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Original article

Longitudinal Associations of Physical Activity Among Females from Adolescence to Young Adulthood

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A B S T R A C T

Purpose: We sought to identify individual, social, and environmental factors associated with moderate-to-vigorous physical activity (MVPA) among females from ages 14 to 23 years.
Methods: A cohort was formed from females originally participating in the Trial of Activity for Adolescent Girls Maryland site. The cohort was recruited from a randomly generated list of eighth grade girls in participating middle schools. A total of 428 females had complete assessments in 2006 (n = 730), 2009 (n = 589), and 2015 (n = 460). The outcome, MVPA, was assessed from accelerometers. Individual and social factors were assessed by questionnaire; body mass index was measured in 2006 and 2009 and self-reported in 2015. Perceived environment was assessed by questionnaire; number of parks near home and distance to parks and schools was assessed by geographic information systems.
Results: Participants were diverse (45.7% white, 24.8% black, 9.9% Hispanic, and 19.6% other). Over time 274 participants had continuously low MVPA, 123 decreased MVPA from age 17 to 23 years, and 31 participants continuously increased MVPA. For each .16-unit decrease in body mass index, MVPA increased 1 minute over time ($p = .007$). For every 1-unit increase in self-management strategies or social support from friends, there was a 4- to 5-minute increase in MVPA ($p < .0001$ and $p = .03$, respectively). A little less than one extra park (.71 parks) within a mile of an individual's home was associated with a 1-minute increase in MVPA ($p < .0001$).
Conclusions: Behavioral strategies combined with neighborhood enhancements may produce the best results for increasing MVPA as adolescent females' transition into adulthood.

IMPLICATIONS AND CONTRIBUTION

Physical activity is a complex behavior that declines during adolescence into young adulthood, particularly among females. A small percentage of females counter this trend and maintain physical activity. To improve or maintain physical activity among females transitioning to adulthood, behavioral strategies combined with neighborhood enhancements may produce the best results.

Physical activity declines during adolescence, particularly among females [1]. Depending on the population studied and assessment method, physical activity declines yearly by 4% [2] to 8% [3]. This decline continues into early adulthood, a transition characterized by adopting adult social roles (e.g., independent living and parenthood). For example, in a study of Australian women initially aged 18–23 years, Bell and Lee observed that moving into a live-in relationship, getting married, and having a child was associated with physical activity declines over a 4-year period [4].

While most females' physical activity declines, some maintain or increase physical activity throughout adolescence and into

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adulthood. However, these patterns are not well characterized. Among the Australian women described previously, 36% remained physically active and 19% became active over 4 years of follow-up [5]. In a study by our team among females initially assessed at age 14 (n = 589), 11% who were inactive became physically active by age 17 years [6]. Those who became active were more likely to be normal weight at baseline and have higher self-esteem regarding their physical attributes at age 17. A better understanding of predictors of physical activity trajectories is needed, particularly among females whose trajectories counter their peers' trends; they may have unique characteristics or conditions that support physical activity.

To identify factors associated with longitudinal physical activity, a multilevel perspective is required [7]. While cross-sectional studies demonstrate that personal factors such as socioeconomic status (SES), race/ethnicity, and self-efficacy; social factors such as peer and parent support; and neighborhood factors, such as distance to recreational facilities, contribute to adolescent physical activity [8,9], little is known how these factors are associated with physical activity longitudinally. Hearst et al. assessed multilevel predictors of physical activity over 2 years among 578 adolescents initially aged 10–16 years [10]. For girls, later puberty and fewer physical activity barriers were associated with higher activity; for boys, physical activity self-efficacy was a predictor. Molina-Garcia et al. evaluated 1-year physical activity change among Spanish youth transitioning from high school [11]. For males, increased distance to school/workplace was associated with decreased active commuting, and decline in social support was associated with decreased leisure time activity. No predictors were noted for females. More information is needed regarding important multilevel predictors of physical activity over time, particularly as adolescents become young adults.

We examined the longitudinal predictors of physical activity in a cohort of females with physical activity assessments at ages 14, 17, and 23. We used a socioecological model to inform assessments of individual, social, and neighborhood variables. We specifically sought to identify the variables associated with moderate-to-vigorous physical activity (MVPA) from adolescence to young adulthood. To provide contextual information to how physical activity may or may not change, we clustered participants with similar physical activity patterns. This information can inform the development of effective interventions to stop the physical activity decline that occurs during adolescence and into young adulthood.

Methods

The Trial of Activity for Adolescent Girls (TAAG) was a group-randomized, controlled trial to determine if an intervention that linked schools to community organizations reduced the age-related decline in MVPA in middle school girls [12]. We enrolled 730 eighth grade girls (aged 14 years) at the Maryland Field Center in the Baltimore, MD/Washington, DC area in spring 2006. Of these, 589 (81%) were rerecruited and measured in 2009 during their 11th grade year (aged 17 years) [13]. In 2015, 460 (78%) participants (aged 23 years) were rerecruited, consented, and measured. Recruitment efforts are described elsewhere [14]. Other TAAG sites did not participate in follow-up assessments. The study was approved by the University of Maryland and the Kaiser Permanente Southern California Institutional Review Boards.

We used a socioecological model to identify potential study variables associated with MVPA [15]. Within this framework, social cognitive theory [16] guided our selection of study variables. The same variables were assessed at all time periods.

Measures

MVPA

The study outcome of daily minutes of MVPA was measured objectively with Actigraph accelerometers (MTI model 7164). The TAAG protocol was used at all time periods; participants wore the monitor during waking hours for seven consecutive days. If inadequate wear time was noted (<4 days, 10 hours/day), a participant was asked to rewear the accelerometer. Data were collected and stored in 30-second intervals. To be able to identify change in MVPA over time, the same count threshold of 3,000/minute was used to determine daily MVPA minutes at all time periods [17].

Individual factors

Body mass index. At ages 14 and 17, height and weight were measured using a stadiometer and calibrated scale. At age 23, participants self-reported height and weight. At ages 14 and 17, we used the Centers for Disease Control and Prevention 2000 sex-specific growth curves to identify healthy weight (<85th percentile), overweight, (85–94th percentiles), and obese (95th percentile and above) body mass index (BMI) categories. At age 23, BMI was categorized as underweight (<18.5 kg/m^2), normal weight (18.5–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2), and obese (≥30 kg/m^2). At age 17, we also asked girls to self-report height and weight. Similar to others [18], measured BMI and self-reported BMI were highly correlated (r = .96). Sensitivity analyses for the correct classification as overweight or obese were 77% (95% confidence interval [CI]: 70%–83%) and 79% (95% CI: 68%–87%), respectively. Specificity was 97% (95% CI: 95%–98%) and 100% (95% CI: 98%–100%) for those not overweight or obese, respectively, to not classify themselves as such.

Demographics. Cohort members self-identified as white, black or African-American, Hispanic/Latina, Asian/Pacific Islander, American Indian/Alaska Native, or other. Mother's and father's education level were separately reported by participants, selecting from six categories ranging from "do not know" to "completed professional/doctoral degree." This variable was used as the SES proxy. We used five questions to ascertain cigarette-smoking behavior, adapted from the 2003 Youth Risk Behavior Survey.

We included additional demographic characteristics assessed by self-report at age 23. These included current educational, employment, and relationship status, personal income, perceived family SES, and if they currently were in a parental role in the lives of children.

Psychological variables. Physical activity self-efficacy was measured with an 8-item, 5-point Likert scale. A sample item is "I can be physically active during my free time on most days no matter how busy my day is." Possible scores ranged from 8 to 40. It has a stability coefficient of .61 across 1 year [19]. Cronbach's alpha was .84 [20].

Self-management strategies were assessed using a modified scale [21]. The scale includes 8 items, with scores from 8 to 40, that represent cognitive (e.g., "I try to think more about the benefits of physical activity and less about the hassles of staying active.") and behavioral (e.g., "I try different kinds of physical