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The importance of intimate partner violence in within-relationship and between-person risk for alcohol-exposed pregnancy.

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Abstract

Background: Pre-conceptual prevention programs geared towards reducing alcohol-exposed pregnancy (AEP) typically emphasize behavioral change of alcohol use and birth control exclusively, but rarely consider other important AEP predictors that may affect behavioral change. Intimate partner violence (IPV) substantially relates to AEP and to AEP predictors, however, few studies have tested if IPV is a unique indicator of prospective AEP risk, as both a main effect and a contextual influence on alcohol use or birth control.

Methods: Using Waves II and III of the National Longitudinal Study of Adolescent to Adult Health (Add Health), multilevel logistic regression models were estimated, in which IPV and birth control (both within-person and between-person) and adolescent alcohol use (between-person only) were examined as unique predictors of AEP compared to both non-pregnancy and non-AEP outcomes over up-to-5 sexual relationships. Interactions between within-person and between-person IPV, and birth control or alcohol use were also tested.

Results: Within-person and between-person IPV significantly related to higher odds of AEP compared to non-pregnancy and non-AEP. Adolescent alcohol use had similarly increased odds for AEP when compared to non-pregnancy or non-AEP outcomes. Only between-person birth control use related to higher odds for AEP compared to non-pregnancy and non-AEP. Between-person IPV also moderated adolescent alcohol use on odds of AEP, such that infrequent adolescent drinkers had higher odds of AEP compared to non-pregnancy or non-AEP if they experienced IPV over their relationships.

Conclusions: IPV is a substantial predictor for AEP as both a direct influence within relationships (within-person) and between individuals (between-person). Intervention and prevention programs focused on reducing AEP may benefit from including IPV-specific curricula.

Approximately 10% of women in the United States consume alcohol while pregnant (Popova et al., 2017). Consequently, fetal alcohol spectrum disorder is one of the most common birth defects in the U.S., with rates ranging from 0.1 per 1000 to 100 per 1000 births, depending upon measurement (May et al., 2009; May et al., 2018). Although there is

considerable attention and effort devoted to alcohol use cessation in pregnancy (Chang, 2009; Mengel et al., 2006; Nilsen, 2009), a large proportion of AEP involves drinking prior to learning of pregnancy status (McCormack et al., 2017). Thus, many prevention programs focus on reducing AEP prior to pregnancy through decreasing alcohol use and increasing pregnancy preventative measures (e.g., Floyd et al., 1999). These programs demonstrate moderate success, however, they often fail to address overarching contexts that can facilitate and maintain these behaviors, which may make behaviors harder to change. Intimate partner violence (IPV) is a particularly important risk factor for AEP, as well as a risk factor for alcohol and birth control use. The current study examines the link between IPV and AEP from a prospective, preconceptional lens, while controlling for other preconceptional AEP risk behaviors, testing the potential importance of including IPV as an AEP risk factor to address in preconceptional AEP prevention programs.

Links between IPV and AEP

IPV strongly associates with AEP (Anderson et al., 2014; Kitsantas et al., 2015; Li et al., 2012; Skagerstrom et al., 2011). A main reason for this may be that IPV victimization is both a precedent of alcohol use (Capaldi et al., 2012; Foran & O'Leary, 2008) and an antecedent (Devries et al., 2014; Derrik & Testa, 2017; Simmons et al., 2015). IPV also relates to lower levels of contraceptive use (Bergman & Stockman, 2015; Deutsch, in press; Maxwell et al., 2015). Consequently, unintended pregnancy, another predictor of AEP (McDonald et al., 2014), is also associated with IPV (Miller et al., 2010; Pallitto et al., 2005).

Underlying mechanisms for the association between IPV and AEP are unclear. Most research examining this association is descriptive. However, associations between IPV and alcohol use can be explained by broader relationship conflict (e.g., Collibee & Furman, 2018; Eckhard et al., 2015; Leonard & Quigley, 1999) and personal coping strategies (e.g., Schumacher et al., 2008; Ivory & Kambouropoulos, 2012; Leonard & Eiden, 2007). Given that IPV can continue during pregnancy, or that pregnancy can contribute to new instances of IPV (James et al., 2013), pregnancy may not be a sufficient deterrent for reducing alcohol use, if underlying IPV-related shared variables strongly maintain levels of alcohol use. Additionally, substance use coercion is a form of IPV itself (Rivera et al., 2015; Warshaw et al., 2014). Thus, alcohol misuse, even within pregnancy, can be maintained in part by their IPV perpetrating partners.

There are also underlying mechanisms explaining the association between IPV and lower birth control use. IPV-related lower birth control is associated with coercive control motives within a relationship (Tanha et al., 2010). Reproductive coercion, in which individuals gain power over their partners by removing their partners' reproductive agency, relates to other forms of IPV (Katz et al., 2017). Pregnancy coercion, another form of IPV reproductive control, can also explain higher rates of unintended pregnancies in IPV-marked relationships (Miller et al., 2010). Although some research indicates that AEP is more prominent in older women (e.g., Harrison & Sidebottom, 2009), pathways between alcohol use, IPV, and low birth control use start in adolescence, (Roberts et al., 2005; Silverman et al., 2001; Teitelman et al., 2008). Therefore, the association between these variables has a strong developmental

context and may require addressing underlying long-standing cognitive schemas or behavioral habits.

Taken together, IPV, alcohol use, low levels of contraception, unintended pregnancy, and AEP may form long-term patterns of association with one another. However, more research is required to understand the genuine ways in which IPV functions as a potential AEP risk factor. It may be important to see if IPV strengthens other AEP risk factors, given the cyclic association between risk variables. In addition, although most studies examining AEP predictors only compare AEP to women who do not drink during pregnancy (e.g., Anderson et al., 2014; Kisanas et al., 2015) this does not accurately inform preconception prevention programs, which emphasize both reducing alcohol use and overall pregnancy. Prospective research that can compare AEP predictors to outcomes that are more favorable than AEP (non-pregnancy and non-drinking pregnancy) may provide insight for prevention programs.

Pre-conceptual AEP prevention programs

The most common format of AEP prevention programs are brief interventions emphasizing motivated behavioral change (e.g., Ceperich & Ingersoll, 2011; Floyd et al., 2007; Ingersoll et al., 2013). Interventions can include motivational interview counseling, assessment feedback, and contraception counseling (Velasquez et al., 2013), although there are also self-guided formats (e.g., Tenkku et al., 2011). Reduced drinking and increased birth control use is guided by a process of self-evaluation and developing plans of change for levels of alcohol use and birth control use (Floyd et al., 2007; Velasquez et al., 2010). The brevity of these programs makes it scalable and easy to implement without requiring a large number of resources, which can be crucial in resource-poor, in-need populations.

Success of preconceptional AEP prevention programs is typically defined as either post-program decrease in alcohol use *and/or* an increase in birth control. These programs do achieve both of these aims (Floyd et al., 2007; Hutton et al., 2014), but have more success in increasing birth control than reducing alcohol use (e.g., Farrell-Caranhan, et al., 2013; Hanson et al., 2017; Wilton, et al., 2013). In other words, programs are more successful at reducing the number of overall potential pregnancies potentially exposed to alcohol, compared to reducing the amount of alcohol consumed that may affect the remaining pregnancies. One potential reason for this may be that these programs tend to focus exclusively on individual-level behavioral change, and do not necessarily account for environments that may provide substantial barriers for change. For example, women in relationships marked by IPV may have a more difficult time either trying to reduce alcohol misuse (e.g., out of a higher need for immediate coping) or trying to obtain birth control (out of fear of partner reactions or even due to active resistance from the partner; de Bocanegra et al., 2010).

Current Study

The purpose of this study is to explore ways in which IPV may serve as a risk factor for AEP. Although IPV is a known predictor of AEP, it will be important to know if IPV has contextual, moderating influences on other AEP predictors, particularly those emphasized as

risk factors in preconceptional prevention programs. As the goals of preconceptional AEP prevention programs are to 1) reduce the number of pregnancies by increasing contraceptive use, and 2) reduce AEP by reducing alcohol use within pregnancies, we compared three outcomes: AEP, non-pregnancy, and no-alcohol-exposed pregnancy (nAEP.) Specifically, we wanted to know if IPV was a unique risk factor for AEP, controlling for birth control use and alcohol use. Utilizing a multi-level, longitudinal design, we were able to examine if IPV was a unique risk factor a) within people, over relationships, and b) between individuals. We hypothesized that within relationships, IPV would relate to higher odds of AEP. In addition, those who reported experiencing higher levels of IPV averaged over all relationships would have higher odds of AEP compared to those who reported lower or no levels of IPV averaged over all relationships. We also hypothesized the effects of birth control use and alcohol use would be similar to prior research. Higher alcohol use would relate to higher odds of AEP, and that higher birth control use would relate to lower odds of AEP (although perhaps only when comparing AEP to non-pregnancy).

We also examined IPV as a potential moderating context. As IPV relates to both higher alcohol use and lower birth control, it is possible that IPV strengthens alcohol use and birth control effects on the odds of AEP. Therefore, we hypothesized that IPV would strengthen the positive effect that alcohol use has on the odds of AEP, and would strengthen the negative effect that birth control use has on the odds of AEP. We included controls of childhood abuse and adolescent intimate partner violence, as well as time-varying contextual variables of the age at the start of relationship and relationship duration. Childhood abuse was included as it is a predictor of AEP (Frankenberger et al., 2015; Whitfield et al., 2003), intimate partner violence victimization (Renner & Slack, 2006) and alcohol use and abuse in adolescence and adulthood (e.g., Dube et al., 2002; Shin et al., 2009). Adolescent intimate partner violence was also included due to relationships between adolescent and young adult re-victimization (Gomez, 2011).

Method

Participants

Participants were from Wave 2 (WII) and 3 (WIII) of the National Longitudinal Study of Adolescent to Adult Health (Add Health). A nationally-representative U.S. sample was first assessed at grades 7 – 12 in 1994–95 (WI), and then followed up in 1996 (WII), 2000–2001 (WIII) and 2004–2005 (Wave 4). Women who completed WII and WIII, reported more than one WIII romantic relationship, and reported alcohol onset by WIII were included in the present analyses. The final sample included 3460 observations for 2097 participants.

Measures

Adult (WIII) Pregnancy status.—Pregnancy status was a three-category variable indicating non-pregnancy (0) nAEP (1) or AEP pregnancy (2) within each romantic relationship. Participants were asked detailed questions about each completed/current pregnancy, and each pregnancy was linked to a reported romantic/sexual relationship. AEP was specifically assessed by the question “During this pregnancy, how often did you drink alcoholic beverages?” for each pregnancy. Options ranged from 0 (never) to 4 (almost every

day). This was collapsed to a binary AEP/non-AEP variable. Multiple pregnancies within a single relationship were aggregated. The non-AEP pregnancy code indicated no alcohol exposure for all reported pregnancies within that romantic/sexual relationship. An AEP pregnancy code indicated at least 1 alcohol-exposed pregnancy for all pregnancies within the specific romantic/sexual relationship.

Adult (WIII) Intimate Partner Violence (IPV) Victimization.—Respondents were asked about having had experienced physical IPV by every sexual partner they reported in WIII. This measure was adapted from the revised Conflicts and Tactics Scale (CTS2; Straus et al., 1996). Physical IPV was measured by asking how often one's partner a) "has threatened you with violence, pushed or shoved you, or thrown something at you that could hurt"¹, b) "has slapped, hit, or kicked you" or if "you had an injury such as a sprain, bruise, or cut because of a fight with (partner). Items were initially measured using a 7 point scale, from 0 (never) to 6 (more than 20 times), with an extra item for indicating that "this hasn't happened in the past year, but did happen before then". Items were re-coded with a binary absence/presence for the prevalence of each indicator of physical IPV (see Straus, 2004). The final score was the sum score for the three items.

Adult (WIII) Consistent Birth Control Use: Participants were asked about their use of condoms and birth control for every sexual relationship that they reported in WIII. For every partner, individuals were asked if they had (vaginal) sex on one or more than one occasion. Those who reported having had sex only one time with each specific partner were asked if they had used any birth control, and for those that reported use, what birth control was used (respondents could choose up to three methods). Those who reported having had sex more than one time with each specific partner were asked if they used any birth control/what types of birth control for the first and most recent time they had sex. Individuals were coded as having had *consistent birth control use* if they reported using any effective birth control (condom, birth control pills, vaginal sponge, foam/jelly, diaphragm, IUD, Norplant, ring, Depo Provera or contraceptive film) for their only or both first and most recent times having had sex. Although the different birth control methods within the consistent birth control group may have varying levels of efficacy/failure (e.g., Kost et al., 2008), we chose to group these together due to the small sample sizes of methods other than condom use and hormonal birth control. Those who reported no birth control use at any time, either first or most recent times or those who reported using only withdrawal or the rhythm method for their BC were coded as having inconsistent birth control use.

Adolescent (WII) IPV victimization was derived from a measure assessing WII reports of up to six sexual/romantic partners (up to three romantic and three non-romantic) they had in the past year (since the last interview at WI). Similar to the WIII measure, participants were asked if their partner(s) had ever threatened them with violence, pushed or shoved the participant or thrown something at the participant that could hurt them. However, these were assessed as binary, not frequency variables. These items were summed for each partner and then averaged across partners.

¹This variable was a composite of psychological (threatening) and physical (pushing, shoving, throwing something that can hurt) items, which we included as a physical item.

Adolescent (WII) Alcohol Use Frequency.—Alcohol use in adolescence was assessed via a past-year frequency variable at WII. This score was initially re-coded with dummy variables to account for abstainers, however, non-abstaining individuals who reported no past year use were also included in this category, as this was a small proportion of individuals ($n = 77$, 2.61%), and such models performed poorly when examining interactions, most likely due to small cell sizes. Therefore, there were two dummy codes reflecting three categories: abstainers/non-abstaining non-users, infrequent drinkers (those who reported drinking once a month or less), and moderate-to-high drinkers, who reported drinking at least two times a month.²

Control Variables.—Two variables were included to contextualize the WIII time-varying romantic relationships. *Length of each sexual relationship* was calculated by subtracting the reported start and end dates (past relationship) or by subtracting the start and the interview date (current relationship). This variable was re-coded into an eight-point scale, ranging from 1 day (0) to more than 4 years (7). *Age at start of each relationship* was assessed by subtracting participants' birth date from the reported start date of the relationship. *Total number of adolescent (WII) relationships* was added as a control for the WII physical violence victimization variable, to distinguish meaning between those who reported either no physically violent relationships or no relationships (both of which would result in scores of 0). This was assessed by counting the number of romantic relationship partners endorsed in the WII relationship measure. *Childhood abuse* was conceptualized as mistreatment by parents or adult caregivers prior to 6th grade (measured in WIII). Participants reported how often adults (parents or other adult caregivers) had slapped, hit, or kicked them, and how often they had “touched you in a sexual way, forced you to touch him or her in a sexual way, or forced you to have sexual relations”. Reporting physical or sexual abuse was coded with a “1” while reporting no physical or sexual abuse was coded with a “0”. Finally, age at WII was included to contextualize the adolescent alcohol use (e.g., contextualize differences between a 13-year-old drinker versus an 18-year-old drinker).

Analytic Plan

A generalized multi-level model nesting relationship within person-level effects compared pregnancy outcomes (AEP versus nAEP or non-pregnancy). This included four relationship-varying effects: IPV, consistent birth control use, age at the start of relationship, and length of relationship. Adolescent alcohol use frequency, IPV/relationship ratio, and the number of romantic partners, along with child abuse and race were considered non-relationship varying (between-person) variables. A main model was first estimated, as well as four models that examined two-way interactions between IPV and either birth control use, or adolescent alcohol use. Two IPV $\times$ adolescent alcohol use interactions were estimated: a cross-level within-person IPV $\times$ between-person alcohol use interaction, and a between-person IPV $\times$ between-person alcohol use interaction. For interactions between IPV and birth control use, there were four possibilities to explore: two cross-level interactions (a within-person IPV $\times$

²An additional category splitting apart moderate and heavy drinkers (e.g., drinking at least three days a week) was initially included in the model. However, due to similarly small cell sizes of this category ($n=78$, 2.65%) the moderate and high categories were combined. Estimations that include both the non-past year drinking and heavy drinking categories are available upon request.

between-person birth control interaction, and a within-person birth control and between-person IPV interaction), and two single-level interactions (within-person or between person only interactions).

Only the first five relationships were included in this model due to low numbers in both the number of reported relationships after 5, as well as the number of reported relationships after 5 that also included pregnancies. Although individuals reported up to 48 relationships, 81.87% participants reported 1 – 5 relationships and 91.06% of relationships with pregnancy outcomes were reported for relationships 1 – 5. Person-means centering was used to assess the direct effects of within-person and between-person effects (Curran & Bauer, 2011) for IPV, age at the start of relationship, and length of relationship. A grand-means centered approach was used for the birth control variable (person-means centering is not advisable for binary variables). All models were estimated using Mplus TWOLEVEL COMPLEX function, which accounts for the stratified sampling and complex survey weights, and a robust maximum likelihood estimator to account for missingness of data.

Results

Total number of relationships reported were: 2 relationships (26.51%), 3 relationships (21.16%), 4 relationships (16.27%) and 5+ relationships (36.06%³). Table 1 presents the correlations and means/frequencies for all variables.

Multilevel Models

Multilevel models were first tested to see if random slopes were necessary in addition to a random intercept. There was no improvement in model fit when adding a random slope of time ($\chi^2(4) = 2.95, p > .05$), or a random slope of IPV, ($\chi^2(2) = 0.32, p > .05$). Although adding a random slope of within-person birth control use significantly improved the model ($\chi^2(2) = 16.42, p < .05$), this model did not converge when adding a subsequent cross-level interaction involving within-person IPV. Therefore, all models were estimated with random intercepts and fixed effects, except when estimating cross-level interactions. Intraclass correlation coefficients were also examined; both the non-pregnancy vs AEP group (ICC = 0.43) and the nAEP vs AEP group (ICC=0.60) had reasonable between-person variability.

Within and between-person main effects of physical IPV, birth control use, and adolescent alcohol use on AEP—Table 2 displays the main effects using either non-pregnancy or nAEP as the reference group. As indicated, there were within-person (relationship-specific) effects. For every increase in presence of a specific physical IPV indicator within a relationship, compared to other relationships, odds of AEP compared to non-pregnancy increased by 164%. Similarly, there was a 1.36 higher odds of AEP compared to nAEP, in relationships with increased IPV indicators compared to other relationships. There were no within-person significant effects for birth control use. In other words, using birth control consistently within a relationship, compared to other relationships, did not significantly increase the odds of AEP compared to non-pregnancy or nAEP outcomes.

³This includes individuals who reported five total relationships or more than five relationships

There were also significant between-person effects distinguishing non-pregnancy from AEP and nAEP from AEP. For every additional physical IPV indicator experienced within the five-year span (averaged over all relationships), compared to other individuals, increased the overall odds of AEP compared to non-pregnancy by 200%, and increased the overall odds of AEP compared to nAEP by 154%. Therefore, not only did IPV have within-relationship influence, but also distinguished AEP outcomes between individuals. In addition, individuals who used birth control more consistently over the 5-year period compared to other individuals decreased odds of AEP by 66% (compared to non-pregnancy) and 62% (compared to nAEP). Finally, alcohol use in adolescence increased odds of AEP. Individuals who reported past-year infrequent drinking in adolescence, compared to those who reported abstinence or no past year drinking, increased odds of overall AEP compared to nAEP in adulthood by 175%. Those who reported heavy or moderate past-year drinking in adolescence, compared to those who reported abstinence or no past year drinking, increased odds of AEP in adulthood by 176% (compared to non-pregnancy) or 195% (compared to nAEP). Therefore, adolescent drinking overall increased higher odds of AEP compared to either non-pregnancy or nAEP outcomes in adulthood.

Interactions between IPV, adolescent alcohol use, and birth control use—

Between-person IPV moderated the effect of infrequent past-year adolescent alcohol use on the odds of AEP compared to non-pregnancy (OR = 1.49, $p < .05$, 95% CI (1.09 – 2.05)) and AEP compared to nAEP, (OR = 1.63, $p < .05$, 95% CI (1.21 – 2.19)). As seen in Figure 1a–b, the odds of AEP compared to non-pregnancy (1a) or nAEP (1b) were generally low.

However, experiencing higher levels of physical IPV substantially increased the effect of infrequent adolescent drinking on the odds of AEP. For example, when examining the odds of AEP compared to nAEP (Figure 1b) the odds of AEP for an infrequent adolescent drinker who experienced no IPV from any romantic relationship in the past five years was 0.15. The odds of AEP for an infrequent adolescent drinker who experienced high IPV (e.g., 3 unique physical IPV indicators averaged across all romantic relationships in the past five years) was 1.03. Comparatively, the odds of AEP for moderate to heavy adolescent drinkers was 0.29 to 0.55 for those who experienced no or high IPV respectively. In other words, higher levels of average physical IPV over the five-year period significantly increased the odds of AEP for infrequent adolescent drinkers, compared to non-drinkers, however, IPV experience did not significantly increase the odds of AEP for moderate-heavy adolescent drinkers, compared to non-drinkers. There were no other significant interactions of IPV on either adolescent alcohol use or birth control use (see Supplemental Table 1a–b).

Post Hoc Tests

Alcohol use was assessed at adolescence (WII) to ensure directionality. Although alcohol use was also assessed at WIII, there was no alcohol use information that accompanied the timeline of relationships or pregnancies beyond the measure of AEP. However, given that alcohol use will most likely change over the five years between WII and WIII (e.g., a trend towards increasing in later adolescence/young adulthood; Chassin et al., 2004), we also ran models using the WIII alcohol variable. As with the main models, there were two dummy codes reflecting three categories (no past-year use, infrequent past year use, and moderate – to – high past year use). As WIII abstainers had been excluded from the study sample, the

young adult no past-year use category included only those who had reported any lifetime use, but no past year use. Supplemental Table 2 displays frequency tables for comparing adolescent and young adult drinking rates. Similarly, in adolescents and young adults, non-abstaining, non-past year drinkers and heavy drinkers had the lowest categories.

Supplemental Table 3a–3b displays the WIII-alcohol use variable models. Similar to the WII alcohol-use model, individuals who reported moderate/heavy alcohol use at WIII had higher odds of (previously) reporting AEP compared to nAEP; compared to non-drinkers, those who reported moderate or heavy drinking had 353% higher odds of an AEP. However, there were no other significant associations between WIII alcohol use and AEP outcomes. In addition, compared to the WII-alcohol model, there were no within-person significant effects of IPV or birth control use on distinguishing AEP from nAEP. There were significant within-person effects distinguishing AEP from non-pregnancy, similar to the WII-alcohol use model. Between-person effects for IPV and birth control were similar to the WII-alcohol use model. There were also no significant interactions.

Discussion

The purpose of this study was to examine the role of physical IPV as a risk factor for AEP as a unique predictor and a potential moderator of the two main behaviors emphasized in preconceptional AEP prevention programs: alcohol use and birth control. We found that IPV was a strong influence on AEP both within specific relationships and between people. IPV had little moderating influence on AEP outcomes; the one significant interaction highlights the contexts in which IPV may strengthen the history of (adolescent) alcohol use on later AEP.

Intimate partner violence as a main effect

As hypothesized, IPV related to higher odds of AEP, alongside higher alcohol use and lower birth control use. Individuals experiencing higher physical IPV within the 5-year period, compared to individuals who experienced less physical IPV, had higher odds of reporting any AEP outcome. This is consistent with studies comparing pregnant women who do or do not abstain from alcohol use (e.g., Kitsantas et al., 2015; McDonald et al., 2014; Powers et al., 2013). Experiencing IPV also had a direct influence on AEP compared to non-pregnancy and nAEP as a within-person (within-relationship) effect.

Given the variety of ways in which physical IPV related to AEP, multiple explanations are needed. The association between IPV and unintended pregnancy, typically via lower associated levels of birth control (Miller et al., 2010; Pallitto et al., 2005) could explain within-person effects of IPV. Physical IPV (as measured here), is often accompanied by other forms of IPV that can further facilitate pregnancy, such as sexual IPV or reproductive coercion (Katz et al., 2017; Tanha et al., 2010). Another contributing explanation, pertaining to the within-person effect of IPV on AEP versus nAEP, may be the continued or even new experiences of IPV *during* pregnancy. There are less reported instances of IPV during pregnancy compared to non-pregnancy (e.g., Silverman, et al., 2006), however relationships marked by IPV can continue into pregnancy (James et al., 2013), and such IPV tends to

increase in severity during pregnancy (Brownridge, et al., 2011). Substance use can increase during this time (Martin et al., 2003), if used as a coping mechanism.

Between-person IPV effects indicate additional third variable explanations for the association between physical IPV and AEP vs nAEP. Variables related to both AEP and IPV include anxiety (Alvik et al., 2006; Pico-Alfonso, et al., 2006) and illicit drug use (Anderson et al., 2012; Harrisson & Sidebottom, 2009). Third variable explanations may also include pervasive forms of IPV such as coercive control, psychological/emotional violence, or even substance use coercion itself (Rivera et al., 2015; Warshaw et al., 2014). These types of IPV result in negative health outcomes such as substance use or lower birth control that are as strong as, or stronger than physical IPV effects (e.g., Ansara & Hindin, 2010; Coker et al., 2002). Most research examining the relationship between IPV and AEP either do not classify IPV typology (Anderson et al., 2014), only assess physical IPV (Kisantas et al., 2015), or aggregate IPV forms (McDonald et al., 2014). Roberts et al., (2014) documented that, within women seeking services for pregnancy termination, psychological IPV did not predict AEP when controlling for physical IPV. However it is unknown if these results generalize to other pregnancy/preconceptual situations.

Intimate partner violence as a moderator

Contrary to hypotheses, IPV was not a prominent moderator for alcohol use or birth control. Infrequent drinking in adolescence, compared to abstinence / no past year drinking, related to increased odds of AEP in young adulthood for those experiencing more IPV. This interaction highlights the way that IPV, or related third-variable contexts, can increase AEP vulnerability for women with a history of lower-level adolescent drinking. The strong association between earlier high drinking trajectories and alcohol use disorders (Deutsch et al., 2017, Hingson et al., 2006) may explain the lack of interaction between IPV and higher levels of adolescent drinking. For heavier adolescent drinkers, alcohol cessation during pregnancy may be more difficult regardless of external environment (e.g., IPV experience). However, IPV contexts may potentially reinforce drinking for individuals with a history of lower level alcohol use; individuals who otherwise may be more likely to stop drinking during pregnancy (Anderson et al., 2014; Okeefe et al., 2015).

Birth control effects were not strengthened by IPV. We expected that there might be an interaction due to the strong relationship between IPV and birth control use (Tanaha et al., 2010) and IPV and unintended pregnancy (Miller et al., 2010). It is possible that other IPV forms more related to birth control use (e.g., coercive control) would strengthen birth control use effects. Alternatively, interactions between IPV and birth control use may be more relevant for unintended pregnancy, compared to AEP outcomes. Given the strong relationship between unintended pregnancy and AEP (e.g., McDonald et al., 2014), it may be beneficial to examine a mediating relationship between IPV/birth control, unintended pregnancy, and AEP.

Intimate Partner Violence as an indicator of AEP risk for intervention programs

The current findings support the notion that IPV, and other (third-variable) predictors that may relate to both AEP and substance use, may warrant special attention in AEP prevention

curricula, as IPV related to declines in both outcomes preferred over AEP: non-pregnancy and nAEP. Most preconceptional short-term AEP interventions demonstrate improvement in birth control use (e.g., Hanson et al., 2017; Ingersoll et al., 2013, 2018, Wilton et al., 2013), indicating AEP prevention through these programs is mostly due to non-pregnancy outcomes. Variables contributing to maintenance of alcohol use, or contexts in which substance use and low birth control use are part of a larger system of lack of control or autonomy, might need emphasis outside of the personal feedback, motivational interview, or self-guided behavioral change formats, particularly for women who become pregnant.

Strengths and Limitations

The longitudinal, prospective data is a strength of the study, allowing us to examine change within individuals (between relationships). We also compared AEP to both favorable outcomes for preconceptional AEP prevention programs: non-pregnancy and nAEP. Prior studies typically only compare AEP and nAEP (pregnancy samples; Anderson et al., 2012; Frankenberger et al., 2015; Skagerstrom et al., 2013). A main limitation is the lack of other important within-relationship variables, particularly alcohol use. Time between adolescent alcohol use and each relationship was up to five years (average time difference between WII age and mean age at relationship start [across all relationships] was 2.74 (SD = 1.67), average time difference between WII age and mean age at due date [across all pregnancies] was 3.42 (SD = 1.82)⁴. Although Add Health includes both WII and WIII past year alcohol use, we used WII to ensure directionality. Another potential issue was the sample age, as women who drink while pregnant tend to skew older (e.g., Meschke et al., 2013) than the youngest sample participants. It is also possible that participants did not recognize their alcohol consumption during pregnancy. Retrospective reports for alcohol use are potentially less valid than prospective reports, although AEP may be more under-reported within prospective studies (Alvik et al., 2006). Finally, we only examined physical IPV. Including other types of IPV (e.g., psychological, emotional, coercive control) could have produced different results.

Implications and Future Directions

It should be noted that longer-term, case-management style AEP interventions, in which participants connect to a variety of services, improve both birth control use and alcohol use behavior (e.g., Grant et al., 2005; Rasmussen et al., 2012). There is also a personal goal component, but these goals are more multidimensional (e.g., “personal skills management”). However, these programs may not be pragmatic in highly impoverished, resource-poor areas; adding emphasis on contextual components to brief, scalable AEP prevention programs may be more feasible.

AEP risk involves more than high alcohol use and low birth control use. Highly complex biological and environmental etiologies for alcohol use and addiction may necessitate longer-term comprehensive care for interventions targeting reduction or abstinence. Such comprehensive care may also be needed for participants who have not only experienced IPV

⁴A small percentage of individuals reported that their first relationship in the past five years started earlier than their reported age at WII (n=37). A small number of individuals also reported that their first pregnancy with their first partner from the past five years was prior to their age at WII (n=38).

or trauma, but also for participants who live in resource-scarce areas or in areas with limited alternatives for social support (e.g., highly rural or isolated areas). Although current interventions have substantially reduced AEP, consideration of mental health and maladaptive environments as barriers for behavioral change are critical for developing new or improved programs.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1A-B.

Level 2 IPV $\times$ adolescent past year drinking frequency interaction predicting odds of AEP vs non-pregnancy (A) and AEP vs nAEP (B)

Note: IPV levels indicate average items endorsed over all relationships in past 5 years.

Range of IPV is from 0 (no items) to 3 (3 items).

Table 1.

Correlations and means/frequencies of all variables across all relationships

	1	2	3	4	5	6	7	8	9	10	11	12
1. Total Pregnancies	-											
2. Total AEP (for pregnancies only)	0.20**	-										
3. Average IPV Victimization Across Relationships	0.27**	0.13*	-									
4. Average Consistent BC Use Across Relationships	-0.29**	-0.11**	-0.17**	-								
5. Average Age at Start of relationship(s)	-0.08**	0.02	-0.04*	0.08**	-							
6. Average Length of Relationship(s)	0.24**	-0.10**	0.14**	-0.14**	-0.16**	-						
7. Adolescent Frequency of Drinking	0.11**	0.16**	0.10**	-0.04*	-0.01	0.06**	-					
8. Adolescent Physical IPV	0.15**	0.05	0.16**	-0.06**	-0.01	0.08**	0.10**	-				
9. Adolescent Total Sexual/Romantic Partners	0.05**	0.01	0.06**	-0.01	-0.15	0.02	0.18**	0.09**	-			
10. Child Abuse	0.05**	0.11**	0.12**	-0.08**	-0.03	-0.01	0.04	0.01	0.03	-		
11. Race	0.08**	0.04	0.03	-0.10**	0.06**	0.04*	-0.07**	0.01-	0.04**	0.11**	-	
12. Age	0.14**	0.02	0.05**	-0.01	0.51**	0.19**	.20**	0.11**	0.14**	0.01	0.08**	-
Mean (SD) [Range] / Frequency												
	0: 63.22%	0: 84.97 %	0.62	0.61	19.06	3.42	1.48	0.11	0.91	0.32	W: 56.59%	16.08
	1: 27.55%	1: 13.20 %	(1.06)	(0.37)	(1.76)	(1.64)	(1.43) ⁵	(0.39)	(0.95)	(0.47)	B: 20.56%	(1.56)
	2: 8.32%	2 - 3: 1.83%	[0 - 6]	[0 - 1]	[15 - 26]	[0 - 7]	[0 - 5]	[0 - 3]	[0 - 5]		L: 15.01%	
	3 - 9: 0.91%										A: 6.26%	
											AIAN: 1.58%	

*
p<.05;**
p<.01

⁵For correlation purposes, we used a continuous drinking frequency variable. However, for the dummy variables, 44.68% of participants reported total abstinence or

Table 2.

Multi-level model parameters for odd ratios of AEP compared to reference variables non-pregnancy and nAEP

	AEP (vs non-pregnancy)	AEP (vs nAEP)
Level 1		
Within-person Physical IPV	1.64 ** (1.27 – 2.12)	1.36 * (1.08 – 1.72)
Within-person Consistent Birth Control Use	0.50 (0.27 – 0.91)	1.71 (0.96 – 3.07)
Within-person Length of Relationship	1.14 * (1.04 – 1.25)	0.88 * (0.80 – 0.97)
Within-person Age at Start of Relationship	0.98 (0.90 – 1.05)	1.05 (0.97 – 1.13)
Level 2		
Between-person Physical IPV	2.00 ** (1.68 – 2.38)	1.54 ** (1.32 – 1.81)
Between-person Consistent Birth Control Use	0.34 ** (0.18 – 0.66)	0.38 * (0.20 – 0.73)
Between-person Length of Relationship	0.94 (0.83 – 1.05)	0.72 ** (0.64 – 0.80)
Between-person Age at Start of Relationship	0.77 ** (0.69 – 0.86)	0.91 (0.80 – 1.04)
Adolescent Infrequent Past Year Drinking (vs non/Abs.)	1.44 (0.94 – 2.18)	1.75 * (1.13 – 2.70)
Adolescent Moderate-Heavy Past Year Drinking (vs non/Abs.)	1.76 * (1.17 – 2.66)	1.95 ** (1.25 – 3.05)
Average IPV Experiences in Adolescent Relationships	1.68 ** (1.24 – 2.28)	1.23 (0.92 – 1.65)
Adolescent Total Romantic/Sexual Partners	1.33 ** (1.11 – 1.58)	1.16 (0.95 – 1.40)
Child Abuse History	1.34 (0.94 – 1.94)	1.33 (0.91 – 1.95)
African American (vs White)	1.35 (0.79 – 2.32)	0.59 (0.35 – 0.98)
Latino/a (vs White)	0.81 (0.46 – 1.41)	0.63 (0.36 – 1.09)
Other Race (vs White)	1.01 (0.43 – 2.34)	1.13 (0.47 – 2.71)
Age at WII	1.22 * (1.04 – 1.43)	0.99 (0.85 – 1.15)

*
 $p < .05$;**
 $p < .01$

Note: AEP = “alcohol-exposed pregnancy”; IPV = “intimate partner violence”; Abs = “abstinence from alcohol