

Joint physical custody and academic achievement among youth: A population-based study with registry linkage

Abstract

Previous research has documented that youth in joint physical custody (JPC) often report fewer mental health problems than peers in other post-separation living arrangements. Whether JPC is associated with functional outcomes such as academic achievement has been less examined, and existing work have relied on self-reported school grades and pertinent controls such as parental education. Using data from the Norwegian population-based youth@hordaland study (n = 7,914), we examined the association between living arrangements and academic achievement among youth (16-19 years) using register-based information on grade point average (range 1-6), parental education, and income. We also assessed the influence of family cohesion and co-residing biological and half/stepsiblings in explaining differences between youth in JPC joint physical custody and other living arrangements. Across all regression models, youth in JPC had significantly higher grade point average (0.2 – 0.4 points) than youth living with a single mother- or father. Parental education had a strong attenuating effect and reduced the magnitude of the difference with 30-35 % for youth in single-parent families and 55 % for youth in stepparent families. In conclusion, we find that youth in JPC have a small but significant academic advantage compared to peers in single-parent families, which is not fully accounted for by objective measures of parental education and income, sibling composition, and family cohesion. Future longitudinal studies are needed to disentangle whether positive outcomes associated with JPC are due to inherent qualities of this living arrangement or better captured by pre-separation selection mechanisms.

Keywords: joint physical custody, shared physical custody, academic achievement, adolescence, family structure

Family scholars have systematically documented that youth with separated parents have lower academic achievement than peers in nuclear two-parent families (Amato, 2001; Härkönen et al., 2017; Nilsen, Breivik, et al., 2020). Fewer parental- and economic resources available for children in separated families are among the common explanations for this link (Amato, 2010). However, post-separation living arrangements are increasingly diverse and differ in how much time each parent spends with their child. Notably, the last decades have emphasized more equal time-sharing between parents through joint physical custody arrangements (JPC) (Steinbach, 2019). The present study sought to investigate whether JPC and other post-separation living arrangements may account for some of the association between parental separation and academic achievement among youth.

Joint physical custody and academic achievement among youth

A key feature of restructuring family life after a separation is the division of time that each parent spends with their child (Bastaitis & Pasteels, 2019). JPC refers to a living arrangement where the child lives about equally with both parents, alternating between two homes (Steinbach, 2019). JPC has gained momentum in countries such as the Netherlands (Poortman & van Gaalen, 2017), Belgium (Vanassche et al., 2017), Sweden (Bergström et al., 2015), and in some states in the US (Meyer et al., 2017). In Norway, the estimated frequency of JPC in separated families increased from 8 % in 2002 to about 30 % in 2012, followed by a reduction of youth living mostly with their mother (Kitterød & Wiik, 2017).

A growing body of research finds that youth in JPC report fewer mental health problems than peers in single- or stepparent families (for reviews, see Nielsen, 2018; Steinbach, 2019). Yet, knowledge of whether JPC is associated with functional outcomes such as academic achievement is limited. A recent review concluded that youth in JPC and single-parent families were most similar on measures of academic achievement (Nielsen,

2018). However, this review included measures of school satisfaction (Bergström et al., 2013) and school engagement (Havermans et al., 2017), which at best are indirect measures of academic achievement.

Only three studies have assessed academic achievement among youth in JPC. A study from Norway found that youth (aged 13-14) in JPC had significantly lower grade point average (GPA) (-0.19 points) than peers in nuclear families, similar to youth in single- and stepparent families (Breivik & Olweus, 2006). However, that study from 1997 was based on a small sample of youth in JPC (n= 24) and GPA was operationalized as the average of three self-reported grades, which might limit the generalizability of their findings. Another study from Belgium found no significant differences in mean self-reported GPA (based on recent grades in 5 subjects) between youth aged 10-16 (n = 135) in JPC and other types of post-separation living arrangements (Spruijt & Duindam, 2009). However, it is unclear whether covariate adjustments were made in these analyses. A more recent study from Germany assessed educational problems operationalized as an index of parental reported school grades in three subjects for children aged 6 to 14 years. That study found that children in JPC (n = 263) had significantly better school grades than peers in sole physical custody. However, the difference was explained by family characteristics, including self-reported parental education, parental conflicts, and parent-child relationships (Steinbach & Augustijn, 2022). As noted by the authors, the study was based on a convenience sample as JPC is still very rare in Germany (< 5% of post-separation families). Thus, whether their findings generalize to other countries with higher rates of JPC is uncertain.

Theoretical considerations

Several arguments have been put forth in the literature about potential benefits and detriments of JPC. On the one hand, JPC is suggested to be beneficial by increasing the

parental and economic resources available for the child, and facilitating collaboration and dampening custody disputes between parents (Braver & Lamb, 2018). Thus, by alleviating some of the risks associated with parental separation (Amato, 1993), one could expect that the academic achievement among youth in JPC are better than in other post-separation living arrangements. In contrast, others note that the frequent shift between two homes may be stressful, increase exposure to parental conflicts, varying parenting styles, and distance to school, friends, and other leisure activities (Chisholm & McIntosh, 2008; Gilmore, 2006). Based on these accounts, JPC could also entail stressors that negatively influences youths' academic achievement.

Another possibility is that mechanisms selecting youth into various post-separation living arrangements exert the main influence on youth's post-separation adjustment. To date, parents choosing JPC have been found to have higher income and educational qualifications and better family relations than parents where the child lives mostly with one parent after a separation (Hjern et al., 2020; Kitterød & Wiik, 2017). Notably, a large register-based study from Denmark found that before birth, about 43% of parents later choosing JPC after separating were in the top two disposable income quintiles compared to about 30% of parents where the child ended up living in a stepfamily or with a single-parent. Similarly, whereas about 18% of mothers and fathers choosing JPC were in the highest educational category, corresponding figures for single and stepparent families were about 7 – 11 % (Hjern et al., 2020).

Parental education is closely linked to youth's academic achievement (Sirin, 2005). Higher parental monitoring and more realistic academic expectations are more common among highly educated parents, and have in turn been linked to better academic achievement among youth (Davis-Kean, 2005; Kristjánsson & Sigfúsdóttir, 2009). As parental education often is established before parents have children and separate, accounting for sound measures

of parental education may be pertinent when comparing the academic achievement among youth in JPC and other post-separation living arrangements.

Studies have documented associations between family income and educational outcomes among children and youth (Elstad & Bakken, 2015). According to family investment- and stress models (see Duncan et al., 2014), higher income allows better possibilities for buying books, private tutoring and living in high-income neighborhoods with better schools, whereas strained household finances may lead to stress and parental mental health problems, in turn reducing parental supervision and engagement in children's academic progress. Previous studies have found that accounting for measures of household income accounts for some of the associations between JPC and mental health problems among youth (Nielsen, 2018). However, we are unaware of previous studies using register-based information on parental income when assessing the link between living arrangements and academic achievement among youth.

Supportive parent-child relationships and higher levels of family cohesion have been linked to higher academic achievement and lower probability of school dropout among youth (Goeke-Morey et al., 2013; Lagana, 2004). Such factors have also been found to attenuate differences between children in JPC and in single-parent families (Steinbach & Augustijn, 2022). It is possible that more equal contact with both parents, and the fact that parents need to have some form of cooperation to practice JPC, preserves a sense of shared family values for children after parental separation. Equal contact with both parents may also provide youth with more parental involvement in their academic progress, leading to better school outcomes than living mostly with one parent. Alternatively, as some have argued (Steinbach et al., 2020), more positive family interactions may be more frequently present in families choosing JPC than other living arrangements before the separation, and thus also represent a factor selecting youth into JPC.

Biological siblings may buffer some of the adverse effects of family dissolution by providing support, continuity, and a shared experience during family reorganization (Jacobs & Sillars, 2012). On the other hand, the presence of half- or stepsiblings (also termed *family complexity*; see Brown (2015)) has been suggested to stress the family system by making roles and obligations between adults (also non-resident parents) and children more unclear, thus complicating the distribution of parental resources (Fomby et al., 2016). In some support of these notions, a recent study found that biological siblings who had experienced parental separation in childhood had more contact and higher emotional closeness than half- and stepsiblings in young adulthood (Steinbach & Hank, 2018). By living in two homes, youth in JPC may be particularly likely to also live with half- or stepsiblings as a parent may have a child from a previous or new relationship. However, family composition research seldom include information about siblings in the analyses (Sanner & Jensen, 2021). As living with half-and stepsiblings has been linked to lower academic achievement among youth (Halpern-Meekin & Tach, 2008; Turunen, 2014), accounting for their presence may provide a more nuanced perspective of the academic achievement among youth in JPC compared to other living arrangements.

Finally, it is possible that children and youth self-select into or out of various post-separation living arrangements depending on characteristics of the child and how they adapt to the divorce or separation process. In the context of academic achievement, students performing more poorly may for instance be less likely to be selected into JPC if it is assumed or experienced that frequent moves between two households are negative for the child's academic achievement. Hence, observed differences in academic achievement among youth across living arrangements may also stem from such child dependent characteristics.

The Norwegian Context

The crude divorce rate in Norway (divorces per capita) more than doubled from the 1960s until today. In 2019, the crude divorce rate was 1.9, similar to the average of the EU-27 countries (1.8; Eurostat, 2021), but lower than in the US (2.7; OECD, 2019). The Norwegian welfare state provides an elaborate social safety net through free access to health care, and to sickness-, unemployment-, and family-related benefits. Public childcare and schools are also highly subsidized, which combined with generous parental leave rights, have facilitated the dual earner family (see Kitterød & Wiik, 2017). After a divorce, custodians are supported by tax deductions, cash allowances, and child support. Still, it is estimated that both men and women experience an approximately 20% decline in disposable income after a divorce (Strand, 2012).

Experiencing parental divorce or separation during childhood has been linked to more school problems (Størksen et al., 2005) and a lower probability of completing higher secondary education (Steele et al., 2009). Drawing on data from the same study as the current investigation, we have previously documented that youth with separated parents have lower GPA (Nilsen, Breivik, et al., 2020), and that youth in JPC report less mental health problems, health complaints, and sleep problems than peers in single- and stepparent families (Nilsen et al., 2018, 2022; Nilsen, Hysing, et al., 2020). Except for the early work by Breivik (2007), previous work has not considered the link between JPC and academic achievement in Norway.

The present study

Given these considerations, this study aimed to document the association between living arrangements and adolescents' academic achievement, and whether accounting for paternal educational qualifications, income, family cohesion, and siblings attenuate any

observed associations. This study contributes by drawing on a unique registry linkage between a population-based study of adolescents with high-quality objective register-based information on GPA, parental education, and income. We also assess the contribution of family cohesion and co-resident siblings in explaining potential differences in GPA between youth in JPC and other post-separation living arrangements. Previous studies have added multiple covariates in the same model when trying to explain differences between JPC and other living arrangements. To better disentangle the individual contribution of our covariates, we present models where each covariate is added separately. We also take a new approach in documenting how youth in JPC are similar – or different – to youth in other living arrangements by calculating the distribution-free overlapping index (Pastore & Calcagni, 2019) for our continuous covariates and outcome measure, as recently proposed by Jensen & Sanner (2021). The present study focuses on older adolescents aged 16-19, a critical period where academic achievements set the stage for later educational qualifications in Norway.

Methods

Design and Procedure

Data stem from the youth@hordaland study conducted in former Hordaland County in Western Norway in 2012. All adolescents born between 1993 and 1995 were invited to participate, whereby 10,257 agreed, yielding a participation rate of 53 %. The main aim of the survey was to assess mental health problems, sociodemographic characteristics, and family factors in adolescence. Information about the study was given by e-mail, and one school hour was allocated to complete the survey by answering an electronic questionnaire. A teacher organized the data collection and ensured confidentiality. Information about the study was sent by post to those not in school, and alternative solutions were made for students in hospitals or institutions.

This study is based on a subsample of adolescents ($n = 9,166$) who consented to register linkage. This subsample was nearly identical to the total sample regarding age, gender, and sociodemographic characteristics (Nilsen, Breivik, et al., 2020). Of these, 7,914 confirmed to live at home with their biological parent(s) (i.e., not in their own apartment, dorm, or with foster- or adoptive parents), and formed the basis for the current investigation.

A previous study found that the mean GPA among participants in the youth@hordaland study was representative for the region and the country as a whole (Hysing et al., 2016). We have also previously documented that the distribution of youth in various living arrangements or family structures from the youth@hordaland study was fairly similar to official country-level statistics of 2012, although differences in methodology does not allow for direct comparison as official statistics does not include JPC as a category (see Nilsen et al., 2022).

Ethics

The youth@hordaland study and the registry-linkage to the Norwegian educational database (NUBD) were approved by the Regional Committee for Medical and Health Research Ethics (REC) in Western Norway. According to Norwegian regulations, adolescents 16 years of age and older make decisions regarding their health, including participation in health studies. The adolescents consented to participate in the study and to the registry linkage on the first page of the electronic questionnaire. Parents/guardians received written information about the study in advance.

Measures from the youth@hordaland study

Living arrangements. The respondents were asked if (1) their biological parents lived together (yes/no), and if *no*, (2) whether their biological parents were divorced or separated (yes, no), and (3) if they still lived at home, who they lived with most of the time

(mostly with mother, mostly with father, equally with both parents). They were also asked to specify others they lived with, including *mother's new partner*, and *father's new partner*.

Based upon these items, the adolescents were categorized into five living arrangements: (1) Nuclear two-parent families (lives with their two biological non-separated parents, $n = 4932$), (2) JPC (lives equally with both parents after a divorce/separation, $n = 357$), (3) single mother families (lives mostly with their divorced/separated single mother with no new partner, $n = 914$), (4) single father families (lives mostly with their divorced/separated single father with no new partner, $n = 192$), (5), stepfamily (lives with their divorced/separated mother or father and his/her new partner, $n = 573$). For the stepfamily category, the vast majority lived with their divorced/separated mother and her new partner (87 %).

Year since separation. We calculated years since separation by subtracting year of participation in the youth@hordaland study by year of parental separation, as indicated by the youth.

Siblings. Three items assessed whether the adolescents lived with biological siblings, half-siblings, and stepsiblings. We created two variables denoting whether the adolescents lived with biological siblings (yes, no), and whether they lived with half-or stepsiblings (yes, no).

Family cohesion was measured by the *family cohesion* subscale of the Resilience Scale for Adolescents (READ; Hjemdal et al., 2006). The psychometric properties of the READ have been assessed in a previous study from the youth@hordaland study (Askeland et al., 2020), and we used the adapted version of the READ that was found to have adequate psychometric properties on the current sample. In this adaptation, the family cohesion subscale consists of 7 items measuring support (e.g., “In my family we support each other”) and shared values (e.g., “In my family we agree on most things”) in the family. The items are

rated on a 5-point Likert scale, from “totally disagree” (scored 1) to “totally agree” (scored 5), and an overall score is created by adding the items together divided by the total number of items. As the family cohesion subscale is a part of the larger READ instrument, no specific instructions about who constituted their family was given. Rather, they were instructed to think about how they felt during the past month about themselves and about people important to them. The omega total coefficient for the family cohesion subscale in the current sample was 0.90 [95% CI: 0.89, 0.90] suggesting high internal consistency.

Ethnicity was based on adolescent self-reported country of birth and categorized as “Norwegian”- or “Foreign”- born.

Measures from registers

Age and sex. Date of birth and sex (female, male) were obtained by the participants’ identity number in the Norwegian National Registry. We calculated the exact age from the date of participation in the youth@hordaland study and the birthdate of the participants.

Grade point average (GPA). The adolescents’ GPA for each year in upper secondary school administered by Statistics Norway. In Norway, school subjects are graded on a scale from 1 (failure) to 6 (excellent). The GPA is calculated by the sum of all grades in a given school year divided by the number of subjects. The GPA used in this study stem from the school year 2011/2012, corresponding to the school year of participation in the youth@hordaland study. The GPA used in the current study forms the basis of admittance to higher education in Norway. There were 226 respondents who had a GPA between 0 and 1, and one respondent with a GPA slightly above 6. These were truncated to nearest possible score (i.e., 1 and 6).

Parental education. The highest completed educational level of mothers and fathers when the adolescents were 16 years of age were also retrieved from NUBD. We used the

International Standard Classification of Education (ISCED) 2011 (UNESCO Institute for Statistics, 2012) to create measures for maternal and paternal educational qualifications.

These variables had four levels: (1) ISCED 0-2 (lower secondary education), (2) ISCED 3-5 (upper secondary education, post-secondary non-tertiary education, short-cycle tertiary education), (3) ISCED 6 (Bachelor's level or equivalent), and ISCED 7-8 (Master's or Doctoral level of education).

Parental income. Mother's and father's net income, i.e., the sum of wages and salaries, income from self-employment, property income and transfers received minus total assessed taxes and negative transfers, was retrieved from the National income registry. To account for the notion that households of different compositions (i.e., number of adults/children) may have different economic needs, we also obtained the equivalized household income that the youth resided in. This is a measure of household income (i.e., the sum of wages and salaries, income from self-employment, property income and transfers received minus total assessed taxes and negative transfers) that is adjusted by an equivalence scale to ease comparison between households of different size and composition. We use the European Union scale where the first adult is given a weight of 1, subsequent adults are given a weight of 0.5, and each child < 14 years is given the weight 0.3 (De Vos & Zaidi, 1997). The income measures in the present study are used by The Norwegian Government to estimate taxation and are of high quality.

Statistical analyses

All analyses were conducted using R version 4.1.1 for Windows. Functions from the “*tidyverse*” R-package were used for data wrangling and creating figures (Wickham et al., 2019). We present descriptive statistics showing frequencies and percentages for categorical variables and means with standard deviations, and medians with the interquartile range (for

income) for numerical variables. We also present statistical tests for differences between youth in JPC and the other living arrangements.

To further assess similarities between living arrangements on our continuous covariates (parental income and family cohesion) and our main dependent variable, we calculated the distribution-free overlapping index using the R-package “*overlapping*” (Pastore & Calcagni, 2019), as suggested by Jensen & Sanner (2021) to better show differences and similarities across family compositions. This index takes a value between 0 and 1, where 1 indicates perfect (100%) distributional overlap between groups. As JPC is the focal interest in the present study, we compared the distributional overlap between youth in JPC and the other living arrangements. The results of these analyses are presented visually as kernel density distribution plots with the overlapping index (in %) embedded in the figures.

Ordinary least squares (OLS) regressions were used to test the association between living arrangements and GPA, using JPC as the reference group. In the first model, we documented the association between living arrangements and GPA, adjusted by age and gender. In the next four models, we successively examined whether parental education, income, siblings, and family cohesion attenuated this association, by entering these covariates separately in each model. Finally, we tested a fully specified model where all covariates were entered simultaneously. The results of the OLS models are presented as unstandardized beta coefficients, representing the predicted mean difference in GPA points between JPC and the other living arrangements. We also estimated the standardized mean difference (SMD) by z-transforming (i.e., setting the grand mean = 0, and a standard deviation = 1) the GPA-variable and re-running the regression analyses. Across all models, due to the scaling and distribution of the GPA, the SMD was approximately equal (to the second decimal point) to the unstandardized beta. Thus, we only present the latter which in this specific case may be interpreted both on the raw metric (i.e., average GPA points) and in standard deviation units.

Missing data was highest for the living arrangement variable (12 %), followed by the family cohesion scale (7%), sibling variables (5%), and fathers net income (4%). The rest of the variables had less than 2 % missing. In all regression analyses, missing values were assumed missing at random (MAR), and imputed using multiple imputation by chained equations with the R-package “*mice*” (van Buuren & Groothuis-Oudshoorn, 2011). A total of 40 imputations with 40 iterations each were performed. Variables entered in the imputation model were: Living arrangement, age, sex, parental education, income measures, family cohesion, siblings, ethnicity, and GPA. Thus, as recommended (see van Ginkel et al., 2020), both the dependent and independent variables were included in the imputation model. The estimates and standard errors from the statistical analyses were pooled into overall estimates using Rubin’s rules (Rubin, 1987). We also report results using complete case analyses in the supplementary materials.

Sensitivity and robustness checks. Analyses were run adding maternal and paternal education and income measures separately, to better tease apart the contribution of maternal/paternal education and income in attenuating differences in GPA across the living arrangements. We also tested whether the association between living with half/stepsiblings on the adolescents GPA was moderated by gender, as a previous large-scale study found that the presence of stepsiblings was more negatively related to the GPA of girls than boys (Turunen, 2014), and as we have found a similar pattern with regards to health complaints in a previous study (Nilsen, Hysing, et al., 2020).

Within post-separation living arrangements, robustness checks were performed adding years since separation as a covariate, as that time since separation has been associated with adolescents’ academic achievement (Baert & Van der Straeten, 2021). As we logically expected variations on this variable by living arrangements (i.e., it takes more time establishing a stepparent family than a single-parent family, and the frequency of JPC have

increased in more recent years), we chose not to include this variable in our main set of analyses.

Half of youth in JPC (50.1%) reported to live with at least one stepparent. To test the robustness of our operationalization of post-separation living arrangements and to better assess the influence of stepparents, we also tested an alternative approach where we separated between youth in JPC and youth living mostly with their mother and mostly with their father, and capture stepparents with a dummy indicator. For youth in JPC, this dummy takes the value of 1 if they reported to live with at least one stepparent (in either mothers or fathers or both households). For youth living mostly with their mother or father, this dummy takes the value of 1 if they also report living with their mother's new partner or father's new partner, respectively.

Data and code availability

Norwegian Health research legislation and the Norwegian Ethics committees require explicit consent from participants in order to transfer health research data outside of Norway. For the present study, ethics approval is also contingent on storing the research data on secure storage facilities accessed through our research institution. Data are from the Norwegian youth@hordaland study whose authors may be contacted at bib@norceresearch.no. Analysis code reproducing all main results are available on the OSF:

<https://doi.org/10.17605/OSF.IO/UJA6S> (Nilsen, 2022).

Preregistration statement

This study was not preregistered.

Results

Sample characteristics

On average, youth in JPC generally had more favorable socioeconomic conditions than youth in single- and stepparent families with significantly higher parental educational

qualifications, higher paternal net income, and higher maternal net income (except when compared to youth in single mother families). They also had significantly higher equivalized disposable income (income scaled by household composition) than youth in single mother families, but not compared to peers in single father and stepparent families. We also note that youth in JPC were more likely to report living with half/stepsiblings than youth living with a single parent, but less so than among youth residing permanently in a stepparent family. The mean GPA and family cohesion scores were similar among youth in JPC and nuclear families, and significantly higher than among youth in other living arrangements (for further details, see Table 1).

---Insert Table 1 about here---

The kernel density distribution plots of comparisons in distributions of income variables and family cohesion between youth in JPC and other living arrangements are shown in Figure 1. These plots complement the information in the descriptive comparisons but provide some additional insights. Whereas the distribution of maternal net income for youth in JPC were most similar to that of youth in single mother (82%) and stepparent families (84%), the distribution of paternal net income had greatest overlap with that of youth in nuclear (84%) and single father families (76%). High overlap in family cohesion scores between youth in JPC and in nuclear families (89%) were also observed.

---Insert Figure 1 about here---

Results from the regression analyses are shown in Table 2. Compared with youth in JPC (reference), youth in nuclear families did not significantly differ across all but one model specification (when adjusting for income measures; $b = 0.13$, $p < 0.01$). Youth in single mother (range -0.32 points to -0.19 point from crude to fully adjusted model) and single father families (range -0.39 points to -0.20 points from crude to fully adjusted model) had

significantly lower GPA across all model specifications, whereas youth in stepparent families did not significantly differ when accounting for parental education and in the fully adjusted model. The largest attenuating effect was observed when accounting for parental educational qualifications which reduced the predicted difference in GPA with about 30-35 % among youth in single-parent families, and about 50 % for youth in stepparent families. Income measures, sibling composition, and family cohesion had smaller attenuating effects.

---Insert Table 2 about here---

Figure 2 displays the density distribution plots of comparisons in distribution of GPA between youth in JPC and other living arrangements. Highest overlap was found between youth in JPC and stepparent families (88%) and nuclear families (85%). The higher GPA among youth in JPC compared to single-and stepparent families primarily stemmed from a larger left tail in the latter groups, indicating that a higher proportion of youth in single and stepparent families had low GPA (i.e., < 3 GPA points), combined with a lower proportion with very high GPA (i.e., > 5.5 GPA points).

---Insert Figure 2 about here---

Independent of post-separation living arrangement, living with biological siblings was associated with significantly higher GPA in both crude ($b = 0.13$, $p < 0.01$) and fully adjusted analyses ($b = 0.09$, $p < 0.01$), whereas living with half/stepsiblings was not significantly related to GPA in neither crude ($b = -0.05$, $p > 0.05$) or fully adjusted analyses ($b = -0.03$, $p > 0.05$). We also tested whether the association between half/stepsiblings and GPA was moderated by gender but did not detect any significant effect (results not shown in Table).

Sensitivity and robustness analyses

Adding maternal and paternal education as separate covariates yielded somewhat smaller attenuating effects than when considered jointly, and in both sets of models, youth in

stepparent families were significantly different to peers in JPC. There were also some small observable differences between maternal and paternal education, whereby the attenuating effect of paternal education was slightly stronger for youth in stepparent families, whereas the attenuating effect of maternal education was slightly stronger for youth in single father families. Adding maternal- and paternal net income, and equivalized disposable income in separate models also yielded somewhat smaller attenuating effects than when considered jointly. No notable differences between these separate adjustments were detected.

Within post-separation living arrangements, we also tested whether adding year since separation as a covariate had any notable impact on the results. Years since separation was significantly but weakly associated with GPA ($b = -0.01$, $p < 0.01$), and slightly attenuated the difference between youth in JPC and youth in stepparent families. It did, however, not change the overall main pattern as reported above.

Using our alternative approach to operationalize post-separation living arrangements yielded highly similar results. Youth in JPC continued to have significantly higher GPA than peers living mostly with their mother or mostly with their father, a difference that remained stable after accounting for stepparents (see Supplementary Table 1). We also tested for differences between youth in JPC with at least one stepparent present compared to those in JPC without any stepparents present but did not detect any significant difference in the adolescents GPA.

Complete case analyses of our main regression models replicated the results obtained from analyses based on multiple imputed data (see Supplementary Table 2).

Discussion

Drawing on high-quality register-information linked to a population-based study in Norway, we sought to document the association between modern living arrangements and adolescents'

academic achievement, and whether accounting for commonly held confounders and potential mechanisms could account for any observed differences. Overall, youth in JPC had a significantly higher GPA than peers in single-parent and stepparent families. Parental education accounted for a sizable proportion of this pattern, whereas weaker attenuating effects were observed in models adjusting for income, family cohesion, and sibling composition. Still, net of these covariates, youth in JPC continued to have a small but significant academic advantage compared to peers in single-parent families. Our results also suggest that research on living arrangements may benefit of considering siblings, as residing with biological siblings was associated with higher GPA net of living arrangement.

Youth in JPC had about 0.25 to 0.40 points higher GPA than peers in single- and stepparent families, and their GPA did not significantly differ to those in nuclear two-parent families. Higher GPA among youth in JPC compared to single-parent families aligns with a recent study from Germany (Steinbach & Augustijn, 2022), but differ from an older study from Norway (Breivik & Olweus, 2006), and one from Belgium (Spruijt & Duindam, 2009), suggesting similar GPA between these groups. As noted, previous research has operationalized GPA based on a small subset of self-reported school grades, and drawn on smaller samples on different age groups, time periods or contexts. Thus, caution should be applied when comparing our results with existing research.

In four models, we examined whether adjustments of parental education, income, family cohesion, and siblings reduced the predicted differences GPA between youth in JPC other post-separation living arrangements. Parental education was the most potent covariate, reducing the predicted differences between JPC and single-parent families by 30-35%, and 55% for youth in stepparent families. Whereas youth in single-parent families continued to have significantly lower GPA after accounting for parental education, youth in stepparent families did not significantly differ. Thus, our results suggest that the on average higher

educational levels among parents of youth in JPC is an important source of inequalities in GPA when compared to single- and stepparent families.

Age of first-time mothers- and fathers in Norway is generally high (Statistics Norway, 2021). Thus, we assume that most parents in our sample had established their highest educational qualifications by the time they had children and separated from their partner. Therefore, our results indicate that pre-existing differences in parental education explains a sizable part of the higher GPA among youth in JPC compared to single- and stepparent families. Combined with the genetic transfer of academic abilities (e.g., Pokropek & Sikora, 2015), educated parents more often engage in parenting practices linked to positive school outcomes among youth than less educated peers, which could be part of the explanation of higher GPA among youth in JPC than in other post-separation living arrangements.

The link between post-separation living arrangements, parental education, and GPA may also form more complex relationships. For instance, frequent contact with both parents through JPC may better transfer the educational skills of both parents to their offspring than single-parent families. Related, it is also plausible that the benefits of having highly educated parents (e.g., higher parental monitoring) are amplified through JPC, as the child has better access to such resources from both parents. Future studies are needed to better examine whether JPC enhances the transmission of academic abilities between parents and their children.

Smaller attenuating effects were observed when accounting for income variables and family cohesion. These results mirror findings of studies focusing on mental health problems (Nielsen, 2018), and suggest that neither differences in income nor family cohesion could account for the higher GPA among youth in JPC. A recent study found that better parent-child relationships, especially the father-child relationship quality, accounted for the higher

GPA among children and youth in JPC than single-parent families (Steinbach & Augustijn, 2022). As discussed by the authors, JPC may facilitate closer relationships between children and both their parents, or alternatively, closer parent-child relationships may already be present among parents opting for JPC. Thus, a more direct measure of the quality of parent-child relationships could have nuanced our findings.

Accounting for biological and half/stepsiblings also had minor attenuating effects. Thus, the potential added complexity of such sibling ties (e.g., Brown et al., 2015) could not account for the higher GPA among youth in JPC. Sharing a household with a biological sibling was associated small academic advantage (0.1-point higher GPA) net of living arrangement and other adjustments. This finding lends some support to recent advances in family research stating the importance of not only considering family compositions or living arrangements solely based on the parental adults present in the home, but also sibling-ties (Sanner & Jensen, 2021). Biological siblings have been proposed to buffer some of the negative experiences of family dissolution by providing support and a sense of shared experience during family reorganization (Jacobs & Sillars, 2012). This may perhaps also protect against poorer academic achievement in the post-separation period. Still, we note that biological siblings also appeared to have a more general buffering effect in our study, as biological siblings were associated with a higher GPA also net of living in a nuclear family.

Last, we note that considerable distributional overlap in GPA was observed between youth in JPC and all other living arrangements. Differences in GPA were primarily due to a higher proportion of youth in single- and stepparent families with low GPA, and a lower proportion with high GPA. Thus, our results suggest that the academic achievement among youth across modern living arrangements is more similar than different. Given the high frequency of experiencing parental divorce or separation during childhood, the small effect sizes detected in this study are still important, as scaled to the population level and over time,

they affect many children. As indicated in our regression models, the higher proportion of youth with low GPA in single- and stepparent families was closely linked to the on average lower parental educational qualifications in these living arrangements compared to JPC. However, it is also possible that adolescents with poor academic performance are less likely to be selected into JPC which should be kept in mind when interpreting these findings. Future studies using longitudinal designs are needed to better establish the temporal order of these associations.

Strengths and limitations

The study's key strengths include the relatively large sample from a population-based study on a well-defined cohort of older adolescents aged 16-19 linked to a high-quality registry to obtain objective measures of GPA, parental education, and income. Whereas the GPA used in the present study forms the basis of admittance into higher education in Norway, the income measures are used by the government to estimate taxation. This represents a comparative strength to previous research relying on self-reported measures that are prone to various biases. Another strength was the inclusion family cohesion and sibling composition in the analyses.

Several limitations should also be acknowledged. First, with a 53% participation rate, caution should be applied when generalizing the results to the population level. Although no information about non-participants was available in the current study, research on former waves of the Bergen Child Study (which the youth@hordaland is nested within) identified psychological problems as a predictor for non-participation (Stormark et al., 2008). As non-participation is also known to be related to lower socioeconomic status, the pattern of attrition in the present study may impact the generalizability of our findings. Still, we note that the GPA in this sample was almost equal to regional and national averages (Hysing et al., 2016),

and the distribution of youth in various living arrangements was similar compared to official country level statistics, indicating that the sample was fairly representative with regards to our main dependent and independent variables.

A second limitation was our measure of family cohesion. This measure is a subscale within the larger READ-instrument and has no specific instructions about whom the respondents should keep in mind when answering questions about their family. Thus, we lack control over whether the respondents' answers to these questions match the family units that they were categorized in.

A third limitation was the cross-sectional data. As discussed, we cannot determine whether observed differences between JPC and other living arrangements are a consequence of inherent qualities of these living arrangements, or whether these differences were already present before parental separation. For instance, the higher prevalence of low GPA scores in single mother- and father families may also suggest that students performing more poorly are less likely to be selected into JPC than other post-separation living arrangements. One exception, however, was our measure of parental education, which we assume for most parents had been established before having children and separating from their partner. A related limitation was the parsimonious set of covariates in our analyses. As post-separation living arrangements are not static but may dynamically change (e.g., through repartnering, new children), unobserved variables could make the living arrangements differ in complex ways not adequately captured in the present study. Nonetheless, the inclusion of high-quality and theoretically motivated covariates, represents a strength of this study compared to previous research on the links between JPC and academic achievement among youth.

Conclusion

Capitalizing on a population-based study with registry linkage, we found that youth in JPC have a significant academic advantage compared to those in single- and stepparent families. Higher parental education accounted for about a quarter of the predicted differences in GPA between the JPC and the single-parent families, and about half of the predicted difference when compared to youth in stepparent families. Thus, our results suggest that a sizable part of the academic inequalities across post-separation living arrangements may be due to selection based on parental education. Still, net of parental education and other family characteristics measured in this study, youth in JPC continued to have a significant albeit small academic advantage compared to youth in single mother- and single father families. Hence, our results leave open the possibility that other inherent qualities of this living arrangement may benefit the academic achievement among youth. Better parent-child relationships is one potential candidate, as found in a previous study (Steinbach & Augustijn, 2022). Related, more equal contact with both parents through JPC may also permit closer parental monitoring including assistance with homework than living mostly with one parent. Still, there is a need for future longitudinal studies to assess whether such factors change during the course from pre- to post-separation family life and their associations with post-separation living arrangements and outcomes among youth in JPC.

Last, identifying the correlates and causes of the higher proportion of youth with low GPA in single- and stepparent families compared to JPC may provide a better understanding of the academic inequalities by parental separation and living arrangements. This could provide a basis for further theory development and efforts to bolster academic achievement in vulnerable groups.

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Table 1*Sample characteristics by living arrangements*

	JPC (ref.)	Nuclear family	Single mother	Single father	Stepfamily
<i>n</i>	357	4932	914	192	573
Age (mean (SD))	17.26 (0.80)	17.39 (0.84)**	17.44 (0.83)	17.50 (0.86)**	17.31 (0.80)
Gender (Male %)	184 (51.5)	2338 (47.4)	385 (42.1)**	105 (54.7)	218 (38.0)**
Ethnicity youth (Norwegian %)	354 (99.4)	4689 (95.9)**	852 (94.4)**	177 (92.7)**	536 (94.7)**
Ethnicity father (Norwegian %)	335 (94.1)	4471 (90.8)*	781 (85.9)**	169 (88.5)*	496 (87.0)**
Ethnicity mother (Norwegian %)	344 (96.4)	4506 (91.4)**	834 (91.3)**	163 (85.3)**	524 (91.6)**
Maternal education			**	**	**
Basic ¹	45 (12.6)	737 (15.0)	179 (19.6)	51 (28.0)	124 (21.7)
Intermediate ²	155 (43.4)	1943 (39.5)	393 (43.0)	82 (45.1)	244 (42.7)
High ³	119 (33.3)	1807 (36.7)	286 (31.3)	37 (20.3)	177 (30.9)
Advanced ⁴	38 (10.6)	438 (8.9)	55 (6.0)	12 (6.6)	27 (4.7)
Paternal education			**	**	**
Basic ¹	45 (12.7)	632 (12.9)	189 (21.8)	42 (22.0)	142 (26.2)
Intermediate ²	174 (49.0)	2310 (47.1)	443 (51.0)	101 (52.9)	293 (54.1)
High ³	95 (26.8)	1256 (25.6)	150 (17.3)	31 (16.2)	76 (14.0)
Advanced ⁴	41 (11.5)	710 (14.5)	86 (9.9)	17 (8.9)	31 (5.7)
Income measures in 1000 USD (median [IQR])					
Maternal net income	61.44 [51.72, 73.57]	54.30 [44.16, 66.23]**	64.57 [53.73, 75.46]	52.09 [42.84, 66.14]**	58.93 [48.86, 68.58]**
Paternal net income	78.74 [62.67, 102.35]	75.10 [61.51, 97.91]	64.31 [47.25, 81.85]**	71.04 [59.30, 88.01]**	63.21 [47.51, 83.69]**
Equivalent disposable income	53.07 [43.28, 65.78]	61.27 [51.48, 73.83]**	46.25 [38.86, 55.59]**	50.14 [41.94, 59.64]	55.62 [45.64, 69.20]
Biological siblings (%)	204 (57.1)	3571 (72.4) **	354 (38.7)**	55 (28.6) **	240 (41.9)**
Half/stepsiblings (%)	138 (38.7)	73 (1.5) **	114 (12.5)**	17 (8.9) **	346 (60.4)**
Year since separation (mean (SD))	8.09 (4.59)	-	10.34 (5.36)**	8.45 (5.64)	12.47 (4.08)**
Family cohesion (mean (SD))	3.93 (0.75)	3.96 (0.80)	3.68 (0.88)**	3.72 (0.87)**	3.64 (0.89)**
GPA (mean (SD))	3.95 (0.87)	4.05 (0.91)	3.66 (1.07)**	3.56 (1.04)**	3.75 (0.95)**

Note. ISCED = International standard classification of education. IQR = Interquartile range. Median and IQR are rounded to nearest whole number. USD = US Dollars converted from Norwegian Kroner based on the average exchange rate of the year 2011 (1 NOK = 0.1786 USD). GPA = Grade point average. ¹ Based on ISCED 0-2 (for a full description, see the Methods section), ² ISCED 3-5, ³ ISCED 6, ⁴ ISCED 7-8. * $p < 0.05$, ** $p < 0.01$. p -values derived from chi-square tests for categorical variables, Kruskal-Wallis rank sum test for income variables, and independent samples t-test for year since separation, family cohesion, and GPA.

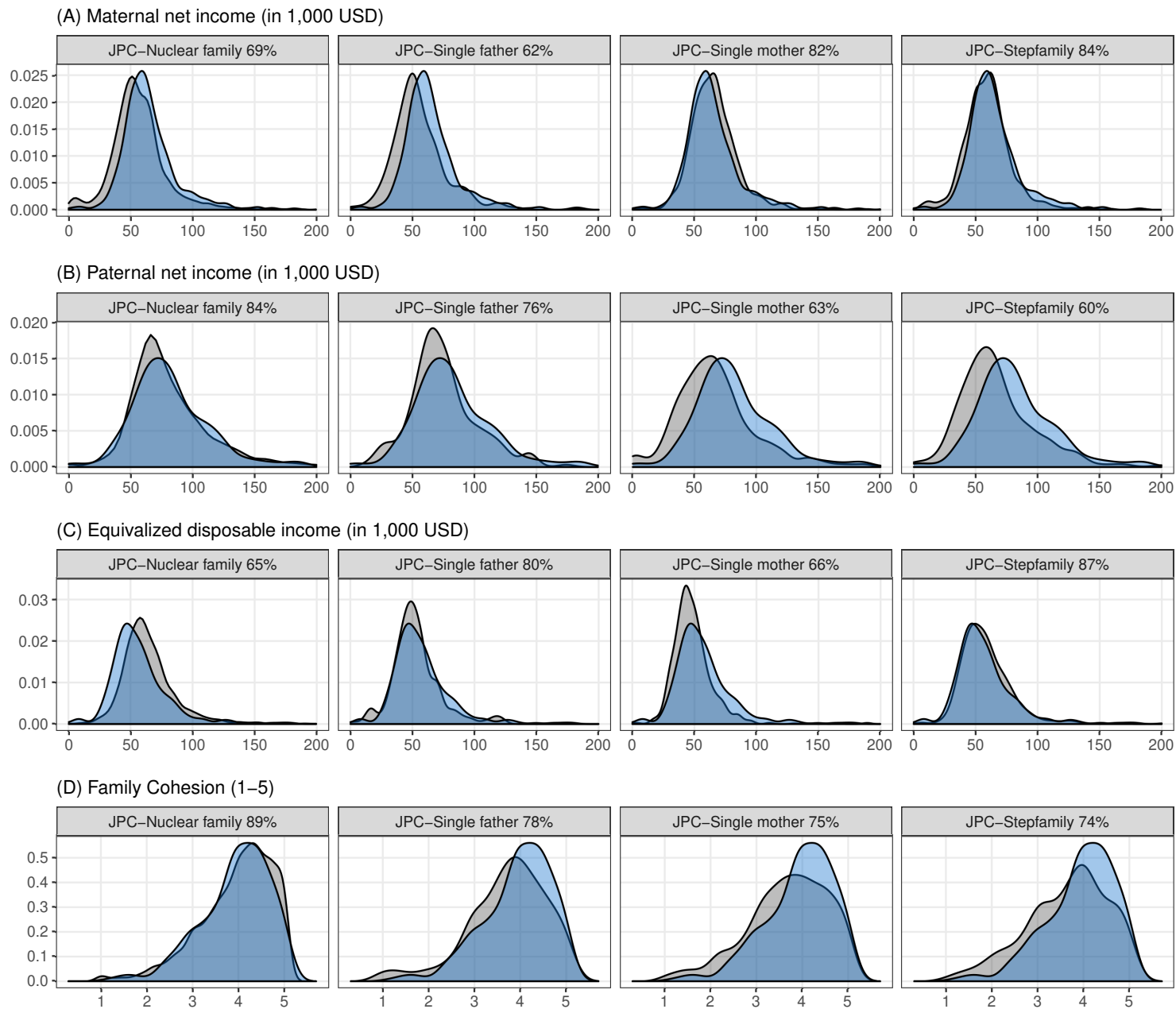
Table 2*Ordinary least squares regressions of relationships between living arrangements and grade point average*

	Model 1	Model 1 + parental education	Model 1 + income	Model 1 + siblings	Model 1 + family cohesion	Fully adjusted
	b (95% CI)	b (95% CI)	b (95% CI)	b (95% CI)	b (95% CI)	b (95% CI)
JPC	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Nuclear family	0.09 [-0.01, 0.19]	0.09 [-0.01, 0.18]	0.13 [0.03, 0.24]*	0.05 [-0.06, 0.16]	0.09 [-0.02, 0.19]	0.07 [-0.04, 0.17]
Single mother	-0.32 [-0.44,-0.20]**	-0.23 [-0.35,-0.12]**	-0.29 [-0.41,-0.17]**	-0.31 [-0.43,-0.19]**	-0.28 [-0.40,-0.16]**	-0.19 [-0.30,-0.07]**
Single father	-0.39 [-0.57,-0.22]**	-0.25 [-0.42,-0.09]**	-0.34 [-0.51,-0.17]**	-0.37 [-0.55,-0.20]**	-0.36 [-0.53,-0.18]**	-0.20 [-0.37,-0.03]*
Stepfamily	-0.24 [-0.36,-0.11]**	-0.11 [-0.23, 0.01]	-0.19 [-0.32,-0.07]**	-0.21 [-0.33,-0.08]**	-0.20 [-0.32,-0.07]**	-0.05 [-0.17, 0.07]

Note. Pooled estimates from 30 imputed datasets shown. Model 1: adjusted by age, and gender. Model 1 + parental education: adjusted by age, gender and highest obtained maternal and paternal education. Model 1 + income: adjusted by age, gender, maternal and paternal net income and equivalized disposable income. Model 1 + siblings: adjusted by age, gender, and the presence of biological and half/stepsiblings. Model 1+ family cohesion: adjusted by age, gender, and the family cohesion subscale. Fully adjusted: adjusted by age, gender, parental education and income, siblings, and family cohesion. JPC = Joint physical custody. Ref. = reference group. b = unstandardized regression coefficient. Note, due to the scaling of the GPA, the *b*'s in these analyses may also be interpreted as the standardized mean difference. * $p < 0.05$, ** $p < 0.01$.

Figure 1

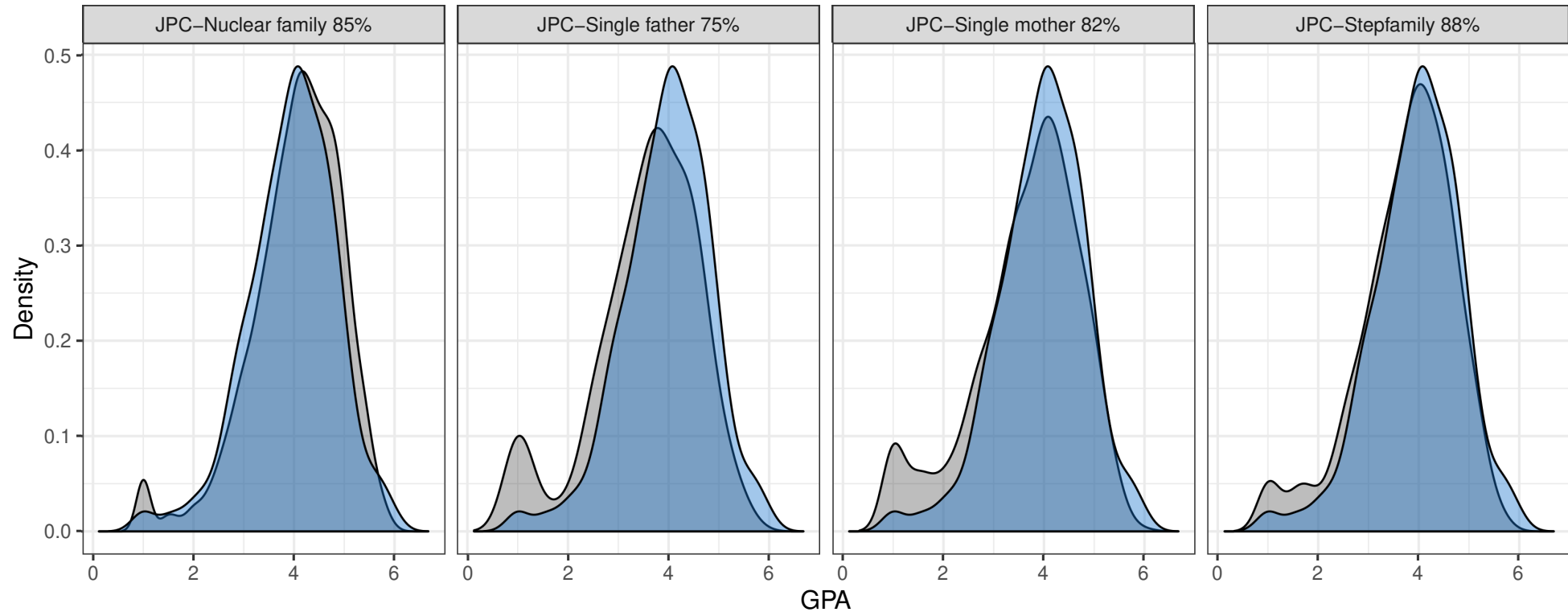
Density plot of the distributional overlap between youth in joint physical custody (JPC) and other living arrangements on income measures and family cohesion scores.



Note. This figure displays the density distribution function of income variables and family cohesion by living arrangements. The blue density curve represents youth in JPC while the gray represents the reference group. The percentages show the distributional overlap calculated by the distribution-free overlapping index. To ease the visual presentation, the income variables have been capped at 200,000 USD.

Figure 2

Density plot of the distributional overlap between youth in JPC and other living arrangements on grade point average



Note. This figure displays the density distribution function of grade point average (GPA) by living arrangements. The blue density curve represents youth in JPC while the grey represents the reference group. The percentages show the distributional overlap calculated by the distribution-free overlapping index.