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Item Type	Article
Authors	Gallagher, Stephen;Whiteley, Jennifer
Citation	Research in Developmental Disabilities;33 (6), pp. 2099-2105
Publisher	Elsevier
Download date	2026-06-05 22:03:54
Item License	https://creativecommons.org/licenses/by-nc-sa/1.0/
Link to Item	https://hdl.handle.net/10344/4373

Social support is associated with blood pressure responses in parents caring for children with developmental disabilities

Running head: Social support and blood pressure

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Highlights

- ▶ Caregiving is associated with high blood pressure in parents.
- ▶ Caregiving is associated with high stress and low social support in parents.
- ▶ Social support is associated with blood pressure responses in parents.
- ▶ The importance of the social support for these families was discussed.

Abstract

The present study tested whether parents caring for children with developmental disabilities would have higher blood pressure compared to parents of typically developing children (controls). It also examined the psychosocial factors underlying this observation. Thirty-five parents of children with developmental disability and thirty controls completed standard measures of perceived stress, child challenging behaviours and social support and wore an ambulatory blood pressure (BP) monitor throughout the day, for one day. Relative to controls, parents caring for children with developmental disabilities reported poorer psychosocial functioning and had a higher mean systolic BP. Of the psychosocial predictors, only social support was found to be predictive. Moreover, variations in social support accounted for some of the between group differences with the β for parental group attenuated from .42 to .34 in regression analyses. It appears that social support may influence blood pressure responses in parental caregivers. Finally, our findings underscore the importance of providing psychosocial interventions to improve the health of family caregivers.

Keywords: Blood Pressure; Caregiving; Child Challenging Behaviour; Stress; Social Support

1. Introduction

Recent research has found parents caring for a child with a developmental disability (e.g. Autism, ADHD) to have poor immune and neuroendocrine functioning (Lovell, Moss & Wetherell, 2012a; Lovell, Moss, & Wetherell, 2012b). Compared to parents of children without disabilities, parents caring for children with developmental disabilities (e.g. Autism, Down syndrome) have been found to have lower antibody responses to medical vaccinations (Gallagher, Phillips, Drayson, & Carroll, 2009a, 2009b), higher levels of proinflammatory cytokines (Lovell et al., 2012a), and greater disruptions of cortisol patterns (Seltzer et al., 2010). In fact, perturbations in these immune and neuroendocrine systems are perhaps some of the likely mechanisms underlying the poor health seen in these parents (Lach et al., 2009; Miodrag & Hodapp 2010).

Although some parents of children with developmental disabilities cope very well and derive great benefit from their caring role others struggle physically, psychologically and socially (Lovell et al., 2012a, b; Lach et al., 2009), and, usually, it is along these dimensions where they differ from control parents (Gallagher, Phillips, Oliver, & Carroll, 2008; Dunn, Burbine, Bowers, & Tantleff-Dunn, 2001; Lovell et al., 2012b; Raina et al., 2005). Further, research in these families has identified a number of key factors which include child challenging behaviours and perceived stress, to be negatively associated with psychological well-being and poor physiological functioning in parents (Brehaut, Kohen, Raina, et al., 2004; Dunn et al., 2001; Eisenhower, Baker, & Blacher, 2005; Floyd & Gallagher, 1997; Gallagher, et al., 2009a; Raina, et al., 2005; Seltzer et al., 2010; White & Hastings, 2004).

In contrast, greater social support has been found to be a strong predictor of better psychological adjustment (Brehaut et al., 2004; Dunn et al., 2001) and neuroendocrine functioning (Lovell et al., 2012b) in these parents. Moreover, the beneficial effect of social support on cardiovascular health is also well-established (for review see Uchino, Cacioppo, & Kiecolt-Glaser, 1996). Thus, given the nature of association that already exists between these psychosocial factors and the psychological and physiological health of these parents, they are likely candidates to examine in this context. To date, we know of no study that has objectively examined the blood pressure responses, or its psychosocial antecedents, in these particular parents.

Given the consensus that poor physiological functioning is associated with parental caregiving of a child with a developmental disability, it is perhaps surprising that indices of cardiovascular system functioning (e.g. blood pressure and heart rate) have not been studied in this context. This becomes more pertinent when one considers that older caregivers of dementia patients are at risk for increased coronary heart disease and stroke (Haley, Roth, Howard, & Safford, 2010; Lee, Colditz, Berkman, & Kawachi, 2003; Schulz & Beach, 1999), with increases in blood pressure one of the likely underlying mechanisms (Chobanian, et al., 2003; von Kanel et al., 2008). Moreover, like older caregivers, parents providing extraordinary care to children with developmental disabilities may also be at increased risk of elevated blood pressure. In fact, one recent study found high blood pressure to be more prevalent in women caring for adults with developmental disabilities compared to women in the general population (Yamaki, Hsieh, & Heller, 2009), albeit this was self-report blood pressure. Indeed, ambulatory monitoring of blood pressure is regarded as the gold standard for the prediction of risk related to high blood pressure and it predicts clinical outcome better than conventional blood-pressure measurements (for review see Pickering, Shimbo, & Hass, 2006)

Consequently, we compared the ambulatory blood pressure responses in parents of children with developmental disabilities to a control group, i.e., parents caring for typically developing children. The psychosocial antecedents of perceived stress, child challenging behaviours and social support that may underlie these observations were also explored. Based on the above evidence, it was predicted that parents caring for children with developmental disabilities would (a) report great levels of perceived stress and lower social support and (b) have higher blood pressure responses relative to control parents, and c) that this difference in blood pressure would be explained by group differences in levels of stress and social support.

2. Methods

2.1 Participants and procedure

Thirty-five parents of children with developmental disabilities and thirty parents of typically developing children (controls) participated. All parents were healthy and were excluded if they had medical conditions (e.g. diabetes) or were taking medication

known to influence blood pressure (e.g., anti-hypertensives). Parents of children with developmental disabilities were recruited via adverts placed in syndrome specific newsletters, special need schools and through word of mouth. In total, 50 parents expressed interest in participating and of these, 35 participated. Those who did not participate cited time-pressures and intrusion of blood pressure monitor on daily life as their reasons. Inclusion criteria for these parents were: providing home care for a child with autism, Down syndrome or other types of developmental disability (e.g. Cornelia de Lange, Smith-Magenis syndromes). Thirteen of these parents self-reported caring for a child with autism, with the remaining reporting caring for a child with other syndromes types. Controls were parents caring for typically developing children recruited via local schools, word of mouth and university advertisements. Forty responded to our call for volunteers and thirty actually participated; again, intrusion of monitor was cited for non-participation. The study was approved by the relevant Research Ethics Committee and all participants gave informed consent.

2.2 Design & Procedure

This was a between groups design involving multiple blood pressure measurements taken across a 24-hour period: cardiovascular readings, pulse rate (PR), systolic (SBP) and diastolic blood pressure (DBP) were taken every hour from 8:00AM to 22:00PM and then every two hours thereafter until 6:00AM. An average of 15 readings was obtained from parents over the course of the day which was a week day (Monday morning to Thursday night). On the morning of participation, parents were fitted with an ambulatory blood pressure monitoring device, which was pre-programmed for set time periods beforehand, and given a pack of psychosocial questionnaires to complete; questionnaires and monitors were collected the following morning. The choice of measurement times was dictated by wishing to capture both the day and night time variation in blood pressure with reduced measurement at night to limit sleep interruptions.

2.3 Demographic and Psychosocial Assessment

Participants' socio-demographics were assessed by standard questions. Participants were asked to specify the occupation of the head of household, which was scored, 1, professional (e.g. physician), 2, managerial (e.g. director), 3, non-manual/clerical (e.g. secretary), 4, manual (e.g. carpenter), 5, semi-skilled manual, (e.g. bus driver), 6, unskilled manual (e.g. labourer) which was then dichotomized into manual (e.g., carpenter, construction worker)/ non-manual (e.g. physician, teacher), as a measure of socio-economic position. To control for anthropometrical and health behaviour confounding, participants self-reported their height and weight for the calculation of their BMI (kg/m²), and were asked, on average how much they smoked (0, 1–5, 6–10, 11–20, and 21+ cigarettes per day); how much caffeine they drank each day (cup or can), 0, 1, 2, 3 +, and how much alcohol they drank (0, 1–5, 6-10, 11–20, 21–40, and 40 + units per week). Participants were also asked how many hours they spent doing exercise activities each week (0, 1-2, 3-5, 6-8, and 8+) and these were coded as, 1, 2, 3, 4, and 5 respectively; a similar question was asked for hours slept that night.

The 4-item Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983) was used to measure psychological stress over the previous month (e.g., In the past month, how often have you felt able to control the important things in your life?). Scale responses range from 0 (never) to 4 (very often) with higher scores indicating greater perceived stress. The 25-item Strengths and Difficulties Questionnaire (Goodman, 1997) was used to screen for child challenging behaviour; parents are asked to rate whether a behaviour (e.g. Often fights with other children or bullies them) is not true (0), somewhat true (1) or certainly true (2) of their child with higher scores indicating more challenging behaviours. A family-specific social support scale was used. This was the 12-item Support Functions Scale (Dunst, Trivette, & Deal, 1988) where parents are asked to rate various sources of support (e.g. 'someone to help take care of my child'), on a 5-point Likert scale ranging from 1(never) to 5(quite often) with higher scores indicating greater social support. All measures were psychometrically sound, with cronbach alphas of .75, .88 and .89 respectively and all have been used in research with these populations previously (Gallagher et al., 2009a; 2009b, White & Hastings, 2004).

2.4 Cardiovascular functioning

A TM-2430 Ambulatory Blood Pressure Monitor (A & D Medical, USA) portable device was used to measure blood pressure levels across the 24-hour period. It is recommended for use by the British Heart Foundation and has been validated for adult samples (Palatini, Frigo, Bertolo, Roman, Da Corta, & Winnicki, 1998). Participants were able to resume their normal activities with few limitations, such as not being able to shower whilst the monitor was attached and refraining from any physical activities such as sports. An initial measurement was taken before the participant began the twenty-four hour interval, in order to address any concerns regarding comfortableness when using the monitor. A&D software which works in accordance with the blood pressure monitors was used to programme, capture and analyse the blood pressure and pulse levels. For the purposes of our analyses, we adopted the procedure used by Pavek and Taube (2009), average mean values for 24-h (8:00AM to 6:00AM), average daytime (8:00AM – 10:00PM) and average night-time (12:00AM- 6:00AM) periods were used as statistical outcome variable. Night-time blood pressure was available for forty-seven parents, 19 of which were control parents. Night time data was included for the calculation of blood pressure dipping status. Absence of a night time dip in systolic blood pressure (SBP) is associated with poorer cardiovascular outcomes, including increased mortality (Fagard, 2009; Minutolo et al., 2011). Categories have been described, based on the night–day blood pressure ratio from 24-h ambulatory blood pressure recordings: “extreme dippers” (> 20% decline), “dippers” (10–20% decline), “non-dippers” (0–10% decline), and “inverted dippers” (an increase from day to night) (Ohkubo et al., 1997).

2.5 Statistical analyses

Initial analyses of group differences were by Chi-square and univariate ANOVA, with partial eta-squared (η^2_p) as the measure of effect size. Occasional differences in degrees of freedom reflect missing data from uncompleted questionnaires and blood pressure readings. Hierarchical linear regression analyses were used to test whether any of the psychosocial variables of interest were mediating the between group differences in blood pressure. Here, parental group, socio-demographics and other potential confounds were entered at Step 1 and each psychosocial variable was entered separately at Step 2. The approach described by Baron and Kenny (1986) and (Frazier, Tix, & Barron, 2004) was applied to test for mediation and has been employed in

similar samples previously (Holmbeck, Coakley, Hommeyer, Shapera, & Westhoven, 2002). In these analyses parents of children with developmental disabilities were coded as 1 and controls coded as 0.

3. Results

3.1 Group differences in socio-demographics, psychosocial factors and cardiovascular functioning

Summary characteristics of the two parental groups are presented in Table 1. As can be seen, the groups are well matched on most of the socio-demographic and health-related variables. However, parents of children with developmental disabilities were more likely to be classed as manual workers, have slept less, cared for slightly older children, and spend more time caring per day compared to control parents. In terms of psychosocial characteristics, parents of children with developmental disabilities also reported higher perceived stress, more child challenging behaviours and lower social support; the effect sizes observed for these were, partial eta-squares of (η^2_p).07, .59, and .12, respectively and these η^2_p values mostly signify medium to large effect sizes.

[Insert Table 1 about here]

Using the established cut-off criteria for SBP dipping status (Ohkubo et al., 1997), among our parents (n= 47) none were classified as extreme dippers, for the remaining categories there were, 18% vs 37% dippers, 63% vs 47% non-dippers and 19% vs 16% inverted dippers among our parents caring for children with developmental disabilities and controls respectively. Although there are more parents caring for children with developmental disabilities classed as non-dippers compared to controls, the distribution across the categories were not significantly different, $\chi^2(2) = 1.96, p = .37$.

As can be seen in Table 2, the parental groups did not differ on mean PR or DBP across the 24-h period, day time or night time. However, parents of children with developmental disabilities had higher mean 24-h SBP levels, daytime SBP, and night period SBP, relative to controls, with a partial eta-squared of .09, .17 and .10 observed in these instances. As SBP was the only cardiovascular measure that distinguished the

two parental groups all subsequent analyses focused on this index as the main outcome variable. Due to the reduced night time monitoring and in order to preserve statistical power, these analyses focused on the day time monitoring period (8:00AM to 10:00PM).

[Insert Table 2 about here]

3.2 Contribution of potential psychosocial variables to group differences in systolic blood pressure

A summary of the linear and hierarchical regression analyses¹ are presented in Table 3. As can be seen, parental group, occupation status, and age of parent were significantly associated with daytime SBP at Step 1. When child challenging behaviours were added at Step 2, parental group, $\beta = .42$, $t = 2.64$, $p = .03$, but not age of parent, $\beta = .28$, $t = 1.38$, $p = .17$, remained significant in the model. There was no significant association between challenging behaviours and SBP. A somewhat similar pattern was evident when perceived stress was added at Step 2, as no association between daytime SBP and perceived stress (see Table 3) was observed. Further, parental group, $\beta = .41$, $t = 2.54$, $p = .01$, and age of parent, $\beta = .33$, $t = 2.20$, $p = .04$, remained significant in the equation and in the case of age of parent, older parents had higher SBP. When social support was added at Step 2, parental group, remained significant, $\beta = .34$, $t = 2.35$, $p = .02$, in the equation; however, social support was a significant negative predictor of daytime SBP; high support was associated with lower blood pressure. In this analysis, β for parental group was attenuated from .42 at Step 1 to .34 at Step 2. This observation led us to statistically test whether the between group differences in SBP were partially explained by parental variations in reporting of social support. Accordingly, we tested for mediation using the Goodman test (Goodman, 1960) and found that social support mediated this association, $z = 2.04$, $p = .04$. Thus, it would seem that social support was not only associated with daytime SBP independently of parental group in these models but it accounted, at least in part, for some of the variation in group differences in SBP. This is illustrated in Figure 1.

¹ By including all potential confounds in the regressions we compromised our case to variable ratio. However, when we just include those confounds that distinguished the groups (age of child, occupation status, sleep and time caring) the results remain unchanged.

[Insert Table 3 about here]

[Insert Figure 1 about here]

4. Discussion

The present study is the first to demonstrate, objectively, that parents of children with developmental disabilities have higher blood pressure over the day than control parents. Further, it appeared that variations in social support, which were lower in parents caring for children with developmental disabilities, accounted for some of the between group differences. Our cardiovascular functioning results are also congruent with the research conducted in older caregivers (Schulz et al., 1997; Vitaliano, Zhang, & Scanlan, 2003; von Kanel, et al., 2008). The results also compliment existing studies in parental caregiver studies that have found poor immune and neuroendocrine functioning relative to controls (Gallagher, et al., 2009a; Seltzer, et al., 2010) and imply that these parents may be at increased risk of future health problems through physiological vulnerability. In fact when one considers that higher systolic blood pressure, as found in the present study, confers higher cardiovascular disease risk than diastolic blood pressure (Chobanian, et al., 2003) it reinforces the notion that caregiving is hazardous to ones health (Vitaliano et al., 2003). Further, these results seem to lend weight, and add more objective data, to the self-reporting of higher blood pressure in these particular parents that has been elsewhere (Yamaki, et al., 2009). More importantly, however, is the fact that these relatively younger caregivers more than likely facing a lifetime of caregiving, these results provide some insight into when psychosocial factors may first exert their influence on their cardiovascular health.

Adjustment for social support, but not stress or child challenging behaviours, attenuated the group differences in systolic blood pressure and those parents reporting more social support had lower blood pressure. The present findings on higher stress and low support in these parents are consistent with earlier studies (Brehaut et al., 2004; Dunn et al., 2001; Gallagher et al., 2008; Raina, et al., 2005). However, to our

knowledge, this is the first time that social support has been found not only to be associated with blood pressure in these parents, but it also partially explained the difference in SBP between them and control parents. This buffering effect of social support is broadly in line with the results of other research in parents caring for children with developmental disabilities using other health indicators (Brehaut, et al., 2004; Dunn, et al., 2001; Eisenhower, et al., 2005; Floyd & Gallagher, 1997; Lovell et al., 2012b; Raina, et al., 2005; White & Hastings, 2004). Elsewhere, social support has also been found to be associated with HPA axis functioning in these parents (Lovell et al., 2012b). Moreover, its beneficial effect on cardiovascular health and other physiological indices is also well-established (Uchino, Cacioppo, & Kiecolt-Glaser, 1996). Further, our mediation effect of social support on caregiver health is not without precedent. The adverse effects of caregiver status (e.g. caregivers to older adults vs controls) on cortisol functioning was found to be mediated by quality of social support (Kim & Knight, 2008), with caregivers reporting lower social support. More importantly however, our findings underscores the importance of providing psychosocial interventions to improve the health of family caregivers (Martire & Schulz, 2007), especially when evidence has found that their social interactions decline over time (Ray & Street, 2006; Shattuck, Wagner, Narendorf, Sterzing, & Hensley, 2011), depriving them of the much needed support. Thus, it could be that the mismatch between the availability of social support and the perceived need for it could result in a lowered perception of social support availability in these parents, leading in turn to increases of blood pressure.

The present study has a number of limitations. Our sample size might be regarded as small, but it is the same order of magnitude as other caregiver-control studies (Gallagher, et al., 2009a; Lovell et al., 2012a). In addition, these samples are notoriously time-pressured and in general are a hard to reach population. However, future studies should aim to recruit larger samples to try and elicit whether there are differences in ‘dipping status’ between these two groups. Although we did not find any associations between child challenging behaviours, stress and blood pressure, the direction of the associations were in the expected direction; again, this could be attributed to statistical power. Further, this data is cross-sectional and longitudinal study designs would be better able to test these bi-directional relationships. There is also the possibility of confounding as a result of unmeasured variables (e.g. exercise over the day, oral contraceptive use) or imperfect matching among participants (e.g. other chronic stressors such as bereavement). Nonetheless, our main

finding survived statistical adjustment for a number of potential demographic and health behaviour confounders and most likely the perceived stress scale would have captured the varying stress levels among our groups. Further, it is hard to difficult to know whether mothers of children with developmental disabilities are more or less likely to use the oral contraceptive than mothers of typically developing children. Moreover, we instructed the participants to refrain from exercise over the day and even when we controlled for time spent caring over the day, a likely marker of activity, the effects were still evident. In addition, our disability sample was a mixed syndrome group, thus it could be that different caregiving and psychosocial factors are at play across disability subtypes. Finally, the measurements took place on a weekday and not at the weekend when the parents are more than likely to be providing increased childcare due to lack of school time. Thus, future studies could explore whether these effects are attenuated or exacerbated at weekends.

In conclusion, the negative impact of caregiving on blood pressure is not restricted to older caregivers, but is also evident in parents caring for children with developmental disabilities. Our results also extend the existing research. As well as having poorer immune and neuroendocrine functioning, our findings demonstrate that their cardiovascular system is equally affected. Moreover, Vitaliano and colleagues (Vitaliano, et al., 2003) located these types of physiological measures early in the causal model leading to poor health outcomes in caregivers, and so it is also conceptually consistent that these measures may be an early warning sign of poor health in these parental caregivers, who often face a lifetime of caregiving. Further, it would appear that social support may influence whether or not blood pressure responses are compromised in parents caring for children with developmental disabilities. Finally, these data indicate that social support may be a key determinant of parental caregivers' cardiovascular health and that interventions targeting such behaviours may bring health benefits.

Acknowledgement

The authors had no potential conflicts of interest and no authors had received any other sources of funding for this study. We would like to thank the Social Issues Reading Group at our University for reading earlier drafts of our manuscript.

Conflict of Interest

None

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Table 1. Demographic, health-related, psychosocial characteristics and cardiovascular functioning of parenting caring for children with developmental disabilities (caregivers) and parental controls (controls)

	Caregivers (N = 35)	Controls (N = 30)	Test of difference
Sex (Female)	31 (84%)	22 (69%)	$\chi^2(1) = 2.17, p = .14$
Marital Status (Partnered)	32 (87%)	27 (87%)	$\chi^2(1) = 0.15, p = .94$
Ethnicity (Caucasian)	34 (97%)	30 (100%)	$\chi^2(1) = 0.87, p = 0.34$
Occupational status (Professional)	18 (55%)	24 (80%)	$\chi^2(1) = 4.58, p = .03$
Mean BMI (SD)	26.4 (5.45)	27.8 (4.50)	F (1,58) = 1.34, $p = .25$
Mean Sleep (SD)	3.5 (0.50)	4.0 (0.82)	F (1,63) = 8.19, $p = .006$
Mean age (SD) years	41.3 (8.56)	40.1 (7.11)	F (1,63) = 0.37, $p = .55$
Mean age of main care recipient (SD) years	10.2 (3.75)	8.5 (4.22)	F (1,63) = 3.23, $p = .07$
Mean hours caregiving (SD) per day	9.8 (5.95)	6.5 (4.94)	F (1,63) = 7.0, $p = .004$
Mean SDQ score (SD)	17.5 (3.45)	10.1 (2.04)	F (1,60) = 89.51, $p < .001$
Mean PSS score (SD)	6.7 (3.28)	5.3 (2.88)	F (1,63) = 3.86, $p = .05$
Mean Social Support score (SD)	35.6 (7.06)	41.0 (10.45)	F (1,62) = 8.04, $p = .006$

*Significant differences are highlighted in **bold**.

Table 2: Ambulatory blood pressure (BP; mmHg) and pulse rate (PR; beats/min) for parents caring for children with developmental disabilities (caregivers) and parents of typically developing children (controls)

	Caregivers	Controls	Test of difference
	Mean (SD)	Mean (SD)	
SBP			
24-h	132.3 (11.81)	125.8 (6.13)	F (1,45) = 7.72, <i>p</i> = .03
Daytime	128.7 (11.03)	120.2 (6.96)	F (1,63) = 13.37, <i>p</i> < .001
Night	113.8 (17.18)	103.7 (9.90)	F (1,45) = 4.87, <i>p</i> = .03
DBP			
24-h	79.8 (9.66)	76.8 (5.32)	F (1,45) = 1.62, <i>p</i> = .21
Daytime	78.5 (8.86)	74.9 (7.05)	F (1,63) = 3.11, <i>p</i> = .08
Night	66.5 (12.62)	61.3 (8.23)	F (1,45) = 2.45, <i>p</i> = .12
PR			
24-h	74.6 (7.47)	76.1 (7.28)	F (1,45) = 0.45, <i>p</i> = .54
Daytime	76.5 (7.94)	76.9 (6.50)	F (1,63) = 0.72, <i>p</i> = .78
Night	65.5 (17.54)	71.4 (10.69)	F (1,45) = 1.73, <i>p</i> = .19

*Significant differences are highlighted in **bold**.

Table 3. Summary of hierarchical regressions predicting daytime SBP in parents caring for children with developmental disabilities and controls

Variables	β	t	p	95 % CI	R ²	ΔR^2
Step 1						
Parental group	.42	2.52	.01	3.8, 13.2		
Gender	-.10	-0.64	.52	-5.9, 4.8		
Marital status	-.26	-1.80	.08	-10.5, .9		
Ethnicity	.14	0.97	.33	-6.7, 31.1		
Occupational status	-.26	-1.79	.08	-9.2, .8		
Time caregiving per day	.04	-0.22	.82	-1.3, 1.2		
Age of parent	.33	2.05	.04	.1, .5		
Age of child	.04	0.23	.72	-3.3, .9		
Exercise per week	-.06	-0.46	.64	-2.9, 1.1		
Number of cigarettes	.15	1.21	.26	-.8, 3.0		
Alcohol units per week	-.07	-0.44	.66	-2.6, .8		
Caffeine per day	-.12	-0.70	.46	-2.7, .9		
Hours slept that night	.12	0.80	.43	-1.8, 5.3		
BMI	-.14	-0.78	.45	-1.3, .2		
					.39	
Step 2						
Problem behaviour	.15	0.65	.52	-.8, .6	.40	.01
Stress	.12	.81	.40	-.6, .9	.40	.01
Social support	-.39	-2.60	.01	-.6, -.1	.48	.11

*Significant associations are highlighted in **bold**.

Figure captions

Figure 1. Mediation analysis of the association between parental group and daytime

SBP for social support: statistics are standardised regression coefficients

