



Social network typology and health among parents of children with developmental disabilities: Results from a national study of midlife adults

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ABSTRACT

Objective: There is increasing interest in the role of contextual factors in promoting well-being among parents of children with developmental disabilities. This study aimed to examine whether social network types moderate the impacts of having a child with a developmental disability on parents' health.

Methods: Using cross-sectional data from the Midlife in the United States survey (MIDUS 2 and Refresher cohorts), we analyzed a sample of 363 parents of children with developmental disabilities and 4,919 parents of children without developmental disabilities. K-means cluster analysis was implemented to identify a social network typology. Modified Poisson and negative binomial regression models estimated the effect of having a child with a developmental disability and the typology on parents' physical health (self-rated health, number of chronic conditions) and mental health (self-rated mental health, major depression).

Results: The cluster analysis revealed two social network types. Parents of children with developmental disabilities were more likely to have "restricted/unsupported" networks, whereas parents in the comparison group were more likely to have "diverse/supported" networks. Social support was more important for differentiating the network types of parents of children with developmental disabilities, while social integration was more salient for the comparison group. Parents of children with developmental disabilities fared worse on all outcomes relative to parents of children without disabilities. However, the typology had a compensatory psychological effect; the diverse/supported network type conferred greater mental health benefits to parents of children with developmental disabilities than to those in the comparison group. The diverse/supported network type was also associated with better physical health, but the associations did not differ between the two parent groups.

Conclusions: The results of this study emphasize the importance of social determinants of well-being for those with exceptional parenting responsibilities. Strengthening social networks may have a particularly positive impact on such parents' mental health.

1. Introduction

Parenting a child with a developmental disability (DD) can be a profoundly stressful experience. Although caregiving is an expected part of becoming a parent, those raising children with developmental disabilities face several unique challenges. Common stressors include managing the child's symptoms (e.g., Shepherd et al., 2017) and co-occurring behavior problems (e.g., Davis and Neece, 2017),

navigating service systems (e.g., Brewer, 2018), stigma, and social exclusion (e.g., Mitter et al., 2019). These challenges are not specific to parents of young children. Developmental disabilities are lifelong in nature and parents often continue to provide daily support and assistance even as their children reach adulthood (Chamak and Bonniau, 2016). The impacts of these long-term parenting responsibilities can be significant. Compared to other parents, those caring for children with DDs report worse mental health (Cohrs and Leslie, 2017; Scherer et al.,

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2019) and face elevated risks of physical morbidities and symptoms (Lovell et al., 2021; Namkung et al., 2018; Smith et al., 2012). These disparities notwithstanding, many parents of children with DDs also demonstrate patterns of resilience (McConnell and Savage, 2015). Such variation raises key questions about the factors that promote well-being in parents despite the exposure to chronic stress.

There is increasing interest in the role that parents' social contexts play in facilitating positive adaptation to caring for a child with a DD (McConnell and Savage, 2015). Extensive research suggests that social networks can have salutary impacts on parents' well-being (Benson, 2016; Gallagher and Whiteley, 2012; Meppelder et al., 2015). However, most prior studies analyze discrete aspects of parents' interpersonal contexts (e.g., social support, social integration). Researchers have argued that because social life is multifaceted, assessing an array of relational attributes, rather than focusing on each in isolation, can offer a more realistic portrayal of individuals' experiences (Fiori et al., 2007; Shiovitz-Ezra and Litwin, 2012). In the present study, we employ a "pattern-centered" approach to provide a more holistic conceptualization of parents' social milieus. Specifically, this analysis aims to: identify and compare the *types* of social networks in which parents of children *with* and *without* DDs are embedded; analyze associations between social network types and parents' physical and mental health; and examine whether such associations vary for parents of children with and without DDs. We also implement a simulation to elucidate which relationship aspects are most important for classifying parents within the social network typology.

1.1. Theoretical background

In this study, we draw on the convoy model of social relations (Kahn and Antonucci, 1980) to inform our understanding of how interpersonal environments impact parents' well-being. According to the convoy model, a network of relations (i.e., a convoy) surrounds and travels with each individual across the lifespan, providing a sense of security by enabling the exchange of support and resources. The nature of one's convoy can vary based on personal characteristics and situational circumstances. Convoys are defined both by objective aspects, like frequency of contact with friends, as well as subjective dimensions, like perceived support (Antonucci et al., 2010). Because these characteristics are often *interconnected*, it may be theoretically important to assess them concurrently (Fiori et al., 2007). To reflect this multidimensionality, scholars have proposed using "pattern-centered" methods to group individuals with similar relational characteristics into broad taxonomies, or "social network types" (Antonucci et al., 2010). This study aims to identify and compare the association between social network types and health in a national sample of parents of children with and without DDs.

1.1.1. Social network types

A social network typology is a parsimonious construct that groups individuals with similar distributional patterns across several relationship indicators. Although the phrase "social network" has become nearly synonymous with online platforms in recent years, our use of the term 'social network typology' is intended to capture the "combination and interaction of disparate ... characteristics" of individuals' social relations (Litwin, 1995, p. 155). Typologies commonly incorporate measures of structure and composition (e.g., marital status; number of friends) (Litwin and Shiovitz-Ezra, 2011), relationship function and strength (e.g., emotional support; frequency of contact) (Fiori et al., 2007), and social integration (e.g., community participation) (Li and Zhang, 2015). Prior research has largely focused on the social network types of older adults to illustrate the importance of contextual factors in the aging process (Antonucci et al., 2010). Less is known about the social network types of adults in midlife or, specifically, of parents.

The number of social network types identified in the literature varies; some studies find as few as two (Ayalon, 2019) and others describe as many as seven (Giannella and Fischer, 2016). Network types are often

provided labels, such as "diverse," "restricted," "friend-focused," and "family-focused," based on their differentiating characteristics (Antonucci et al., 2010). Prior studies rarely examine *which* characteristics are most influential in sorting individuals to a given network type, resulting in typologies that are something of a 'black-box.' In terms of health impacts, well-being tends to be greater for those in network types characterized by high degrees of social integration or support, and worse among those in network types defined by limited social participation or strained relationships. This pattern of findings has been detailed across a wide array of physical and mental health outcomes (Fiori et al., 2007; Li and Zhang, 2015; Litwin and Shiovitz-Ezra, 2011; Santini et al., 2015; Shiovitz-Ezra and Litwin, 2012).

1.1.2. Social environments of parents of children with developmental disabilities

Previous research assessing the health impacts of contextual factors among parents of children with DDs has largely focused on single aspects of parents' social lives, such as particular relationship functions (e.g., Gallagher and Whiteley, 2012) or certain kinds of network resources (e.g., Meppelder et al., 2015). This "variable-centered" approach has indeed provided meaningful insights. However, as the convoy model suggests, accounting for the multifaceted nature of interpersonal environments could help to elucidate the role of the broader social context in promoting positive adaptation in parents of children with DDs. To our knowledge, a pattern-centered approach has yet to be employed in research about parents of children with DDs. Prior studies in this population have, however, considered some of the measures that are commonly used to construct social network typologies. For instance, evidence suggests that parents of children with DDs receive lower levels of social support (Gallagher and Whiteley, 2012), have less interaction with friends and relatives (Namkung et al., 2018), and experience higher rates of marital instability (Seltzer et al., 2011; though see Freedman et al., 2012) compared to other parents.

There are theoretical reasons to suspect that the association between social network types and health may vary for parents of children *with* and *without* DDs. The convoy model stipulates that personal and situational characteristics, such as role demands and expectations associated with parenting a child with a DD, affect one's need for coping assistance. Kahn and Antonucci (1980) hypothesized that the resources provided by one's convoy may moderate the association between such factors (e.g., parenting stress) and individuals' well-being. This theoretical expectation is similar to the buffering hypothesis, which posits that positive social ties may provide greater protection to individuals under circumstances of stress (e.g., Cohen and Wills, 1985). Indeed, evidence from the general population indicates that having a supportive and integrated social network type may attenuate the negative effects of stressful life experiences (Förster et al., 2018). A few "variable-centered" studies about families of children with DDs have also found that specific social relation attributes moderate the deleterious impacts of stressful parenting (Gouin et al., 2020; Ha et al., 2011). Building on this research, we consider the potentially compensatory role of social network types for parents of children with DDs by examining whether the health impacts differ from those experienced by parents of children without DDs.

1.2. Current study

In the present study, we utilized a pattern-centered approach to characterize the social network types of midlife parents of children with and without DDs. By assessing an array of relationship characteristics simultaneously, we sought to better understand the role of interpersonal contexts in promoting positive adaptation to stressful parenting. Based on past research, we hypothesized that parents of children with DDs would be more likely to have network types characterized by limited social integration and support, and that they would also have worse health, relative to parents of children without DDs. Guided by the stress-buffering and convoy theories, we further hypothesized that social

network types with more resources would be associated with better health for all parents, but that the magnitude of these associations would be *larger* for those with children with DDs. Given the wide range that has been previously reported, we did not have an *a priori* expectation of the number of social network types that we would identify in the data. Finally, in an exploratory analysis, we demonstrate a method to determine which factors are most important for differentiating social network types.

2. Methods

2.1. Data and sample

The data for this study were from the survey of Midlife in the United States (MIDUS), a national study of health and aging. MIDUS data can be accessed through the ICPSR data repository (<https://www.icpsr.umich.edu/web/ICPSR/series/203>). The initial wave of data (MIDUS I) was collected in 1994–1995 and included a sample of 7,108 respondents. Participants were aged 25–74 years, English-speaking, non-institutionalized, and living in the 48 continental states in the U.S. Respondents participated in telephone interviews and completed a self-administered questionnaire. The original cohort was re-interviewed 9–10 years later at MIDUS II (2004–2006). The retention rate for the second wave was 75% (Radler and Ryff, 2010). To promote research on health and aging in diverse populations, a random sample of African Americans from Milwaukee, Wisconsin was recruited to participate at the second wave ($n = 592$). The total sample size for MIDUS II was 5,555 (including Milwaukee respondents).

In 2011–2014, the baseline MIDUS cohort was replenished with a newly recruited national sample ($n = 3,577$) and a second representative sample of African Americans from Milwaukee ($n = 508$). Data collection procedures for this “Refresher” cohort replicated those used in the original study. The analyses that follow combine data from MIDUS II and the Refresher, as pooling cohorts allowed us to obtain a larger sample of parents of children with DDs. MIDUS data collection procedures were approved by the Institutional Review Board at the University of Wisconsin-Madison.

This study focuses on the experiences of parents; respondents without children were excluded from the sample ($n = 1,511$). Two analytic subsamples were subsequently derived: (1) parents of children with developmental disabilities (e.g., autism, cerebral palsy, epilepsy, intellectual disability), and (2) a comparison group comprised of parents of children without developmental disabilities. Respondents who had provided disability-related caregiving to family or friends in the 12 months preceding the survey and parents of children with serious mental illnesses were excluded from the comparison group.

Most variables for this study were drawn from the questionnaire portion of the MIDUS survey. Respondents who only completed the telephone interview were thus omitted from the sample ($n = 1,164$). The final sample included of 363 parents of children with DDs and 4,919 parents of children without DDs.

2.2. Measures

The key independent variables were parenting group and social network typology. The outcomes were four measures related to parents’ mental and physical health.

Social network variables. Eleven measures characterizing respondents’ social lives were used to construct the social network typology. Survey items, response categories, and psychometric properties are detailed in [supplementary Table S1](#).

Marital status was a binary variable (married or living with a partner; not married and not living with a partner). Two measures of social support (*friend* support, *kin* support) were included; each was a scale constructed from a parallel set of four items (e.g., How much do your [friends/family members] really care about you?). Two measures of

social strain (*friend* strain, *kin* strain) captured the negative quality of respondents’ relationships; each was also based on a parallel set of four items (e.g., How often do your [friends/family members] criticize you?). The support and strain scales were calculated as the average across the four constituent items (Brooks et al., 2014).

Four variables were used to measure social integration. Dichotomous variables captured whether, in a typical month, individuals *spent time volunteering* (yes; no) and whether they *attended meetings* in the community (yes; no). *Religious congregation attendance* assessed the frequency of participation in religious congregation activities (e.g., dinners, volunteering, attending religious services). *Socializing with neighbors* measured how often respondents “have a real conversation or get together socially” with their neighbors.

Mental health. Two mental health outcomes were analyzed. *Major depression* was defined using a screening version of the Composite International Diagnostic Interview (CIDI). The CIDI short form assesses major depression based on the prior 12 months using criteria specified in the Diagnostic and Statistical Manual for Mental Disorders (third edition, revised; American Psychiatric Association, 1987). A positive screen for major depression requires individuals, for a period of at least two weeks in the prior year, to have experienced depressed mood or anhedonia most of the day, nearly every day, as well as at least four other symptoms associated with depression. CIDI diagnoses have demonstrated good sensitivity and specificity, test-retest reliability, and clinical validity (Blazer et al., 1994; Kessler et al., 1998).

Self-rated mental health (SRMH) was assessed with a single survey item. Participants were asked to rate their current “mental or emotional health” on a five-point scale (poor, fair, good, very good, excellent). There is evidence that SRMH correlates well with multi-item measures of mental health and well-being (e.g., Ahmad et al., 2014). Following previous studies (e.g., Chiu et al., 2017; Zhang and Ta, 2009), SRMH was dichotomized (poor/fair = 1; good/very good/excellent = 0). This categorization is commonly used by public health agencies to monitor mental health in the population (e.g., Cree et al., 2018).

Physical health. Respondents’ physical health was operationalized with two measures. Participants reported on whether, in the last year, they had experienced or been treated for any of 29 different chronic conditions such as high blood pressure, arthritis, and migraine headaches (see supplement [Figure S1](#) for a complete list). A measure for the *number of chronic conditions* was equal to the count of endorsed items.

Self-rated health (SRH) was measured using a single survey item. Respondents were asked: “In general, would you say your physical health is excellent, very good, good, fair, or poor?” Prior studies have shown SRH to be associated with objective health outcomes and predictive of mortality (Benyamini, 2011). Consistent with previous research (e.g., Falconer and Quesnel-Vallée, 2017; Zhang and Ta, 2009) and following the standard used by national public health initiatives (Office of Disease Prevention and Health Promotion, 2021), we analyzed SRH as a binary variable (poor/fair = 1; good/very good/excellent = 0). As a sensitivity analysis, we ran models with SRH and SRMH operationalized as continuous variables; the results were completely consistent and thus we proceeded with the dichotomized outcomes.

Covariates. The regression models controlled for relevant socio-demographic characteristics: *sex* (male; female); *age* (in years); *race/ethnicity* (white, non-Hispanic; black, non-Hispanic; other race/ethnicity); *educational attainment* (less than a high school degree; high school degree; some college; college degree; advanced degree); *employment status* (currently working; not working); and *number of children*, top-coded at 4 due to skewness.

Three health behaviors were also included as controls. *Smoking status* was measured as a categorical variable (never smoked; used to smoke; currently smokes). *Frequency of physical exercise* ranged from (1) never to (6) several times a week (Lachman and Agrigoroaei, 2010). *Number of alcoholic drinks* per week was measured using information on the number of days per week (in the last month) that respondents reported drinking alcohol and the number of drinks consumed on those days

(Goldwater et al., 2019). Due to skewness, number of drinks was top-coded at 20. Finally, the models controlled for the MIDUS sample from which each respondent was drawn (MIDUS II, II-Milwaukee, Refresher, Refresher-Milwaukee). A sensitivity analysis indicated that the effect of having a child with a DD did not vary by MIDUS cohort, suggesting that combining samples would not bias the results.

2.3. Analytical approach

Descriptive statistics. We first compared parents of children with and without DDs across all study variables. Significant differences were determined with chi-squared tests for categorical variables, t-tests for continuous variables, and a Wilcoxon rank-sum test for the number of chronic conditions due to skewness. All tests were two-tailed.

Table 1

Descriptive statistics of study variables for parents of children with and without developmental disabilities (N = 5,282).

	Parents of children without DDs (n = 4,919)	Parents of children with DDs (n = 363)	p
	% or M (SD)	% or M (SD)	
Social network variables			
Married/has cohabiting partner, %	74.81	70.25	.054
Friend support, M (SD)	3.27 (.67)	3.09 (.79)	<.001
Friend strain, M (SD)	1.80 (.54)	1.89 (.61)	.008
Freq. contact with friends, M (SD)	3.44 (1.51)	3.18 (1.68)	.002
Kin support, M (SD)	3.51 (.59)	3.32 (.72)	<.001
Kin strain, M (SD)	2.03 (.62)	2.25 (.71)	<.001
Freq. of contact with kin, M (SD)	3.86 (1.26)	3.73 (1.37)	.05
Volunteers, %	49.87	43.38	.018
Attends community meetings, %	54.87	47.75	.009
Freq. attends religious congregation, M (SD)	2.04 (1.51)	1.72 (1.53)	<.001
Freq. socializes with neighbors, M (SD)	2.01 (1.59)	1.65 (1.51)	<.001
Sociodemographic characteristics			
Sex (Female), %	54.12	60.61	.017
Age, years, M (SD)	54.85 (13.13)	52.00 (12.89)	<.001
Race/Ethnicity, %			.002
White, non-Hispanic	77.60	70.08 [#]	
Black, non-Hispanic	10.76	12.47	
Other ¹	11.64	17.45 [#]	
Educational attainment, %			<.001
Less than high school	6.57	12.15 [#]	
High school degree	25.70	22.93	
Some college	29.02	32.60	
College degree	22.51	17.68 [#]	
Advanced degree	16.20	14.64	
Number of children, %			<.001
One	16.83	7.44 [#]	
Two	37.28	32.23	
Three	23.85	23.97	
Four or more	22.05	36.36 [#]	
Currently employed, %	62.70	61.00	.53
Sample, %			<.001
MIDUS II	56.96	52.89	
MIDUS II-Milwaukee	5.77	6.89	
MIDUS Refresher	33.71	32.89	
MIDUS Refresher-Milwaukee	3.56	7.99 [#]	
Health behaviors			
Smoker status, %			<.001
Never smoked	53.48	47.93 [#]	
Used to smoke	32.59	30.03	
Currently smokes	13.93	22.04 [#]	
Alcoholic drinks per week, M (SD)	2.27 (4.38)	2.03 (4.18)	.32
Freq. vigorous activity, M (SD)	2.89 (1.85)	2.99 (1.81)	.31
Health outcomes			
Major depression, %	8.80	18.73	<.001
Self-rated mental health, %			<.001
Good, very good, excellent	92.76	79.06	
Poor, fair	7.24	20.94	
Self-rated health, %			<.001
Good, very good, excellent	84.08	71.35	
Poor, fair	15.92	28.65	
Number of chronic conditions, M (SD)	2.19 (2.33)	2.93 (2.94)	<.001

Notes: (1) Includes respondents self-identified as Asian, Native American, Alaskan, Native Hawaiian, Pacific Islander, Hispanic ethnicity, or other race/ethnicity. (#) Significant row-wise difference (p < .05).

Cluster analysis. To identify a social network typology, we conducted a k-means cluster analysis using the eleven variables that tap attributes of respondents' social lives. K-means is a non-hierarchical classification technique that groups observations iteratively with the goal of minimizing the error sum-of-squares (Everitt et al., 2011). The social network variables were standardized by unit variance prior to clustering. Respondents with missing values on any of these variables were temporarily dropped (n = 278), as the algorithm requires complete data. The k-means procedure was implemented with squared Euclidean distance as the proximity measure and with initial centroids selected at random. To determine the optimal number of clusters, we conducted the k-means procedure across a range of possible values and used diagnostic indices to compare the relative performance of the cluster solutions (supplemental Figures S2-S4). We implemented three alternative

multivariate techniques (hierarchical clustering, k-medians, partitioning around medoids) to check the robustness of the findings (Everitt et al., 2011). The optimal solution produced by each method matched the results of the k-means procedure.

Once the number of clusters was determined, we ran a simulation to assess the relative importance of the social network variables to the k-means solution. Following the implementation of the k-means routine, each variable was randomly permuted and a corresponding “misclassification rate” was calculated (Breiman, 2001). This procedure quantifies the change in accuracy of the cluster assignments after random noise is added to each variable. The simulation was run 10 times; we present the median misclassification rate as a measure of each variable’s “importance.”

Regression analysis. Because the prevalence of each binary outcome (major depression, SRMH, SRH) was relatively common (i.e., >10%), the models were estimated on the risk metric using modified Poisson regression with a robust variance estimator (Zou, 2004). The chronic conditions models were estimated with negative binomial regression as there was evidence of overdispersion. We first ran models to assess the main effects of having a child with a DD and respondents’ social network type on each health outcome. We then included a two-way interaction (parent group X social network type) to examine whether the association between social network type and health varied for parents of children with and without DDs.

The interaction terms in the models described above reflect the departure from multiplicativity. It is possible in a multiplicative model to observe a statistically significant interaction on the additive scale but not on the multiplicative scale (VanderWeele and Knol, 2014). Thus, we also examined the additive interaction, which corresponds with risk differences (or absolute risk reduction). The presence of an additive interaction is considered to be relevant for public health (VanderWeele and Knol, 2014) as it can indicate, for example, whether social support confers a larger reduction in the *probability* of an adverse health outcome for one group versus another. Some researchers (e.g., Vandembroucke et al., 2007) argue that this interpretation is more instructive than evaluating differences in terms of relative risks. Furthermore, the few prior studies that examined associations between social relations and health for parents of children with and without DDs found evidence of

differential effects on the additive scale (Gouin et al., 2020; Ha et al., 2011). Thus, consistent with current recommendations (e.g., Vandembroucke et al., 2007; VanderWeele and Knol, 2014), we present estimates of interaction on both scales.

To assess the additive interaction (i.e., the risk difference), we first estimated the effect of the social network typology by calculating the difference in the predicted probabilities (or count) of the outcome for respondents in each social network type; this was computed separately for parents of children with and without DDs. We then tested whether the effects of the social network typology were significantly different between the two parent groups.

Missing data did not exceed 3% for any variable. To obtain unbiased estimates and standard errors, missing data were multiply imputed with 10 data sets using chained equations. The social network typology variable was also imputed for respondents who were excluded from the cluster analysis due to missingness (n = 278). As a sensitivity analysis, we estimated the regression models using only complete cases; the results were virtually identical to the analyses of multiply imputed data. The study was strongly powered to detect meaningful effects (all >0.90), which was defined as a 1/2 standard deviation change in each outcome (Cohen, 1988; Kline, 2004). Based on the actual effects and sample size, the achieved power for the present study ranged from 0.85 to 0.99. The analyses were conducted in Stata (StataCorp, 2019) and R (R Core Team, 2020); a syntax file is provided in an electronic supplement.

3. Results

3.1. Descriptive statistics

Table 1 presents bivariate comparisons of the social network variables, sociodemographic characteristics, health behaviors, and health outcomes for parents of children with and without DDs. Relative to the comparison group, parents of children with DDs reported significantly less supportive and more straining friend and kin relationships, less frequent contact with friends and kin, and lower levels of social integration (i.e., volunteering, participating in meetings, attending religious congregations, socializing with neighbors).

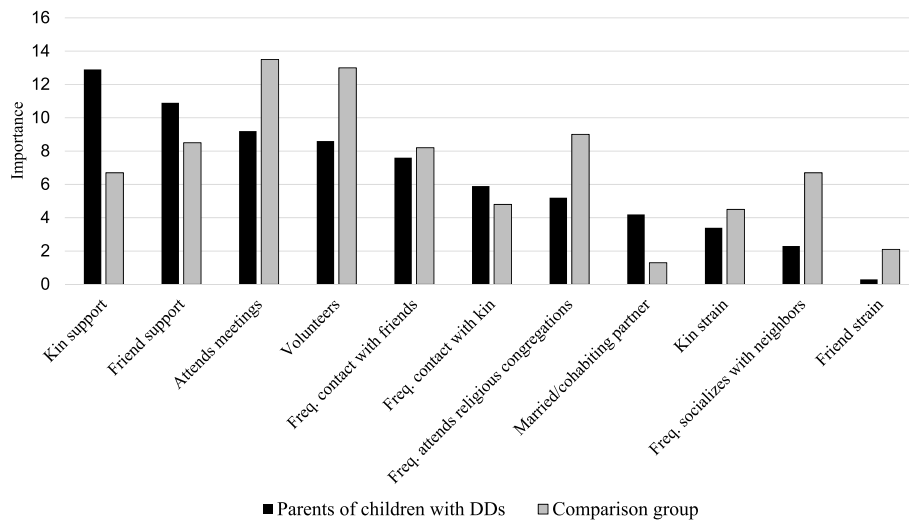
With respect to sociodemographic characteristics, a greater

Table 2
Cluster analysis variables and parent group by social network type (N = 5,282).

	Restricted/Unsupported		Diverse/Supported	
	% or M (SD) ¹	z-score	% or M (SD) ¹	z-score
Married or has cohabiting partner, %	68.94	-0.13	79.54	0.12
Friend support, M (SD)	2.89 (.74)	-0.54	3.52 (.49)	0.39
Friend strain, M (SD)	1.87 (.58)	0.13	1.75 (.51)	-0.10
Freq. contact with friends, M (SD)	2.66 (1.68)	-0.50	3.97 (1.12)	0.36
Kin support, M (SD)	3.22 (.70)	-0.47	3.70 (.41)	0.33
Kin strain, M (SD)	2.23 (.67)	0.29	1.91 (.57)	-0.21
Freq. of contact with kin, M (SD)	3.44 (1.48)	-0.33	4.46 (.98)	0.24
Volunteers, %	17.78	-0.63	72.86	0.47
Attends community meetings, %	22.41	-0.64	77.85	0.47
Freq. attends religious congregation, M (SD)	1.31 (1.36)	-0.47	2.53 (1.39)	0.34
Freq. socializes with neighbors, M (SD)	1.39 (1.42)	-0.37	2.41 (1.55)	0.26
Distribution of sample across social network types				
Total sample, %	42.27		57.73	
Parents of children without DDs, %	41.20		58.80	
Parents of children with DDs, %	56.45		43.55	

Notes: N = 363 parents of children with developmental disabilities and 4,919 comparison group parents.

(1) Value of the untransformed variable.



Note: "Importance" (the y-axis) reflects the rate at which respondents are assigned to the wrong cluster after a variable is randomly permuted (i.e., misclassification). Higher rates of misclassification indicate greater variable importance. The simulation was performed 10 times for each variable; the median misclassification rate is presented in this chart.

Fig. 1. Variable importance for the social network typology, by parent group.

Table 3
Regression models for physical and mental health outcomes (N = 5,282).

	Major Depression (Modified Poisson)		Poor/Fair SRMH (Modified Poisson)		Poor/Fair SRH (Modified Poisson)		Number of chronic conditions (Negative binomial)	
	Base Model	Interaction	Base Model	Interaction	Base Model	Interaction	Base Model	Interaction
	RR (SE)	RR (SE)	RR (SE)	RR (SE)	RR (SE)	RR (SE)	IRR (SE)	IRR (SE)
Parent of child with DD (Ref=comparison group)	1.53*** (0.18)	1.75*** (0.23)	1.92*** (0.22)	2.03*** (0.25)	1.45*** (0.12)	1.37** (0.13)	1.26*** (0.06)	1.24** (0.08)
Social network type (SNT) (Ref=restricted/unsupported)	0.60*** (0.06)	0.63*** (0.06)	0.48*** (0.05)	0.50*** (0.06)	0.68*** (0.04)	0.67*** (0.05)	0.84*** (0.02)	0.84*** (0.03)
Parent group x SNT		0.57 (0.18)		0.74 (0.25)		1.23 (0.24)		1.04 (0.11)

Note. ***p < .001, **p < .01, *p < .05. N = 363 parents of children with developmental disabilities and 4,919 comparison group parents. Abbreviations: developmental disability (DD); risk ratio (RR); incidence rate ratio (IRR); standard error (SE); self-rated mental health (SRMH); self-rated health (SRH); social network type (SNT). Models control for: sex, age, race/ethnicity, education, number of children, employment, MIDUS sample, smoking, alcohol consumption, and exercise activity.

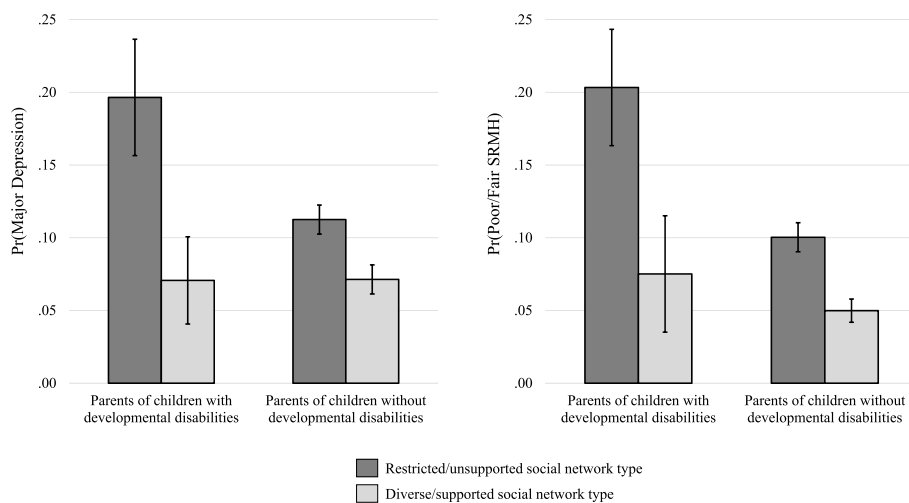


Fig. 2. Predicted probabilities of major depression (LEFT) and poor/fair self-rated mental health (RIGHT) by parent group and social network type.

proportion of parents of children with DDs were female and nonwhite. Parents of children with DDs tended to be younger, had less education, and had more children than those in the comparison group. There was no difference between the parent groups with respect to employment. In terms of health behaviors, a greater percentage of parents of children with DDs were current smokers as compared to other parents. The two parent groups reported similar levels of alcohol consumption and exercise. Parents of children with DDs reported worse health than the comparison group on all four outcomes.

3.2. Cluster analysis results

We adopted a 2-cluster solution as each diagnostic index indicated $k = 2$ was optimal (supplement Figures S2-S4). Table 2 includes the distributions of the social network variables across the two clusters. The first cluster was characterized by higher levels of relationship strain, lower levels of support, limited social integration, and less frequent contact with friends and kin, relative to the second cluster. Reflecting these characteristics, we labeled the social network types “restricted/unsupported” and “diverse/supported.”

Table 2 (lower panel) shows the distribution of the sample across the social network types. The restricted/unsupported type comprised about 42% of the overall sample. A significantly greater percentage of parents of children with DDs were clustered in the restricted/unsupported network than were parents in the comparison group (56% vs. 41%; $\chi^2 = 30.92$, $p < .001$). Table S2 in the supplement includes the distributions of the other study variables across the social network types.

Fig. 1 presents the results of the permutation simulation, stratified by parent group. The variables most important to the cluster solution for parents of children without DDs were associated with *social participation*: meeting attendance, volunteering, and involvement in a religious congregation. That is, the classification of individuals in the comparison group to either the diverse/supported network type or the restricted/unsupported network type was most influenced by the extent of parents’ engagement in community activities.

In contrast, the cluster assignments of parents of children with DDs relied more on respondents’ levels of *social support*. Specifically, kin and friend support were the most influential variables for determining whether parents of children with DDs were clustered in the diverse/supported network type or restricted/unsupported network type. In both parent groups, social support was more important than social strain, and contact with friends was more important than contact with kin.

3.3. Regression analysis results

Mental health. The regression model results are presented in Table 3. Parents of children with DDs had an increased risk of major depression relative to comparison group parents (relative risk [RR]: 1.53, $p < .001$). Regarding the social network typology, having a diverse/supported network was associated with a significantly lower risk of major depression compared to those in the restricted/unsupported network type (RR: 0.60, $p < .001$). There was no statistically significant interaction between social network type and parent group on the multiplicative scale (RR: 0.57, $p = .078$). Concerning SRMH, parents of children with DDs were more likely to report poor/fair mental health relative to comparison group parents (RR: 1.92, $p < .001$). Respondents with diverse/supported networks were less likely to report poor/fair mental health compared to those in the restricted/unsupported network type (RR: 0.48, $p < .001$). There was no evidence of multiplicative interaction between parent group and social network typology with respect to SRMH (RR: 0.74, $p = .38$).

Fig. 2 plots the results of the additive interaction analysis. The probabilities used to calculate the additive interaction are provided in the supplement (Table S3). Relative to those with restricted/unsupported networks, having a diverse/supported network type was associated with a significantly lower probability of major depression for both

parent groups (parents of children with DDs: 0.13, $p < .001$; comparison group: 0.04, $p < .001$). However, this association was *significantly greater* for parents of children with DDs (risk difference [RD]: 0.09, $p = .007$). A similar pattern was observed for SRMH. Compared to those with the restricted/unsupported network type, having a diverse/supported network was associated with a lower probability of poor/fair SRMH for both groups of parents (parents of children with DDs: 0.13, $p < .001$; comparison group: 0.05, $p < .001$). As with major depression, the impact of having a diverse/supported network on SRMH was *significantly greater* for parents of children with DDs (RD: 0.08, $p = .016$). Hence, with respect to both mental health outcomes, having a diverse/supported network was *differentially beneficial* for parents of children with DDs, as measured on the additive scale.

Physical health. The regression results for the physical health outcomes are presented in Table 3. Relative to the comparison group, parents of children with DDs had a significantly higher risk of reporting poor/fair physical health (RR: 1.45, $p < .001$), and those in diverse/supported social networks had a significantly lower risk of reporting poor/fair physical health than respondents with restricted/unsupported networks (RR = 0.68, $p < .001$). The results of the negative binomial model suggest that parents of children with DDs had a significantly greater number of chronic conditions than other parents (incidence rate ratio [IRR]: 1.26, $p < .001$) and individuals with a diverse/supported network had significantly fewer chronic conditions than respondents in the restricted/unsupported network type (IRR: 0.84, $p < .001$).

The interaction between social network typology and parent status was not significant on either scale in the poor/fair self-rated health model (RR: 1.23, $p = .29$, Table 3; RD: 0.02, $p = .70$, supplement Table S3) or in the chronic conditions model (IRR: 1.04, $p = .72$, Table 3; RD: 0.01, $p = .98$, supplement Table S3). Thus, in contrast to mental health, the physical health benefits of having a diverse/supported network type did not significantly differ by parent group status.

4. Discussion

We employed a pattern-centered approach to better understand the associations between interpersonal contexts and health among parents of children with developmental disabilities. Prior analyses have considered the health effects of individual aspects of parents’ relationships, whereas the present research assessed an array of relationship factors simultaneously. Rather than being data-driven, the hypotheses tested in this study were derived from theoretical formulations. We drew on the convoy model (Kahn and Antonucci, 1980) to develop a social network typology for midlife parents from a large national sample. Identifying network types allowed us to provide a more holistic characterization of social life – as well as its impact on parents’ well-being. This study, which examines the relationships between social network types and health of parents of children with and without DDs, contributes to the literature in several ways.

We found that two types of networks best characterized the interpersonal contexts of parents in midlife. Parents in the diverse/supported network type tended to be more socially integrated, had higher levels of support from friends and relatives, and reported less social strain than those in the restricted/unsupported network type. Consistent with our hypothesis, parents of children with DDs were more likely to have restricted/unsupported networks, providing them with fewer social resources. This finding is aligned with evidence documenting lower levels of support and social participation among parents of children with DDs relative to controls (Gallagher and Whiteley, 2012; Namkung et al., 2018). Notably, although the majority of parents of children with DDs had restricted/unsupported networks, many did not. About four-in-ten of these parents were actively engaged in their communities and had supportive and high-quality relationships with friends and relatives. These findings suggest that many parents of children with DDs are able to maintain some degree of social integration amidst challenging family circumstances.

Our study presents novel findings concerning the salience of different network attributes to parents' "convoys." Specifically, we assessed the relative importance of each relationship variable to the classification of respondents to their respective social network types. This analysis revealed several insights. Kin and friend support were found to be the most influential factors for determining the social network types of parents of children with DDs. A somewhat different pattern was observed for the comparison group; social integration (i.e., meeting attendance, volunteering, religious congregation attendance) was paramount for delineating the social network types of parents of children without DDs. These findings provide a theoretical contribution to the literature by describing which factors are most important for defining parents' network types and by identifying how such patterns vary across individuals with different life experiences (i.e., parenting a child with a developmental disability).

Social support and social integration have been recognized as representing distinct mechanisms through which individuals engage their networks (Berkman and Glass, 2000). Though there is some disagreement in the literature, support functions are thought to be most impactful by assisting those experiencing life challenges (Kawachi and Berkman, 2001; Thoits, 2011). Alternatively, structural aspects of social life may be beneficial in general. Social integration is a commonly mentioned structural feature that is presumed to exert a "main effect" (Kawachi and Berkman, 2001); for example, participation in the community and with voluntary organizations provides meaning and purpose regardless of one's exposure to stress (Berkman and Glass, 2000). Our findings may be signaling these mechanisms. Kin and friend support were paramount for delineating the social network types of individuals raising children with DDs, which may reflect the elevated levels of stress that these parents experience. In contrast, for comparison group parents, community participation mattered most, whereas social support was less pertinent.

Next, we assessed the associations between parent status, social network type, and health. Consistent with our hypotheses, parents raising children with DDs fared worse on each outcome. With respect to the social network typology, the main effect indicated that, for parents generally, those with a diverse/supported network type experienced better health relative to individuals with restricted/unsupported networks. The size of the effects of having a child with a DD and of having a diverse/supported network were mostly in the small-to-medium range (Olivier et al., 2017). The findings are nonetheless meaningful given that the regression models controlled for an array of potential confounders, and that the effects of having a child with a DD were observed even after adjusting for the presence of a diverse/supported network.

We investigated whether the health benefits of having a diverse/supported network would be greater for parents of children with DDs relative to the comparison group. The findings partially supported our hypotheses. First, there was evidence suggesting that the association between the social network typology and parents' mental health differed for those with children with and without DDs. The significant interaction was observed on the additive scale. These findings suggest that social resources may serve a *compensatory* role by buffering the effects of having a child with a DD on parents' well-being. The attenuating impacts of the typology were sufficiently large in magnitude that, among those with diverse/supported networks, there was *no statistically significant difference* in the probability of an adverse mental health outcome between parents of children with and without DDs. Parent group disparities in mental health were, instead, *only* observed for those with restricted/unsupported networks.

In contrast, the associations between social network types and physical health did not differ between the two parent groups. Prior studies report conflicting findings as to whether the salutary benefits of social resources vary for parents of children with and without DDs (Gallagher and Whiteley, 2013; Lovell et al., 2012). The relationship between network resources and physical health is likely far more complex than what is portrayed in the present analysis. For instance, there

are several behavioral channels through which social relations are thought to influence physical well-being (e.g., social control, social influence; Thoits, 2011) and our network variables may not have adequately captured these constructs. Other proposed pathways linking social ties to well-being are more proximal to *psychological* functioning (e.g., self-esteem), perhaps explaining why there was greater evidence of a buffering effect for *mental health* among those with exceptional parenting responsibilities.

While social support appeared to be most salient for parents of children with DDs, the qualities of well-resourced networks also seemed to track together. That is, those with greater social support were more socially integrated and had higher quality relationships. Given this correlation, it is possible that personal investments in one domain may spill over into another. For example, community participation provides opportunities for social exchange which, in turn, could lead to increased access to supportive relationships. Future research might also consider how broader structural conditions impact the factors most relevant to parents' social network types. For instance, the contemporary COVID-19 pandemic may have imposed greater limitations on social participation than on the ability to receive social support. In addition, as web-based social interaction has become more common, parents of children with DDs may be better able to access support with less risk of stigma or judgement.

This study has several limitations. First, there are many functions of social support (e.g., instrumental, informational) that enhance individuals' abilities to cope with life challenges. Unfortunately, our data only included items concerning emotional support. MIDUS also did not assess whether respondents engaged contacts through online platforms, and social media is increasingly utilized by parents of children with DDs for information and support (Shepherd et al., 2020). We did not include a measure of spouse support in the network typology as nearly 30% of respondents were unmarried. Future research could consider exploring the role of the spousal relationship in the networks of married parents of children with DDs. We also did not have information about respondents' residential locations. Understanding geographic differences in social resources could be a fruitful area for future inquiry. Additionally, the analyses with cross-sectional data cannot provide evidence of causal relationships between network types and health. Analytical approaches that leverage longitudinal data, such as autoregressive cross-lagged panel models, are needed to make causal inferences and to test for reciprocal associations and selection effects, i.e., the possibility that health influences parents' social networks (e.g., Li and Zhang, 2015).

Based on our review of the literature, k-means is the most commonly employed method to identify social network types. However, other data segmentation and reduction techniques exist, each with advantages and disadvantages. Another limitation relates to the characteristics of the analytic sample. Respondents included in the analysis had higher than average levels of education; generalizations to the broader population should be made accordingly. We pooled data from MIDUS II and the Refresher to obtain an adequate number of parents of children with DDs. Although we controlled for the MIDUS cohort, it is possible that there was other unmeasured confounding for which the models did not account. In addition, DDs were identified using parent reports and were not clinically ascertained.

Although gradients in health have been observed between parents of children with different developmental conditions (Smith et al., 2012), the sample size did not permit a stratified analysis by disability. Our analyses also did not account for the child's level of impairment, as this information is not collected by MIDUS. Profiling the health and social networks of parents raising children with different conditions and of varying disability severity would be informative. Future studies might also consider how parents leverage disability-specific networks for resources, information, and advice.

This study also had several strengths. We report on one of the first attempts to develop a social network typology for individuals in midlife, marking a contribution to the social convoy literature which largely

focuses on older adults. The pooling together of MIDUS II and the Refresher cohorts provided a large, national sample of parents of children with DDs. These individuals did not enroll in the MIDUS study specifically to discuss their parenting experiences, thus reducing the potential for self-selection bias. The pattern-centered perspective offers an innovative approach to better understand resilience in parents of children with DDs. In particular, we characterized the multifaceted nature of parents' interpersonal contexts by accounting for an array of social relationship attributes simultaneously. Additionally, we demonstrated a novel technique that quantified the importance of each of these attributes to the social network typology. This method has practical relevance: it details which social resources were most salient to parents of children with and without DDs, and thus may be helpful for tailoring support interventions. More generally, the pattern-centered approach may be of use for practitioners working with families of children with DDs; it provides a tool to map out the array of resources to which parents have access. By assessing network types, professionals can identify which parents have heightened vulnerability – particularly with respect to mental health – and who might benefit from additional social connection.

Credit author statement

Robert S. Dembo: Conceptualization; methodology; programming; formal analysis; writing – original draft. Nick Huntington: Methodology; programming; formal analysis. Monika Mitra: Supervision; writing – reviewing and editing; project management. Abby E. Rudolph: Methodology; writing – reviewing and editing. Margie E. Lachman: Supervision; writing – reviewing and editing. Marsha R. Mailick: Writing – original draft; writing – reviewing and editing; supervision; project management.

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Appendix A. Supplementary data

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