	7.7	9.8	4.7	7.8	7.6
Hardly true	8	9.9	5.3	8.8	7.5
Moderately true	17.9	18.7	16.8	18.3	17.7
Exactly sure	66.4	61.5	73.1	65.2	67.3
<b>I am confident that I could handle unexpected events well</b>					
Not at all true	13.2	16.8	8	13.4	12.9
Hardly true	11.4	12	10.7	11.5	11.4
Moderately true	25.2	25.1	25.3	26.7	24
Exactly sure	50.2	46.1	56.1	48.4	51.6
<b>Thanks to my resourcefulness, I know how to manage unexpected (unforeseen) situations</b>					
Not at all true	13.1	16.2	8.6	15.8	11
Hardly true	12.6	13.5	11.3	11.7	13.2
Moderately true	28.1	27	29.6	27.4	28.6
Exactly sure	46.3	43.3	50.5	45.1	47.2
<b>I can solve most problems if I make the necessary effort</b>					
Not at all true	10.4	14.9	4.1	9.1	11.4
Hardly true	10.2	11.5	8.2	11.5	9.1
Moderately true	21.7	22.4	20.7	22.8	20.9
Exactly sure	57.7	51.2	66.9	56.6	58.6
<b>I can remain calm when facing difficulties because I can rely on my own coping abilities</b>					
Not at all true	16.6	20.5	11.1	14.8	18
Hardly true	12.9	13.9	11.5	13.8	12.2
Moderately true	22.3	21.2	23.8	20.2	23.9
Exactly sure	48.2	44.4	53.6	51.2	46
<b>When I am faced with a problem, I can usually find several solutions</b>					
Not at all true	14.5	18.7	8.6	12.8	15.8
Hardly true	12	13.5	9.9	13.6	10.7
Moderately true	23.1	22.1	24.4	25.5	21.2
Exactly sure	50.5	45.8	57.1	48.1	52.4
<b>If I am in trouble, I can usually think of a solution</b>					
Not at all true	10.2	13.9	4.9	9.9	10.4
Hardly true	9.8	11.3	7.8	11.1	8.8
Moderately true	21.9	22.8	20.7	24.1	20.2
Exactly sure	58.1	52	66.5	54.9	60.6
<b>I can usually handle whatever comes my way</b>					
Not at all true	26.5	31.3	19.7	26.1	26.8
Hardly true	14.9	14.8	15.2	15.8	14.3
Moderately true	24.9	22.2	28.5	26.3	23.7
Exactly sure	33.7	31.7	36.6	31.9	35.2

**Supplementary file 3. Distribution of responses to each statement from the general self efficacy scale in 2019, by age group and invitation to participate in DREAMS, among AGYW followed up in 2019.**

**a(ii). Gem**

	Overall	Age group at cohort enrolment		Invited to DREAMS in 2018	
	Total (N=1018) %	13-17 (N=622) %	18-22 (N=396) %	Never invited (N=436) %	Invited in 2018 (N=582) %
<b>I can always solve difficult problems if I try hard enough</b>					
Not at all true	10.3	12.2	7.3	9.4	11.0
Hardly true	13.6	15.6	10.4	13.8	13.4
Moderately true	25.1	24.6	26.0	25.9	24.6
Exactly sure	51.0	47.6	56.3	50.9	51.0
<b>If someone is against me (opposes me), I can find the means and ways to get what I want</b>					
Not at all true	11.7	12.4	10.6	9.6	13.2
Hardly true	12.8	14.1	10.6	12.8	12.7
Moderately true	22.4	21.2	24.2	22.5	22.3
Exactly sure	53.1	52.3	54.5	55.0	51.7
<b>It is easy for me to stick to my aims and accomplish my goals</b>					
Not at all true	4.0	4.2	3.8	3.9	4.1
Hardly true	10.8	11.4	9.8	10.3	11.2
Moderately true	18.5	18.8	17.9	17.0	19.6
Exactly sure	66.7	65.6	68.4	68.8	65.1
<b>I am confident that I could handle unexpected events well</b>					
Not at all true	9.1	10.1	7.6	10.6	8.1
Hardly true	16.1	17.0	14.6	15.1	16.8
Moderately true	26.4	25.2	28.3	28.2	25.1
Exactly sure	48.3	47.6	49.5	46.1	50.0
<b>Thanks to my resourcefulness, I know how to manage unexpected (unforeseen) situations</b>					
Not at all true	9.9	12.1	6.6	11.9	8.4
Hardly true	18.3	20.3	15.2	18.3	18.2
Moderately true	27.7	25.2	31.6	27.8	27.7
Exactly sure	44.1	42.4	46.7	42.0	45.7
<b>I can solve most problems if I make the necessary effort</b>					
Not at all true	7.1	8.7	4.5	6.0	7.9
Hardly true	10.5	12.4	7.6	9.4	11.3
Moderately true	24.8	24.0	26.0	25.5	24.2
Exactly sure	57.7	55.0	61.9	59.2	56.5
<b>I can remain calm when facing difficulties because I can rely on my own coping abilities</b>					
Not at all true	16.1	19.1	11.4	19.3	13.7
Hardly true	16.6	18.6	13.4	15.1	17.7
Moderately true	24.3	22.3	27.3	22.9	25.3
Exactly sure	43.0	39.9	48.0	42.7	43.3
<b>When I am faced with a problem, I can usually find several solutions</b>					
Not at all true	9.6	11.1	7.3	10.6	8.9
Hardly true	11.6	12.4	10.4	12.2	11.2
Moderately true	27.3	27.8	26.5	26.8	27.7
Exactly sure	51.5	48.7	55.8	50.5	52.2
<b>If I am in trouble, I can usually think of a solution</b>					
Not at all true	5.3	6.8	3.0	5.3	5.3
Hardly true	9.4	10.5	7.8	7.6	10.8
Moderately true	24.6	24.9	24.0	23.9	25.1
Exactly sure	60.7	57.9	65.2	63.3	58.8
<b>I can usually handle whatever comes my way</b>					
Not at all true	24.4	27.2	19.9	25.5	23.5
Hardly true	17.6	19.1	15.2	17.7	17.5
Moderately true	26.6	23.2	32.1	26.1	27.0
Exactly sure	31.4	30.5	32.8	30.7	32.0

**Supplementary file 3. Distribution of responses to each statement from the general self efficacy scale in 2018, by age group and invitation to participate in DREAMS, among AGYW followed up in 2019.**

**b(i). Nairobi**

	Overall	Age group at cohort enrolment		Invited to DREAMS by 2018	
	Total (N=836) %	15-17 (N=466) %	18-22 (N=370) %	Never invited (N=212) %	Invited by 2018 (N=624) %
<b>I can always solve difficult problems if I try hard enough</b>					
Not sure	2	2.6	1.4	2.8	1.8
Not at all true	2.6	2.4	3.0	3.3	2.4
Hardly true	6.6	6.9	6.2	6.1	6.7
Moderately true	23.6	22.7	24.6	20.8	24.5
Exactly sure	64.6	65.5	63.5	66.0	64.1
Missing	0.6	0	1.4	0.9	0.5
<b>If someone is against me (opposes me), I can find the means and ways to get what I want</b>					
Not sure	3.2	3	3.5	5.2	2.6
Not at all true	8.9	7.7	10.3	14.2	7.1
Hardly true	11.7	12.9	10.3	10.4	12.2
Moderately true	20.5	21.5	19.2	20.8	20.4
Exactly sure	55.1	54.9	55.4	48.6	57.4
Missing	0.6	0	1.4	0.9	0.5
<b>It is easy for me to stick to my aims and accomplish my goals</b>					
Not sure	1.6	1.7	1.4	2.4	1.3
Not at all true	3.9	3.6	4.3	6.6	3.0
Hardly true	6.6	6	7.3	7.5	6.3
Moderately true	17.7	16.3	19.5	18.4	17.5
Exactly sure	69.6	72.3	66.2	64.2	71.5
Missing	0.6	0	1.4	0.9	0.5
<b>I am confident that I could handle unexpected events well</b>					
Not sure	4.2	4.5	3.8	5.2	3.8
Not at all true	5.1	4.7	5.7	7.5	4.3
Hardly true	11	10.9	11.1	10.8	11.1
Moderately true	28.8	28.1	29.7	29.2	28.7
Exactly sure	50.2	51.7	48.4	46.2	51.6
Missing	0.6	0	1.4	0.9	0.5
<b>Thanks to my resourcefulness, I know how to manage unexpected (unforeseen) situations</b>					
Not sure	3.5	3.9	3.0	4.2	3.2
Not at all true	5.5	4.9	6.2	7.1	5.0
Hardly true	11.2	12.2	10.0	9.9	11.7
Moderately true	28.1	27.5	28.9	26.9	28.5
Exactly sure	51.1	51.5	50.5	50.9	51.1
Missing	0.6	0	1.4	0.9	0.5
<b>I can solve most problems if I make the necessary effort</b>					
Not sure	1.3	1.9	0.5	2.4	1.0
Not at all true	2.5	1.7	3.5	3.8	2.1
Hardly true	7.5	6.9	8.4	6.1	8.0
Moderately true	19.7	19.7	19.7	21.2	19.2
Exactly sure	68.3	69.7	66.5	65.6	69.2
Missing	0.6	0	1.4	0.9	0.5
<b>I can remain calm when facing difficulties because I can rely on my own coping abilities</b>					
Not sure	2.3	2.6	1.9	3.3	1.9
Not at all true	5.1	4.7	5.7	7.1	4.5
Hardly true	8.0	8.6	7.3	8.5	7.9
Moderately true	23.6	25.5	21.1	21.2	24.4
Exactly sure	60.4	58.6	62.7	59	60.9
Missing	0.6	0	1.4	0.9	0.5
<b>When I am faced with a problem, I can usually find several solutions</b>					
Not sure	1.4	1.1	1.9	2.4	1.1
Not at all true	4.4	3.2	5.9	6.6	3.7
Hardly true	7.5	8.8	5.9	9.9	6.7
Moderately true	27	28.1	25.7	27.4	26.9
Exactly sure	59	58.8	59.2	52.8	61.1
Missing	0.6	0	1.4	0.9	0.5
<b>If I am in trouble, I can usually think of a solution</b>					
Not sure	1.2	1.3	1.1	1.9	1
Not at all true	3	2.6	3.5	3.8	2.7
Hardly true	5.4	6.4	4.1	5.2	5.4
Moderately true	23.2	24	22.2	24.5	22.8
Exactly sure	66.6	65.7	67.8	63.7	67.6
Missing	0.6	0	1.4	0.9	0.5
<b>I can usually handle whatever comes my way</b>					
Not sure	2.8	3	2.4	3.8	2.4
Not at all true	6.6	5.6	7.8	9	5.8
Hardly true	10	12	7.6	10.4	9.9
Moderately true	28.7	28.8	28.6	28.8	28.7
Exactly sure	51.3	50.6	52.2	47.2	52.7
Missing	0.6	0	1.4	0.9	0.5

**Supplementary file 3. Distribution of responses to each statement from the general self efficacy scale in 2019, by age group and invitation to participate in DREAMS, among AGYW followed up in 2019.**

**b(ii). Nairobi**

	Overall	Age group at cohort enrolment		Invited to DREAMS by 2018	
	Total (N=852) %	15-17 (N=464) %	18-22 (N=388) %	Never invited (N=224) %	Invited by 2018 (N=628) %
<b>I can always solve difficult problems if I try hard enough</b>					
Not sure	3.1	3.2	2.8	3.6	2.9
Not at all true	2.3	2.6	2.1	1.8	2.5
Hardly true	7.7	9.3	5.9	8.9	7.3
Moderately true	20.7	17.5	24.5	25.9	18.8
Exactly sure	66.2	67.5	64.7	59.8	68.5
<b>If someone is against me (opposes me), I can find the means and ways to get what I want</b>					
Not sure	2.5	2.4	2.6	2.7	2.4
Not at all true	7	7.5	6.4	8	6.7
Hardly true	12.7	11.2	14.4	15.2	11.8
Moderately true	22.3	22	22.7	23.2	22.0
Exactly sure	55.5	56.9	53.9	50.9	57.2
<b>It is easy for me to stick to my aims and accomplish my goals</b>					
Not sure	1.3	1.3	1.3	1.8	1.1
Not at all true	1.9	2.4	1.3	0.9	2.2
Hardly true	8.1	8.2	8	8.5	8.0
Moderately true	20.1	18.3	22.2	27.2	17.5
Exactly sure	68.7	69.8	67.3	61.6	71.2
<b>I am confident that I could handle unexpected events well</b>					
Not sure	5.2	5.6	4.6	4	5.6
Not at all true	3.9	5.2	2.3	3.1	4.1
Hardly true	9.4	8.8	10.1	9.8	9.2
Moderately true	25.5	26.3	24.5	32.1	23.1
Exactly sure	56.1	54.1	58.5	50.9	58.0
<b>Thanks to my resourcefulness, I know how to manage unexpected (unforeseen) situations</b>					
Not sure	3.6	3.4	3.9	3.1	3.8
Not at all true	4.5	5.2	3.6	2.2	5.3
Hardly true	12.1	12.3	11.9	16.5	10.5
Moderately true	25.5	24.1	27.1	29.5	24.0
Exactly sure	54.3	55	53.6	48.7	56.4
<b>I can solve most problems if I make the necessary effort</b>					
Not sure	0.8	0.6	1	0	1.1
Not at all true	2.3	2.2	2.6	1.8	2.5
Hardly true	7.7	9.3	5.9	8	7.6
Moderately true	19.8	17.9	22.2	23.2	18.6
Exactly sure	69.2	70	68.3	67.0	70.1
<b>I can remain calm when facing difficulties because I can rely on my own coping abilities</b>					
Not sure	3.6	3.7	3.6	4	3.5
Not at all true	5.2	6.5	3.6	3.6	5.7
Hardly true	8.8	9.3	8.2	7.1	9.4
Moderately true	22.7	22	23.5	22.8	22.6
Exactly sure	59.7	58.6	61.1	62.5	58.8
<b>When I am faced with a problem, I can usually find several solutions</b>					
Not sure	2.7	2.6	2.8	1.8	3.0
Not at all true	2.3	2.6	2.1	3.1	2.1
Hardly true	11.2	12.9	9	11.6	11.0
Moderately true	23.6	23.3	24	25.4	22.9
Exactly sure	60.2	58.6	62.1	58	61.0
<b>If I am in trouble, I can usually think of a solution</b>					
Not sure	2.3	2.4	2.3	2.2	2.4
Not at all true	1.9	2.4	1.3	2.7	1.6
Hardly true	7.7	8.8	6.4	9.8	7.0
Moderately true	21.1	20	22.4	25.9	19.4
Exactly sure	66.9	66.4	67.5	59.4	69.6
<b>I can usually handle whatever comes my way</b>					
Not sure	3.5	4.5	2.3	2.7	3.8
Not at all true	4.7	4.7	4.6	4	4.9
Hardly true	10.9	11.2	10.6	12.1	10.5
Moderately true	28.4	27.8	29.1	33.9	26.4
Exactly sure	52.5	51.7	53.4	47.3	54.3

**Supplementary file 3. Distribution of responses to each statement from the general self efficacy scale in 2018, by age group and invitation to participate in DREAMS, among AGYW followed up in 2019.**

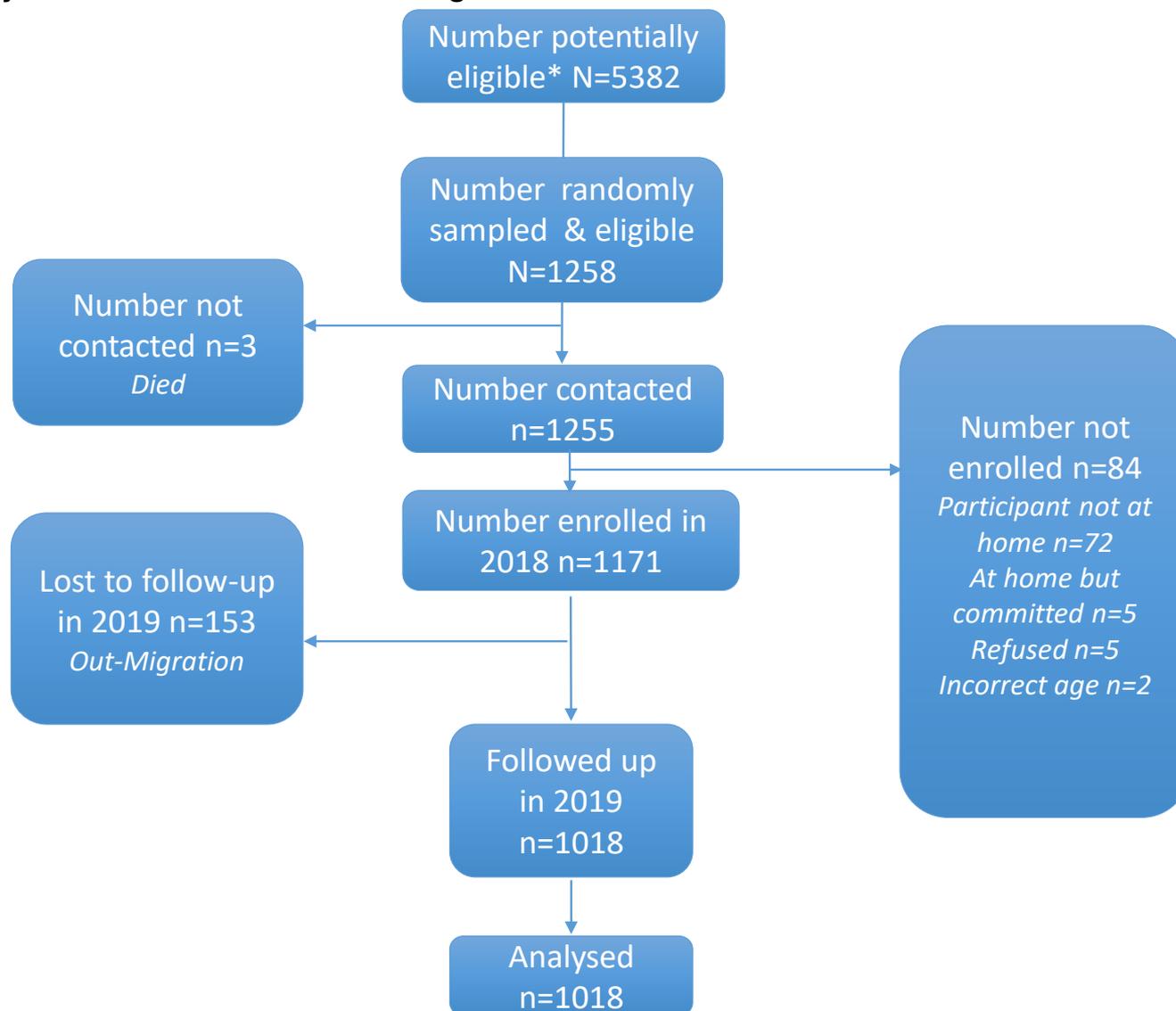
**c(i). uMkhanyakude**

	Overall	Age group at cohort enrolment		Invited to DREAMS by 2018	
	Total (N=1853) %	13-17 (N=1041) %	18-22 (N=812) %	Never invited (N=886) %	Invited by 2018 (N=967) %
<b>I can always solve difficult problems if I try hard enough</b>					
Not at all true	22.5	25.3	18.8	22.9	22
Hardly true	14.1	14.9	13.1	13.5	14.6
Moderately true	11.6	12.7	10.2	13.2	10.1
Exactly sure	51.9	47.2	57.9	50.3	53.3
<b>If someone is against me (opposes me), I can find the means and ways to get what I want</b>					
Not at all true	20.5	21.9	18.6	21.4	19.5
Hardly true	15.3	17.6	12.3	14.9	15.6
Moderately true	11.3	12.2	10.1	11.9	10.8
Exactly sure	53	48.3	59	51.8	54.1
<b>It is easy for me to stick to my aims and accomplish my goals</b>					
Not at all true	14.4	14.5	14.2	15.3	13.4
Hardly true	11.8	12.6	10.7	13	10.7
Moderately true	10	10.8	9.1	11.5	8.7
Exactly sure	63.8	62.2	66	60.2	67.2
<b>I am confident that I could handle unexpected events well</b>					
Not at all true	17.2	17.8	16.5	17.9	16.5
Hardly true	11.8	13.4	9.6	11.4	12.1
Moderately true	11.5	13.1	9.6	13.7	9.6
Exactly sure	59.5	55.7	64.3	57	61.7
<b>Thanks to my resourcefulness, I know how to manage unexpected (unforeseen) situations</b>					
Not at all true	19.4	21.6	16.5	19.9	18.9
Hardly true	12.3	12.9	11.5	12	12.5
Moderately true	12.3	13.3	11	13.1	11.5
Exactly sure	56.1	52.3	61.1	55.1	57.1
<b>I can solve most problems if I make the necessary effort</b>					
Not at all true	26.6	29.7	22.5	27.7	25.5
Hardly true	12.4	12	12.9	11.5	13.2
Moderately true	10.7	11	10.5	12	9.6
Exactly sure	50.3	47.4	54.1	48.9	51.6
<b>I can remain calm when facing difficulties because I can rely on my own coping abilities</b>					
Not at all true	12.8	12.8	12.8	12.9	12.7
Hardly true	10.7	11.6	9.5	10.5	10.9
Moderately true	9.8	11.5	7.6	10.8	8.9
Exactly sure	66.7	64.1	70.1	65.8	67.5
<b>When I am faced with a problem, I can usually find several solutions</b>					
Not at all true	10.4	12.9	7.1	9.7	11
Hardly true	14.3	14.7	13.8	14.3	14.3
Moderately true	10.8	12.3	8.9	11.2	10.4
Exactly sure	64.5	60.1	70.2	64.8	64.3
<b>If I am in trouble, I can usually think of a solution</b>					
Not at all true	12.4	15.1	9	11.4	13.3
Hardly true	13.4	13	14	13.9	13
Moderately true	11.4	12.9	9.6	12.1	10.9
Exactly sure	62.7	59.1	67.4	62.6	62.8
<b>I can usually handle whatever comes my way</b>					
Not at all true	25.4	25.4	25.4	28.7	22.3
Hardly true	11.6	13.8	8.7	10.7	12.4
Moderately true	11.9	13.3	10.2	13.1	10.9
Exactly sure	51.1	47.6	55.7	47.5	54.4

**Supplementary file 3. Distribution of responses to each statement from the general self efficacy scale in 2019, by age group and invitation to participate in DREAMS, among AGYW followed up in 2019.**

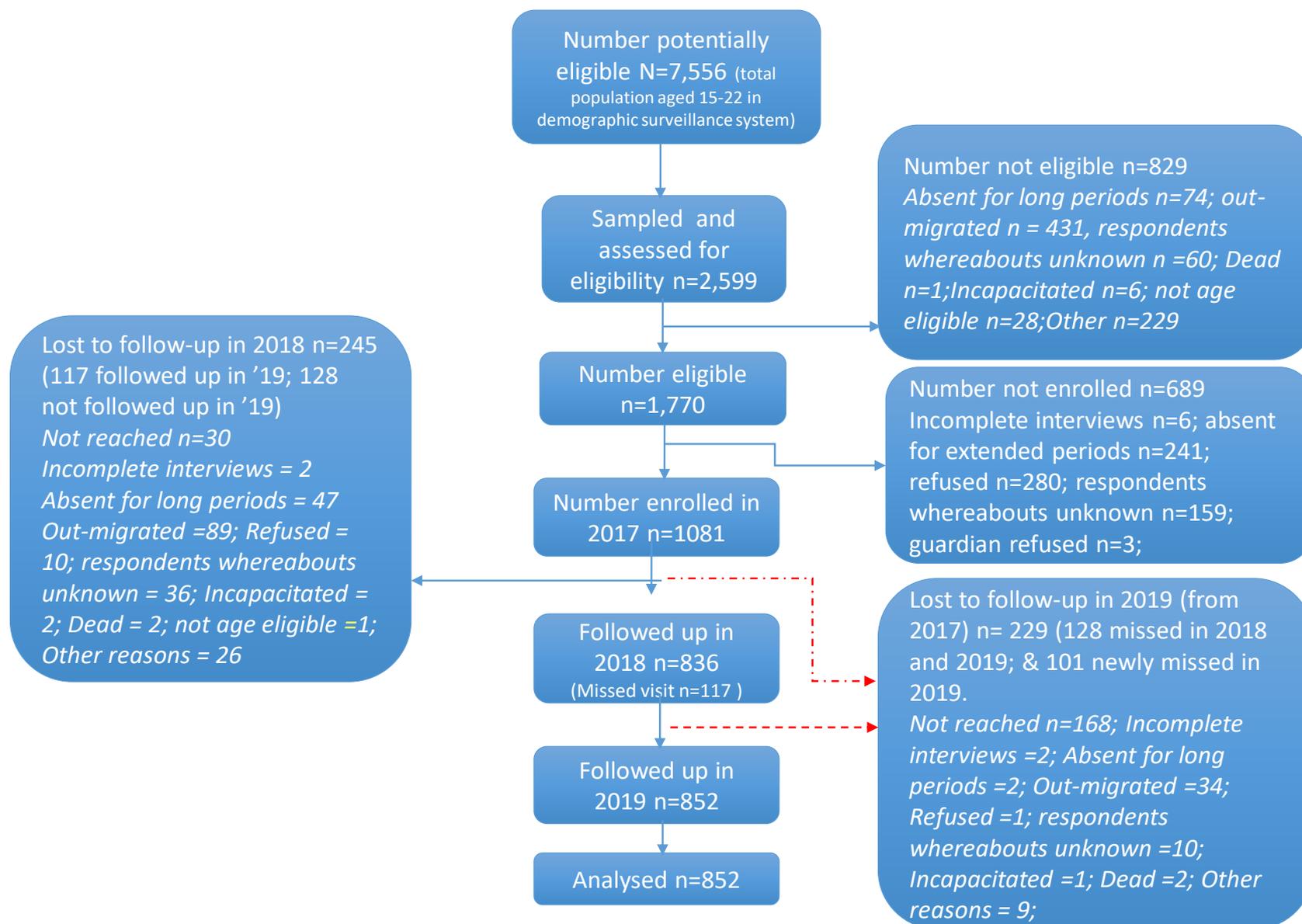
**c(ii). uMkhanyakude**

	Overall	Age group at cohort enrolment		Invited to DREAMS by 2018	
	Total (N=1712) %	13-17 (N=972) %	18-22 (N=740) %	Never invited (N=809) %	Invited by 2018 (N=903) %
<b>I can always solve difficult problems if I try hard enough</b>					
Not at all true	19.9	24.4	13.9	20.4	19.4
Hardly true	8.7	9.6	7.6	9.3	8.2
Moderately true	17.2	17.6	16.6	16.4	17.8
Exactly sure	54.3	48.5	61.9	53.9	54.6
<b>If someone is against me (opposes me), I can find the means and ways to get what I want</b>					
Not at all true	17.5	18.5	16.2	18.4	16.7
Hardly true	11.2	12.8	9.1	10.9	11.4
Moderately true	15.2	15.7	14.6	16.2	14.4
Exactly sure	56.1	53	60.1	54.5	57.5
<b>It is easy for me to stick to my aims and accomplish my goals</b>					
Not at all true	10	10.1	10	10	10.1
Hardly true	9.9	11.4	8	10.1	9.7
Moderately true	13.4	13.4	13.5	15.7	11.4
Exactly sure	66.6	65.1	68.5	64.2	68.8
<b>I am confident that I could handle unexpected events well</b>					
Not at all true	14	16.4	10.9	13.8	14.2
Hardly true	10.6	12.4	8.1	10.6	10.5
Moderately true	16.5	17.3	15.5	17.8	15.4
Exactly sure	58.9	53.9	65.4	57.7	59.9
<b>Thanks to my resourcefulness, I know how to manage unexpected (unforeseen) situations</b>					
Not at all true	16.4	19.7	12	16.8	15.9
Hardly true	11.6	13	9.9	11.5	11.7
Moderately true	17	17.5	16.4	18	16.1
Exactly sure	55	49.9	61.8	53.6	56.3
<b>I can solve most problems if I make the necessary effort</b>					
Not at all true	18.8	22.7	13.6	18.9	18.7
Hardly true	13.3	13.8	12.6	14.1	12.5
Moderately true	15.1	15.3	14.7	15.2	15
Exactly sure	52.9	48.1	59.1	51.8	53.8
<b>I can remain calm when facing difficulties because I can rely on my own coping abilities</b>					
Not at all true	8.4	9.6	6.8	8.7	8.1
Hardly true	10.3	11.8	8.2	10.8	9.9
Moderately true	12.8	13.1	12.4	13.7	12
Exactly sure	68.6	65.5	72.6	66.9	70.1
<b>When I am faced with a problem, I can usually find several solutions</b>					
Not at all true	7	9.1	4.2	6.6	7.3
Hardly true	13.3	16	9.6	14.5	12.2
Moderately true	15.1	14.5	15.9	15.2	15.1
Exactly sure	64.7	60.4	70.3	63.8	65.4
<b>If I am in trouble, I can usually think of a solution</b>					
Not at all true	7.5	8.8	5.8	7.3	7.8
Hardly true	10.7	12.2	8.8	11.9	9.7
Moderately true	14.2	15.6	12.3	14.5	14
Exactly sure	67.5	63.3	73.1	66.4	68.5
<b>I can usually handle whatever comes my way</b>					
Not at all true	18.7	22.6	13.5	19.4	18.1
Hardly true	13.5	13.5	13.5	14.2	12.8
Moderately true	14.7	15.4	13.6	14.7	14.6
Exactly sure	53.2	48.5	59.3	51.7	54.5

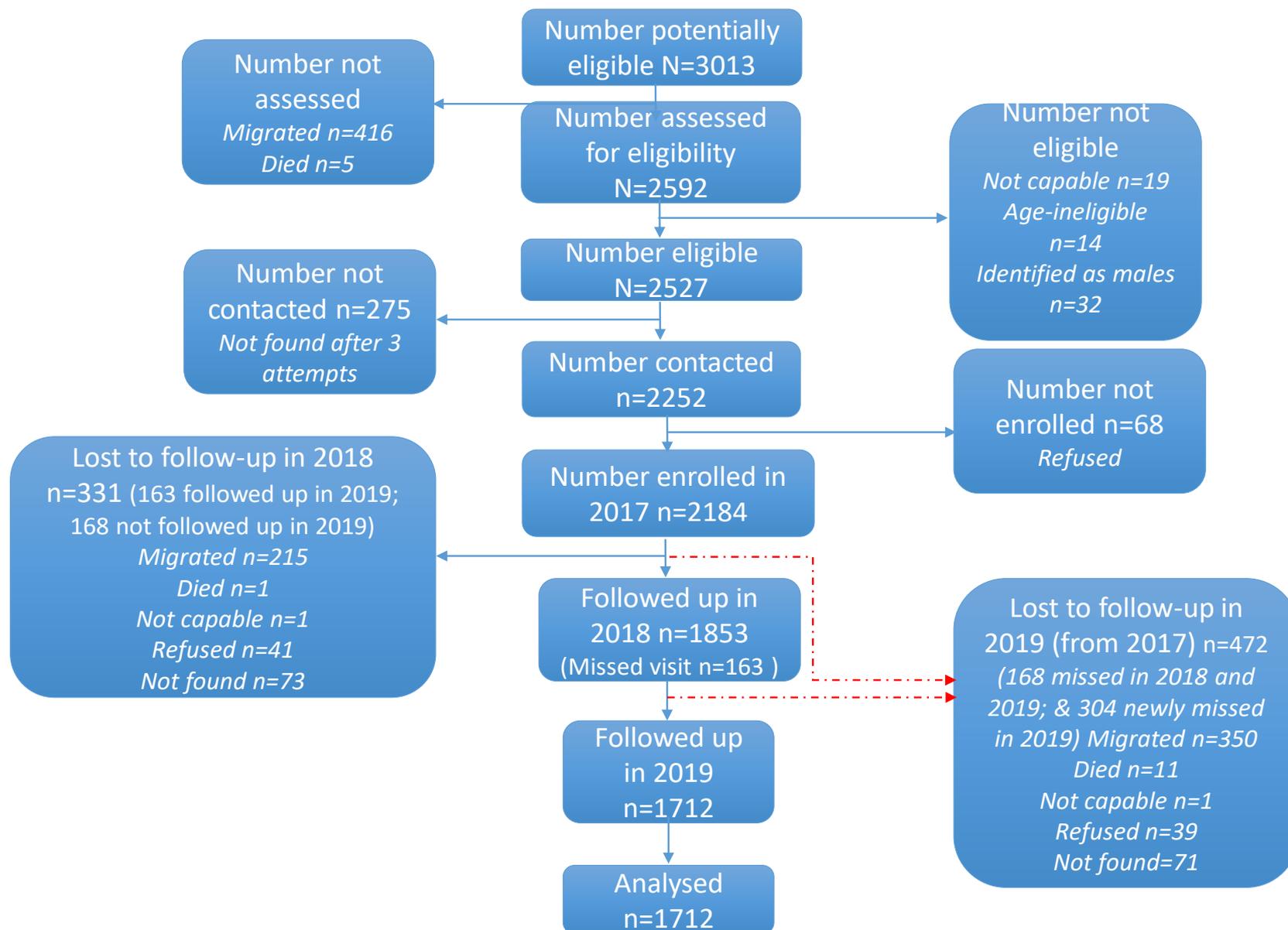
**Supplementary file 4a. AGYW Cohort flow diagram: Gem**

\*All AGYW aged 13-22 resident in 2018 in households participating in population-based surveys in the Gem demographic surveillance system

## Supplementary file 4b. AGYW cohort flow diagram: Nairobi



## Supplementary file 4c. AGYW Cohort flow diagram: uMkhanyakude



**Supplementary file 5: Proportions of AGYW retained in the study vs lost to follow up by 2019 (endline), by AGYW characteristics at study enrolment, in three settings**

**a. Gem**

Characteristics at enrolment in 2018	2018	2019		p value <sup>a</sup>
	Enrolled (N=1171) n (col%)	Followed up (N=1018) n (row %)	Lost to follow up (N=153) n (row %)	
<b>Invited in 2018</b>				
No	514 (43.9)	436 (84.8)	78 (15.2)	0.058
Yes	657 (56.1)	582 (88.6)	75 (11.4)	
<b>Age group</b>				
13-17	684 (58.4)	622 (90.9)	62 (9.1)	<0.001
18-22	487 (41.6)	396 (81.3)	91 (18.7)	
<b>Educational attainment</b>				
Primary/None	481 (41.1)	435 (90.4)	46 (9.6)	<0.001
Secondary and above	411 (35.1)	372 (90.5)	39 (9.5)	
Unknown	279 (23.8)	211 (75.6)	68 (24.4)	
<b>Socio-economic status</b>				
Low	480 (41.0)	424 (88.3)	56 (11.7)	0.361
Middle	223 (19.0)	195 (87.4)	28 (12.6)	
High	468 (40.0)	399 (85.3)	69 (14.7)	
<b>Food insecurity*</b>				
No	918 (78.4)	789 (85.9)	129 (14.1)	0.056
Yes	253 (21.6)	229 (90.5)	24 (9.5)	
<b>Ever had sex</b>				
No	766 (65.4)	701 (91.5)	65 (8.5)	<0.001
Yes	405 (34.6)	317 (78.3)	88 (21.7)	
<b>Ever been pregnant</b>				
No	956 (81.6)	859 (89.9)	97 (10.1)	<0.001
Yes	215 (18.4)	159 (74.0)	56 (26.0)	

a Chi square p-value comparing difference in proportions followed up between each category of characteristics at enrolment

\* Food insecurity was defined based on this question; In the past 4 weeks, did you or any household member go to sleep at night hungry because there was not enough food? With responses(Yes, No)

**Supplementary file 5: Proportions of AGYW retained in the study vs lost to follow up by 2019 (endline), by AGYW characteristics at study enrolment, in three settings**

**b. Nairobi**

Characteristics at enrolment in 2017	2017		2019		p-value <sup>a</sup>
	Enrolled (N=1081)	Followed up (N=852)	Lost to follow up (N=229)		
	n (col %)	n (row %)	n (row %)		
<b>Invited in 2017</b>					
No	545 (50.4)	400 (73.4)	145 (26.6)		
Yes	536 (49.6)	452 (84.3)	84 (15.7)		<0.001
<b>Age group</b>					
15-17	547 (50.6)	464 (84.8)	83 (15.2)		
18-22	534 (49.4)	388 (72.7)	146 (27.3)		<0.001
<b>Currently in school</b>					
No	455 (42.1)	312 (68.6)	143 (31.4)		
Yes	626 (57.9)	540 (86.3)	86 (13.7)		<0.001
<b>Socio-economic status</b>					
Poor	361 (33.4)	303 (83.9)	58 (16.1)		
Medium	360 (33.3)	277 (76.9)	83 (23.1)		0.013
Wealthy	360 (33.3)	272 (75.6)	88 (24.4)		
<b>Food insecure*</b>					
No	730 (67.5)	564 (77.3)	166 (22.7)		
Yes	351 (32.5)	288 (82.1)	63 (17.9)		0.071
<b>Ever had sex</b>					
No	644 (59.6)	557 (86.5)	87 (13.5)		
Yes	437 (40.4)	295 (67.5)	142 (32.5)		<0.001
<b>Ever pregnant</b>					
No	782 (72.3)	647 (82.7)	135 (17.3)		
Yes	299 (27.7)	205 (68.6)	94 (31.4)		<0.001
<b>Marital status</b>					
Never married	843 (78.0)	695 (82.4)	148 (17.6)		
Ever married/co-habiting	238 (22.0)	157 (66.0)	81 (34.0)		<0.001

<sup>a</sup> Chi square p-value comparing difference in proportions followed up between each category of characteristics at enrolment

\* Food insecurity was defined as using the question: In the past 4 weeks, did you or any household member go to sleep at night hungry because there was not enough food? (yes, no)

**Supplementary file 5: Proportions of AGYW retained in the study vs lost to follow up by 2019 (endline), by AGYW characteristics at study enrolment, in three settings**

**c. uMkhanyakude**

Characteristics at enrolment in 2017	2017		2019		p-value <sup>a</sup>
	Enrolled (N=2184)	Followed up (N=1712)	Lost to follow-up (N=472)		
	n (col %)	n (row %)	n (row %)		
<b>Invited in 2017</b>					
Yes	639 (29.3)	528 (82.6)	111 (17.4)		
No	1545 (70.7)	1184 (76.6)	361 (23.4)		0.002
<b>Age group</b>					
13-14	460 (21.1)	414 (90.0)	46 (10.0)		
15-17	688 (31.5)	558 (81.1)	130 (18.9)		
18-19	475 (21.8)	348 (73.3)	127 (26.7)		
20-22	561 (25.7)	392 (69.9)	169 (30.1)		<0.001
<b>Currently in school</b>					
No	540 (24.7)	359 (66.5)	181 (33.5)		
Yes	1644 (75.3)	1353 (82.3)	291 (17.7)		<0.001
<b>Socio-economic status*</b>					
Low	727 (35.1)	592 (81.4)	135 (18.6)		
Middle	747 (36.0)	576 (77.1)	171 (22.9)		
High	600 (28.9)	479 (79.8)	121 (20.2)		0.116
<b>Food insecurity**</b>					
No	1497 (68.7)	1175 (78.5)	322 (21.5)		
Yes	682 (31.3)	532 (78.0)	150 (22.0)		0.799
<b>Ever had sex</b>					
No	1278 (59.8)	1063 (83.2)	215 (16.8)		
Yes	861 (40.3)	615 (71.4)	246 (28.6)		<0.001
<b>Ever pregnant</b>					
No	1576 (73.0)	1275 (80.9)	301 (19.1)		
Yes	583 (27.0)	420 (72.0)	163 (28.0)		<0.001
<b>Migrated***</b>					
No	1781 (81.6)	1432 (80.4)	349 (19.6)		
Yes	403 (18.5)	280 (69.5)	123 (30.5)		<0.001

a Chi square p-value comparing difference in proportions followed up between each category of characteristics at enrolment

\*110 missing values

\*\* Food insecurity was defined as any report of reducing the size of food portions or skipping meals by any member of a household because there was not enough money to buy food in the past 12 months

\*\*\*Migration was defined as any movement within or outside surveillance area since age of 13

**Supplementary file 6. Sociodemographic characteristics of DREAMS beneficiaries and non-beneficiaries at the time of cohort enrolment, by age-group, among those followed-up in 2019**

**a. Gem**

Characteristics at enrolment in 2018	Age 13-22			Age 13-17			Age 18-22		
	Overall (N=1018) % (col)	Never invited (N=436) % (col)	Invited in 2018 (N=582) % (col)	Overall (N=622) % (col)	Never invited (N=261) % (col)	Invited in 2018 (N=361) % (col)	Overall (N=396) % (col)	Never invited (N=175) % (col)	Invited in 2018 (N=221) % (col)
<b>Age</b>									
13-17	61.1	59.9	62.0						
18-22	38.9	40.1	38.0						
<b>Education completed</b>									
None/primary	42.7	40.1	44.7	57.4	52.1	61.2	19.7	22.3	17.6
Secondary/tertiary	36.5	32.8	39.3	23.3	23.4	23.3	57.3	46.9	65.6
Unknown	20.7	27.1	16.0	19.3	24.5	15.5	23.0	30.9	16.7
<b>Socio-economic status</b>									
Low	41.7	36.0	45.9	42.0	38.7	44.3	41.2	32.0	48.4
Middle	19.2	19.0	19.2	19.5	19.9	19.1	18.7	17.7	19.5
High	39.2	45.0	34.9	38.6	41.4	36.6	40.2	50.3	32.1
<b>Food insecure</b>									
No	77.5	82.6	73.7	79.4	83.5	76.5	74.5	81.1	69.2
Yes	22.5	17.4	26.3	20.6	16.5	23.5	25.5	18.9	30.8
<b>Orphanhood</b>									
No	60.4	59.4	61.2	63.7	62.8	64.3	55.3	54.3	56.1
Maternal	3.4	3.4	3.4	2.7	3.1	2.5	4.5	4.0	5.0
Paternal	9.0	8.3	9.6	8.5	9.2	8.0	9.8	6.9	12.2
Total	3.2	4.4	2.4	2.3	3.1	1.7	4.8	6.3	3.6
Unknown	23.9	24.5	23.4	22.8	21.8	23.5	25.5	28.6	23.1
<b>Sexual and pregnancy history</b>									
Never had sex	68.9	64.0	72.5	88.6	84.7	91.4	37.9	33.1	41.6
Ever sex, never pregnant	15.5	17.4	14.1	9.0	11.9	6.9	25.8	25.7	25.8
Ever pregnant	15.6	18.6	13.4	2.4	3.4	1.7	36.4	41.1	32.6

**Supplementary file 6. Sociodemographic characteristics of DREAMS beneficiaries and non-beneficiaries at the time of cohort enrolment, by age-group, among those followed-up in 2019**
**b. Nairobi**

Characteristics at enrolment in 2017	Age 15-22			Age 15-17			Age 18-22		
	Overall (N=852) % (col)	Never invited (N=224) % (col)	Invited by 2018 (N=628) % (col)	Overall (N=464) % (col)	Never invited (N=95) % (col)	Invited by 2018 (N=369) % (col)	Overall (N=388) % (col)	Never invited (N=129) % (col)	Invited by 2018 (N=259) % (col)
<b>Age</b>									
15-17	54.5	42.4	58.8						
18-22	45.5	57.6	41.2						
<b>DSS study site</b>									
Korogocho	60.2	63.8	58.9	60.8	72.6	57.7	59.5	57.4	60.6
Viwandani	39.8	36.2	41.1	39.2	27.4	42.3	40.5	42.6	39.4
<b>Ethnicity</b>									
Somali	8.9	7.1	9.6	9.9	5.3	11.1	7.7	8.5	7.3
Kamba	17.5	17.9	17.4	17.9	18.9	17.6	17	17.1	17
Kikuyu	31.9	27.2	33.6	32.5	31.6	32.8	31.2	24	34.7
Kisii	3.9	4.9	3.5	4.3	1.1	5.1	3.4	7.8	1.2
Luhya	15.8	16.1	15.8	16.4	16.8	16.3	15.2	15.5	15.1
Luo	15.7	17.4	15.1	14	18.9	12.7	17.8	16.3	18.5
Other	6.2	9.4	5.1	5	7.4	4.3	7.7	10.9	6.2
<b>Religion</b>									
Catholic	28.6	29.5	28.3	27.2	32.6	25.7	30.4	27.1	32
Other Christian	54.7	53.6	55.1	56	51.6	57.2	53.1	55	52.1
Muslim	14.4	15.2	14.2	14.7	13.7	14.9	14.2	16.3	13.1
No religion /other	2.2	1.8	2.4	2.2	2.1	2.2	2.3	1.6	2.7
<b>Currently in school</b>									
No	36.6	48.7	32.3	14.4	21.1	12.7	63.1	69	60.2
Yes	63.4	51.3	67.7	85.6	78.9	87.3	36.9	31	39.8
<b>Education completed</b>									
None/incomplete primary	10.8	13.4	9.9	14.2	20	12.7	6.7	8.5	5.8
Complete primary	20	24.1	18.5	22	27.4	20.6	17.5	21.7	15.4
Some secondary	48.1	33.9	53.2	60.1	45.3	64	33.8	25.6	37.8
Complete secondary/tertiary	21.1	28.6	18.5	3.7	7.4	2.7	42	44.2	40.9
<b>Self assessed household poverty</b>									
Very poor	13.5	10.3	14.6	12.5	8.4	13.6	14.7	11.6	16.2
Moderately poor	78.9	80.4	78.3	79.3	83.2	78.3	78.4	78.3	78.4
Not poor	7.6	9.4	7	8.2	8.4	8.1	7	10.1	5.4
<b>Socio-economic status</b>									
Low	35.6	34.4	36	37.5	37.9	37.4	33.2	31.8	34
Medium	32.5	35.3	31.5	33.6	40	32	31.2	31.8	30.9
High	31.9	30.4	32.5	28.9	22.1	30.6	35.6	36.4	35.1
<b>Food insecure</b>									
No	66.2	74.1	63.4	65.1	73.7	62.9	67.5	74.4	64.1
Yes	33.8	25.9	36.6	34.9	26.3	37.1	32.5	25.6	35.9
<b>Gender of household head</b>									
Male	61.5	64.3	60.5	59.1	62.1	58.3	64.4	65.9	63.7
Female	38.5	35.7	39.5	40.9	37.9	41.7	35.6	34.1	36.3
<b>AGYW is the household head</b>									
No	96.6	95.1	97.1	98.7	97.9	98.9	94.1	93	94.6
Yes	3.4	4.9	2.9	1.3	2.1	1.1	5.9	7	5.4
<b>Orphanhood</b>									
Not an orphan	77.8	75.9	78.5	80.2	78.9	80.5	75	73.6	75.7
Single/double orphan	22.2	24.1	21.5	19.8	21.1	19.5	25	26.4	24.3
<b>Sexual and pregnancy history</b>									
Never had sex	65.4	55.8	68.8	89.2	86.3	90	36.9	33.3	38.6
Ever sex, never pregnant	10.6	11.6	10.2	5.4	6.3	5.1	16.8	15.5	17.4
Ever pregnant	24.1	32.6	21	5.4	7.4	4.9	46.4	51.2	44
<b>Ever given birth</b>									
No	77.9	71	80.4	95.7	95.8	95.7	56.7	52.7	58.7
Yes	22.1	29	19.6	4.3	4.2	4.3	43.3	47.3	41.3

**Supplementary file 6. Sociodemographic characteristics of DREAMS beneficiaries and non-beneficiaries at the time of cohort enrolment, by age-group, among those followed-up in 2019**

**c. uMkhanyakude**

Characteristics at enrolment in 2017	Age 13-22			Age 13-17			Age 18-22		
	Overall (N=1712) % (col)	Never invited (N=809) % (col)	Invited by 2018 (N=903) % (col)	Overall (N=972) % (col)	Never invited (N=364) % (col)	Invited by 2018 (N=608) % (col)	Overall (N=740) % (col)	Never invited (N=445) % (col)	Invited by 2018 (N=295) % (col)
<b>Age group</b>									
13-14	24.2	20.4	27.6	42.6	45.3	41.0			
15-17	32.6	24.6	39.8	57.4	54.7	59.0			
18-19	20.3	23.2	17.7				47.0	42.2	54.2
20-22	22.9	31.8	15.0				53.0	57.8	45.8
<b>Current school/education level</b>									
In school: primary or less	8.9	6.1	11.4	15.5	13.2	16.9	0.1	0.2	0.0
In school: secondary/tertiary	70.2	63.4	76.3	83.4	85.4	82.2	52.8	45.3	64.1
Not in school: none or complete primary	1.4	2.2	0.7	1.0	1.4	0.8	3.0	3.8	1.7
Not in school: incomplete secondary	7.1	9.8	4.8				15.8	17.1	13.9
Not in school: complete secondary/tertiary	12.4	18.6	6.9				28.3	33.6	20.3
<b>Area</b>									
Rural	64.5	59.2	69.2	64.2	56.7	68.7	64.9	61.3	70.3
Peri-urban/urban	35.5	40.8	30.8	35.8	43.3	31.3	35.1	38.7	29.7
<b>Migrated</b>									
No	83.6	80.1	86.8	93.4	92.9	93.8	70.8	69.7	72.5
Yes	16.4	19.9	13.2	6.6	7.1	6.3	29.2	30.3	27.5
<b>Socio-economic status</b>									
Low	34.6	30.5	38.2	33.7	26.6	38.0	35.7	33.7	38.6
Medium	33.6	34.2	33.1	33.3	35.4	32.1	34.1	33.3	35.3
High	28.0	30.2	26.0	30.3	35.2	27.5	24.9	26.1	23.1
Unknown	3.8	5.1	2.7	2.6	2.7	2.5	5.4	7.0	3.1
<b>Food insecure</b>									
No	68.8	65.4	71.9	78.2	79.9	77.2	56.6	53.6	61.0
Yes	31.2	34.6	28.1	21.8	20.1	22.8	43.4	46.4	39.0
<b>Sexual and pregnancy history</b>									
Never had sex	62.4	53.3	70.6	89.5	89.5	89.4	27	23.7	31.9
Ever sex, never pregnant	12.8	14.5	11.2	5.7	5.0	6.1	22.1	22.3	21.7
Ever pregnant	24.8	32.2	18.2	4.9	5.5	4.5	50.9	54	46.4
<b>Violence</b>									
No	65.8	66.3	65.3	63.5	62.1	64.3	68.8	69.7	67.5
Yes	34.2	33.8	34.7	36.5	37.9	35.7	31.2	30.3	32.5

## Supplementary file 7. Distribution of aspirations and expectations scores in 2019, among AGYW followed up in 2019, by age group and invitation to DREAMS

## a. Gem

Aspirations ("How important are the following things to you?")	Overall		13-17 (N=622)				18-22 (N=396)			
	Total (N=1018)		Not invited (N=261)		Invited in 2018 (N=361)		Not invited (N=175)		Invited in 2018 (N=221)	
	n	%	n	%	n	%	n	%	n	%
<b>Finishing secondary school</b>										
Not important at all	23	2.3	5	1.9	6	1.7	8	4.6	4	1.8
Not very important	21	2.1	5	1.9	5	1.4	3	1.7	8	3.6
Somewhat important	31	3.0	7	2.7	10	2.8	8	4.6	6	2.7
Very important	943	92.6	244	93.5	340	94.2	156	89.1	203	91.9
<b>Going to college/university</b>										
Not important at all	24	2.4	7	2.7	6	1.7	8	4.6	3	1.4
Not very important	47	4.6	10	3.8	19	5.3	8	4.6	10	4.5
Somewhat important	55	5.4	12	4.6	15	4.2	17	9.7	11	5.0
Very important	892	87.6	232	88.9	321	88.9	142	81.1	197	89.1
<b>Owning own home</b>										
Not important at all	18	1.8	6	2.3	7	1.9	4	2.3	1	0.5
Not very important	97	9.5	24	9.2	34	9.4	14	8.0	25	11.3
Somewhat important	75	7.4	11	4.2	30	8.3	13	7.4	21	9.5
Very important	828	81.3	220	84.3	290	80.3	144	82.3	174	78.7
<b>Having good job/ stable income</b>										
Not important at all	8	0.8	4	1.5	3	0.8	1	0.6	0	0.0
Not very important	12	1.2	4	1.5	5	1.4	2	1.1	1	0.5
Somewhat important	21	2.1	9	3.4	6	1.7	3	1.7	3	1.4
Very important	977	96.0	244	93.5	347	96.1	169	96.6	217	98.2
<b>Having children</b>										
Not important at all	24	2.4	7	2.7	11	3.0	4	2.3	2	0.9
Not very important	125	12.3	45	17.2	49	13.6	10	5.7	21	9.5
Somewhat important	108	10.6	23	8.8	40	11.1	17	9.7	28	12.7
Very important	761	74.8	186	71.3	261	72.3	144	82.3	170	76.9
<b>Getting married/finding a partner</b>										
Not important at all	43	4.2	7	2.7	22	6.1	7	4.0	7	3.2
Not very important	183	18.0	53	20.3	69	19.1	23	13.1	38	17.2
Somewhat important	126	12.4	28	10.7	47	13.0	22	12.6	29	13.1
Very important	666	65.4	173	66.3	223	61.8	123	70.3	147	66.5

<b>Expectations ("What are the chances that you will..?")</b>										
<b>Finish primary school</b>										
High (or already achieved)	921	90.5	237	90.8	330	91.4	153	87.4	201	91.0
About 50/50	49	4.8	16	6.1	25	6.9	1	0.6	7	3.2
Low	23	2.3	3	1.1	4	1.1	12	6.9	4	1.8
Not applicable	25	2.5	5	1.9	2	0.6	9	5.1	9	4.1
<b>Finish secondary school</b>										
High (or already achieved)	704	69.2	177	67.8	260	72.0	104	59.4	163	73.8
About 50/50	177	17.4	59	22.6	84	23.3	11	6.3	23	10.4
Low	90	8.8	16	6.1	14	3.9	36	20.6	24	10.9
Not applicable	47	4.6	9	3.4	3	0.8	24	13.7	11	5.0
<b>Go to university</b>										
High (or already achieved)	437	42.9	124	47.5	195	54.0	56	32.0	62	28.1
About 50/50	388	38.1	106	40.6	133	36.8	43	24.6	106	48.0
Low	144	14.1	23	8.8	30	8.3	52	29.7	39	17.6
Not applicable	49	4.8	8	3.1	3	0.8	24	13.7	14	6.3
<b>Have job that pays well</b>										
High (or already achieved)	424	41.7	125	47.9	184	51.0	43	24.6	72	32.6
About 50/50	517	50.8	126	48.3	162	44.9	103	58.9	126	57.0
Low	77	7.6	10	3.8	15	4.2	29	16.6	23	10.4
<b>Be able to own your own home</b>										
High (or already achieved)	516	50.7	139	53.3	181	50.1	89	50.9	107	48.4
About 50/50	454	44.6	115	44.1	161	44.6	78	44.6	100	45.2
Low	48	4.7	7	2.7	19	5.3	8	4.6	14	6.3
<b>Stay in good health most of time</b>										
High (or already achieved)	519	51.0	137	52.5	193	53.5	81	46.3	108	48.9
About 50/50	475	46.7	118	45.2	162	44.9	90	51.4	105	47.5
Low	24	2.4	6	2.3	6	1.7	4	2.3	8	3.6

## Supplementary file 7. Distribution of aspirations and expectations scores in 2019, among AGYW followed up in 2019, by age group and invitation to DREAMS

## b. Nairobi

Aspirations ("How important are the following things to you?")	Overall (2019)		15-17 (N=464)				18-22 (N=388)			
	Total (N=852)		Never invited by 2018 (N=95)		Invited by 2018 (N=369)		Never invited by 2018 (N=129)		Invited by 2018 (N=259)	
	n	%	n	%	n	%	n	%	n	%
<b>Finishing secondary school</b>										
Not important at all	25	2.9	3	3.2	3	0.8	7	5.4	12	4.6
Not very important	32	3.8	8	8.4	11	3.0	8	6.2	5	1.9
Somewhat important	38	4.5	2	2.1	8	2.2	7	5.4	21	8.1
Very important	757	88.8	82	86.3	347	94.0	107	82.9	221	85.3
<b>Going to college/university</b>										
Not important at all	31	3.6	2	2.1	6	1.6	9	7.0	14	5.4
Not very important	50	5.9	8	8.4	17	4.6	10	7.8	15	5.8
Somewhat important	96	11.3	8	8.4	42	11.4	16	12.4	30	11.6
Very important	675	79.2	77	81.1	304	82.4	94	72.9	200	77.2
<b>Owning your own home</b>										
Not important at all	4	0.5	0	0.0	2	0.5	0	0.0	2	0.8
Not very important	18	2.1	3	3.2	6	1.6	0	0.0	9	3.5
Somewhat important	49	5.8	3	3.2	20	5.4	14	10.9	12	4.6
Very important	781	91.7	89	93.7	341	92.4	115	89.1	236	91.1
<b>Having a good job/stable income</b>										
Not important at all	2	0.2					1	0.8	1	0.4
Not very important	8	0.9	1	1.1	5	1.4	1	0.8	1	0.4
Somewhat important	28	3.3	5	5.3	9	2.4	5	3.9	9	3.5
Very important	814	95.5	89	93.7	355	96.2	122	94.6	248	95.8
<b>Having children</b>										
Not important at all	4	0.5	1	1.1	1	0.3	1	0.8	1	0.4
Not very important	41	4.8	4	4.2	25	6.8	4	3.1	8	3.1
Somewhat important	134	15.7	22	23.2	68	18.4	15	11.6	29	11.2
Very important	673	79.0	68	71.6	275	74.5	109	84.5	221	85.3
<b>Getting married/finding a partner</b>										
Not important at all	17	2.0	3	3.2	6	1.6	1	0.8	7	2.7
Not very important	84	9.9	12	12.6	43	11.7	7	5.4	22	8.5
Somewhat important	175	20.5	23	24.2	84	22.8	18	14.0	50	19.3
Very important	576	67.6	57	60.0	236	64.0	103	79.8	180	69.5

<b>Expectations ("What are the chances that you will..?")</b>										
<b>Finish primary school?</b>										
High(or already achieved)	816	95.8	93	97.9	363	98.4	118	91.5	242	93.4
About 50/50	5	0.6	0	0.0	1	0.3	0	0.0	4	1.5
Low	31	3.6	2	2.1	5	1.4	11	8.5	13	5.0
<b>Finish secondary school?</b>										
High(or already achieved)	599	70.3	67	70.5	295	79.9	75	58.1	162	62.5
About 50/50	76	8.9	10	10.5	35	9.5	2	1.6	29	11.2
Low	177	20.8	18	18.9	39	10.6	52	40.3	68	26.3
<b>Go to university?</b>										
High(or already achieved)	277	32.5	34	35.8	150	40.7	28	21.7	65	25.1
About 50/50	302	35.4	40	42.1	157	42.5	34	26.4	71	27.4
Low	273	32.0	21	22.1	62	16.8	67	51.9	123	47.5
<b>Have a job that pays well?</b>										
High(or already achieved)	356	41.8	43	45.3	172	46.6	45	34.9	96	37.1
About 50/50	423	49.6	49	51.6	179	48.5	66	51.2	129	49.8
Low	73	8.6	3	3.2	18	4.9	18	14.0	34	13.1
<b>Be able to own your own home?</b>										
High(or already achieved)	462	54.2	61	64.2	207	56.1	62	48.1	132	51.0
About 50/50	331	38.8	30	31.6	146	39.6	51	39.5	104	40.2
Low	59	6.9	4	4.2	16	4.3	16	12.4	23	8.9
<b>Stay in good health most of the time?</b>										
High(or already achieved)	535	62.8	57	60.0	225	61.0	80	62.0	173	66.8
About 50/50	301	35.3	38	40.0	137	37.1	47	36.4	79	30.5
Low	16	1.9	0	0.0	7	1.9	2	1.6	7	2.7

**Supplementary file 7. Distribution of aspirations and expectations scores in 2019, among AGYW followed up in 2019, by age group and invitation to participate in DREAMS**

**c. uMkhanyakude**

Aspirations ("How important are the following things to you?")	Overall		13-17 (N=972)				18-22 (N=740)			
	Total (N=1712)		Never invited (N=364)		Invited by 2018 (N=608)		Never invited (N=445)		Invited by 2018 (N=295)	
	n	%	n	%	n	%	n	%	n	%
<b>Finishing secondary school</b>										
Not important at all	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Not very important	5	0.3	1	0.3	0	0.0	3	0.7	1	0.3
Somewhat important	4	0.2	0	0.0	3	0.5	0	0.0	1	0.3
Important	409	23.9	81	22.3	132	21.7	115	25.9	81	27.5
Very important	1128	65.9	272	74.7	458	75.3	237	53.4	161	54.6
Already achieved	164	9.6	10	2.8	15	2.5	88	19.8	51	17.3
Don't know	1	0.1	0	0.0	0	0.0	1	0.2	0	0.0
<b>Going to college/university</b>										
Not important at all	3	0.2	1	0.3	0	0.0	2	0.5	0	0.0
Not very important	20	1.2	3	0.8	5	0.8	10	2.3	2	0.7
Somewhat important	13	0.8	0	0.0	6	1.0	4	0.9	3	1.0
Important	457	26.7	90	24.7	141	23.2	138	31.0	88	29.8
Very important	1202	70.2	270	74.2	453	74.5	282	63.4	197	66.8
Already achieved	12	0.7	0	0.0	2	0.3	6	1.4	4	1.4
Don't know	5	0.3	0	0.0	1	0.2	3	0.7	1	0.3
<b>Owning your own home</b>										
Not important at all	17	1.0	2	0.6	9	1.5	5	1.1	1	0.3
Not very important	75	4.4	20	5.5	31	5.1	16	3.6	8	2.7
Somewhat important	25	1.5	6	1.7	11	1.8	4	0.9	4	1.4
Important	646	37.7	119	32.7	219	36.0	177	39.8	131	44.4
Very important	942	55.0	217	59.6	337	55.4	239	53.7	149	50.5
Already achieved	1	0.1	0	0.0	0	0.0	0	0.0	1	0.3
Don't know	6	0.4	0	0.0	1	0.2	4	0.9	1	0.3
<b>Having a good job/stable income</b>										
Not important at all	1	0.1	0	0.0	0	0.0	0	0.0	1	0.3
Not very important	4	0.2	2	0.6	1	0.2	1	0.2	0	0.0
Somewhat important	14	0.8	3	0.8	5	0.8	6	1.4	0	0.0
Important	515	30.1	96	26.4	164	27.0	157	35.3	98	33.2
Very important	1176	68.7	263	72.3	438	72.0	279	62.7	196	66.4
Already achieved	1	0.1	0	0.0	0	0.0	1	0.2	0	0.0
Don't know	1	0.1	0	0.0	0	0.0	1	0.2	0	0.0
<b>Having children</b>										
Not important at all	276	16.1	87	24.0	98	16.1	51	11.5	40	13.6
Not very important	435	25.4	85	23.4	174	28.6	107	24.0	69	23.4
Somewhat important	103	6.0	25	6.9	41	6.7	27	6.1	10	3.4
Important	532	31.1	99	27.3	172	28.3	155	34.8	106	35.9
Very important	312	18.2	55	15.2	104	17.1	87	19.6	66	22.4
Already achieved	5	0.3	1	0.3	1	0.2	2	0.5	1	0.3
Don't know	48	2.8	11	3.0	18	3.0	16	3.6	3	1.0
<b>Getting married/finding a partner</b>										
Not important at all	256	15.0	72	19.8	84	13.8	58	13.1	42	14.2
Not very important	428	25.0	78	21.4	171	28.1	109	24.6	70	23.7

Somewhat important	96	5.6	26	7.1	38	6.3	21	4.7	11	3.7
Important	533	31.2	107	29.4	185	30.4	144	32.4	97	32.9
Very important	351	20.5	69	19.0	115	18.9	98	22.1	69	23.4
Already achieved	1	0.1	0	0.0	0	0.0	1	0.2	0	0.0
Don't know	46	2.7	12	3.3	15	2.5	13	2.9	6	2.0

<b>Expectations ("What are the chances that you will..?")</b>										
<b>Finish primary school?</b>										
High (or already achieved)	1693	98.9	362	99.5	604	99.3	435	97.8	292	99.0
About 50/50	5	0.3	0	0.0	3	0.5	2	0.5	0	0.0
Low	7	0.4	2	0.6	0	0.0	5	1.1	0	0.0
Don't know	7	0.4	0	0.0	1	0.2	3	0.7	3	1.0
<b>Finish secondary school?</b>										
High (or already achieved)	1498	87.5	325	89.3	537	88.3	378	84.9	258	87.5
About 50/50	133	7.8	32	8.8	58	9.5	25	5.6	18	6.1
Low	59	3.5	5	1.4	5	0.8	34	7.6	15	5.1
Don't know	22	1.3	2	0.6	8	1.3	8	1.8	4	1.4
<b>Go to university?</b>										
High (or already achieved)	984	57.5	258	70.9	371	61.0	205	46.1	150	50.9
About 50/50	395	23.1	72	19.8	154	25.3	101	22.7	68	23.1
Low	215	12.6	25	6.9	40	6.6	95	21.4	55	18.6
Don't know	118	6.9	9	2.5	43	7.1	44	9.9	22	7.5
<b>Have a job that pays well?</b>										
High (or already achieved)	957	55.9	240	65.9	368	60.5	201	45.2	148	50.2
About 50/50	460	26.9	88	24.2	164	27.0	131	29.4	77	26.1
Low	129	7.5	9	2.5	23	3.8	56	12.6	41	13.9
Don't know	166	9.7	27	7.4	53	8.7	57	12.8	29	9.8
<b>Be able to own your own home?</b>										
High (or already achieved)	995	58.1	234	64.3	385	63.3	216	48.5	160	54.2
About 50/50	454	26.5	94	25.8	143	23.5	135	30.3	82	27.8
Low	87	5.1	7	1.9	25	4.1	36	8.1	19	6.4
Don't know	176	10.3	29	8.0	55	9.1	58	13.0	34	11.5
<b>Stay in good health most of the time?</b>										
High (or already achieved)	898	52.5	205	56.3	347	57.1	185	41.6	161	54.6
About 50/50	491	28.7	105	28.9	170	28.0	140	31.5	76	25.8
Low	70	4.1	13	3.6	19	3.1	27	6.1	11	3.7
Don't know	253	14.8	41	11.3	72	11.8	93	20.9	47	15.9

**Supplementary file 8. Conventional univariable and multivariable logistic regression model for the association between invited to DREAMS by 2018\* with social support\*\* in 2019, showing all covariates.**

**a. Gem**

Variables at enrolment in 2018	Total N (1018)	Social support		Unadjusted OR			Fully adjusted OR***			
		n (411)	%	OR	(95% CI)	p (LRT)	aOR	(95% CI)	p (LRT)	
<b>Invited to DREAMS</b>										
No	436	156	35.8	ref			0.01	ref		0.02
Yes	582	255	43.8	1.4	1.1	1.8		1.4	1.1	1.8
<b>Age group</b>										
13-17	622	229	36.8	ref			0.004	ref		0.2
18-22	396	182	46	1.5	1.1	1.9		0.8	0.6	1.1
<b>Educational attainment</b>										
Primary/None	435	146	33.6	ref				ref		<0.001
Secondary and above	372	181	48.7	1.9	1.4	2.5	<0.001	2	1.5	2.8
Unknown	211	84	39.8	1.3	0.9	1.8		1.3	0.9	1.9
<b>Socio-economic status</b>										
Low	424	197	46.5	ref				ref		0.2
Middle	195	71	36.4	0.7	0.5	0.9	0.004	0.7	0.5	1.1
High	399	143	35.8	0.6	0.5	0.9		0.7	0.5	1.0
<b>Orphanhood</b>										
No	615	246	40.0	ref				ref		0.9
Maternal	35	16	45.7	1.3	0.6	2.5		1.2	0.6	2.5
Paternal	92	38	41.3	1.1	0.7	1.7	0.949	0.9	0.5	1.4
Total	33	12	36.4	0.9	0.4	1.8		0.8	0.4	1.7
Unknown	243	99	40.7	1.0	0.8	1.4		1.0	0.7	1.4
<b>Food insecurity<sup>a</sup></b>										
No	789	296	37.5	ref				ref		0.06
Yes	229	115	50.2	1.7	1.3	2.3	0.001	1.4	1.0	2.1
<b>Sexual/pregnancy history</b>										
Never had sex	701	251	35.8	ref				ref		
Ever sex, never pregnant	158	77	48.7	1.7	1.2	2.4		1.7	1.1	2.4
Ever pregnant	159	83	52.2	2.0	1.4	2.8	<0.001	2.1	1.4	3.3

CI confidence interval; OR odds ratio; LRT likelihood ratio test

\* Invited to DREAMS by 2018 defined as self-reported invitation to participate in DREAMS in 2018 (cohort enrolled in Gem in 2018).

\*\* Social support defined as answering 'yes' to at least 3 of the following 4 questions: "Is there a female in your community from whom you can borrow money in an emergency?"; "Do you have at least one trusted female friend?"; "Do you know a woman in your community, other than a mother or guardian, whom you could turn to if you had a serious problem?"; "Do you have a safe and private place to meet with girls and young women who are like you?"

\*\*\* Fully adjusted model included: age, education, socio-economic status, orphanhood, food insecurity, sexual and pregnancy history

a Food insecurity was defined based on the question: In the past 4 weeks, did you or any household member go to sleep at night hungry because there was not enough food? With responses(Yes, No)

**Supplementary file 8. Conventional univariable and multivariable logistic regression model for the association between invited to DREAMS by 2018\* with social support\*\* in 2019, showing all covariates.**

**b. Nairobi**

Variables at enrolment in 2017	Total N (852)	Social support n (480)	row %	Unadjusted OR OR	p (95% CI) (LRT)			Fully adjusted OR*** aOR (95% CI)	p (LRT)		
<b>Invited by 2018</b>											
No	224	111	49.6	ref				ref			
Yes	628	369	58.8	1.5	1.1	2.0	0.02	1.4	1.0	1.9	0.04
<b>Age group</b>											
15-17	464	266	57.3	ref							
18-22	388	214	55.2	0.9	0.7	1.2	0.5				
<b>Currently in school</b>											
No	312	166	53.2	ref							
Yes	540	314	58.2	1.2	0.9	1.6	0.2				
<b>Age-education</b>											
15-17 & in school:											
secondary/tertiary	272	174	64	ref				ref			
15-17 & in school: primary or less	125	62	49.6	0.6	0.4	0.9	0.001	0.7	0.4	1.0	0.06
15-17 & not in school	67	30	44.8	0.5	0.3	0.8		0.7	0.4	1.2	
18-22 & in school: tertiary or less											
18-22 & in school: tertiary or less	143	78	54.5	0.7	0.4	1.0		0.8	0.5	1.3	
18-22 & not in school: primary or less											
18-22 & not in school: primary or less	89	39	43.8	0.4	0.3	0.7		0.6	0.3	1.3	
18-22 & not in school: incomplete secondary											
18-22 & not in school: incomplete secondary	55	31	56.4	0.7	0.4	1.3		1.2	0.5	2.5	
18-22 & not in school: complete secondary/tertiary											
18-22 & not in school: complete secondary/tertiary	101	66	65.3	1.1	0.7	1.7		1.4	0.8	2.5	
<b>DSS study site</b>											
Korogocho	513	259	50.5	ref				ref			
Viwandani	339	221	65.2	1.8	1.4	2.4	<0.001	1.2	0.9	1.8	0.2
<b>Marital status</b>											
never married	695	392	56.4	ref				ref			
prev married/living w partner	24	11	45.8	0.7	0.3	1.5	0.5	1.3	0.5	3.5	0.2
curr married/living w partner	133	77	57.9	1.1	0.7	1.5		1.9	1.0	3.6	
<b>Sexual &amp; pregnancy history</b>											
Never had sex	555	328	59.1	ref				ref			
Ever sex, never preg	90	45	50	0.7	0.4	1.1	0.07	0.6	0.4	1.1	0.03
Ever pregnant	205	105	51.2	0.7	0.5	1.0		0.5	0.2	0.9	
<b>Food insecure<sup>a</sup></b>											
No	564	327	58	ref				ref			
Yes	288	153	53.1	0.8	0.6	1.1	0.2	1.1	0.8	1.5	0.6
<b>Socio-economic status</b>											
Poor	303	138	45.5	ref				ref			
Medium	277	160	57.8	1.6	1.2	2.3	<0.001	1.5	1.0	2.1	0.01
Wealthy	272	182	66.9	2.4	1.7	3.4		1.9	1.2	3.0	
<b>Self-assessed household poverty<sup>b</sup></b>											
Very poor	115	63	54.8	ref				ref			
Moderately poor	672	380	56.5	1.1	0.7	1.6	0.9	1.0	0.7	1.5	1.0
Not poor	65	37	56.9	1.1	0.6	2.0		1.0	0.5	1.9	
<b>Orphanhood</b>											
No	663	378	57.0	ref				ref			
Yes (mother/both parents died)	189	102	54.0	0.9	0.6	1.2	0.6	1.0	0.7	1.4	1.0

CI confidence interval; OR odds ratio; LRT likelihood ratio test

\* Invited to DREAMS by 2018 defined as self-reported invitation to participate in DREAMS in 2017 and/or 2018.

\*\* Social support defined as answering 'yes' to at least 3 of the following 4 questions: "Is there a female in your community from whom you can borrow money in an emergency?"; "Do you have at least one trusted female friend?"; "Do you know a woman in your community, other than a mother or guardian, whom you could turn to if you had a serious problem?"; "Do you have a safe and private place to meet with girls and young women who are like you?"

\*\*\* Fully adjusted model included: composite age-education variable; DSS study site; marital status; sexual and pregnancy history; socio-economic status; food insecurity; self-assessed household poverty; orphanhood

a Food insecurity was defined as using the question: In the past 4 weeks, did you or any household member go to sleep at night hungry because there was not enough food? (yes, no)

b Self-assessed household poverty was based on the responses to the question: In your opinion, how do you assess the economic situation of your household now? (Very poor, moderately poor or not poor)

**Supplementary file 8. Conventional univariable and multivariable logistic regression model for the association between invited to DREAMS by 2018\* with social support\*\* in 2019, showing all covariates.**

**c. uMkhanyakude**

Variables at enrolment in 2017	Total N (1712)	Social support n (778)	row %	Unadjusted OR				Fully adjusted OR***			
				OR	(95% CI)	p (LRT)	aOR	(95% CI)	p (LRT)		
<b>Invited by 2018</b>											
No	809	358	44.3	ref				ref			
Yes	903	420	46.5	1.1	0.9	1.3	0.3	1.1	0.9	1.3	0.5
<b>Age group</b>											
13-14	414	197	47.6	ref				ref			
15-17	558	244	43.7	0.9	0.7	1.1	0.7	0.9	0.7	1.1	0.5
18-19	348	159	45.7	0.9	0.7	1.2		1.0	0.7	1.5	
20-22	392	178	45.4	0.9	0.7	1.2		1.1	0.7	1.6	
<b>Area</b>											
Rural	1,095	518	47.3	ref				ref			
Peri-urban/urban	603	255	42.3	0.8	0.7	1.0	0.05	0.8	0.7	1.0	0.09
<b>Age 13-17, or 18-22 in school<sup>a</sup></b>											
Age 13-17	1385	637	46.0	ref							
Age 18-22 and in school	972	441	45.4								
	391	185	47.3								
<b>incomplete secondary education<sup>b</sup></b>											
Yes	117	51	43.6	0.9	0.6	1.3	0.7	0.8	0.5	1.3	0.5
<b>completed secondary education<sup>c</sup></b>											
Yes	209	90	43.1	0.9	0.7	1.2	0.4	0.8	0.6	1.2	0.2
<b>Socio-economic status</b>											
Low	592	262	44.3	ref				ref			
Middle	576	281	48.8	1.2	1.0	1.5	0.3	1.2	1.0	1.5	0.3
High	479	207	43.2	1.0	0.8	1.2		1.0	0.7	1.2	
Unknown	65	28	43.1	1.0	0.6	1.6		1.0	0.6	1.7	
<b>Food insecure<sup>d</sup></b>											
No	1,175	553	47.1	ref				ref			
Yes	532	223	41.9	0.8	0.7	1.0	0.05	0.8	0.6	1.0	0.04
<b>Migrated<sup>e</sup></b>											
No	1,432	644	45	ref				ref			
Yes	280	134	47.9	1.1	0.9	1.5	0.4	1.2	0.9	1.6	0.2
<b>Sexual &amp; pregnancy history</b>											
Never had sex	1,065	493	46.3	ref				ref			
Ever sex, never pregnant	218	86	39.4	0.8	0.6	1.0	0.1	0.8	0.6	1.1	0.2
Ever pregnant	423	199	47	1.0	0.8	1.3		1.1	0.8	1.4	

CI confidence interval; OR odds ratio; LRT likelihood ratio test

\* Invited to DREAMS by 2018 defined as self-reported invitation to participate in DREAMS in 2017 and/or 2018.

\*\* Social support defined as answering 'yes' to at least 3 of the following 4 questions: "Is there a female in your community from whom you can borrow money in an emergency?"; "Do you have at least one trusted female friend?"; "Do you know a woman in your community, other than a mother or guardian, whom you could turn to if you had a serious problem?"; "Do you have a safe and private place to meet with girls and young women who are like you?"

\*\*\* Fully adjusted model included: age group in 4 categories, area, education (dummy variables 18-22 not in school and in/complete secondary - defined in 'b' and 'c' below), socio-economic status, food insecurity, migration, sexual & pregnancy history.

a Reference category for schooling dummy variables includes everyone who is in school, or 13-17 and out of school (very few, as almost all 13-17s are in school), or 18-22 and out of school with no/primary only education (few)

- b Dummy variable, where 'no' (0) = all non-missing values of age and schooling, and those not coded as yes (not "18-22 not in school and incomplete secondary")
- c Dummy variable, where 'no' (0) = all non-missing values of age and schooling, and those not coded as yes (not "18-22 not in school and complete secondary")
- d Food insecurity was defined as any report of reducing the size of food portions or skipping meals by any member of a household because there was not enough money to buy food in the past 12 months
- e Migration was defined as any movement within or outside surveillance area since age of 13

**Supplementary file 8. Conventional univariable and multivariable logistic regression model for the association between invited to DREAMS by 2018\* with self-efficacy\*\* in 2019, showing all covariates.**

**d. Gem**

Variables at enrolment in 2018	Total N (1018)	Self-efficacy		Unadjusted OR				Fully adjusted OR***			
		n (351)	%	OR	(95% CI)	p	(LRT)	aOR	(95% CI)	p	(LRT)
<b>Invited to DREAMS</b>											
No	436	145	33.3	Ref				Ref			
Yes	582	206	35.4	1.1	0.9	1.4	0.5	1.2	0.9	1.6	0.2
<b>Age group</b>											
13-17	622	187	30.1	Ref				Ref			
18-22	396	164	41.4	1.6	1.3	2.1	<0.001	1.0	0.7	1.4	0.8
<b>Educational attainment</b>											
Primary/None	435	103	23.7	Ref				Ref			
Secondary and above	372	171	46	2.7	2.0	3.7	<0.001	2.6	1.8	3.6	<0.001
Unknown	211	77	36.5	1.9	1.3	2.7		1.8	1.2	2.7	
<b>Socio-economic status</b>											
Low	424	136	32.1	Ref				Ref			
Middle	195	60	30.8	0.9	0.7	1.4	0.06	1.0	0.6	1.4	0.06
High	399	155	38.8	1.4	1.0	1.8		1.4	1.0	1.9	
<b>Orphanhood</b>											
No	615	205	33.3	Ref				Ref			
Maternal	35	10	28.6	0.8	0.4	1.7	0.3	0.8	0.4	1.8	0.5
Paternal	92	39	42.4	1.5	0.9	2.3		1.3	0.8	2.1	
Total	33	15	45.5	1.7	0.8	3.4		1.5	0.7	3.1	
Unknown	243	82	33.7	1.0	0.7	1.4		1.0	0.7	1.4	
<b>Food insecurity<sup>a</sup></b>											
No	789	271	34.3	Ref				Ref			
Yes	229	80	34.9	1.0	0.8	1.4	0.9	1.2	0.8	1.7	0.5
<b>Sexual/pregnancy history</b>											
Never had sex	701	219	31.2	Ref				Ref			
Ever sex, never pregnant	158	65	41.1	1.54	1.1	2.2	0.006	1.3	0.9	1.9	0.06
Ever pregnant	159	67	42.1	1.6	1.1	2.3		1.6	1.1	2.5	

CI confidence interval; OR odds ratio; LRT likelihood ratio test

\* Invited to DREAMS by 2018 defined as self-reported invitation to participate in DREAMS in 2018 (cohort enrolled in Gem in 2018).

\*\* Self efficacy definition: Binary outcome variable constructed based on a series of ten questions comprising a general self-efficacy scale, where a cut-off value of  $\geq 3.5$  was used to define higher self-efficacy (yes).

\*\*\* Fully adjusted model included: age group, educational attainment, socio-economic status, orphanhood, food insecurity, sexual and pregnancy history

a Food insecurity was defined based on the question: In the past 4 weeks, did you or any household member go to sleep at night hungry because there was not enough food? With responses(Yes, No)

**Supplementary file 8. Conventional univariable and multivariable logistic regression model for the association between invited to DREAMS by 2018\* with self-efficacy\*\* in 2019, showing all covariates.**

**e. Nairobi**

Variables at enrolment in 2017	Total N (852)	Self-efficacy		Unadjusted OR			p (LRT)	Fully adjusted OR***			
		n (465)	%	OR	(95% CI)			aOR	(95% CI)		p (LRT)
<b>Invited by 2018</b>											
No	224	113	50.4	1				1			
Yes	628	352	56.1	1.3	0.9	1.7	0.1	1.3	0.9	1.8	0.1
<b>Age group</b>											
15-17	464	247	53.2	1				1			
18-22	388	218	56.2	1.1	0.9	1.5	0.4	1.2	0.8	1.6	0.4
<b>Site</b>											
Korogocho	513	266	51.9	1				1			
Viwandani	339	199	58.7	1.3	1	1.7	0.05	1.2	0.8	1.8	0.4
<b>Ethnicity</b>											
Somali	76	29	38.2	0.4	0.3	0.7		1.0	0.3	3	
Kamba	149	79	53.0	0.8	0.5	1.2	0.04	0.8	0.5	1.2	0.9
Kikuyu	272	160	58.8	1				1			
Kisii	33	20	60.6	1.1	0.5	2.3		1.1	0.5	2.3	
Luhya	135	75	55.6	0.9	0.6	1.3		0.9	0.6	1.4	
Luo	134	78	58.2	1	0.6	1.5		1.1	0.7	1.7	
Other	53	24	45.3	0.6	0.3	1.1		1.2	0.4	3.2	
<b>Religion</b>											
Catholic	244	133	54.5	1				1			
Other Christian	466	271	58.2	1.2	0.9	1.6	<0.01	1.2	0.9	1.7	0.2
Muslim	123	48	39.0	0.5	0.3	0.8		0.5	0.2	1.5	
No religion /other	19	13	68.4	1.8	0.7	4.9		1.9	0.7	5.3	
<b>Food insecure<sup>a</sup></b>											
No	564	313	55.5	1				1			
Yes	288	152	52.8	0.9	0.7	1.2	0.5	0.9	0.7	1.3	0.7
<b>Orphanhood</b>											
Not an orphan	663	360	54.3	1				1			
Single/double orphan	189	105	55.6	1.1	0.8	1.5	0.8	1	0.7	1.5	0.9
<b>Currently in school</b>											
No	312	178	57.1	1				1.0			
Yes	540	287	53.1	0.9	0.6	1.1	0.3	0.8	0.5	1.2	0.3
<b>Sexual/pregnancy history</b>											
Never had sex	557	301	54.0	1				1			
Ever sex, never preg	90	48	53.3	1	0.6	1.5	0.8	0.8	0.5	1.3	0.4
Ever pregnant	205	116	56.6	1.1	0.8	1.5		0.6	0.2	1.6	
<b>Ever given birth</b>											
No	664	357	53.8	1				1.0			
Yes	188	108	57.4	1.2	0.8	1.6	0.4	1.4	0.5	4	0.5
<b>Self assessed household poverty<sup>b</sup></b>											
Very poor	115	67	58.3	1				1.0			
Moderately poor	672	358	53.3	0.8	0.6	1.2	0.3	0.8	0.5	1.2	0.2
Not poor	65	40	61.5	1.2	0.6	2.1		1.2	0.6	2.3	

<b>Socio-economic status</b>											
Poor	303	162	53.5	1				1.0			
Medium	277	141	50.9	0.9	0.7	1.3	0.1	0.9	0.6	1.3	0.5
Wealthy	272	162	59.6	1.3	0.9	1.8		1.1	0.7	1.7	
<b>Gender of household head</b>											
Male	524	285	54.4	1				1.0			
Female	328	180	54.9	1	0.8	1.4	0.9	1.0	0.7	1.4	1
<b>AGYW is the household head</b>											
No	823	447	54.3	1				1.0			
Yes	29	18	62.1	1.4	0.6	3	0.4	1.3	0.6	3.1	0.5

CI confidence interval; OR odds ratio; LRT likelihood ratio test

\* Invited to DREAMS by 2018 defined as self-reported invitation to participate in DREAMS in 2017 and/or 2018.

\*\* Self efficacy definition: Binary outcome variable constructed based on a series of ten questions comprising a general self-efficacy scale, where a cut-off value of  $\geq 3.5$  was used to define higher self-efficacy (yes).

\*\*\* Fully adjusted model included: age group, DSS study site, ethnicity, religion, food insecurity, orphanhood, in/out of school, sexual and pregnancy history, birth history, self assessed household poverty, socio-economic status, gender of the household head, whether or not the AGYW was the household head

a Food insecurity was defined as using the question: In the past 4 weeks, did you or any household member go to sleep at night hungry because there was not enough food? (yes, no)

b Self-assessed household poverty was based on the responses to the question: In your opinion, how do you assess the economic situation of your household now? (Very poor, moderately poor or not poor)

**Supplementary file 8. Conventional univariable and multivariable logistic regression model for the association between invited to DREAMS by 2018\* with self-efficacy\*\* in 2019, showing all covariates.**

**f. uMkhanyakude**

Variables at enrolment in 2017	Total N (1712)	Self-efficacy		Unadjusted OR			Fully adjusted OR***				
		n (829)	%	OR	(95% CI)	p (LRT)	aOR	(95% CI)	p (LRT)		
<b>Invited by 2018</b>											
No	809	384	47.5	ref				ref			
Yes	903	445	49.3	1.1	0.89	1.3	0.5	1.3	1.0	1.5	0.03
<b>Age group</b>											
13-14	414	157	37.9	ref				ref			
15-17	558	257	46.1	1.4	1.1	1.8	<0.001	1.4	1.1	1.8	<0.001
18-19	348	196	56.3	2.1	1.6	2.8		2.1	1.5	3.0	
20-22	392	219	55.9	2.1	1.6	2.7		2.2	1.5	3.4	
<b>Area</b>											
Rural	1095	545	49.8	ref				ref			
Peri-urban/urban	603	277	45.9	0.9	0.7	1.0	0.1	0.8	0.7	1.0	0.07
<b>Age 13-17, or 18-22 in school<sup>a</sup></b>											
Age 13-17	972	414	42.6								
Age 18-22 and in school	391	222	56.8								
<b>Age 18-22, not in school and incomplete secondary education<sup>b</sup></b>											
Yes	117	57	48.7	1.0	0.7	1.5	1	0.8	0.5	1.2	0.2
<b>Age 18-22, not in school and completed secondary education<sup>c</sup></b>											
Yes	209	127	60.8	1.8	1.3	2.4	<0.001	1.2	0.8	1.7	0.4
<b>Socio-economic status</b>											
Low	592	264	44.6	ref				ref			
Middle	576	283	49.1	1.2	1.0	1.5	0.05	1.2	1.0	1.6	0.02
High	479	253	52.8	1.4	1.1	1.8		1.5	1.2	2.0	
Unknown	65	29	44.6	1.0	0.6	1.7		1.0	0.6	1.8	
<b>Food insecure<sup>d</sup></b>											
No	1175	568	48.3	ref				ref			
Yes	532	260	48.9	1.0	0.8	1.3	0.8	0.9	0.7	1.1	0.4
<b>Migrated<sup>e</sup></b>											
No	1432	691	48.3	ref				ref			
Yes	280	138	49.3	1.0	0.8	1.3	0.8	0.8	0.6	1.1	0.1
<b>Sexual &amp; pregnancy history</b>											
Never had sex	1065	470	44.1	ref				ref			
Ever sex, never pregnant	218	126	57.8	1.7	1.3	2.3	<0.001	1.3	1.0	1.9	0.2
Ever pregnant	423	231	54.6	1.5	1.2	1.9		1.1	0.8	1.6	
<b>Experienced violence</b>											
No	1126	540	48.0	ref							
Yes	586	289	49.3	1.1	0.9	1.3	0.6	1.1	0.9	1.3	0.5

CI confidence interval; OR odds ratio; LRT likelihood ratio test

\* Invited to DREAMS by 2018 defined as self-reported invitation to participate in DREAMS in 2017 and/or 2018.

\*\* Self efficacy definition: Binary outcome variable constructed based on a series of ten questions comprising a general self-efficacy scale, where a cut-off value of  $\geq 3.5$  was used to define higher self-efficacy (yes).

\*\*\* Fully adjusted model included: age group, education, area, sexual & pregnancy history, socio-economic status, food insecurity, migration, violence

a Reference category for schooling dummy variables includes everyone who is in school, or 13-17 and out of school (very few, as almost all 13-17s are in school), or 18-22 and out of school with no/primary only education (few)

b Dummy variable, where 'no' (0) = all non-missing values of age and schooling, and those not coded as yes (not "18-22 not in school and incomplete secondary")

c Dummy variable, where 'no' (0) = all non-missing values of age and schooling, and those not coded as yes (not "18-22 not in school and complete secondary")

d Food insecurity was defined as any report of reducing the size of food portions or skipping meals by any member of a household because there was not enough money to buy food in the past 12 months

e Migration was defined as any movement within or outside surveillance area since age of 13

**Supplementary file 9(a). Sensitivity analyses alternative methods to estimate causal effect of DREAMS on social support in 2019, among all AGYW followed up in 2019**

	% Social support in total study population	Estimated % social support if none benefit from DREAMS	95% CI	Estimated % social support if all benefit from DREAMS	95% CI	Difference in estimated %	95% CI
<b>Gem</b>							
<b>Age 13-22 years at cohort enrolment</b>							
PS-regression adjustment*	40.4	35.5	31.1,39.6	43.3	39.3,47.3	7.8	2.1,14.0
PS-stratification	40.4	35.9	31.2,40.5	43.6	39.5,47.4	7.6	1.8,13.9
PS-inverse probability of treatment weighting	40.4	35.8	31.4,40.0	43.3	39.7,47.3	7.5	0.9,13.4
Counterfactual framework multivariable outcome regression	40.4	35.6	31.0,40.2	43.4	39.3,47.1	7.8	1.7,13.6
<b>Age 13-17 years at cohort enrolment</b>							
PS-regression adjustment*	37.0	31.2	26.0,37.3	40.7	35.7,46.3	9.5	1.9,17.3
Counterfactual framework multivariable outcome regression	37.0	30.5	25.1,36.4	41.2	36.1,46.1	10.6	3.3,18.0
<b>Age 18-22 years at cohort enrolment</b>							
PS-regression adjustment*	44.9	43.5	35.7,51.1	48.2	41.6,55.0	4.7	-4.5,14.1
Counterfactual framework multivariable outcome regression	44.9	43.6	36.0,51.0	46.9	39.9,53.1	3.3	-6.7,13.5
<b>Nairobi</b>							
<b>Age 15-22 years at cohort enrolment</b>							
PS-regression adjustment*	56.3	49.4	42.6,56.2	58.2	54.1,62.3	8.8	1.2,16.7
PS-stratification	56.3	48.4	41.4,55.4	58.3	54.2,62.2	9.8	1.4,17.4
PS-inverse probability of treatment weighting	56.3	49.1	42.3,56.2	58.2	54.1,62.2	9.1	1.3,17.1
Counterfactual framework multivariable outcome regression	56.3	49.8	43.1,56.9	58.2	54.1,62.3	8.4	0.4,16.4
<b>Age 15-17 years at cohort enrolment</b>							
PS-regression adjustment*	57.3	46.1	36.2,55.6	60.0	54.6,65.0	14.0	3.0,25.0
Counterfactual framework multivariable outcome regression	57.3	47.2	37.6,57.0	59.6	54.1,64.5	12.3	1.0,23.5
<b>Age 18-22 years at cohort enrolment</b>							
PS-regression adjustment	55.2	53.3	43.9,61.3	56.0	49.5,62.5	2.6	-7.3,14.1
Counterfactual framework multivariable outcome regression	55.2	52.8	43.5,61.3	56.6	50.3,62.9	3.8	-6.7,15.1

**uMkhanyakude****Age 13-22 years at cohort enrolment**

PS-regression adjustment*	45.4	44.2	40.5,47.7	46.0	42.5,49.5	1.8	-3.2,6.6
PS-stratification	45.4	44.1	40.4,47.4	46.0	42.6,49.7	1.9	-2.8,6.9
PS-inverse probability of treatment weighting	45.4	44.0	40.4,47.4	45.7	42.1,49.2	1.7	-3.2,6.4
Counterfactual framework multivariable outcome regression	45.4	44.0	40.4,47.6	45.9	42.3,49.3	1.8	-3.0,6.8

**Age 13-17 years at cohort enrolment**

PS-regression adjustment*	45.4	43.2	38.0,48.1	46.7	42.7,50.7	3.6	-2.6,10.2
Counterfactual framework multivariable outcome regression	45.4	42.6	37.4,47.8	46.7	42.7,50.7	4.1	-2.1,10.5

**Age 18-22 years at cohort enrolment**

PS-regression adjustment*	45.5	45.6	41.2,50.4	44.9	39.1,50.4	-0.6	-7.5,6.6
Counterfactual framework multivariable outcome regression	45.5	45.9	41.6,50.8	44.7	38.9,50.2	-1.2	-8.1,5.9

PS : propensity score

Outcome definitions: Binary outcome variable constructed where a high level of social support was defined as a 'yes' response to at least three out of four questions: "Is there a female in your community from whom you can borrow money in an emergency?"; "Do you have at least one trusted female friend?"; "Do you know a woman in your community, other than a mother or guardian, whom you could turn to if you had a serious problem?"; "Do you have a safe and private place to meet with girls and young women who are like you?"

\*Primary approach & main result reported in table 3

**Supplementary file 9(b): Sensitivity analyses (alternative methods) to estimate causal effect of DREAMS on self efficacy in 2019, among all AGYW followed up in 2019**

	% Self efficacy in total study population	Estimated % self efficacy if none benefit from DREAMS	95% CI	Estimated % self efficacy if all benefit from DREAMS	95% CI	Difference in estimated %	95% CI
<b>Gem</b>							
<b>Age 13-22 years at cohort enrolment</b>							
PS-regression adjustment*	34.5	31.8	27.3,36.0	35.6	31.1,39.0	3.8	-4.0,9.1
PS-stratification	34.5	32.5	27.7,36.2	35.3	31.3,39.6	2.8	-2.3,8.6
PS-inverse probability of treatment weighting	34.5	32.3	27.2,36.8	35.8	32.7,40.4	3.5	-1.8,11.2
Counterfactual framework multivariable outcome regression	34.5	31.9	27.2,36.6	35.6	31.2,39.8	3.7	-2.2,10.4
<b>Age 13-17 years at cohort enrolment</b>							
PS-regression adjustment*	30.1	27.0	21.6,31.7	32.8	28.2,37.8	5.7	-0.1,13.4
Counterfactual framework multivariable outcome regression	30.1	25.6	20.8,31.9	32.7	28.5,37.2	7.1	0.8,13.3
<b>Age 18-22 years at cohort enrolment</b>							
PS-regression adjustment*	41.4	41.0	33.6,49.8	41.2	34.2,46.6	0.2	-11.7,9.6
Counterfactual framework multivariable outcome regression	41.4	41.8	35.5,49.8	40.1	31.6,46.3	-1.7	-13.0,8.8
<b>Nairobi</b>							
<b>Age 15-22 years at cohort enrolment</b>							
PS-regression adjustment*	54.6	50.5	43.8,58.2	56.3	52.2,60.2	5.7	-2.7,13.9
PS-stratification	54.6	49.2	42.7,57.3	56.4	52.3,60.3	7.1	-2.2,14.6
PS-inverse probability of treatment weighting	54.6	49.8	42.9,57.3	56.4	52.3,60.3	6.6	1.5,14.8
Counterfactual framework multivariable outcome regression	54.6	51.1	44.4,58.7	56.1	52.2,60.0	5.0	-3.2,12.9
<b>Age 15-17 years at cohort enrolment</b>							
PS-regression adjustment*	53.2	50.6	41.3,61.2	53.9	49.0,59.0	3.3	-8.7,14.3
Counterfactual framework multivariable outcome regression	53.2	52.9	43.1,63.2	53.8	48.6,58.8	0.9	-10.8,12.2
<b>Age 18-22 years at cohort enrolment</b>							
PS-regression adjustment	56.2	50.5	41.9,59.5	59.1	53.2,65.5	8.6	-3.0,19.8
Counterfactual framework multivariable outcome regression	56.2	49.0	40.5,58.9	59.0	53.1,65.6	10.0	-0.9,20.6

**uMkhanyakude****Age 13-22 years at cohort enrolment**

PS-regression adjustment*	48.4	45.5	42.1,49.3	51.0	47.4,54.4	5.4	0.5,10.1
PS-stratification	48.4	45.9	42.5,49.7	50.9	47.5,54.2	4.9	0.2,9.7
PS-inverse probability of treatment weighting	48.4	45.6	42.1,49.3	50.8	47.2,54.1	5.2	0.3,9.7
Counterfactual framework multivariable outcome regression	48.4	45.5	42.0,49.3	50.8	47.3,54.2	5.3	0.3,9.8

**Age 13-17 years at cohort enrolment**

PS-regression adjustment*	42.6	38.7	33.6,44.1	45.3	41.4,49.7	6.7	0.3,12.6
Counterfactual framework multivariable outcome regression	42.6	38.6	33.6,44.0	45.5	41.5,49.8	6.9	0.5,12.9

**Age 18-22 years at cohort enrolment**

PS-regression adjustment*	56.1	54.5	49.9,59.4	58.3	52.2,64.0	3.8	-3.6,11.2
Counterfactual framework multivariable outcome regression	56.1	54.6	50.1,59.5	57.8	51.4,63.3	3.2	-4.5,10.7

PS : propensity score

Outcome definitions: Binary outcome variable constructed based on a series of ten questions comprising a general self-efficacy scale, where a cut-off value of  $\geq 3.5$  was used to define high self-efficacy.

\*Primary approach & main result reported in table 3