

HIV-related sexual decisions made by African-American adolescents living in different family structures: study from an ecodevelopmental perspective

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Purpose: The purpose of this study was to explore the association between the dynamics of family structure and sexual behaviors of African-American adolescents using the ecodevelopmental theory.

Methods: This study stratified data from 1,617 African-American adolescents of the Add Health Wave I respondents with an identified family composition. It examined the associations between family structure, parenting function, and adolescents' sexual decision-making: age of first sexual intercourse, sexual initiation before age 16, and using a condom during the first and last sexual intercourse.

Results: Emotional connection between parents and children (feeling more love from the father: $\beta=0.17$, $P=0.0312$; feeling more love from the mother: $\beta=0.3314$, $P=0.0420$) and mothers' less permissive attitude toward adolescents' sexual experience in their teens ($\beta=0.33$, $P=0.0466$) are positively associated with late age of sexual initiation of adolescents living in two-parent households. School-level factors ($\beta=0.07$, $P=0.0008$) and the adolescents' characteristics (being older: 0.42 , $P=0.0002$; heterosexuality: $\beta=2.28$, $P=0.0091$) are the factors most positively related to the age of sexual initiation for those living with a single parent. Immediate social determinants, other than family factors (such as land use of immediate area [rural]: $\beta=9.84$, $P<0.0001$; the condition of living unit: $\beta=1.55$, $P=0.0011$; and safety of neighborhood: $\beta=4.46$, $P=0.004$), are related to late age of sexual initiation among those living with other relatives/alone. A higher tendency of condom use consistency was present in adolescents living with two parents compared to those living in other family structures.

Conclusion: Less parent/child connection and parent/family influence were found in African-American adolescents living with other relatives or alone, suggesting that living with two residential parents plays an essential role in their late sexual initiation and could account for an important element to combat high HIV incidence of African-American adolescents.

Keywords: ecodevelopmental theory, African-Americans, adolescents, family structure, parenting function, sexual behaviors

Introduction

African-Americans aged 13–24 years have the highest rate of HIV and AIDS among all age and racial groups in the US. Due to lack of adequate knowledge, adolescents tend to experiment with new things, conform to peers, and hold a low-risk perception of HIV infection compared to adults with low self-perceived HIV/sexually transmitted infection (STI) risks^{1–3} and thus, adolescents tend to have low likelihood of testing

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for HIV.⁴ Although school-based interventions targeting school-age children and adolescents are aimed at increasing HIV/AIDS knowledge, increasing the likelihood of using a condom correctly, and increasing intentions to use a condom during sexual intercourse,⁵⁻⁷ randomized controlled trials (RCTs) showed that most of the school-based intervention programs demonstrated short-term effectiveness in modifying adolescents' sexual risk behaviors,^{5,8-10} suggesting that a multilevel approach is essential to maintain long-term behavior change.¹¹ Therefore, this study examined the barriers to the long-term effectiveness of interventions through an "ecodevelopmental lens" and suggested corresponding solutions for maintenance of intervention effectiveness.

Theoretical framework: the ecodevelopmental theory

The ecodevelopmental theory,^{12,13} presented by Szapocznik and Coatsworth, is an extended social ecological model,¹⁴ with an emphasis on the structure, organization, integration, and function of young adults' social ecology over time. Similar to the social ecological model, the ecodevelopmental theory has a total of four domains, from the innermost to the outermost layers: microsystem, mesosystem, exosystem, and macrosystem. The theory emphasizes the crucial aspect of family function and interactions among various protective and risk processes from a developmental perspective.

In the ecodevelopmental theory,^{12,13} the adolescent is the center of the model, and the proximal social contexts develop the microsystem. Parents are the most fundamental element in an adolescent's behavioral development, and other proximal social contexts such as other family members, peers, and people at school tend to play an essential role in modifying the adolescent's behaviors because of the nature of development in adolescence.¹⁵⁻¹⁷

The interactions between parents and social contexts in the microsystem form the mesosystem, including parental monitoring and involvement in adolescents' peer affiliation, can directly¹⁸⁻²⁰ and indirectly^{21,22} impact adolescents' behaviors.

Other factors, such as parents' socioeconomic status, which affect parenting styles and family function directly and influence the adolescent indirectly, create the exosystem. The socioeconomic issues associated with poverty are limited access to health care, housing, and HIV prevention education. The concentrated disadvantage and housing instability are associated with less social cohesion resulting in more crime and violence in the neighborhood,²³ as well as adolescents' early sexual initiation,²⁴ lower condom use,²⁵ and higher rates of STIs.²⁶

Finally, society, policies, and cultures around the adolescent and parents create the macrosystem. One example is that the acculturation differences between Hispanic parents and the adolescents are associated with weakened family function and put the adolescents at higher risk of substance use and HIV infection.^{27,28}

The importance of parents and family function on adolescents' behavioral development is well depicted in previous studies.^{19,22,29-36} The question of whether the associations of parenting function/social contexts and adolescents' risk of contracting HIV can be modified by family structures remains. The missing information is vital to develop a sustainable intervention program, especially when an increasing trend of single-parent homes^{37,38} is observed and a high proportion of single mothers are supported by maternal grandmother and other female family members,³⁹ the dynamics of family composition and interactions among biological parents and co-parents can play an essential role in modifying adolescents' sexual behaviors and risk of contracting HIV. Therefore, the objective of this study was to reveal the interactions between family structure and parenting function/social determinants that are associated with adolescents' sexual decision-making (the outcome). A total of four outcomes were examined: age at initiation of sexual experience, sexual experience by 16 years of age, condom use at the first and last sexual intercourse. This study answered questions about whether the associations between parenting function/social contexts and outcomes are modified by the composition of the family, whether different sexual decisions are related to elements in different systems, and whether the factors which are positively associated with the usage of a condom at the first sexual intercourse are the same ones associated with the usage of a condom at the last sexual intercourse.

Methods

Database: the National Longitudinal Study of Adolescent to Adult Health

This study was a retrospective cross-sectional study, using Wave I data of the National Longitudinal Study of Adolescent to Adult Health (Add Health).^{40,41} Add Health is a longitudinal study of the nationally representative US adolescents from 1994 to 2008 with four waves of interviews. A sample of 80 high schools and 52 middle schools was selected from the US with unequal probabilities of selection. Incorporating systematic sampling methods and implicit stratification assured that the sample was nationally representative with respect to region, urbanicity, school size, school type, and ethnicity. Add Health Wave I, including an in-school questionnaire and in-

home interviews, was conducted when respondents were in grades 7–12 in 1994–1995. Add Health Wave II, conducted in 1996, covered the same questions of in-home interviews of Wave I and additional details, such as sun exposure and nutrition. Therefore, Waves I and II gathered adolescents' social and demographic information, as well as behavior decision-making. Add Health Wave III was collected in years 2001 and 2002 measuring the outcomes of decision-making, such as relationships, sexual experience, mental health, and criminal records. Add Health Wave IV collected in years 2008 and 2009, gathered longitudinal information on respondents' social, economic, and health status, and involvement of criminal justice system. All waves of Add Health were linked with pseudo identification; respondents were not identified through any information of the database. The target population of this study was African-American respondents in Wave I of Add Health.

Participants

A total of 1,619 African-American adolescents with an average age of 16.2 years (range = 11.6–21.2 years) were in Wave I of Add Health. Two HIV-infected respondents were excluded from analysis since the cause of infection was unknown. This sample (N=1,617) comprised 17% of those aged 10–13 years, 67% of those aged 14–17 years, and 16% of those aged ≥ 18 years. The sample was split equally by gender. A second sample was developed for further analyses. The second sample (N=829) comprised only those adolescents who had initiated sexual intercourse prior to the survey.

Measures and operationalization

Predictors

Sixty survey items were used to create four systems of the theoretical framework (Table 1). For some variables measured with more than one question from Add Health^{40,41} (such as school-level factors), a composite measure was developed by incorporating those variables listed under the measure (Table 1). Independent variables in various systems of the ecodevelopmental theory include 11 variables in the microsystem (school-level factors, religion, peers, neighborhood, mother's love, father's love, physical condition of dwelling unit, types of dwelling unit, physical condition of neighborhood buildings, safety of living environment, and dominant land use of the immediate area); 6 variables in the mesosystem (mother's involvement, father's involvement, mother's attitude toward an adolescent having sexual experience in their teens, father's attitude toward an adolescent having sexual experience in their teens, mother's attitude

toward an adolescent's birth control use, and father's attitude toward an adolescent's birth control use); 3 variables in the exosystem (mother's occupation, father's occupation, and household income); and 3 variables in the macrosystem (mother's receipt of public assistance, father's receipt of public assistance, and receipt of supplemental security income of any household members).

The Cronbach's alpha of composite measures for school-level factors ($\alpha=0.89$), peers ($\alpha=0.74$), religion ($\alpha=0.89$) and neighborhood ($\alpha=0.63$), mother's love ($\alpha=0.94$), and father's love ($\alpha=0.98$) in the microsystem indicates high levels of internal consistency. The Cronbach's alpha of composite measures for mother's involvement ($\alpha=0.81$), father's involvement ($\alpha=0.97$), mother's attitude toward an adolescent having sexual experience in their teens ($\alpha=0.92$), and father's attitude toward an adolescent having sexual experience in their teens ($\alpha=0.99$) in the mesosystem also demonstrated high internal consistency.

Family structure

Family structure was measured using the following variables: living with residential father, living with residential mother, living with grandparents, and living with others. Due to limited sample size, living with grandparents and living with others were collapsed into a single variable, resulting in three classes of family structure: living with both parents (i.e., two-residential parent household), living with a single parent (i.e., single-residential household), and other living arrangements (i.e., living with other relatives/alone).

Outcome variables

Three dichotomous and one continuous outcome were included in this study. The three dichotomous outcome variables were as follows: 1) having sexual intercourse before the first interview, 2) using a condom at first sexual intercourse, and 3) using a condom at last sexual intercourse. These variables are from single item responses in the Add Health^{40,41} Wave I survey.

Age at first sexual intercourse was developed using information from Waves I, III, and IV of Add Health to reduce the proportion of missing data. The information on age at first sexual intercourse in Waves III and IV was used first because it was direct information obtained from the original questionnaires; then the information in Wave I was used for missing information in Waves III and IV with calculation using months and years of birthday and first sexual experience. The "age at first sexual intercourse" was a continuous outcome variable. Except for the age of sexual initiation, the

Table 1 Sixty survey items and associated Cronbach's alpha values in each of four systems of the ecodevelopmental theory using Wave I Add Health

Systems	Variables (questions)	Cronbach's alpha
Microsystem	School-level factors (12 questions)	0.89
	“Have you ever received an out-of-school suspension from school?”	
	“Have you ever been expelled from school?”	
	“How often did you have trouble: getting along with your teachers?”	
	“How often did you have trouble: paying attention in school?”	
	“How often did you have trouble: getting your homework done?”	
	“How often did you have trouble: getting along with other students?”	
	“You feel close to people at school.”	
	“You feel like you are part of your school.”	
	“Students at your school are prejudiced.”	
	“You are happy to be at school.”	
	“The teachers at your school treat students fairly.”	
	“You feel safe in school.”	
	Religion (2 questions)	0.89
	“In the past 12 months, how often did you attend religious services?”	
	“How important is religion to you?”	
	Peer knowledge (3 questions)	0.74
	“Your closest friends are quite knowledgeable about the withdrawal method of birth control.”	
	“Your closest friends are quite knowledgeable about how to use a condom correctly.”	
	“Your closest friends are quite knowledgeable about the rhythm method of birth control and when it is a ‘safe’ time during the month for a woman to have sex and not get pregnant.”	
	Closeness with people in the neighborhood (4 questions)	0.63
	“People in this neighborhood look out for each other.”	
	“Do you usually feel safe in your neighborhood?”	
	“On the whole, how happy are you with living in your neighborhood?”	
	“If, for any reason, you had to move from here to some other neighborhood, how happy or unhappy would you be?”	
	Feeling love from the mother (4 questions)	0.94
	“Most of the time, your mother is warm and loving toward you.”	
“You are satisfied with the way your mother and you communicate with each other.”		
“How close do you feel to your mother?”		
“How much do you think your mother cares about you?”		
Feeling love from the father (4 questions)	0.98	
“Most of the time, your father is warm and loving toward you.”		
“You are satisfied with the way your father and you communicate with each other.”		
“How close do you feel to your father?”		
“How much do you think your father cares about you?”		
Condition of dwelling unit (1 question)	—	
Dwelling unit type (1 question)	—	
Condition of neighborhood buildings (1 question)	—	
Safety of living environment (1 question)	—	
Dominant land use of the immediate area (1 question)	—	
Mesosystem	Mother's involvement (5 questions)	0.81
	“On a scale of 1–5, where 1 is low and 5 is high, how disappointed would your mother be if you did not graduate from college?”	
	“On a scale of 1–5, where 1 is low and 5 is high, how disappointed would your mother be if you did not graduate from high school?”	
	“Gone to a religious service or church-related event with you mother in the past 4 weeks.”	
	“Talked about your school work or grades with you mother in the past 4 weeks.”	
	“Talked about other things you are doing in school with you mother in the past 4 weeks.”	
	Father's involvement (5 questions)	0.97
	“On a scale of 1–5, where 1 is low and 5 is high, how disappointed would your father be if you did not graduate from college?”	
	“On a scale of 1–5, where 1 is low and 5 is high, how disappointed would your father be if you did not graduate from high school?”	

(Continued)

Table 1 (Continued)

Systems	Variables (questions)	Cronbach's alpha
	"Gone to a religious service or church-related event with you father in the past 4 weeks."	
	"Talked about your school work or grades with you father in the past 4 weeks."	
	"Talked about other things you are doing in school with you father in the past 4 weeks."	
	Mother's attitude toward adolescent's sexual behavior (2 questions)	0.92
	"How would your mother feel about your having sex at this time in your life?"	
	"How would your mother feel about your use of a condom?"	
	Father's attitude toward adolescent's sexual behavior (2 questions)	0.99
	"How would your father feel about your having sex at this time in your life?"	
	"How would your father feel about your use of a condom?"	
	Mother's attitude toward adolescent's birth control use (1 question)	—
	Father's attitude toward adolescent's birth control use (1 question)	—
Exosystem	Household income (1 question)	—
	Occupation of the mother (1 question)	—
	Occupation of the father (1 question)	—
Macrosystem	Mother received public assistance (1 question)	—
	Father received public assistance (1 question)	—
	Supplemental security income (1 question)	—
Outcomes	Adolescent's age at initiation of sexual experience	—
	Adolescent had sexual experience by 16 years of age	—
	Adolescent used a condom at first sexual intercourse	—
	Adolescent used a condom at last sexual intercourse	—

Notes: "—" indicates only one question/item was used, and thus, no Cronbach's alpha is reported. Questions were directly quoted from Add Health, In-Home Questionnaire for Public-Use Data. Data from Harris et al⁴⁰; Data from Harris and Richard Udry.⁴¹

data for all variables used in this study were from Wave I as described previously.

Statistical analyses

Linear regression analysis was conducted for the continuous outcome. Logistic regression analysis was conducted for each dichotomous outcome. All analytical procedures were performed using SAS software 9.3 (SAS Institute Inc., Cary, NC, USA). The sampling weights were applied in the data analysis using PROC SURVEY procedures.

Ethics statement

This study received approval from the University of Houston Committee for the Protection of Human Subjects.

Results

A total of 1,617 African-Americans in Wave I of Add Health were retained, and their characteristics are presented in Table 2. Approximately 2% of the target population was a sexual minority (homosexual or bisexual), and 10% of them had had HIV tests. Ten percent of the respondents who had a sexual experience contracted at least one STI. Approximately 40% of the participants who had a sexual experience used a condom at first sexual intercourse, and about the same proportion of them used a condom at last sexual intercourse. Approximately 80% of the adolescents

lived with the biological mother, while 32% of them lived with the biological father. Regarding the family structures, 37% lived with two residential parents, 51% lived with a single parent, and 12% lived with other relatives or alone.

Linear regression of age at first sexual intercourse

Different independent variables associated with adolescents' late age of sexual initiation were observed for those living in different family structures. Feeling more love from the father ($\beta=0.17$, $P=0.0312$) and the mother ($\beta=0.14$, $P=0.0420$) and mother's negative attitude toward the adolescent having sexual experience in their teens ($\beta=0.33$, $P=0.0466$) were positively associated with late sexual initiation of adolescents living in two-parent households, while higher influence of school-level factors ($\beta=0.07$, $P=0.0008$), heterosexuality ($\beta=2.28$, $P=0.0091$), and receiving supplemental security income ($\beta=1.37$, $P=0.018$) were related to later sexual initiation of those living in single-parent households. Factors associated with immediate social contexts, such as condition of building ($\beta=1.55$, $P=0.0011$), land use of immediate area (rural: $\beta=9.84$, $P<0.0001$), and safety of neighborhood ($\beta=4.46$, $P=0.004$), were significantly associated with later age of initiation of those living with other relatives/alone. Unlike the positive association with adolescents living in two-parent households, feeling love from the mother was negatively

Table 2 Demographic characteristics of African-American adolescents in Wave I of Add Health

Variable	N	Weighted frequency	Weighted percentage (SD)	$\chi^2(df)$	P-value
Age groups (years)				75.46 (2)	<0.0001
10–13	253	562,899	15.44 (3.46)		
14–17	1,149	2,370,744	65.04 (2.06)		
≥18	280	711,498	19.52 (2.67)		
Gender				0.01 (1)	0.9363
Female	846	1,817,501	49.86 (1.74)		
Male	771	1,827,639	50.14 (1.74)		
Sexual orientation				818.29 (1)	<0.0001
Majority (heterosexual)	1,583	3,560,170	97.67 (0.50)		
Minority (homosexual or bisexual)	34	84,970	2.33 (0.50)		
Age at first sexual intercourse (years)				156.14 (3)	<0.0001
<10	152	369,481	10.14 (1.13)		
10–15	509	1,258,876	34.54 (2.58)		
16–20	176	393,246	10.79 (1.39)		
Never had sexual intercourse	780	1,623,537	44.54 (2.92)		
HIV test				560.64 (1)	<0.0001
Tested	141	366,360	10.09 (1.02)		
Never tested	1,472	3,269,809	89.91 (1.02)		
Numbers of sexually transmitted infection (STI)				450.09 (3)	<0.0001
More than one STI	18	40,852	1.12 (0.33)		
Have one STI	62	157,312	4.31 (0.61)		
No STI	756	1,822,171	49.91 (1.49)		
Never had sexual intercourse	780	1,623,537	44.47 (1.44)		
Condom use at first intercourse				35.30 (2)	<0.0001
Never had sexual intercourse	780	1,623,537	44.69 (2.92)		
Used a condom	536	1,223,387	33.68 (2.36)		
Not used a condom	294	785,743	21.63 (1.45)		
Condom use at last intercourse				32.36 (2)	<0.0001
Never had sexual intercourse	780	1,623,537	45.04 (1.45)		
Used a condom	518	1,184,020	32.85 (1.42)		
Not used a condom	308	809,984	22.39 (1.84)		
Giving sex in exchange for drugs or money				952.29 (1)	<0.0001
No	1,581	3,539,624	98.17 (0.42)		
Yes	24	65,927	1.83 (0.42)		
Biological mother				1028.10 (2)	<0.0001
Not known	26	74,572	2.05 (0.41)		
Know	203	551,897	15.18 (1.32)		
Living with biological mother	1,386	3,009,647	82.77 (1.40)		
Biological father				137.80 (2)	<0.0001
Not known	194	501,515	13.82 (1.29)		
Know	817	1,951,062	53.76 (1.73)		
Living with biological father	602	1,176,562	32.42 (2.37)		
Family structure of household				102.84 (2)	<0.0001
Both parents in the household [‡]	699	1,348,321	36.99 (2.59)		
Single parent in the household [‡]	771	1,868,598	51.26 (2.85)		
Other relatives or live alone	147	428,222	11.75 (1.22)		
Know how to use a condom				783.58 (4)	<0.0001
Strongly disagree	45	101,273	2.89 (0.53)		
Disagree	72	162,904	4.65 (0.66)		
Neither agree nor disagree	108	221,942	6.34 (0.77)		
Agree	560	1,267,897	36.19 (1.77)		
Strongly agree	780	1,749,329	49.93 (2.33)		

Notes: N=1,617 observations; Rao-Scott chi-square test was performed using design-adjusted, survey-weighted; [‡]residential parent(s): biological parent, adoptive parent, step-parent, foster parent, etc.

associated with the age of sexual initiation for adolescents living with other relatives/alone ($\beta=-0.23$, $P=0.0325$); but mother's involvement was positively related to later sexual initiation for those living with other relatives/alone ($\beta=0.44$, $P=0.0383$). Some elements were shared by adolescents living in single-parent or two-parent households. For example, mother's positive attitude toward an adolescent's condom use was associated with early sexual initiation (single-parent household: $\beta=-0.29$, $P=0.0289$; two-parent household: $\beta=-0.28$, $P=0.0351$). A better condition of dwelling unit was associated with late sexual initiation of adolescents living with a single parent ($\beta=0.63$, $P=0.0218$) and with other relatives/alone. However, receiving supplemental social security income had different associations with the age of sexual debut of adolescents living in different family structures: positive association with late sexual initiation of adolescents living in a single-parent household ($\beta=1.37$, $P=0.018$), but positive association with early sexual initiation of those living with other relatives/alone ($\beta=-3.47$, $P=0.0446$) (Table 3).

Logistic regression of sexual initiation before the first interview (mean age 16 years)

Maternal factors associated with adolescents who had sexual initiation older than age 16 years were shared by those living with a single-parent (feeling love from the mother: OR=0.88, $P=0.0208$; mother's negative attitude toward an adolescent having sexual experience in teens: OR=0.84, $P=0.0417$) or two parents (feeling love from the mother: OR=0.85, $P=0.0267$; mother's negative attitude toward an adolescent having sexual experience in teens OR=0.68; $P=0.0005$) in a home. Feeling the significance of religion (OR=1.17; $P=0.0071$) and having friends who had knowledge of sexual information (OR=1.12; $P=0.042$) were related to adolescents living with two parents having sexual initiation before age 16 years. Alternatively, having friends who had knowledge of sexual information (OR=0.56; $P=0.0361$) was positively associated with adolescents living with other relatives/alone having sexual initiation older than 16 years. The higher

Table 3 Linear regression of age at first sexual intercourse of African-American adolescents in Wave I of Add Health

System	Outcome	All	Structure 1	Structure 2	Structure 3
Microsystem	School-level factors	0.05**	0.06	0.07***	0.02
	Friends had knowledge of sexual information	-0.12*	0.23	-0.11	-0.21*
	Feeling love from the mother	0.08	-0.23*	0.13	0.12*
	Feeling love from the father	0.06	0.02	-0.03	0.17*
	Dominant land use of immediate area (rural)	0.88	9.84****	1.30	-1.18
	Dominant land use of immediate area (suburban)	0.43	-0.66	0.36	0.21
	Building (detached single-family house)	0.32	-2.61*	0.43	-0.14
	Building (mobile home/trailer)	0.26	-3.20*	-0.08	0.17
	Building (single-family row/town house)	0.09	-1.66	-0.05	-0.78
	The condition of dwelling unit	0.21	1.55**	0.63*	-0.29
	Condition of neighborhood building	-0.45	-4.43***	-0.58	0.32
	Safety of living environment	0.83	4.46**	0.44	0.08
	Mesosystem	Mother's involvement	-0.02	0.44*	-0.04
Mother's attitude toward adolescent's use of birth control		-0.36****	-0.44	-0.29*	-0.28*
Mother's attitude toward adolescent having sexual experience in teens		0.15	-0.19	0.16	0.33*
Exosystem	Household income	-0.00***	-0.00	-0.01	-0.00
	Mother's occupation (none)	-0.54	-1.44	-0.94	-0.07
	Mother's occupation (restaurant worker, personal service)	-0.68*	-2.74**	-0.55	-0.60
	Mother's occupation (computer specialist, office worker)	-0.62	-2.27	-0.45	-0.95*
	Father's occupation (none)	-0.52	-3.33	-2.19	-0.66
	Father's occupation (restaurant worker, personal service)	-0.12	-2.31*	0.19	0.30
Macrosystem	Father's occupation (computer specialist, office worker)	0.61	2.49	0.67	0.34
	Received supplemental security income	0.87	-3.47*	1.37*	-0.61
	Mother received public assistance	0.08	1.70	0.60	-0.95
Individual	Father received public assistance	-0.63	0.55	0.91	0.17
	Age	0.43***	0.26	0.42***	0.40***
	Sexual orientation (sexual majority)	2.33**	2.34	2.28**	0.10
	Knowledge about condom use	-0.28	-1.43**	-0.42	0.00
R square		0.150	0.69	0.18	0.17

Notes: Structure 1: adolescents lived with other relatives or lived alone; Structure 2: adolescents lived in a single-parent household; Structure 3: adolescents lived in a two-parent household. Sample sizes: Structure 1 (N=64), Structure 2 (N=505), Structure 3 (N=456), and all (N=1,025). * $P<0.05$; ** $P<0.01$; *** $P<0.001$; **** $P<0.0001$.

influence of school-level factors in their teens (OR=0.93; $P=0.0019$) and father's negative attitude toward an adolescent having a sexual experience (OR=0.11; $P<0.0001$) in their teens were associated with an adolescent's first sexual experience older than 16 years among those living with a single parent (Table 4).

Logistic regressions of condom use at first and last sexual intercourse

No specific elements were associated with condom use at both first and last intercourse. For adolescents living in a two-parent household, higher influence of school-level factors (OR=1.05; $P=0.0278$), mother's negative attitude toward the adolescent having sexual experience in teens (OR=1.45; $P=0.0086$), father's positive attitude toward the adolescent having sexual experience in teens (OR=0.72; $P=0.0448$), and living in a less safe neighborhood (OR=0.16; $P=0.0023$) were associated with a higher likelihood of condom use at first sexual intercourse, while having friends who had knowledge of sexual information (OR=1.37; $P=0.0001$), receiving supplemental security income (OR=14.16; $P=0.0161$), and lower influence of school-level factors (OR=0.94; $P=0.0401$) were associated with a higher likelihood of condom use at last sexual intercourse. For adolescents living in a single-parent household, higher influence of school-level factors (OR=1.03; $P=0.0294$) and acquired knowledge about condom use (OR=1.69; $P=0.0062$) were related to condom use at first sexual intercourse; and mother's negative attitude toward the adolescent's condom use (OR=1.25; $P=0.0146$) and acquired knowledge about condom use (OR=1.75; $P=0.0107$) were

associated with a higher likelihood of condom use at last sexual intercourse. For those living with other relatives/alone, feeling the love from the father (OR=1.68; $P=0.0234$) was associated with a higher likelihood of condom use at first sexual intercourse but not at last sexual intercourse (Table 5).

Condom consistency at first and last sexual intercourse

A higher proportion of adolescents living in a two-parent households used a condom at both first and last sexual intercourse (52.45%) than those living in a single-parent household (41.29%) or living with other relatives/alone (42.36%). Also, a higher proportion of adolescents living in a single-parent household (25.62%) or living with other relatives/alone did not use a condom (24.33%) at both first and last sexual intercourse than those living in two-parent households (21.23%). Adolescents living with other relatives or alone tended not to use a condom at first sexual intercourse but used a condom at last sexual intercourse (19.69%), compared to those living with a single parent (14.45%) or two parents (12.34%). Conversely, adolescents living in a single-parent household tended to use a condom at first sexual intercourse but did not use a condom at last sexual intercourse (18.64%), compared to teens living in a two-parent household (13.99%) or living with other relatives/alone (13.62%) (Table 6).

Discussion

The current study shows that feeling love from the mother and mother's attitude toward an adolescent having sexual experience in their teens for adolescents living in a two-parent

Table 4 Logistic regression of African-American adolescents with sexual initiation prior to age of 16 years

System	Variables	All	Structure 1	Structure 2	Structure 3
Microsystem	School-level factors	0.96**	0.86	0.93**	1.00
	Significance of religion	1.01	0.58	0.97	1.17**
	Friends had knowledge of sexual information	1.05	0.56*	1.05	1.12*
	Feeling love from the mother	0.95*	1.26	0.88*	0.85*
	The condition of dwelling unit (very poorly kept vs. very well kept)	1.71	1.40	3.84*	1.66
	The condition of dwelling unit (poorly kept vs. very well kept)	1.06	71.81	1.35	0.92
	The condition of dwelling unit (fairly well kept vs. very well kept)	1.10	6.20	1.63	0.68
Mesosystem	Father's involvement	1.12*	1.07	1.01	1.16
	Mother's attitude toward adolescent having sexual experience in teens	0.84	0.42	0.84*	0.68***
	Father's attitude toward adolescent having sexual experience in teens	0.95	0.63	0.11****	0.92
	Mother's attitude toward adolescent's use of birth control	1.31****	1.73	1.35**	1.15
Individual	Age	1.35****	2.36***	1.21**	1.59****
	Knowledge about condom use	1.73****	14.56****	1.99**	1.28
	Gender (female vs. male)	0.70*	1.53	0.61*	0.88
C statistic		0.81	0.92	0.81	0.83

Notes: Estimates are odds ratios. Target population was those who had sexual debut before the first interview of Add Health study. Structure 1: adolescents lived with other relatives or lived alone; Structure 2: adolescents lived in a single-parent household; Structure 3: adolescents lived in a two-parent household. Sample sizes: Structure 1 (N=147), Structure 2 (N=771), Structure 3 (N=699), and all (N=1,198). * $P<0.05$; ** $P<0.01$; *** $P<0.001$; **** $P<0.0001$.

Table 5 Logistic regressions of African-American adolescents using a condom at first and last sexual intercourse

System	Variables	First sexual intercourse			Last sexual intercourse				
		All	Structure 1	Structure 2	Structure 3	All	Structure 1	Structure 2	Structure 3
Microsystem	School-level factors	1.03**	1.07	1.03*	1.05*	1.01	1.11	1.02	0.94*
	Significance of religion	1.03	1.31	1.01	0.98	0.99	1.19	0.89*	1.20
	Friends had knowledge of sexual information	1.04	1.51	1.09	0.86	1.01	0.82	0.95	1.37***
	Feeling closeness with people in neighborhood	1.05	0.91	0.98	1.13	1.10*	1.15	1.06	1.18
	Feeling love from the father	1.03	1.68*	0.83	1.02	0.92	0.78	1.04	0.95
Mesosystem	Safety of living environment	0.75	0.23	1.29	0.16**	0.65	0.28	0.41	0.89
	Mother's attitude toward adolescent having sexual experience in teens	0.97	1.11	0.86	1.45**	0.94	1.09	1.02	0.92
	Father's attitude toward adolescent having sexual experience in teens	1.01	1.21	1.22	0.72*	1.01	1.21	0.78*	1.06
Macrosystem	Mother's attitude toward adolescent's birth control use	1.10	0.93	1.03	1.43	1.15	1.10	1.25*	1.29
	Father's attitude toward adolescent's birth control use	0.96	0.38	1.09	0.83	0.97	0.87	0.65**	0.90
	Received supplemental security income	1.12	4.62	0.75	4.50	0.81	0.39	0.62	14.16*
	Age	1.01	0.70	0.89	1.20	0.86*	0.34**	0.88	0.95
	Knowledge about condom use	1.22	0.78	1.69**	0.86	1.29	0.79	1.75*	0.89
C statistic	Gender (female vs. male)	1.31	3.37	1.17	2.87*	0.75	0.74	0.66	0.83
		0.61	0.82	0.61	0.70	0.62	0.75	0.66	0.75

Notes: Estimates are odds ratios. Structure 1: adolescents lived with other relatives or lived alone; Structure 2: adolescents lived in a single-parent household; Structure 3: adolescents lived in a two-parent household; Sample sizes: Structure 1 (N=94), Structure 2 (N=426), Structure 3 (N=317), and all (N=625).

*P<0.05; **P<0.01; ***P<0.001.

Table 6 African-American adolescents' condom use behavior at first and last sexual intercourse

Family structure	Used a condom at first sexual intercourse	Used a condom at last sexual intercourse	Percentage (SD)
Structure 1	No	No	24.33 (4.99)
	Yes	No	13.62 (3.50)
	No	Yes	19.69 (4.31)
	Yes	Yes	42.36 (5.79)
Structure 2	No	No	25.62 (2.68)
	Yes	No	18.64 (1.91)
	No	Yes	14.45 (2.52)
	Yes	Yes	41.29 (2.58)
Structure 3	No	No	21.23 (3.30)
	Yes	No	13.99 (2.74)
	No	Yes	12.34 (2.10)
	Yes	Yes	52.45 (3.42)

Notes: Structure 1: adolescents lived with other relatives or lived alone; Structure 2: adolescents lived in a single-parent household; Structure 3: adolescents lived in a two-parent household; all participants =837; Rao-Scott chi-square (df)=18.15(4); P -value =0.0012.

household are positively associated with adolescents delaying sexual initiation, while for those living in a single-parent household, other social contexts (school-level factors) and individual characteristics (sexual orientation) are associated with adolescents delaying sexual initiation. Results suggest the associations of adolescents' risk of HIV and the influence of parents and other social determinants differ by different family structures. Living with two parents, adolescents' emotional connection with parents and knowledge of mother's negative attitude toward the adolescent having a sexual experience in their teens were highly associated with adolescents' low risk of HIV. The findings support the results of Guilamo-Ramos et al's review:⁴² maternal factors are found to be more important than paternal factors to delay the sexual activity for African-American adolescents living in a two-parent household. Moreover, the association of school-level factors and the age of sexual initiation is significant among adolescents living with a single parent, other relatives, or alone. School-level factors and individual characteristics (e.g., age and sexual orientation) are highly associated with age of sexual initiation for those living with a single parent, while the living environment (e.g., housing in rural areas, condition of the dwelling unit, and safety of neighborhood) is associated with the age of sexual initiation for those living with other relatives or alone. Findings suggest that adolescents living in a two-parent household have a stronger connection with mothers and could benefit from the mother-child connection, and that sexually related decision-making was significantly related to individual characteristics and school-level factors among adolescents living in a single-parent household, and that immediate social contexts, which are also in the microsystem, are associated

with sexually related decision making of adolescents living with other relatives/alone.

This study reveals adolescents' condom use behaviors were not associated with the same factors. For example, feeling love from the father and parents' attitude toward the adolescent's birth control use were significantly associated with condom use behavior at first sexual intercourse, while father's attitude toward the adolescent's birth control and parents' attitude toward the adolescent having a sexual experience in their teens were significantly associated with condom use behavior at last sexual intercourse. The findings support previous studies that family support and family connectedness are significantly associated with condom use consistency.⁴³⁻⁴⁷ Additionally, less religiosity of the young person was associated with higher risk of condomless sex at last sexual intercourse backing up previous studies pertaining to the significance of religion to the adolescent and its association with a low likelihood of risky sexual behavior.^{21, 43} This study specified that the positive association was strong for adolescents living in a single-parent home but not for those living in other family structures. Moreover, higher connection with school-level factors was significantly related to condom use at first sexual intercourse and a risk factor of condom use at last sexual intercourse in the current study, Abebe et al. found that school attachment was a protective factor significantly associated with low risk of inconsistent condom use and multiple sexual partners.⁴³ It is understandable that different results were presented in this study since the school-level factors in the current study comprise multiple dimensions of school factors, such as interactions between the individual-teacher and individual-other students as well as the overall atmosphere of the school. Unlike measuring

school attachment only in Abebe et al.'s study, the influence of different school-level factors on the adolescent can be enhanced or reduced over time.

Finally, through observing condom use behavior at both first and last intercourse, this study indicates that adolescents living with two parents are more likely to use a condom consistently than those living in other family structures. This study extends the findings of Manning et al.⁴⁸ that adolescents living with two biological parents tend to have condom use consistency, showing that adolescents living with two residential parents tended to have higher condom consistency than others living in other family compositions. Furthermore, this study found that adolescents living with other relatives or alone tended to use a condom at last sexual intercourse but not at first sexual intercourse, while those living with a single parent were more likely to use a condom at first sexual intercourse than at last sexual intercourse. Finally, no specific factors having the same association with condom use at both first and last sexual intercourse were identified, suggesting other elements, such as dynamics of the relationship (which was not addressed in this study), may play a role in modifying an adolescent's decision on condom use. The clinical implications are that adolescents living with other relatives or alone should be educated about the importance of condom use before sexual initiation and that those living in single-parent households should be urged to use a condom at every sexual intercourse to increase condom use consistency among those living in a household other than two-parent homes.

This study should be interpreted considering several limitations. First, the Add Health study^{40,41} was designed to consist of only students enrolled in school. Therefore, school-aged children not enrolled in school were not included in the sampling design. However, it is known that those who are not enrolled in schools are likely to be at higher risk of contracting HIV due to limited exposure to information about HIV transmission.^{49,50} Second, the Add Health study^{40,41} uses self-reported measures, and, thus may be subject to social acceptability or recall bias. Finally, although several models were developed to study African-American adolescents' sexual decisions, only one wave of Add Health was used; therefore, no causal or directional inferences can be drawn from the results. Also, due to the cross-sectional study design, the family structures of adolescents might not actually reflect the change of family structures. The changes of family structure or the stability of the family structure can be an essential element influencing an adolescent's behavioral development.

Despite these limitations, there are merits to this study. First, the potential interactions between family composition

and social determinants were presented with stratification by family structure. Thus, the results can be interpreted for specific subpopulations and associated clinical implications for future development of intervention programs. Second, applying the ecodevelopmental theory to examine factors in different social contexts systematically allows us to explore the potential influence of social determinants. It is essential to study the parental influence on African-American adolescents raised in single-parent, female-headed households. Finally, examining several sexual decisions of African-American adolescents provides insight into the factors associated with an adolescent's sexual behavior. The logistic regression of an adolescent's sexual experience before the first interview discloses the dynamics between family structure and social determinants at the time of the survey; the linear regression of the age of an adolescent's sexual initiation showed the potential mechanism and prompted elements that may trigger an adolescent's sexual initiation. Also, for a better understanding of an adolescent's condom use consistency, further study should focus on the influence of scenario, infection status of the partners, and situation to explore understanding of adolescents' condom use behavior.

Conclusion

We used ecodevelopmental theory and stratification by family structure to systemically examine elements from different social contexts and parental functions independently. Results show that adolescents living in a two-parent household tend to have later sexual initiation, a better sexually related health status and condom consistency than peers living in other family structures, and that factors associated with parents (such as feeling love from the parents) play a more significant role in adolescents living in a two-parent household, whereas factors associated with immediate social environment (such as feeling closeness with people in their neighborhood) are more related to those living in a single-parent household or with other relatives/alone to modify adolescents' sexual decision-making. This study provides information regarding the influence of parents and household structure on adolescents' sexual decisions to contribute to the knowledge of HIV risk among African-American adolescents.

Disclosure

The authors report no conflicts of interest in this work.

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