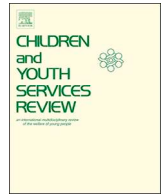




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## Exploring the protective factors of children and families identified at highest risk of adverse childhood experiences by a predictive risk model: An analysis of the growing up in New Zealand cohort

Matthew C. Walsh\*, Sophie Joyce, Tim Maloney, Rhema Vaithianathan

Centre for Social Data Analytics, Auckland University of Technology, New Zealand

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### ABSTRACT

**Aims:** With increasing access to integrated administrative data, and advances in predictive analytics, it is both theoretically possible and practically feasible to use predictive risk models (PRMs) to automatically risk stratify entire birth-cohorts as to their risk of experiencing multiple adversities in childhood (Vaithianathan et al., 2013, 2018; Rouland & Vaithianathan, 2018). Such automated screening tools allow agencies to identify families at highest risk and offer them preventive services in a timely fashion. However, little is known about what protective factors might exist amongst families who are identified as high risk by PRMs. Identifying protective factors is an important step in designing preventive services for families identified by PRM tools as well as helping social workers take a strengths-based approach to these families.

**Methods:** We used multiple waves of the Growing Up in New Zealand (GUiNZ) study which follows a cohort of children and their families (n = 5562). Children were coded to reflect the number of adversities they experienced by 54 months based on standard measures of Adverse Childhood Experiences (ACEs) (Felitti et al., 1998). A PRM was trained to predict two or more ACEs experienced by 54 months using only administrative data available at birth and routinely held by the government, and the most at-risk children (comprising the top 20% of risk) were retained for our analysis. This study examines potential protective factors associated with having no observed ACEs despite being predicted to be at high risk of ACEs. We coded these factors from multiple waves of mother and partner surveys, with 749 factors identified as candidate protective factors. These 749 factors were coded into conceptual domains using previous literature: mother-partner, family finances, parent health and wellbeing, community or neighborhood, or parent-child. Forward, backward and multivariable regressions were utilized to identify factors with the strongest associations with having no observed ACEs despite being in the high risk GUiNZ group of children.

**Results:** Of the whole cohort, 790 children were identified as being at greatest risk. Of these, 164 experienced no observed ACEs. The 749 protective factors that were tested fell into the following domains: mother-partner relationship (9%), family finances (23%), parent health and wellness (14%), community or neighborhood (36%), and parent-child relationship (9%). Those that were significantly associated with high risk children with no observed ACEs were from the following domains: mother-partner relationship (40%), family finances (22%), parent health and wellness (15%), community or neighborhood (13%), and parent-child relationship (13%).

**Conclusions:** Our findings suggest that important protective factors exist in the domain mother-partner relationship. While many of these factors might not be mutable, these results are suggestive of a useful domain for program designers and policy-makers to consider when serving high risk families. They might also be useful factors on which to focus when approaching families for recruitment into services.

The objective of this current manuscript is to explore a rich longitudinal cohort to identify potential protective factors as a first step in designing programs for families identified that would enable frontline workers to take a strengths-based approach. Recent research in

identifying protective factors for adverse childhood outcomes have focused on neighborhood context (Baglivio, Wolff, Epps, & Nelson, 2017) and resilience domains (Banyard, Hamby, & Grych, 2017; Bethell, Newacheck, Hawes, & Halfon, 2014). A 2016 manuscript focused on a

\* Corresponding author at: Auckland University of Technology, Private Bag 92006, Auckland 1142, New Zealand.

E-mail address: [matthew.walsh@aut.ac.nz](mailto:matthew.walsh@aut.ac.nz) (M.C. Walsh).

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larger set of potential protective variables and found mediation of risk consistent with regard to having supportive and safe neighborhoods, a safe school environment, and parents who supervise their youth's friendships (Moore & Ramirez, 2016). We had the opportunity to expand on the scope of investigated domains for protective factors and focus on adversities experienced before children enter primary school.

A second interest in this paper is to complement some of the research that shows the utility of Predictive Risk Models (PRMs). PRMs exploit historical correlations and patterns in routinely collected administrative data to assign a risk score for an adverse event such as a future child abuse (Putnam-Hornstein & Needell, 2011; Rouland & Vaithianathan, 2018; Vaithianathan, Rouland, & Putnam-Hornstein, 2018; Wilson, Tumen, Ota, & Simmers, 2015). One advantage is that these PRM tools can be automated using linked administrative data systems to find those children and families at greatest risk, and to provide agencies with an opportunity to provide timely early preventive services to families at highest risk in order to lower that risk (Bovens & Zouridis, 2002; Elgin, 2018). However, such approaches can be very negative and stigmatizing. Many families who have complex challenges and are identified by a risk model know that they have these issues, but still would like their services to focus not on the risks but on their strengths. Qualitative research suggests that families who might be approached as a result of a high risk score want to be approached from a strengths-based position (Brown, Chouldechova, Putnam-Hornstein, Tobin, & Vaithianathan, 2019).

Strengths-based and solution-focused approaches are often viewed as more empowering and respectful for vulnerable populations (Berg, 1994; Corcoran, 2004; McMillen, Curtis, & Sherraden, 2004). Our study is a first step in trying to capture information on strengths within these high risk families and thereby providing frontline workers with tools to engage families from a strengths perspective. Combined with motivational interviewing and solution-focused therapies, social workers will be better armed to work with families with complex challenges.

These models hold the promise of better targeting limited resources in the context of fiscal restraints (Cuccaro-Alamin, Foust, Vaithianathan, & Putnam-Hornstein, 2017; de Haan & Connolly, 2014), but flawed uses of these models threaten the public's trust (Cohen, Amarasingham, Shah, Xie, & Lo, 2014; Russell, 2015). In addition, while offering the prospect of accurately screening and stratifying large populations of children and families for risk of future maltreatment, these tools provide little indication of how to prevent future adverse outcomes (Gillingham, 2015; Munro, Taylor, & Bradbury-Jones, 2014). Additionally, there is a paucity of studies on the sorts of very high-need and complex family situations which are identified by PRM type tools. These families typically have multiple children, many of whom might have had previous child welfare involvement (Brown, Cohen, Johnson, & Salzinger, 1998). Additionally, many of the parents have *multiple sources of risk* – such as substance abuse, mental health problems and poverty. As a recent evidence review by the National Academy of Sciences on programs for mothers with adversities notes, “Many parents face two or more of these challenges, and some face nearly all of them. There has been *almost no rigorous evaluation* of interventions for these very complex cases, and many of these families are referred to child welfare agencies” (National Academies of Sciences, 2016, page 251).

Therefore, while the technology to identify these highest risk families may now exist, frontline workers want to know what protective or strength factors should be considered when designing interventions for families (Gaudin, 1993; Sinclair & Bullock, 2002; Whittaker, 2009). Even without using a PRM approach, every child welfare organization is tasked with identifying children at highest risk of adverse outcomes. Results from this investigation should help child welfare professionals design programs and policies that prevent adverse outcomes by identifying and supporting protective factors associated with high risk children.

## 1. Methods

The GUiNZ study is a longitudinal birth cohort of children and their parents (Morton et al., 2010, 2012; Morton, Ataoa Carr, Grant, Berry, Marks, Chen, & Lee, 2014). Parents were enrolled and interviewed during pregnancy and at several points including at 9, 24, and 54 months after birth. All of these waves were used for the present study. Data were collected on numerous standardized questionnaires as well as demographics, health histories and behaviors, community and neighborhood characteristics, and social and cognitive measures.

The predictors (i.e., explanatory variables) were taken exclusively from the antenatal examinations for both the mother and partner to ensure that they were available at the time of birth. While GUiNZ did not intentionally identify ACEs, because they collected very rich data, we were able to map each ACE (with the exception of sexual abuse and neglect) onto the GUiNZ data (Felitti et al., 1998; Walsh, Joyce, Maloney, & Vaithianathan, 2019). Appendix 1 provides the questions and waves that were used to check whether the child had experienced an ACE by 54 months. Each child in the dataset was coded as to whether the child had any of the ACEs identified in the data for up to 54 months.

To construct our study sample, we started with 5562 births in the GUiNZ data with completed antenatal and 54 month surveys. The following respondents were excluded on the following basis: (i) did not respond to the items that were used as predictors (see Appendix 2); (ii) did not have a partner at time of birth, or (iii) the partner did not complete the partner survey. We restrict the sample to those who had partner surveys because we wanted full information when ascertaining ACEs and the largest possible set of potential protective factors. This left, 3883 participants (60.8% of original cohort) in the study sample.

A PRM was trained to predict if the child had two or more ACEs experienced by 54 months. The predictors were GUiNZ variables that most closely corresponded to data that we know to be available as administrative data routinely collected by the New Zealand government and available at the birth of the child (Vaithianathan, Maloney, Putnam-Hornstein, & Jiang, 2013). These include: age, income, education, health behaviors, ethnicity, employment status, relationship status, beneficiary status, and household and car ownership, among others (see Appendix 2 for a list of these 28 ‘administrative’ variables). All analyses used Stata Version 14.2.

To summarize this first stage, a predictive risk model was trained to predict the number of ACEs that the child would have before they turned 54 months old, *using only predictors that were observed at or prior to birth* and had a counterpart in administrative data. We used an 80–20% split and trained the model on 80% of the data. We tested the PRM using the remaining 20% of the sample not used in testing.

The next stage was to identify children who were at highest risk of ACEs. To do this, the estimated coefficients of the logistic-regression PRM were applied to the full 3883 children in the study sample. We ranked the children according to the predicted risk of having 2 or more ACEs, and flagged the 20% ( $n = 790$ ) of children with the highest predicted risk. This process created the sample of high risk GUiNZ children ( $n = 767$ ). In this group of children, we created a new outcome variable indicating which of these high risk children had zero observed ACEs.

We next coded a total of 749 potentially protective factors that were observed in the antenatal and 9 month examinations which could potentially explain the children in the sample of high risk GUiNZ children who ended up with zero ACEs. We categorized the 749 factors into one of 5 domains: Community and Neighborhood (36%), Family Finances (23%), Parent-Child relationship (18%), Parent Health and Wellness (14%), and Mother-partner relationship (9%). We undertook the analysis in two stages. In the first, 749 separate logistic models with the outcome of having no observed ACEs despite being in the high risk

group of GUiNZ children was estimated for each potential protective factor. The factors that were significant at the 1.0% threshold were collected and included in a forward and backward stepwise logistic regression at the 1.0% threshold. We stated no hypothesized relationships between the domains and having no observed ACEs despite being in the high risk GUiNZ group of children. While we could have used methods to adjust alpha to help control for the multiple tests that we completed, this was an exploratory analysis and we were equally concerned with minimizing type II errors. Not adjusting p-values to account for multiple testing have been supported by several manuscripts. In summary, when it comes to exploratory studies, a strict adjustment for multiple comparisons is not required (Althouse, 2016; Feise, 2002; Rothman, 2010).

To enable comparison across different protective factors, we also calculated the fully standardized effect sizes. This allowed comparison across variables that had different units of measure, as it showed the impact of a standard deviation change in the protective factor on the standard deviation of the probability that the child would have no observed ACEs, despite being at highest risk of two or more ACEs. Therefore, factors could be ranked according to the impact size.

## 2. Results

The estimated logistic-regression model was created using 80% of the sample ( $n = 3,046$ ). When evaluated using the remaining 20% of the sample ( $n = 790$ ), the Area Under the receiver operator characteristic Curve (AUC) was 0.76. Of the 790 children in the testing dataset, children in the highest quintile of risk were 4.5 times as likely to have 2 or more observed ACEs compared to children not in the highest quintile of risk (55% compared to 12%). In addition, mean ACEs count in the testing dataset were 1.75 of those identified at highest risk compared with 0.57 for the rest of the study population. Also in the testing dataset, 19% ( $n = 33$ ) had no observed ACEs. Combining the testing and training datasets together, 21% ( $n = 164$ ) had no observed ACEs.

Children at the highest risk of ACEs tend to have lower family income and live disproportionately in the poorer neighborhoods. A total of 44.7% of children at highest risk lived in the most deprived neighborhoods (Dep 9–10; (Atkinson, Salmond, & Crampton, 2014)) compared with 14.4% of the rest of the sample. Similarly, around 41.6% of the mothers in the high risk sample are aged under 25 years of age compared with 6.2% of mothers in the rest of the GUiNZ sample. Also, while 32.2% of the mothers with children at highest risk of experiencing ACEs reported New Zealand European ethnicity, so did 72.3% of

**Table 1**  
Protective Factors associated with having no observed Adverse Childhood Experiences (ACEs) in a group of children in the highest 20% risk of ACEs. Growing up in New Zealand (GUiNZ) participants with mother and partner data ( $n = 767$ ), 2009–2015.

Domain	Investigated Factors	Number and Percent Significant	
		Bivariate <sup>a</sup>	Multivariate
Mother-Partner	67	22 (32.8%)	5 (7.5%)
Family Finances	172	12 (7.0%)	2 (1.1%)
Parent Health and Wellness	105	8 (7.6%)	0 (0.0%)
Community and Neighborhood	271	7 (2.6%)	2 (0.7%)
Parent-Child	134	7 (5.2%)	3 (2.2%)
All Factors	749	565 (7%)	12 (1.6%)

<sup>a</sup> Bivariate results collected from individual logistic regression models for each of the 749 factors and having no observed ACEs in children at highest risk of ACEs. Multivariate results based on the forward and backwards selection of the 54 results found significant at the 0.01 levels from the bivariate results.

the rest of the sample.

We now turn to the protective factors associated with being in the high risk sample but not having an ACE. Table 1 summarizes the findings for each of the five protective domains (Appendix 3 provides examples of variables from each domain). There are individual factors in each domain associated with having no observed ACEs despite being in the highest risk group. The mother-partner factors have the highest percentage of factors found and associated in both the bivariate and multivariate results – with 32.8% of tested factors surviving the bivariate selection and 7.5% surviving the multivariate tests. Over 7% of investigated variables in the family finances and parent health and wellness were also associated with these children who had no observed ACEs. On the other hand, while a majority of tested variables (271 of the 749) were related to community and neighborhood factors, only 7 of these (2.6%) were significantly associated with having no ACEs at the 1% significance level.

Table 2 provides details of 56 factors associated with having no observed ACEs despite being at high risk of ACEs at the 1% significance level in the bivariate analyses. Twelve factors were significant in the forward and backward regressions. These factors listed in table 2 include 5 from the Mother-partner domain (41.7% of all factors identified).

Fig. 1 provides a visualization of the standardized effect sizes across the domains of factors that are found to be significant in the bivariate and multivariate results. Each dot represents one factor that was found to be associated with having no ACEs despite being at high risk of experiencing adversities. The highest number and overall magnitude of the fully standardized effect sizes were from factors in the Mother-Partner domain.

Bivariate results show the standardized regression coefficient for all variables with p-value < 0.01. The Multivariate results show the factors that remain statistically significant at p-value < 0.01 in either the backward or forward selection.

## 3. Discussion

Using predictive risk modelling, we identified a group of Growing Up in New Zealand study children at high risk of experiencing childhood adversities. Inside this high risk group we identified 164 children with no observable ACEs. We grouped 749 possible factors into 5 domains and looked for protective factors associated with these 164 children. A striking finding was the significance of the mother-partner domains. This is a particularly important finding because few programs meant to prevent adversities (such as *Early Head Start* or *Nurse-Family Partnership*) have explicit modules that address the mother-partner relationship. Healthy couple relationships have been shown to promote family stability and provide greater opportunity to experience positive child development (Schulz et al., 2010). Child welfare professionals have historically been ignored as a potential delivery system for relationship education (Schramm, Futris, Galovan, & Allen, 2013). The importance of expanding home visitation services to include strengthening inter-partner relationships was identified when a review of current programs did not reveal any description of modules that improve relationships among adults (Sar, Antle, Bledsoe, Barbee, & Van Zyl, 2010) Programs such as *Within My Reach* and *Within Our Reach*, derived from the Prevention and Relationship Enhancement Program (PREP) (Markman, Renick, Floyd, Stanley, & Clements, 1993), focusing on relationship education have shown preliminary evidence in specific low-income populations for some child outcomes, such as improving children's mental health status (Sterrett-Hong, Antle, Nalley, & Adams, 2018). While child welfare professionals believe that relationship education can be of use in supporting the safety and well-being of children they serve (Antle, Frey, Sar, Barbee, & Zyl, 2010), more research is needed to understand how best to efficiently integrate this education into existing services (Scarow, Futris, & Fuhrman, 2014). In addition, programming will need to be culturally responsive and

**Table 2**  
 Select\* Standardized Coefficients between Antenatal and 9 Month Mother and Partner Growing Up in New Zealand Survey (GUINZ) Variables and having no observed ACEs in Growing Up in New Zealand children in top 20% Risk Group (N = 767), New Zealand 2009–2015.

Domain	Question	Bivariate	Multivariate Backwards	Multivariate Forward
Mother-Partner	Decreasing report of shouting at each other when upset (Partner – 9 Month)	0.58	0.36	0.33
	Decreasing report of shouting at each other when upset (Mother – 9 Month)	0.57		
	Decreasing report of shouting at each other when upset (Mother – Antenatal)	0.50	0.33	
	Decreasing report of getting angry with partner (Mother – 9 Month)	0.49		
	Decreasing report of disliking each other's ideas (Mother – Antenatal)	0.48	0.31	0.30
	Decreasing report of getting angry with partner (Partner – 9 Month)	0.47		
	Decreasing report of disliking each other's ideas (Mother – 9 Month)	0.46		
	Decreasing report of disliking each other's ideas (Partner – 9 Month)	0.40		
	Increasing report of seeing partner next to me when imagining the future (Partner – 9 Month)	0.39		
	Increasing report of seeing partner as a source of support (Partner – 9 Month)	0.39		
	Decreasing report of shouting at each other when upset (Partner – Antenatal)	0.38		
	Decreasing report of getting angry with partner (Mother – Antenatal)	0.37		
	Decreasing report of stress on who does household chores	0.34		
	Increasing report of satisfaction with help from Partner (Partner – 9 Month)	0.34	0.47	
	Decreasing report of arguing with partner during disagreements (Mother – Antenatal)	0.31		
	Increasing agreement with concept that when you have children, you should expect to stay together (Partner – 9 Month)	0.30		
	Increasing report of acting supportive and understanding towards each other (Partner – 9 Month)	0.29		
	Increasing report of partner being a source of support (Mother – 9 Month)	0.28		
	Decreasing report of disliking each other's ideas (Mother -Antenatal)	0.28		
	During the past four weeks, how often did you argue with each other when you disagree about something?	0.27		
Decreasing report of partner's parents being a source of support (Partner – 9 Month)	0.26	0.16		
Decreasing report of getting angry with partner (Partner – Antenatal)	0.24			
Family Finances	Report of household income source – Unemployment Benefit (Partner – Antenatal)	0.38		
	Decreasing composite score of material deprivations (Mother – 9 Month)	0.38		
	Increasing outlook on general economic situation in country compared to 12 months ago (Partner – 9 Month)	0.38		0.21
	Report of personal income source – Unemployment Benefit (Partner – Antenatal)	0.36		
	Report of personal income source - Unemployment Benefit (Mother – Antenatal)	0.34		
	Report of personal income source – Sickness Benefit (Mother – Antenatal)	0.33		
	Report of stress – worry about current housing difficulties (Partner – 9 Month)	0.32		
	Report of being forced to buy cheaper food to afford other things needed (Mother – 9 Month)	0.31		
	Report of using food grants/banks because not enough money for food (Mother – 9 Month)	0.31		
	Increasing outlook on general economic situation in country compared to 12 months ago (Mother – 9 Month)	0.24		
Parent Health and Wellness	Not reporting personal Income Source: No Income	0.21	0.23	0.19
	Report of personal income source – Interest, Dividends, Rent, Other	0.19		
	Lower report of being upset because of unexpected events (Mother – Antenatal)	0.43		
	Lower reported composite stress score over the past 7 days (Mother – Antenatal)	0.37		
	Lower report of being angered because of things outside of your control (Mother – Antenatal)	0.36		
	Higher self-reported health (Mother – 9-Month)	0.33		
	Higher self-reported health (Mother – Antenatal)	0.30		
	Increasing report of being so unhappy that I have been crying (Mother – Antenatal)	0.28		
	Higher self-reported health (Partner – 9 Month)	0.25		
	Lower report of feeling unable to control important things in life over the past 4 weeks	0.23		

(continued on next page)

Table 2 (continued)

Domain	Question	Bivariate	Multivariate Backwards	Multivariate Forward
Community and Neighborhood	Decreasing report of source of stress – family members not getting on (Partner – 9 Month)	0.44		
	Report of living in a specific neighborhood: Pregnancy Related Reason (Partner – Antenatal)	0.41		
	Report of what would make neighborhood better: less rubbish lying around (Partner – Antenatal)	0.29	0.21	
	Decreasing report of source of stress – family members not getting on (Partner – Antenatal)	0.28		
	Report of having social network – Parent/Baby Group (Mother – 9 Month)	0.23		
	Report of living in specific neighborhood: I like the local lifestyle (Mother – Antenatal)	0.21		
Parent-Child	Report of living in specific neighborhood: with similar population groups (Mother – Antenatal)	0.20	0.22	0.20
	Increasing report of source of stress – another child's behaviour (Partner – 9 Month)	0.36		
	Not reporting wanting child to take on challenges as one of the most important values for your child (Mother – 9 Month)	0.30	0.22	
	Not reporting wanting child to take on challenges as one of the most important values for your child (Partner – 9 Month)	0.30	0.35	
	Increasing report of taking an active interest in baby (Partner – 9 Month)	0.34		
	Decreasing report of source of stress – being the parent of this baby (Partner – 9 Month)	0.33		
	Decreasing report of source of stress – another child's behaviour (Partner – Antenatal)	0.27		
	Increasing report of meeting your expectations as a parent (Partner – 9 Month)	0.26	0.29	0.23

\* Only variables with p-value < 0.01 from the list of evaluated variables are included in this table. These variables were then added to a multivariate model and only those variables retained in the forward and backward models (p < 0.01) have coefficients included in the table above.

sensitive to have an impact as a large proportion of high risk families tended to be from minority populations. The effects of concentrated disadvantage in neighborhoods has been found to be associated with ACEs and while we found fewer specific community and neighborhood factors associated with high risk children with no ACEs, additional research on neighborhood effects is required (Baglivio et al., 2017).

Reviews of effective interventions for child abuse and neglect have shown that interventions that included all family members and are strengths-based often have better outcomes for children (Amato, 2004; Marsiglio, Amato, Day, & Lamb, 2000). When the co-parental relationship is not supportive, children are exposed to increased non-effective parenting strategies (Amato, 1998). Even for non-residential partners, a crucial mediating variable for child development is the partner's relationship with the mother (Amato, 2004; Marsiglio et al., 2000).

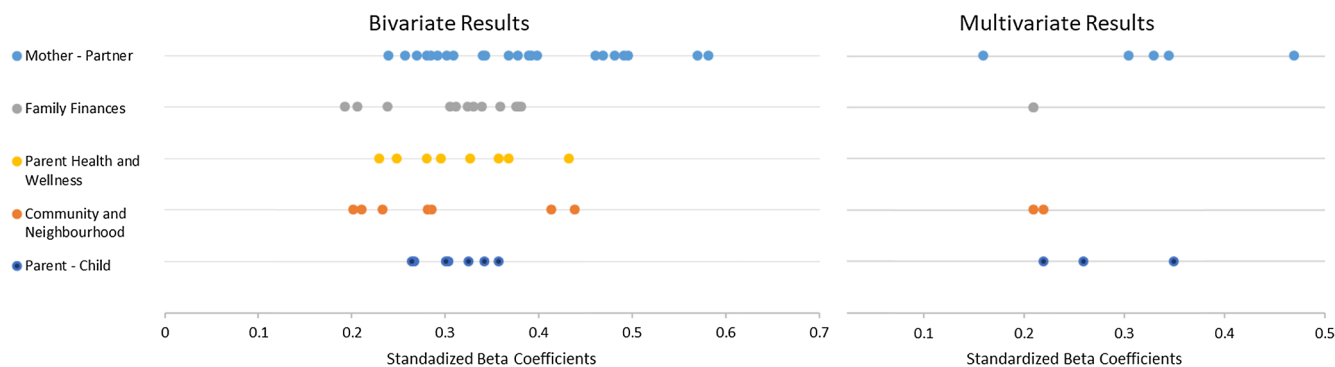
Although these variables identified are not found in administrative data, future work should look into the effect of adding these variables back into the original PRM to see how the performance of the model varies and identify additional properties of the misclassified cases. In many respects GUINZ participants that had partner complete the surveys are different from those without partner data. Additional work on the generalizability of these results to all children is needed.

#### 4. Limitations

It is plausible that our correlations between mother-partner factors and having no observed ACEs might be focused only on those specific ACEs that are related to parental conflict (divorce or fighting between parents). We conducted a sensitivity analysis by excluding those ACEs that were associated directly with partner conflict (parental separation and partner intimate violence) from the definition of ACEs. After estimating a new predictive model of risk to predict the redefined count of ACEs, assigning risk scores to all GUINZ participants and focusing on the top 20% at risk, 5 of the 9 identified potential protective factors in the mother-partner domain remained significant at the 0.01 level. The other 4 identified measures from Table 2 remained associated at the 0.05 level. It is always possible that differential ACE patterns are found due to some parents having increased fear of self-incrimination. While some children with no ACEs likely have experienced ACEs, we are unable to determine the potential bias in these preliminary results due to some parents not disclosing ACEs.

For this preliminary review of the potential protective factors, we had no a priori hypotheses. An exhaustive investigation of interactions or specific subgroup effects was not feasible given the sample size. Even with the current methods, we run the risk of making erroneous inferences using statistical tests due to the large set of statistical inferences that were conducted simultaneously. We have slightly addressed this by lowering the standard 0.05 statistical threshold to 0.01, but these results should be seen as a first step to generate a more specific set of hypotheses to test in experimental settings. We conducted the bivariate analyses with different p-value thresholds (0.05 and 0.001). At the 0.001 level, 11 factors were found to be correlated with having no observed ACEs despite being in the high risk group of GUINZ children, and five of those factors were in the mother-partner domain. At the 0.05 level 87 factors were correlated, and 17 of those factors were in the mother-partner domain.

In addition, the dataset allows an analysis up to age 54 months only. Protective factors might be different for older children and should be tested across different cohorts and age groups. As this cohort ages, we might be able to ascertain what percentage of total ACEs can be expected to have accrued by 54 months. Another decision used for these analyses was to focus on children that had 0 observed ACEs compared to those with 1 or more in the high risk group. As the literature from this field often uses a cutoff of 3+ ACEs to predict later outcomes, we might not be highlighting the protective factors of most interest to health researchers. Still, the original CDC-Kaiser study of ACEs (Felitti



**Fig. 1.** Bivariate and Multivariate (Forward and Backward Selection) protective factors associated with having no observed ACEs in the high risk (top 20%). Results for all GUiNZ participants in the highest 20% risk category where partners completed the survey ( $n = 767$ ).

et al., 1998) did find a dose-response relationship between ACEs and negative health. Protective factors related to no ACEs in high risk children are still of value. Another potential limitation is our use of the top 20% of at-risk children to search for protective factors. There is no clinical meaning in selecting the top 20%. This decision was chosen in this investigation based on sample size and being a plausible starting point. Different protective factors might be found using different cut points on what constitutes high risk.

Also, our classification system of variables into 5 categories is simplistic and based purely on researcher intuition. Many of the topics could easily fall into multiple categories. For example, the partner reporting that he lives in a specific neighborhood due to pregnancy reasons could be just as easily classified under family finances or, as was done in these analyses, under community and neighbourhood. Replicating these results and testing interventions focused on the mother-partner relationship should be a priority going forward. Also of potential interest would be to see if these potential factors are

predictive in all GUiNZ children and not just those identified at highest risk.

## 5. Conclusions

Our study indicates that the positive relationship between a mother and her partner offers important strengths in families facing multiple risk factors for experiencing childhood adversities. These results support additional resources going towards enhancing programs in these areas. As family structures evolve, policies to increase effective co-parenting should be investigated, implemented and tested.

## Declaration of Competing Interest

All authors report grants from New Zealand Ministry of Social Development (formally Superu) during the conduct of the study.

## Appendix 1. Adverse childhood experience mappings to Growing up in New Zealand (GUiNZ)

**Parent or Partner Depression (9P, 54M):** If the partner or parent had a score of 10 or higher on the Patient Health Questionnaire Depression Screener, we assigned the child as having this ACE (Kroenke, Spitzer and Williams, 2001).

**Parent or Partner Problem Drinker (9P, 54M):** A child was assigned this ACE if the mother reported 14 or more drinks per week, or reported binge drinking at least weekly. Due to data anonymization protocols of the GUiNZ study, these definitions were slightly modified for the partner questionnaire and the child was assigned as having this ACE if the partner reported 20 or more drinks containing alcohol per week. Binge drinking behavior was not asked about during any partner survey.

**Parent or Partner Illegal Street Drugs Use (9M, 9P):** Participants were asked if they had used hard drugs, marijuana, or amphetamines since the birth of the child. If yes, the child was coded as having this ACE.

**Parent or Partner Conviction and Jail Time (9P, 54M):** Participants were asked if they had ever been convicted of a crime that resulted in jail time since the birth of the child. If yes, the child was coded as having this ACE.

**Parent or Partner Intimate Partner Violence (9M, 9P, 24P, 54M):** A child was coded as having this ACE when the mother or partner reported pushing, shoving, throwing or breaking things 'quite often' when arguing, or that arguments 'quite often' resulted in hitting, kicking, pushing, or slapping (Pryor, 2004).

**Mother Divorce or Separation (9M, 24M, 54M):** Mothers were asked if they had a cohabiting partner during all waves of the interviews. Children were coded as having this ACE if the cohabiting partner was no longer present or switched.

**Child Physical Abuse (24CM, 54CM):** When responding to how often they smack their child when naughty, a response of 'often' or 'very often' resulting in coding the child as having this ACE. Also, mothers were asked if they smack, grab, or physically punish their child when disobedient. A response of 'half the time', 'very often', or 'always', resulted in the child being assigned this ACE.

**Child Emotional Abuse (24M, 24P, 24CM, 54CM):** Mothers and partners were asked how often they do the following: criticize their child's ideas, shout at their child when the child misbehaves, and explode with anger when the child misbehaves. A response of 'very often', 'extremely often', or 'all the time' resulted in coding the child as having this ACE. In addition, if a mother reported exploding with anger at least 'half the time' or shouting at the child when he/she misbehaves at least 'very often' the child was also coded as having this ACE.

**NOTE:** The survey month and mother or partner surveys used are highlighted in parentheses for each ACE. For example (9M, 9P, 54CM) would refer to data used to measure this ACE from the 9 month mother and partner and 54 month child-mother surveys.

## Appendix 2. Variables and categorizations from the Growing up in New Zealand study (GUiNZ), New Zealand 2009–2015. Antenatal Mother and Partner interviews included in the Adverse Childhood Experiences predictive model with correlates from data available from administrative Statistics New Zealand data

Single Status: Yes, No

Mother age: Under 20, 20–25, 26–30, 31–35, 36–40, > 40

Household Income Group: ≤20 K, > 20 K – ≤30 K, > 30 K – ≤50 K, > 50 K – ≤70 K, > 70 K – ≤100 K, > 100 K – ≤150 K, > 150 K, Missing

Beneficiary: Receiving any kind of benefit, Not Receiving any kind. Benefit information missing

NZ Deprivation Index: 9–10, 7–8, 5–6, 3–4, 1–2

Household ownership: Don't know/other/missing, Freehold, Own mortgage, Family Trust, Private rental, Public rental, Free rental

Years living at current home: Missing years living at home, 0–6 months, 6 months–1 year, 1 year–2 years, 2 years–4 years, > 4 years

Number of house moves last five years: > 6, 5, 4, 3, 2, 1, 0

Motor Vehicle available: Yes, No

Relationship status: No relationship, Married, Cohabiting (living together), Couple (not living together), Dating

Household Size: 1, 2, 3, 4, 5, 6, 7, 8, > 8

Current employment (Employed base category)

Unemployed, Other employed

Mother education (No high school base category)

Secondary school, Diploma, Bachelor, Higher degree

Mother self-prioritised main ethnicity: European, Asian, Maori, Pacific, Other

Mother smoking: Yes, No

Body Mass Index group: 0–18.5, 18.5–25, 25–30, 30–35, > 35 Missing

Aware pregnancy: 1–3 weeks, 4–5 weeks, 6–7 weeks, > 7 weeks

Anxiety or panic attacks diagnosed by a doctor: Never, Before Pregnancy, Before and During Pregnancy, During Pregnancy, Missing

More than 20 drinks per week, before or during pregnancy: Yes, No

Partner throws, breaks or hits when arguing, quite often or more frequent: Yes, No

Family doctor before pregnancy: Yes, No

Seen a family doctor since becoming pregnant: Yes, No

Did you have a Lead Maternity Caregiver (LMC): Yes, No

Disability lasting 6 months or more: Yes, No

Partner smokes: Yes, No, Missing

Partner depression: Yes, No, Missing

Partner employment (Partner unemployed base category)

Partner employed, Partner student, Partner employed missing

Partner schooling (Partner no secondary school base category)

Partner secondary school: Partner Diploma, Partner Bachelor, Partner Higher Degree, Partner education missing

<https://www.health.govt.nz/publication/nzdep2013-index-deprivation>

## Appendix 3. Growing up in New Zealand (GUiNZ) Antenatal and 9-Month Partner and Mother survey components tested in the bivariate analysis of the factors associated with having no observed ACEs in the highest risk group ordered by assigned domain and number of variables

Variable Grouping	Number of Variables	Domain
Co-parenting Support (How involved is your partner in the day to day care of your baby?)	31	Mother Partner
Strength of Partnership (Agreement with: When I imagine what my life will be like in the future I always see my partner standing next to me)	18	Mother Partner
Iowa Family Warmth Scale (During the past four weeks how often did you act supportive and understanding towards each other)	18	Mother Partner
Income Sources (Do you have household Income from wages, salary, commissions, bonuses paid by an employer?)	90	Family Finances
Occupation Related Questions (Are you planning to take any leave from employment when this baby is born?)	57	Family Finances
Economic Perceptions (How do you think your household financial situation compares with 12 months ago?)	10	Family Finances
Characteristics of the Household and Home (How many bedrooms are there in this house?)	9	Family Finances
Reported Deprivations (Have you continued wearing shoes with holes because you could not afford replacements?)	7	Family Finances
Sources of Worry (To what extent are the following a source of stress for you and your family, worry about current housing difficulties?)	28	Parent Health and Wellness
Individual Skills and Strengths (Have other people ever singled you out for being better than MOST others your own age for any of a list of possibilities?)	22	Parent Health and Wellness
Perceived Stress Scale (In the last four weeks, how often have you felt nervous and stressed?)	21	Parent Health and Wellness
Postnatal Depression Scale (In the past 7 days, I have felt sad or miserable)	20	Parent Health and Wellness
General Health and Health Behaviors (Do you currently have a disability that is long term, lasting 6 months or more?)	8	Parent Health and Wellness
Pregnancy Related Health Care Utilization (Did you have any treatment to assist you with becoming pregnant?)	6	Parent Health and Wellness
Characteristics of the Neighborhood: Subjective and Objective (Agreement with: It is safe to walk around the neighborhood at night.)	164	Community and Neighborhood
Identity and Knowledge of Culture (How involved are you in your traditional cultural activities?)	28	Community and Neighborhood
Larger Community Support (How helpful do you find your extended family?)	24	Community and Neighborhood

Community Connectedness (Agreement with: I have little to do with people in this neighborhood)	21	Community and Neighborhood
Social Networks (What is the community or communities of people to which you belong based around?)	21	Community and Neighborhood
Feelings about Community and Family Adaptation (Agreement with: I feel like I belong in my community)	13	Community and Neighborhood
Time Spent with your Child (Agreement with: I take an active interest in my baby)	47	Parent Child
Satisfaction with Parenting (How well are you meeting your expectations for yourself as a parent of a new baby?)	23	Parent Child
Parenting Values (Which three of these values are MOST IMPORTANT to your child's development, for example to be a good person?)	20	Parent Child
Involved with tasks associated with taking care of child (To what extent are you involved in the day to day care of your baby?)	13	Parent Child
Hopes and Dreams for Child (Coded responses from: Please give us one or two sentences about the hopes, dreams and expectations you have for your baby?)	12	Parent Child
Work Family Life Balance (Agreement with: Thinking about the children interferes with my life at work)	10	Parent Child
Confidence with Parenting (How confident are you when caring for your baby?)	9	Parent Child

## Appendix A. Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.childyouth.2019.104556>.

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