Trajectories of personal agency by gender and pubertal development among adolescents in Kinshasa: Longitudinal evidence from the GlobalEarly Adolescent Study

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ABSTRACT

Background: Empowerment research has largely focused on adult women with little focus on younger adolescents. Additionally, despite recognition that empowerment is a process, few studies have longitudinally explored its development.

Methods: We used secondary data from four waves of the Global Early Adolescent Study to explore trajectories in the development of three domains of agency (i.e. the internal processes composing empowerment) - Freedom of Movement, Voice, and Decision-Making - for 1188 boys and 1153 girls in Kinshasa, Democratic Republic of Congo. Respondents were age 10–14 at enrollment and followed through age 14–18. We created scales for each domain and conducted gender- and age-stratified latent growth curve modeling with random effects, comparing age 10–14 to age 15–18, accounting for clustering within individuals over waves. We examined the role of puberty within each domain in the analysis of age 10–14.

Results: Scores across all domains increased with age for boys and girls, with the exception of Voice amongst boys 10–14. Rates of change varied by age group and gender; for boys, scores increased at a faster rate for older boys relative to younger boys for Freedom of Movement ($\beta_{(10-14)}$: 3.98 versus $\beta_{(15-18)}$: 6.12) and Voice ($\beta_{(10-14)}$: .50 versus $\beta_{(15-18)}$: 2.54). Relative to younger girls, scores amongst older girls increased at a faster rate for Freedom of Movement ($\beta_{(10-14)}$: 1.76 versus $\beta_{(15-18)}$: 3.72) and a slower rate for Decision-Making ($\beta_{(10-14)}$: 6.41 versus $\beta_{(15-18)}$: 2.80). Puberty was associated with significant increases in scores across all domains for both genders, with the exception of Decision-Making for girls.

Interpretation: Young people develop/acquire different forms of agency at different stages of adolescence and development is not uniform across forms. Gender inequalities in agency amplify at puberty, signaling the need to intervene at or before this critical stage of development.

1. Introduction

Growing interest in the role of empowerment in reducing gender inequalities culminated in the establishment of Sustainable Development Goal 5, "achieving gender equality and empower[ing] all women and girls" by 2030 (Goal 5). Research on women's empowerment is expansive, with measures spanning multiple domains, such as educational, economic, and sexual and reproductive health (Malhotra &

Schuler, 2005; van Eerdewijk et al., 2017, p. 84). Research on the measurement and meaning of empowerment during adolescence, and particularly young adolescence (aged 10–14), is more limited (Hinson et al., 2021). Young adolescence is a time of rapid growth and a period of transition to adulthood, when behaviors and attitudes are initiated and codified, with significant long-term implications for well-being (Igras et al., 2014). Given the dearth of information and the importance of adolescence, there is increasing focus on understanding how to effectively intervene in adolescents' health and development (Igras et al.,

2014; Lane et al., 2017) but efforts are hindered by a number of factors, including measurement limitations, lack of longitudinal perspectives, and an almost exclusive focus on women and girls.

There is broad consensus that empowerment includes both internal processes, herein referred to as "agency", which represent the ability to freely define and act upon one's choices, and external factors, referred to as "opportunity structures" (e.g., economic, social, political), that promote or inhibit individuals achievement of these goals (Malhotra & Schuler, 2005; van Eerdewijk et al., 2017, p. 84). Increasingly, researchers recognize the multi-dimensional nature of empowerment, i.e. individuals may demonstrate empowerment to varying degrees across multiple domains, including household decisions, financial decisions, and sexual and reproductive health (Malhotra & Schuler, 2005; van Eerdewijk et al., 2017, p. 84). Recent efforts have attempted to define and operationalize these domains among adult women, particularly economic and reproductive empowerment (Fox & Romero, 2017; Moreau et al., 2020); however, lack of research among young adolescents limits the potential of this evidence. Many concepts theorized to be relevant for the empowerment of adults, such as women's financial or sexual and reproductive decision-making, are less salient among young adolescents as they are generally more dependent on adults, including their parents and other caretakers, and sexual behaviors are nascent.

Empowerment is also recognized as a process, wherein empowerment evolves over time (Sharaunga et al., 2019), yet few studies have explored this construct longitudinally; that is, examining how, and for whom, empowerment changes. This gap in longitudinal evidence has been recognized by multiple scholars as a deterrent to progress in understanding and addressing the role of empowerment in developmental trajectories and health outcomes (Closson et al., 2018; Rostosky et al., 2008; Salazar et al., 2004). Levels of empowerment among women are known to differ by age, marital status, and parity (Karp et al., 2020; Sell & Minot, 2018), but these events are, again, rarely applicable to young adolescents.

Puberty represents a hallmark of adolescent development, not only signaling physical changes and reproductive capacity, but also social changes with increasing autonomy. In girls, early puberty includes development of breasts and pubic hair with a clear biological marker of late puberty with the onset of menarche, while for boys, there are an array of markers, including development of facial, body, and pubic hair, changing voice, growing penis and testicles, and appearance of sperm in ejaculate (Rosen, 2004). Socially, pubertal development coincides with a reorientation of influences from parents to peers and increasing engagement with social environments outside of the home (Crone & Dahl, 2012). Pubertal development brings about significant cognitive changes, including heightened abstract and critical thinking abilities, increased sensitivity to rewards, and the gradual development of cognitive control and decision-making skills (Steinberg, 2008). Alongside these shifts, there is an intensification of gendered expectations regarding appropriate behavior and increasingly dividing roles, power and opportunities between boys and girls (Bello et al., 2017; Blum et al., 2017; Mmari et al., 2018). Gendered views of sexuality, primarily that girls are sexually vulnerable and boys are predators, promote restrictions on movement for girls and separation of boys and girls (Al-Attar et al., 2017; Blum et al., 2017). These gendered views likely impact adolescent's ability to make choices and act on these choices, yet, no studies have specifically explored how puberty influences empowerment trajectories in adolescence.

In addition to the lack of a developmental perspective on empowerement, research has also failed to examine gender differences in empowerment trajectoires in this critical period of the lifecourse, due to a lack of research on boys. This limits gender-specific comparisons of empowerment trajectories and the factors that shape them to guide gender transformative interventions that engage all genders. Such interventions generally do not engage boys and men, despite ample evidence that male participation can promote and encourage gender equality (Kato-Wallace et al., 2016). Additionally, while the importance of intervening early in adolescence is increasingly recognized (Igras et al., 2014; Lane et al., 2017), interventions are often hampered by a lack of evidence-based research on the appropriateness or effectiveness of strategies for young boys (Kato-Wallace et al., 2016).

The Democratic Republic of Congo (DRC) is a Central African country with high gender inequality, ranking 152 out of 193 countries in gender inequality according to the Gender Inequality Index (United Nations Development Programme, 2023). Strongly held patriarchal beliefs are pervasive (Moreau et al., 2021). For example, only half of women report that they have the final say in their own health care and three-quarters of women agree that a man is justified in beating his wife for reasons such as burning food or refusing sex (Ministère du Plan et Suivi de la Mise en œuvre de la Révolution de la Modernité (MPSMRM), Ministère du Plan, 2014). The DRC is also a country beset with civil conflict, and these patriarchical attitudes combined with ongoing civil unrest lead to high levels of violence; more than half (52%) of women report ever experiencing physical violence and one quarter (27%) report ever experiencing sexual violence (Ministère du Plan et Suivi de la Mise en œuvre de la Révolution de la Modernité (MPSMRM), Ministère du Plan, 2014).

Kinshasa, the capital of the DRC, is poised to become the most populous city in Africa by 2030 (World Bank, 2018). Approximately 80% of the population lives in slum conditions (UN Habitat, n.d.), with numerous health and safety risks for adolescents, who comprise approximately one-quarter of the population. Qualitative research amongst adolescents girls describes a sudden shift in expectations beginning at puberty, with a rapid and frequent onset of sexual advances (McLean & Modi, 2016). This is supported by quantitative evidence; a survey conducted amongst adolescent girls age 11–18 found that 93% experienced verbal sexual harassment and three in four had experienced attempted rape (Jonas et al., 2022). Approximately one in five young adolescents (aged 10–14) in poor communities in Kinshasa perceive their neighborhoods as unsafe, and one in four report low neighborhood cohesion, or trust in their neighborhood (Mmari et al., 2021). Violence perpetration in Kinshasa is common, with one study in poor communities finding that 33% of young adolescents reported perpetrating violence in the previous six months (Beckwith et al., 2022). The various health and safety risks faced by this adolescent cohort, coupled with entrenched patriarchy and gender inequality, underscore the urgency of understanding adolescent development, to intervene and improve health outcomes during this critical time.

1.1. Objective

We used secondary data from the Global Early Adolescent Study (GEAS) to address current research limitations and explore trajectories in the development of agency over the course of adolescence. The GEAS is a multi-country longitudinal study of adolescents that focuses on understanding the effect of gender norms on adolescent health and development. Young adolescents were enrolled at ages 10–14 and followed annually for five years. Our specific objective is to describe how three domains of agency hypothesized to be relevant to young adolescents – voice (e.g. the ability to voice opinions and ask questions), freedom of movement, and decision-making – evolve and change as adolescents age. Describing these trajectories in both boys and girls is key to understanding critical points of intervention.

2. Methods

2.1. Data source and study design

The data come from an existing longitudinal cohort of young adolescents from the GEAS in Kinshasa, DRC. The GEAS is a global study designed to investigate how gender norms evolve throughout adolescence and inform an array of health and well-being outcomes, including agency (Global Early Adolescent Study). Adolescents were followed up over a period of five years between 2017 and 2022. Due to changes in skip patterns and question wording between Wave 1 (2017) and subsequent waves, this analysis used data collected between Wave 2 (2018) and Wave 5 (2022); however, we provide details of the original Wave 1 sample and sampling strategy for completeness.

At Wave 1, both in-school and out-of-school adolescents were selected from two randomly selected urban poor communities if they were between 10 and 14 years of age, were able to understand the survey tool, provided assent, and if parental consent was provided. In-school adolescents (n = 2016) were selected from 80 randomly selected public and Catholic schools and stratified based on age and sex. Schools compiled a list of all adolescents that met eligibility criteria. If there were fewer than 25 eligible adolescents, all were selected. Simple random sampling from a list of all eligible adolescents was used in schools with greater than 25 eligible adolescents. Out-of-school adolescents (n = 826) were randomly selected from the same neighborhood based on a listing of all adolescents age 10–14 created by community-based organizations via community mapping. Approximately half the in-school (n = 1013) and out-of-school adolescents (n = 446) participated in the Growing Up Great! (GUG!) intervention, implemented by Save the Children. GUG! was a norm shifting multi-level gender transformative intervention that engaged young adolescents and their networks of parents, teachers and health care providers to improve knowledge, health and gender positive attitudes, skills and self-efficacy (Mmari et al., 2023). The intervention was implemented between Waves 1 and 2, thus all observations in this analysis were gathered post-intervention.

More detail on the Global Early Adolescent study procedures can be found at the GEAS website, including the baseline GUG! Report (Growing Up GREAT, 2018 report).

2.2. Analytic sample

Skip patterns and wording for some items differed between Wave 1 and subsequent waves; to maximize comparability across time, we used data from Wave 2 through Wave 5 and defined Wave 2 as baseline. Of the 2842 adolescents who completed the original Wave 1 survey, 2587 participated in Wave 2. We dropped any adolescents who were interviewed only once (n = 246) resulting in 2341 adolescents (n = 1188 boys and n = 1153 girls, 91.0% retention from Wave 2). There were no significant differences in the distributions of gender, age, or enrollment in the intervention between the full Wave 2 baseline sample and the analytic sample (Appendix Table 1) and, thus, we did not adjust for differential loss-to-follow-up.

2.3. Measures

We used the GEAS measures of agency, previously validated among young adolescents across 15 countries to explore Freedom of Movement, Voice, and Decision-Making scales (Zimmerman et al., 2019); Freedom of Movement (5 items) measured adolescents' ability to move in their community without adult supervision; Voice (7 items) assessed adolescents' ability to express needs and opinions; Decision-Making (4 items) evaluated adolescents' ability to make a decision by themselves without an adult. All items were scored on a four-point Likert scale, from "never" (0) to "often" (3) and totaled within each wave into three continuous measures. Within each scale, we normalized the additive score to a 100-point scale for comparison purposes. Table 1 shows the items used to comprise each scale, along with the wave and domain-specific Cronbach's alpha.

Our key independent variables were age, gender, and pubertal status. Adolescents self-identified as boys or girls at Wave 1 and self-reported age at each wave. We included pubertal status as a self-reported time-varying variable. Though there is not a "gold-standard" for measurement of puberty within surveys, a number of studies have demonstrated reliability and validity of self-report of pubertal status through identification of physical changes (Brooks-Gunn et al., 1987; Petersen et al., 1988; Walker et al., 2020). Girls were asked if their breasts had started to grow and if they had started menstruating, and if yes, age at first menarche. Girls were not asked to report age at breast development. Boys were asked if they had ever had a wet dream, if they had started puberty (specifically "Have you started puberty? For example, have your penis or testicles started to get larger compared to when you were younger"), if their voice had started to change, and if they had started growing facial hair. If they said yes, boys were then asked at what age each had started.

These markers are generally indicative of late stage pubertal development, thus we are not able to estimate age of pubertal onset specifically, and rather identify the age at which adolescents have developed pubertal markers. As there is a lack of one clear biological signal in boys, we relied on reporting of pubertal markers and defined pubertal status based on when they first reported any two of the four signals mentioned above. For boys who had not started puberty at enrollment, we identified the first survey at which they reported any two of these events and their age at the time of the survey. For boys who reported at least two of these signals at initial enrollment, we took the age at which the second signal was reported to determine pubertal status. At each age, pubertal status was then coded as 0 if age was less than the age at which pubertal markers were reported or 1 if it was the same age or later. Results from sensitivity analyses conducted using three of four signals for boys were largely consistent.

Table 1
Items included in the GEAS Agency Scales and wave and domain-specific Cronbach's alpha.

Domain and item wording	Cronbach's alpha			
	Wave			
	Two	Three	Four	Five
Freedom of Movement Scale: Can you tell me how often you were allowed to do the following alone (without and adult present)?	0·75	0·79	0·82	0·84
Go to recreational activities (like sports clubs) Go to a party with boys and girls Meet with friends in the afternoon or evening Go to community center/movies/youth center Visit a friend of the opposite sex				
Voice Scale: How often are the following statements true to you?	0·72	0·75	0·81	0·79
My parents or guardians ask for my opinion on things My parents or guardians listen when I share my opinion My friends ask my advice when they have a problem If I see something wrong in school or the neighborhood, I feel I can tell someone, and they will listen I can speak up in class when I have a comment or question I can speak up when I see someone else being hurt I can ask adults for help when I need it				
Decision-making Scale: How often are you asked to make the following decisions on your own, without an adult?	0·65	0·71	0·71	0·78
What clothes to wear when you are not in school/working What to do in your free time What to eat when you are not at home Who you can have as friends				

We also included GUG! intervention enrollment status at Wave 1, given the potential relationship between the gender norms related intervention and agency. Of note, earlier analysis of the GUG! intervention demonstrated that it was not successful at shifting gender norms perceptions about stereotypical traits or roles (Gayles et al., 2023). We also included two indicators of socioeconomic status that we hypothesized may confound the relationship of agency and our primary relationships of interest (age, gender, and puberty), specifically school enrollment and wealth tertile.

2.4. Analysis

Data were included from each wave in which an adolescent participated, ranging from two to four waves. Analyses for each scale were conducted independently, thus, an adolescent may have data for one scale (e.g. Freedom of Movement) and be included in scale-specific analyses, but have missing data for another (e.g. Voice) and be dropped from scale-specific analyses. We first conducted exploratory analyses to identify missing data by item and scale across the survey waves. At each observation, if half or fewer of the items within each scale were missing, we imputed the missing values with the mean of the remaining items of that scale.(Fox-Wasylyshyn & El-Masri, 2005). We imputed between .70% and 2.56% of observations across wave/scale combinations. If more than half of the items within each scale were missing, we did not include the observation in analyses for that wave/scale. Fewer than 1% of observations had more than half of items missing within any wave/scale combination.

For each scale, we conducted latent growth curve modeling with mixed model specification, including both fixed- and random-effects parameters (Ghisletta et al., 2015; Teachman, 2014), to account for the unbalanced nature of the data (Laird & Ware, 1982; Wooldridge, 2019) and for clustering within individuals over waves, stratified by gender. In the latent growth model with mixed-effects specifications, both intercepts and slopes are random. The β coefficients are the fixed parameters in the model, which are presented in the results and shown in the table. Because 95% of both boys and girls reported pubertal markers by age 15, we also stratified analyses by age, stratifying by age 10–14 and 15–18. Age was centered at the gender-specific mean age in all analyses and puberty was included only in stratified analyses of age 10–14. We tested for non-linearity across all scales and found no significant non-linear effects.

All analyses were conducted using Stata 18.0 (StataCorp, 2023).

2.5. Ethics commitee approval

Analyses in this publication were undertaken as a secondary review of previously collected data and were provided without identifiable information. Ethical review and approval was provided by the Johns Hopkins Bloomberg School of Public Health [FWA00000287] Institutional Review Board.

3. Results

The mean age, wealth tertile, and intervention enrollment status as measured at Wave 2 and the time-varying school enrollment status at each wave and mean age of pubertal markers are shown in Table 2. There were no significant differences in either age distribution or intervention status between boys and girls. Mean age at pubertal markers of adolescents was 13.9 for boys and 12.5 for girls.

Fig. 1 below shows the distribution of scales by age and gender. There is considerable variation across scores at every age, with a tendency towards greater outliers among girls for the Freedom of Movement scale and among boys for the Decision-Making scale. There was significant variability in the distributions across scale, age, and gender. For example, the median score for girls in the Freedom of Movement scale was zero until age 13, implying that their autonomy in movement

Table 2
Sociodemographic characteristics of the analytic sample.

	Boys		Girls	
	n = 1188		n = 1153	
	%	SE	%	SE
Wave 2				
Mean age	12.8	.04	12.8	.04
Wealth tertile				
Lowest	34.9	1.39	31.0	1.37
Middle	31.8	1.35	35.6	1.42
Highest	33.4	1.37	33.4	1.40
Intervention				
Control	49.1	1.45	50.2	1.47
Intervention	50.9	1.45	49.8	1.47
Time-varying				
School enrollment				
Wave 2	79.0	1.18	82.4	1.12
Wave 3	85.5	1.05	85.2	1.07
Wave 4	80.5	1.22	82.6	1.17
Wave 5	73.2	1.48	73.4	1.51
Mean age pubertal onset	13.9	.04	12.5	.04

did not emerge until they were at least 12 years of age. Conversely, the median of the Decision-Making scale was 100 for girls at age 17 and for boys at age 18, which suggests that by these ages, girls and boys universally attain autonomy in decision-making about their daily activities.

Across Freedom of Movement, Voice, and Decision-Making, scores for boys increased with age, though rates of change varied by age group strata and domain (Table 3). Scores increased at a higher rate per year amongst older boys relative to younger boys for Freedom of Movement (ß$_{(10-14)}$: 3.98 (95% CI: 2.92–5.04) versus ß$_{(15-18)}$: 6.12 (95% CI: 4.91–7.33)), and for Voice (ß$_{(10-14)}$: .50 (95% CI: 1.51-.51) versus ß$_{(15-18)}$: 2.54 (95% CI: 1.49–3.59)), and did not differ significantly between age cohorts for Decision-Making ((ß$_{(10-14)}$: 3.81 (95% CI: 2.70–4.93) versus ß$_{(15-18)}$: 2.92 (95% CI: 1.90–3.94)). In only one domain, Voice, and one age group, 10–14, were there no gains with age. Existence of pubertal markers, which was included in the age group 10–14 analysis, was significantly associated with increased agency scores across all domains, ranging from ß$_{(DM)}$: 4.99 (95% CI: 2.48–7.49) to ß$_{(FOM)}$: 7.62 (95% CI: 5.14–10.10). Wealth and school enrollment largely showed no relationship with scores for boys, with the exception of lower Freedom of Movement amongst the wealthiest 10–14 year old boys. Boys age 10–14 who were enrolled in the intervention had significantly higher Voice scores than their control counterparts, but there was no association across other domains or ages.

Scores across all domains increased with age for girls, though gains per year tended to be lower than boys (Table 4). Freedom of Movement scores increased at a higher rate per year for older relative to younger girls (ß$_{(10-14)}$: 1.76 (95% CI: 0.81–2.71) versus ß$_{(15-18)}$: 3.72 (95%CI: 2.44–5.00)), while for Voice there was no difference by age cohort (ß$_{(10-14)}$: 1.39 (95% CI: .27–2.51)versus ß$_{(15-18)}$: 1.33 (95% CI: 0.18–2.49)), and for Decision-Making, scores increased at a slower rate for older relative to younger girls (ß$_{(10-14)}$: 6.41 (95% CI: 5.14–7.68) versus ß$_{(15-18)}$: 2.80 (95% CI: 1.70–3.90)). Development of markers of puberty was associated with higher scores for Freedom of Movement and Voice (ß$_{(FOM)}$: 3.60 (95% CI: 1.30–5.91)and ß$_{(Voice)}$: 3.14 (95%CI: 0.37–5.91)), but was not associated with Decision-Making. As with gains per age, gains tended to be lower for girls than for boys when they exhibited markers of puberty. Wealth and school enrollment were inconsistently associated with scores across all domains and ages. Girls age 15–18 who were enrolled in the intervention had significantly higher Decision-Making scores than their control counterparts, but there was no association across other domains or ages.

Fig. 2 below shows the predicted mean score for each scale by age and gender, adjusted for the existence of markers of puberty, intervention enrollment, school enrollment (at baseline), and wealth tertile at baseline.
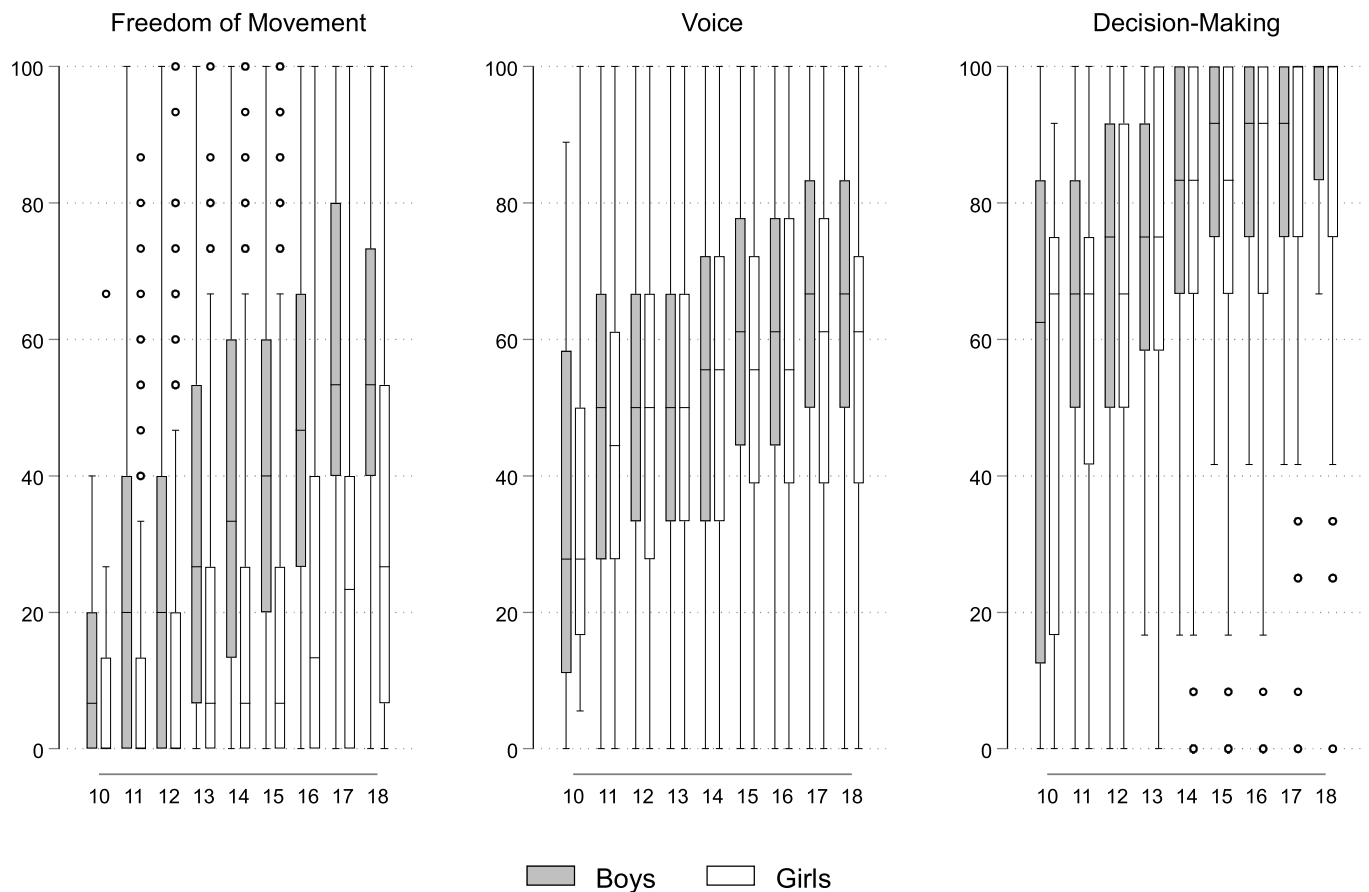
Freedom of Movement · Voice · Decision-Making

Fig. 1. Distibution of agency scores by domain across age and gender: Global Early Adolescent Study, Kinshasa, DRC.

4. Discussion and next steps

Unique and gendered patterns in the development of agency were apparent across all three agency domains, with evidence that puberty was associated with significant gains for both boys and girls in most domains. These findings are important in that they indicate 1) young people develop/acquire different forms of agency at different stages of adolescence and 2) gender inequalities in young people's assets (including agency) amplify at puberty, signaling the need to intervene at or before this critical stage of development.

From age 10, girls report less freedom to move within their community and these inequalities relative to boys only grow as adolescents age. While inequality in movement has been documented in qualitative research of adolescents (Hallman et al., 2015; Mmari et al., 2018) and in qualitative and quantitative research among adult women (Asi, 2021), the stark pattern seen in our research underscores how quickly gender-based inequities manifest. Unexpectedly, we found that gains in Freedom of Movement accelerated after the development of pubertal markers for girls, which differs from qualitative research on adolescents indicating puberty is associated with greater restrictions on movement for girls (Hallman et al., 2015; Mmari et al., 2018). Restrictions on female movement are frequently justified by concerns over safety, particularly protection from sexual violence, which accelerates after puberty (Hallman et al., 2015; Mmari et al., 2018). These concerns are strongly associated with gendered expectations of male aggression and female vulnerability (McLean & Modi, 2016). One explanation for greater gains after puberty may be increased expectations to work outside the home and/or take on a greater share of household chores, such as going to the market (McLean & Modi, 2016). Future research will incorporate specific opportunity structures, such as perceived neighborhood and economic security, to explore how adolescents'

freedom of movement trajectories vary according to social context. Given that the GEAS draws exclusively from an urban poor sample, however, more research is needed to confirm whether these findings hold among other populations.

Patterns in higher and rapidly accelerating Freedom of Movement scores among boys is consistent with research from multiple settings, including South Africa (Hallman et al., 2015) and the US (Mmari et al., 2018), wherein boys typically have less oversight and more autonomy. Such patterns may not, however, result in positive outcomes for boys, as greater movement is also associated with heightened risk for violence, traffic injuries, and substance use, which contribute to substantially higher mortality rates among adolescent boys than girls (Elliott et al., 2016; Patton et al., 2016). That risks to health and wellbeing for boys do not result in similar movement restrictions underscores the way that safety and protection against safety concerns are interpreted through a gendered perspective. Safety for girls may be considered the absence of sexual harassment and violence, with interventions to promote safety largely operating through restricting girls' movement and constraining engagement with external threats. While boys may face different, but equally harmful threats, such as physical violence, fewer constraints are generally placed on their movement, which may subsequently increase their risk for morbidity and mortality.

The development of young people's ability to be heard (Voice scale) was more complicated than the stark linear trend shown in Freedom of Movement, but gender disparities were also present. Gains in girls' ability to voice concerns were largely consistent across all ages, while boys' ability to voice their opinion were stagnant in early adolescence and appeared to accelerate at older ages. Qualitative evidence from Kinshasa suggests that gendered expectations for girls promote submission and docility relative to expectations of authority and dominance for males (McLean & Modi, 2016), however, at younger ages, we see

Table 3
Mixed effects linear regression results for boys, stratified by age 10–14 and 15-18.

	Freedom of Movement				Voice				Decision-Making			
	10–14		15–18		10–14		15–18		10–14		15–18	
	Beta	95% CI	Beta	95% CI	Beta	95% CI	Beta	95% CI	Beta	95% CI	Beta	95% CI
Age	**3.98**	**(2.92-5.04)**	**6.12**	**(4.91-7.33)**	-.50	(-1.51-.51)	**2.54**	**(1.49-3.59)**	**3.81**	**(2.70-4.93)**	**2.92**	**(1.90-3.94)**
Puberty	**7.62**	**(5.14-10.10)**			**5.17**	**(2.86-7.48)**			**4.99**	**(2.48-7.49)**		
School enrollment	-2.70	(-5.63-.23)	**-5.50**	**(-8.63–2.37)**	**3.49**	**(0.78-6.2)**	2.43	(-.26-5.12)	**5.55**	**(2.62-8.48)**	.18	(-2.34-2.69)
Wealth (ref: Lowest)												
Middle	-1.12	(-4.28-2.04)	1.43	(-2.40-5.26)	-1.10	(-4.06-1.85)	-3.13	(-6.39-13)	2.54	(-.66-5.75)	.24	(-2.63-3.12)
Highest	**-3.25**	**(-6.41–0.1)**	2.76	(-1.01-6.54)	-.52	(-3.47-2.43)	-.42	(-3.64-2.79)	.91	(-2.29-4.11)	.18	(-2.66-3.02)
Intervention (ref: Control)												
Intervention	-.65	(-3.18-1.89)	.64	(-2.47-3.74)	**2.67**	**(0.29-5.04)**	.50	(-2.14-3.14)	-1.71	(-4.28-87)	1.60	(-.73-3.93)
Constant	36.02	(32.06-39.97)	41.48	(37.19-45.77)	44.56	(40.89-48.23)	55.17	(51.49-58.85)	68.01	(64.04-71.97)	77.38	(74-80.76)

Bold is significant at p < .05.

Table 4
Mixed effects linear regression results for girls, stratified by age 10–14 and 15-18.

	Freedom of Movement				Voice				Decision-Making			
	10–14		15–18		10–14		15–18		10–14		15–18	
	Beta	95% CI	Beta	95% CI	Beta	95% CI	Beta	95% CI	Beta	95% CI	Beta	95% CI
Age	**1.76**	**(0.81-2.71)**	**3.72**	**(2.44-5.00)**	**1.39**	**(0.27-2.51)**	**1.33**	**(0.18-2.49)**	**6.41**	**(5.14-7.68)**	**2.80**	**(1.70-3.90)**
Puberty	**3.60**	**(1.3-5.91)**			**3.14**	**(0.37-5.91)**			-1.49	(-4.59-1.61)		
School enrollment	-1.59	(-4.03-.86)	**-5.32**	**(-8.24–2.4)**	1.87	(-1.06-4.8)	**3.91**	**(0.99-6.83)**	.87	(-2.41-4.15)	-2.19	(-4.95-.58)
Wealth (ref: Lowest)												
Middle	**-1.92**	**(-4.23–0.39)**	2.34	(-1.03-5.71)	2.48	(-.47-5.42)	1.62	(-1.96-5.2)	.19	(-2.99-3.36)	.47	(-2.83-3.76)
Highest	.83	(-1.57-3.23)	**4.78**	**(1.32-8.23)**	**4.27**	**(1.22-7.33)**	2.88	(-.78-6.54)	1.27	(-2.03-4.56)	**3.58**	**(0.21-6.95)**
Intervention (ref: Control)												
Intervention	-.04	(-1.93-1.84)	1.01	(-1.71-3.73)	.91	(-1.49-3.31)	.94	(-1.95-3.83)	1.36	(-1.23-3.95)	**3.38**	**(0.72-6.04)**
Constant	15.98	(12.45-19.5)	17.33	(13.39-21.27)	45.35	(41.06-49.64)	49.12	(45.1-53.14)	50.61	(45.97-55.25)	63.04	(55.61-70.48)

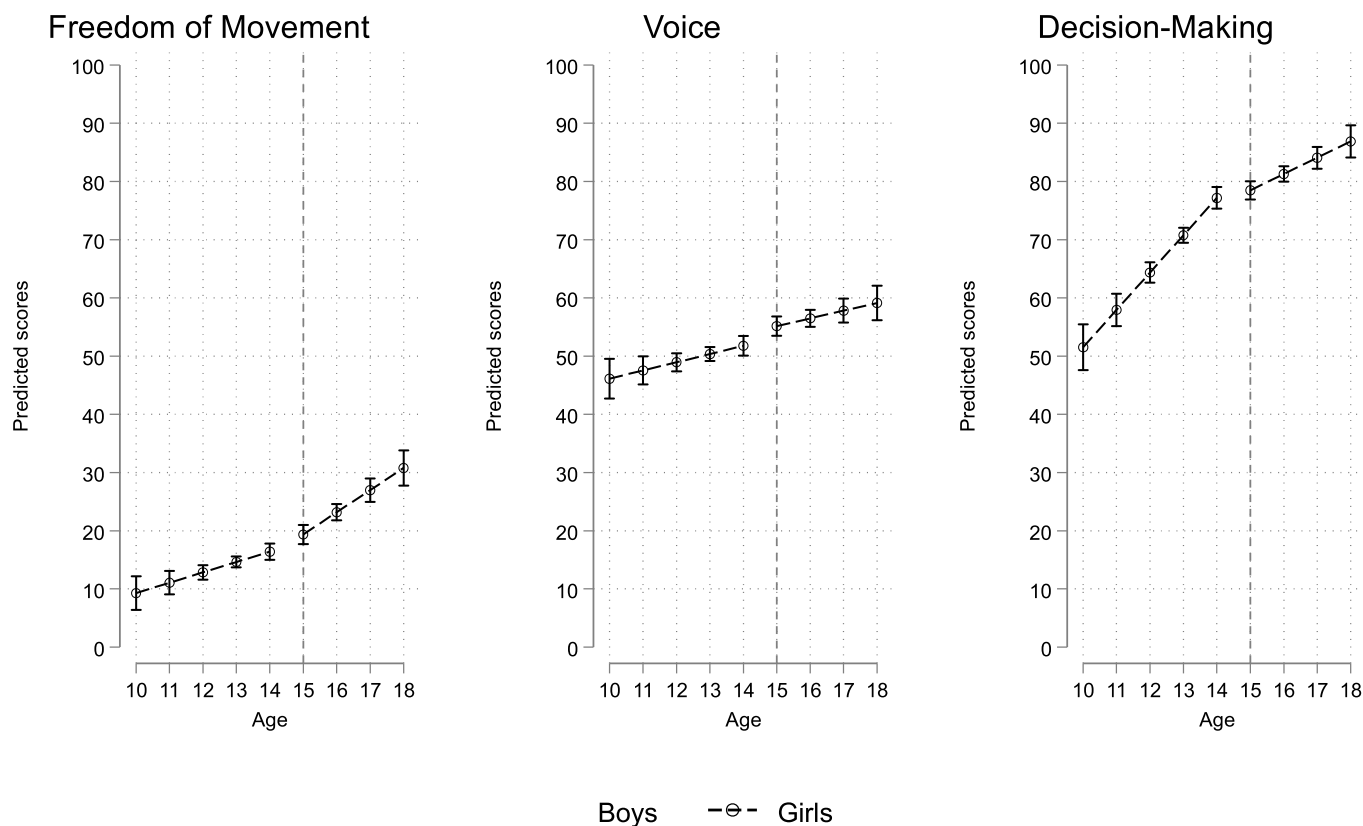Bold is significant at p < .05 Italics is significant at p < .10.

Fig. 2. Predicted scores by domain of agency by age and gender: Global Early Adolescent Study, Kinshasa, DRC.

little difference between genders. This underscores the importance of early adolescence as a time to intervene to promote gender equity. As with Freedom of Movement, puberty appeared to serve as a catalyst for gender-specific trajectories that show diverging gains between males and females.

Finally, we see relatively little difference between boys and girls related to their perceived ability to make every-day decisions that are relevant to them. There is a clear trajectory towards greater decision-making power with age, particularly amongst younger girls, which plateaus at older ages. We did, however, see that puberty was associated with increased decision-making for boys, but not for girls. That there was less variation at older ages demonstrates the need to refine measures for older adolescents who increasingly make adult decisions. In later waves of the GEAS, additional questions were included across all domains that reflected what were hypothesized to be more age-specific items, including questions on decision-making about peers and relationships. Future research will explore whether the integration of these questions results in greater variation within scales and is better able to discriminate between those with high-versus low-decision-making ability and whether gendered differences exist at older ages.

There are few relevant studies with which we can compare trajectories, however, our findings confirm the importance of puberty as a significant event in the development of agency and align with the substantial literature confirming gendered power imbalances in adulthood that are broadly related to voice (Weber et al., 2019). While puberty is defined by a range of biological processes, these differences are the result of the social processes that accompany puberty, such as the promotion of male voices and influence relative to promotion of female docility, reinforcing expected roles for men and women as adolescents transition to adulthood. Our findings are supported by qualitative research in Kinshasa that documents significant pressure for young women to be submissive and align with traditional ideas of "good girls", particularly after puberty (McLean & Modi, 2016). There is, however,

little research that has been conducted amongst boys or their caregivers to understand how puberty is viewed and its influence on boys' autonomy. The dearth of comparative data, especially for boys, highlights the need for more research in this population. Though gender inequality is present throughout the life-course, interventions to address gendered imbalances in decision-making, autonomy, and empowerment have historically focused on older adolescents or adult women. Our findings underscore the importance of intervening to promote greater equality *prior* to onset of puberty, as imbalances manifest almost immediately upon puberty.

We note, however, that pubertal status is challenging to measure given that it is a process, rather than a singular event. Due to data limitations, we estimated pubertal status for girls only via the development of late stage pubertal markers, e.g. age at first menarche, which overestimates age at onset (Rosen, 2004). Given cultural significance of the menstrual cycle as a marker of "womanhood", however, it is likely that this serves as both a biological and social marker of puberty (Chang et al., 2010) and therefore believe it is a reliable indicator. Establishing the onset of puberty for males is more difficult. We chose to define pubertal status for boys based on reporting two of four biological signals. We felt the individual and social processes associated with puberty (i.e. reorientation from parents to peers, intensification of gender norms etc) would likely begin with the first signs of puberty, rather than at later stages, and affect agency trajectories at earlier, rather than later ages. Thus, it was more reasonable to use two of four markers, rather than all four markers, to define age of attainment of pubertal markers. Our results do, however, underscore the need for further refinement in ways to measure pubertal onset, particularly for males.

Another limitation of our study is the use of data from an urban poor sample in Kinshasa which may limit the generalizability of findings. This may also explain inconsistent results related to the wealth and school enrollment over time, as the majority of our sample was poor. That our results generally align with qualitative data from multiple settings,

however, speaks to the potential of these findings to be applicable on a broad scale. Despite these limitations, our paper makes substantial contributions to the field of adolescent health. We use unique longitudinal data of young adolescents who are largely neglected in health research and use measures that were specifically developed and tested amongst this population. We include both boys and girls which highlights important difference in trajectories and further highlights the importance of puberty.

5. Conclusion

Taken as a whole, our findings point to the complexity of adolescent development and the need to consider how specific domains of agency develop, by gender, when designing interventions. Puberty significantly increased gender disparities in agency, signaling the importance of intervening prior to puberty when differences accelerate.

CRediT authorship contribution statement

Linnea A. Zimmerman: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Investigation, Formal analysis, Data curation, Conceptualization. **Celia Karp:** Writing – review & editing, Writing – original draft, Supervision, Formal analysis. **Kimberly Mihayo:** Writing – review & editing, Formal analysis, Data curation. **Astha Ramaiya:** Writing – review & editing, Project administration, Data curation, Conceptualization. **Eric Mafuta:** Writing – review & editing, Validation, Supervision, Resources, Project administration, Methodology, Investigation. **Caroline Moreau:** Writing – review & editing, Writing – original draft, Resources, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization. **Saifuddin Ahmed:** Writing – review & editing, Visualization, Supervision, Formal analysis.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:
Linnea A Zimmerman reports financial support was provided by the Eunice Kennedy Shriver National Institute of Child Health and Human Development. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix

Table 1
Comparison of gender, age, and enrollment status between full Wave 2 and analytic sample

	Wave 2		Analytic sample		
	n = 2587		n = 2341		
	%	SE	%	SE	p-value
Gender					
Boys	50.75	1.03	50.81	1.03	.95
Girls	49.25	1.03	49.19	1.03	
Mean age	12.82	.03	12.82	.03	.96
Intervention status					
Control	49.64	1.03	49.62	1.03	.98
Intervention	50.36	1.03	50.38	1.03	

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