

Accepted Manuscript

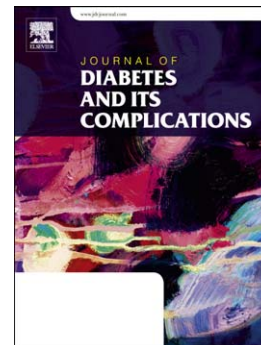
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PII: S1056-8727(16)30285-9
DOI: doi: [10.1016/j.jdiacomp.2016.07.006](https://doi.org/10.1016/j.jdiacomp.2016.07.006)
Reference: JDC 6794

To appear in: *Journal of Diabetes and Its Complications*

Received date: 8 April 2016
Revised date: 22 June 2016
Accepted date: 13 July 2016



Please cite this article as: Joensen, L.E., Willaing, I., Holt, R.I.G., Wens, J., Skovlund, S. & Peyrot, M., Household composition and psychological health: Results of the second Diabetes Attitudes, Wishes and Needs (DAWN2) study, *Journal of Diabetes and Its Complications* (2016), doi: [10.1016/j.jdiacomp.2016.07.006](https://doi.org/10.1016/j.jdiacomp.2016.07.006)

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Household composition and psychological health:**Results of the second Diabetes Attitudes, Wishes and Needs (DAWN2) study**

Lene E Joensen ¹, Ingrid Willaing ¹, Richard IG Holt ²,

Johan Wens ³, Søren Skovlund ⁴, Mark Peyrot ⁵

¹Steno Diabetes Center, Gentofte, Denmark, ²University of South Hampton, Southampton, UK,

³University of Antwerp, Antwerp, Belgium, ⁴Novo Nordisk, Copenhagen, Denmark

⁵Loyola University Maryland, Baltimore, MD, USA.

Correspondence to:

Lene E. Joensen

Niels Steensens Vej 6

DK-2820 Gentofte

Denmark

+45 3075 5281 (phone)

ljoe@steno.dk

Word count:

Abstract: 198. Main manuscript: 3687 words. 4 tables (1215 words)

STRUCTURED ABSTRACT

Aims: 1) to explore the effect of household composition on the psychological health of adults with diabetes by comparing those living with other adult(s) including a partner with those living with neither partner nor other adult(s); 2) to examine potential mediation of social support in the association between household composition and psychological health.

Methods: The study is part of the DAWN2 study conducted in 17 countries. The population comprised 8,596 people with diabetes (PWD). Multiple regression models (linear and binary) were applied.

Results: People living with ‘other adult(s) but no partner’ experienced significantly lower *well-being*, higher *diabetes distress* and worried more frequently about *hypoglycaemic events* than those with a partner or those not co-habiting with another adult. However, participants living with ‘other adult(s) but no partner’ were more empowered compared to the other household composition groups. The association between household composition and psychological health was not mediated by diabetes-specific social support.

Conclusions: The study indicates the psychological vulnerability of respondents living without a partner but with other adult(s). Appropriate support interventions must be developed and tested in order to enhance psychological health in people with diabetes living with other adults such as adult children, but with no partner.

Keywords: psychological health, household composition, social network, social support.

1 INTRODUCTION

Diabetes is associated with poor psychosocial health including diabetes distress and low quality of life [1-3]. Living with diabetes involves and is influenced by the context in which people live. However, research focusing on the importance of social network (structural dimensions of social relations) is limited in the diabetes literature, also with regards to the influence of social network on psychological health.

Living without a partner is one measure of social network and is associated with poor health and higher mortality in the general population and among people with chronic diseases including heart disease [4-8]. Few studies have explored cohabitation status as a determinant of quality of life, psychological well-being or glycaemic control in adults with diabetes. These studies suggest an association between living without a partner and poor quality of life, poor psychological well-being and poor glycaemic control [7-12] but these studies do not explain this association. Social support may mediate the relationship between cohabitation and health outcomes [13,14], which raises the question of whether associations between cohabitation and diabetes outcomes primarily reflect living with a supportive person. Exploring household social relationships by cohabitation status alone ignores people living without a partner who may live with an alternative source of adult support, e.g., parent or adult offspring. Household composition is a broader indicator of day-to-day social support from different household members. Different social relations all provide the opportunity for social support, but it is likely that close relationships - such as marital relationships - influence psychological health to a greater extent than less close relationships [15]. Based on this, we hypothesized that 1) adult household members of people with diabetes all provide social support with beneficial impact on psychological well-being; 2) people living with a partner have better psychological well-being than people who live without a partner, but with other adults; 3) people living with

other adults have higher psychological well-being than people living without adult support persons.

The second Diabetes, Attitudes, Wishes and Needs (DAWN2) study is a multinational study that provides a holistic assessment of diabetes care and management among people with diabetes and includes information from a variety of perspectives on psychological health, social support provision and social support impact [16]. The DAWN2 study offers a unique possibility to explore the psychosocial characteristics of people from different household compositions in a broad context.

The aim of this study was to compare the psychological health of people with diabetes living with or without another adult, including the significance of relationship of that adult to the person with diabetes. The study explored psychological health outcomes between four different household compositions: living with a partner and other adult(s), living with a partner but no other adult(s), living with other adult(s) but no partner, living with neither partner nor other adult(s) and examined the role of social support level from different support providers.

2 SUBJECTS

The present analysis is part of the DAWN2 study, a cross-sectional survey, which was conducted during 2012 in 17 countries across four continents. The population comprised 8,596 people with diabetes (1,368 with type 1 diabetes and 7,228 with type 2 diabetes), with approximately 500 from each country (80 and 420 with type 1 diabetes and type 2 diabetes respectively). The population, design, methodology and validated measures of the DAWN2 study have been thoroughly described in previous publications [16,17].

3 MATERIAL AND METHODS

3.1 Measures

Household composition was measured by the question “What is your current living situation? Do you live with...” which included eight multiple responses 1) a spouse/partner, 2) son/daughter(s) under 18 years of age 3) with son/daughter(s) ages 18 years or over 4) with parent(s) 5) other adult relative(s), 6) other non-adult relative adult(s), 7) other child(ren) under 18 years of age and 8) alone. For the purpose of this study, the question was grouped into a) living with a partner and other adult(s), b) living with a partner and no other adult(s), c) living with other adult(s) but no partner, d) living with neither partner nor other adult(s). All four categories included people with and without children under 18 years of age (Table 1).

Participant characteristics included age, gender, presence of complications, college education (no/at least some) and diabetes type. People with type 1 diabetes were defined as those diagnosed aged <30 years and who started insulin treatment at diagnosis and continued to use insulin. Individuals with type 2 diabetes were defined as those diagnosed aged ≥ 30 years and who did not start insulin treatment at diagnosis. People with type 2 diabetes were furthermore divided by treatment (non-medicated, non-insulin medication and insulin treated).

The exploration of diabetes-specific social support was divided into *social support provision* (who and how many people provide support for people with diabetes) and *social support level* (what is the level of the support received). *Diabetes-specific social support provision* included a measure developed for the DAWN2 study that assessed which person was most involved in helping the respondent manage diabetes other than health care professionals. The answer categories of the measure were spouse/partner, son/daughter aged 18 years and above, parent, other adult relative, other non-adult relative and none of the people listed. A question about the number of people to whom respondents could talk about

their diabetes (other than Health Care Professionals) was also included as a measure of social support provision. *Diabetes-specific social support level* was measured by the DAWN Support for Diabetes Self-Management Profile (DSDSP). This measure explored how supportive five potential support providers had helped the respondent manage diabetes over the past 12 months. The potential support persons included family, friends and people close to the person with diabetes, people at work, health care team and other people in the community. Answer categories were “not supportive”, “somewhat supportive” and “very supportive”. A composite score of the five questions was also used with scores ranging from 0 (no support) to 100 (maximum support from all the people listed). We also explored the level of social support individually for the five types of support providers using dichotomized versions of the single items indicating high to moderate support (somewhat or very supportive) vs. low support (not supportive) from the provider.

Psychological outcomes included: WHO Well-Being Index (WHO-5) composite score [18] and Problem Areas in Diabetes Scale 5 (PAID-5) composite score [19]. Worry of hypoglycaemia was measured as the percentage of participants reporting “mainly agree” or “fully agree” that they worry about hypoglycaemic events and percentage of participants reporting “mainly agree” or “fully agree” that they worry about night-time hypoglycaemia. Diabetes empowerment was measured by the Diabetes Empowerment Scale-DAWN short form (DES-DSF) composite score ranging from 0 (not empowered) to 100 (maximum empowerment) [17]. DES-DSF focuses on the participants’ capability to manage their own diabetes and engage in activities to improve care for other people with diabetes, measured by five questions e.g., “you seek out the information you need to manage your diabetes”. Answer categories ranged from never (1) to always (5).

3.2 Statistical analyses

Data were weighted in comparison with the general population in each country in terms of age, gender and level of education.

Multiple regression analyses (linear and binary) were performed to explore differences between the four groups with regards to psychological health. Multilevel regression models were applied to adjust for clustering within countries. Main analyses exploring the associations between household composition and psychological aspects of diabetes were performed adjusted for age, gender, educational level, diabetes duration and type of diabetes (model 1). Associations between household composition and psychological outcomes were further adjusted for diabetes-specific social support by including level of support from family and friends and number of people to talk to about diabetes as a third step in the models (model 2). If the association between household composition and psychological outcome was statistically non-significant after this final adjustment, the impact of cohabitation status was interpreted as fully mediated by diabetes-specific social support. To elaborate further the role of diabetes-specific social support, the association between diabetes-specific social support and psychological outcomes was explored with multiple regression analyses for each diabetes-specific social support measure (most involved person in diabetes management, number of people to talk to about diabetes and social support level (DSDSP)) including age, gender, diabetes duration, educational status and diabetes type but not household composition.**4 RESULTS**

4.1 Participant characteristics

Table 1 shows the characteristics of participants by household composition. The analyses showed significant country differences with regards to household composition, e.g., people living with a partner and other adult(s) ranged from 6.2% in Denmark to 37.5% in India. With regards to diabetes type, the unadjusted analyses showed that the rate of people with type 1 diabetes was significantly higher in people living with ‘other adult(s) and no partner’ compared to the other household composition groups. Significant differences were also found with regards to age, diabetes duration and college education (Table 1).

Almost two thirds of those living with ‘other adult(s) but no partner’ live with their adult children. Approximately one quarter lives with their parents while one quarter lives with other adults. In comparison 87% of people living with ‘partner and other adult’ live with their adult children, approximately 12% with parents and approximately 12% with other adults (Table 1).

4.2 Diabetes-specific social support

Table 2 shows the distribution of social support provision and social support level by household composition. As expected the most important person from whom support was provided differed between the groups; for example people living only with a partner more often indicated their partner as most supportive person. Furthermore, 57% of people with diabetes living ‘with neither partner nor other adult’ indicated no adult as the most supportive person. In comparison, the proportion of people with no adult support was 12% in people living with ‘partner and other adult’. Also significantly more people with diabetes living with ‘neither partner nor other adult’ indicated that they had no one to whom they could talk about their diabetes compared to the other groups. The overall differences in diabetes-specific social support provision remained significant after adjustment for age, gender, diabetes duration, education and diabetes type.

Differences in household composition were associated with diabetes-specific social support level; participants living with ‘neither partner nor other adults’ had the lowest levels of social support when compared to the other groups, except for support from health care professionals. No difference was seen in level of overall diabetes-specific social support (DSDSP score) between ‘partner and other adult’, ‘partner but no other adult’ and ‘other adult but no partner’ and only small differences were seen in relation to support from family and friends.

4.3 Psychological aspects of diabetes

Psychological well-being and diabetes distress: *Psychological well-being* was lowest and *diabetes distress* was highest among people with diabetes living with ‘other adult(s) but no partner’ compared to the other household composition groups. By contrast, people living with ‘partner and no other adult(s)’ had significantly better psychological well-being than people living with ‘partner and other adult(s)’ (Table 3). Overall, the analysis showed no significant

differences between people living with “neither partner nor other adult” and people living with a partner with regards to level of distress or well-being. However, the results showed a tendency towards people living with ‘partner and no other adult(s)’ to have the best psychological well-being, as the difference between people living with ‘a partner and no other adult’ and ‘neither partner nor other adult’ was borderline significant ($p=0.09$).

Worries about hypoglycaemia: People living with ‘other adult(s) but no partner’ more frequently *worried about hypoglycaemic events* (overall and nocturnal events) compared to all other groups. Furthermore, people living with ‘partner and other adult(s)’ worried more frequently about hypoglycaemia compared to people with ‘neither partner nor other adult(s)’.

Diabetes empowerment: Contrary to the other psychological outcomes, participants living with ‘other adult(s) but no partner’ were slightly more empowered than all other household compositions groups. People living with ‘partner and other adult(s)’ had lowest empowerment compared to the other household composition groups. No differences were found between people living with ‘partner but no other adult’ and people living with ‘neither partner nor other adult’ with regards to diabetes empowerment.

4.4 Influence of diabetes-specific social support on the association between household composition and poor psychological health

The analyses adjusting for diabetes-specific social support changed the differences between household composition and psychological outcomes only slightly (Table 3, model 2). The only additional significant differences found after including diabetes-specific social support in the analyses, were significantly higher diabetes distress among people living with ‘partner and other adult(s)’ when compared to people living with ‘neither partner nor other adult(s)’. Furthermore, there was no longer a difference in level of empowerment or worrying about nocturnal hypoglycaemia between people living with ‘partner and other adult(s)’ and

people with ‘neither partner nor other adult(s)’. However, after inclusion of diabetes-specific social support in the analyses people living with ‘partner but no other adults’ had significantly higher diabetes empowerment compared to people living with ‘neither partner nor other adult’.

4.5 Association between diabetes-specific social support and psychological health

Support provision: The analyses showed significant associations between perceiving ‘spouse/partner’ as the most supportive person and higher psychological well-being and higher diabetes empowerment (Table 4). However, those indicating ‘no adult(s)’ as most supportive person worried less about hypoglycaemic events and had less diabetes distress compared to those with an adult supporter. Those indicating ‘other adult(s)’ as most supportive person experienced lowest well-being, worried most frequently about hypoglycemic events and had the highest level of diabetes distress, but also the highest level of diabetes empowerment.

Participants indicating ‘no one to talk to about own diabetes’ had lower psychological well-being and lower diabetes empowerment, but worried less about hypoglycaemic events and had lower diabetes distress.

Social support level: Those experiencing high to moderate diabetes-specific social support (from all listed support providers) had significantly better well-being and higher diabetes empowerment (Table 4). Those experiencing high to moderate support from people at work or school had significantly lower diabetes distress. Those experiencing high to moderate support from family, friends, people at work/school or others had significantly higher worry about hypoglycemia.

5 DISCUSSION

This study shows that people living with other adult(s) but no partner have lower psychological well-being, higher distress, and more frequent worries about hypoglycemia, but have slightly higher diabetes empowerment compared to those with other household compositions. This is not explained by difference in diabetes-specific social support from family or friends or having people to talk to about diabetes in general. Furthermore, people that indicate another adult as most supportive person have lower psychological health compared to both people having primary support from a partner or no adult(s).

Previous studies have shown that people living without a partner have less social support and lower psychological well-being compared to people living with a partner [13,14,20]. However, our study shows that a large proportion of people living without a partner lives with other adult(s) and that the level of social support of these people does not differ markedly from people living with a partner. Surprisingly, living with an adult other than a partner was not associated with better psychological outcomes when compared to people living without support. On the contrary, living with another adult other than a partner is associated with worse psychological health. This was seen when comparing people living with only a supportive adult to people living with no support, as well as when comparing people living with a partner and another adult person to people living exclusively with a partner. This psychological vulnerability of people living with other adults may be explained by higher relationship strain experienced in this group. The characteristics of a relationship with other adults, such as a parent or adult child, differ from the relationship with a partner and may cause more conflicts or demands with regards to diabetes. Studies in type 1 diabetes have shown that adolescents with diabetes experience being scrutinised, blamed and controlled by their parents [21,22]. With regards to the relational strain of people with diabetes living with an adult child, the DAWN 2 study showed that family members of people with diabetes generally experience a high degree of distress [23]. It is likely that a

child's worries affect the parent with the disease to a higher degree than that of other support persons. However, very little is known about the effect of parenting while living with a chronic illness and we do not know if people living with other adults experience higher social strain, as the measures of social support used in the study do not reflect this, .

Our data showed a higher frequency of complications among those living with other supportive adults. Diabetes complications are associated with poor glycemic control [24] and may be a sign of struggling to manage diabetes. Another explanation of the psychological vulnerability of people living with other adults than partners may reflect more difficulties in managing their diabetes. However, our study also showed slightly higher empowerment in people living with another supportive adult, which indicates that they feel more capable of managing diabetes compared to people living alone or with a partner. As this group also has the lowest psychological well-being, the slightly higher empowerment may indicate that having to rely on oneself in day-to-day management of diabetes results in greater strain. Further studies are needed to explain the psychological vulnerability of people living with other adult(s) than a partner.

It is also surprising that, despite experiencing the lowest level of social support and being the most likely to report having no one to talk to, people living with no adults did not have the lowest psychological well-being. This indicates that social support may not be the most important element in obtaining psychological well-being in people with diabetes. Our study did not include factors such as self-management behaviors or glycemic control that are also related to psychological health [25,26].

A main limitation of this study is the cross-sectional design preventing conclusions about the causality of the relationships between cohabitation status and psychological health in people with diabetes. Furthermore, the participant recruitment was through mass invitations and may have led to self-selection of people who are less vulnerable to low social resources.

Study participants with low social resources may therefore have better psychological health compared to non-participants with the same level of social support and the associations between household composition, social support and psychological health may be underestimated. The measures used in the study are all self-reported and proxies for more complex phenomena. For example, we only included some aspects of social relations and future research could benefit from exploring social relations more broadly. A thorough description of strengths and limitations of the DAWN2 study has been published in earlier papers [16].

Future research is needed into mechanisms of interactions between social network, social support and psychological well-being also with regards to potential subgroup differences, as for example gender and age influence the preferences and needs for social support [27]. This multinational study indicates psychological vulnerability of respondents living without a partner but with other adults. A focus on differences in social resources among people with diabetes is relevant in clinical practice, as well as the impact of low social resources on psychological well-being. Appropriate support interventions must be developed and tested in order to enhance psychological health in people with diabetes living with other adults such as adult children, but with no partner.

ACKNOWLEDGEMENTS

The DAWN2 Study Group consists of a lead national investigator from each country and members of the DAWN2 IPPC: Rachid Malek, Algeria; Johan Wens, Belgium; João Eduardo Salles, Brazil; Katharina Kovacs Burns and Michael Vallis, Canada; Xiaohui Guo, China; Ingrid Willaing and Søren Eik Skovlund, Denmark; Gerard Reach, France; Norbert Hermanns and Bernd Kulzer, Germany; Sanjay Kalra, India; Antonio Nicolucci and Marco Comaschi, Italy; Hitoshi Ishii, Japan; Miguel Escalante, Mexico; Frans Pouwer, the Netherlands; Andrzej Kokoszka, Poland; Alexander Mayorov, Russian Federation; Edelmiro

Menéndez Torre, Spain; Ilhan Tarkun, Turkey; Melanie Davies, Richard Holt, Angus Forbes, and Neil Munro, UK; Mark Peyrot, USA. The authors acknowledge the contribution of the International Diabetes Federation and the numerous other international and national experts and patient advocates who have contributed directly to the design of the DAWN2 study during 2010–2011. The complete list of study experts and ‘people with diabetes’ advisers is available at www.dawnstudy.com. All DAWN2 surveys were conducted by Harris Interactive Inc., an independent research organization. The authors acknowledge Anna Ginovker of Harris Interactive for directing the global fieldwork and Bioscript Medical Ltd for providing assistance with obtaining ethical approvals in several countries, as well as Tawhid Ahmad and Helen Swainston of Bioscript Medical Ltd for medical writing and editorial support. Harris Interactive conducted the surveys and provided expertise in designing the questionnaires and planning survey implementation, including sampling frames and strategies, questionnaire administration strategies, weighting criteria, etc. Giuseppe Lucisano from Consorzio Mario Negri Sud performed the initial coding of the measures used in this study

The DAWN2 study is funded by Novo Nordisk A/S.

CONFLICTS OF INTEREST

L.J. and I.W. are employed by Steno Diabetes Center A/S, a research hospital working in the Danish National Health Service and owned by Novo Nordisk A/S. Steno Diabetes Center receives part of its core funding from unrestricted grants from the Novo Foundation and Novo Nordisk IW has acted as an advisory board member for Novo Nordisk A/S. RIGH has received funding for travel and accommodation to attend DAWN2 IPPC meetings, but has not received any fee for this work from Novo Nordisk. He has acted as an advisory board member and speaker for Novo Nordisk, and as a speaker for Sanofi-Aventis, Eli Lilly, Otsuka and Bristol-Myers Squibb. He has received grants in support of investigator

trials from Novo Nordisk. JW has acted as an advisory board member for Eli Lilly, Bristol-Myers Squibb/AstraZeneca and Novo Nordisk. SS is an employee of Novo Nordisk A/S, Copenhagen, Denmark. MP has recently received research grants and/or consulting fees from Amylin, Genentech, Eli Lilly, MannKind, Medtronic and Novo Nordisk. He has received speaking honoraria from Novo Nordisk and has participated in advisory panels for Novo Nordisk and Roche. He has received financial support from Novo Nordisk for his participation as Principal Investigator for the DAWN2 study.

ACCEPTED MANUSCRIPT

REFERENCES

1. Peyrot M, Rubin RR, Lauritzen T, Snoek FJ, Matthews DR, Skovlund SE. Psychosocial problems and barriers to improved diabetes management: Results of the Cross-National Diabetes Attitudes, Wishes and Needs (DAWN) Study. *Diabet Med.* 2005;22(10):1379-85.
2. Holt RIG, Nicolucci A, Kovacs Burns K, Escalante M, Forbes A, Hermanns N, et al. Diabetes Attitudes, Wishes and Needs second study (DAWN2): Cross-national comparisons on barriers and resources for optimal care -- healthcare professional perspective. *Diabet Med.* 2013;30(7):789-98.
3. Egede LE, Dismuke CE. Serious psychological distress and diabetes: A review of the literature. *Current Psychiatry Reports.* 2012;14(1):15-22.
4. Berkman LF, Syme SL. Social networks, host resistance, and mortality: a nine-year follow-up study of Alameda County residents. *Am J Epidemiol.* 1979;109(2):186-204.
5. House JS, Landis KR, Umberson D. Social relationships and health. *Science.* 1988;241(4865):540-5.
6. Nilsson PM, Nilsson JA, Ostergren PO, Berglund G. Social mobility, marital status, and mortality risk in an adult life course perspective: the Malmo Preventive Project. *Scand J Public Health.* 2005;33(6):412-23.
7. Eller M, Holle R, Landgraf R, Mielck A. Social network effect on self-rated health in type 2 diabetic patients--results from a longitudinal population-based study. *Int J Public Health.* 2008;53(4):188-94.
8. Metayer C, Coughlin SS, McCarthy EP. Marital status as a predictor of survival in idiopathic dilated cardiomyopathy: the Washington DC dilated cardiomyopathy study. *Eur J Epidemiol.* 1996;12(6):573-82.
9. Lloyd CE, Wing RR, Orchard TJ, Becker DJ. Psychosocial correlates of glycemic control: The Pittsburgh Epidemiology of Diabetes Complications (EDC) study. *Diabetes Research and Clinical Practice.* 1993;21(2-3):187-95.
10. Hart HE, Bilo HJ, Redekop WK, Stolk RP, Assink JH, Meyboom-de JB. Quality of life of patients with type I diabetes mellitus. *Qual Life Res.* 2003;12(8):1089-97.
11. Peyrot M, McMurry J, Kruger DF. A biopsychosocial model of glycemic control in diabetes: Stress, coping and regimen adherence. *Journal of Health and Social Behavior.* 1999;40(2):141-58.
12. Wikby A, Hornquist JO, Andersson PO. Background, quality of life and metabolic control in patients with insulin-dependent diabetes mellitus. *Diabetes Research and Clinical Practice.* 1991;13(1-2):53-61.
13. August KJ, Sorkin DH. Marital status and gender differences in managing a chronic illness: The function of health-related social control. *Social Science and Medicine.* 2010;71(10):1831-8.
14. Gove WR, Hughes M, Style CB. Does marriage have positive effects on the psychological well-being of the individual? *Journal of Health and Social Behavior.* 1983;24(2):122-31.
15. Berkman LF, Glass T, Brissette I, Seeman TE. From social integration to health: Durkheim in the new millennium. *Social Science & Medicine.* 2000;51(6):843-57.
16. Peyrot M, Burns KK, Davies M, Forbes A, Hermanns N, Holt R, et al. Diabetes attitudes Wishes and Needs 2 (DAWN2): A multinational, multi-stakeholder study of psychosocial issues in diabetes and person-centred diabetes care. *Diabetes Research and Clinical Practice.* 2013;99(2):174-84.
17. Nicolucci A, Kovacs Burns K, Holt RIG, Comaschi M, Hermanns N, Ishii H, et al. Diabetes Attitudes, Wishes and Needs second study (DAWN2): Cross-national benchmarking of diabetes-related psychosocial outcomes for people with diabetes. *Diabetic Medicine.* 2013;30(7):767-77.
18. Bech P, Gudex C, Staehr Johansen K. The WHO (Ten) well-being index: Validation in diabetes. *Psychotherapy and Psychosomatics.* 1996;65(4):183-90.

19. McGuire BE, Morrison TG, Hermanns N, Skovlund S, Eldrup E, Gagliardino J, et al. Short-form measures of diabetes-related emotional distress: The Problem Areas in Diabetes Scale (PAID)-5 and PAID-1. *Diabetologia*. 2010;53(1):66-9.
20. Kawachi I, Berkman L. Social ties and mental health. *J Urban Health Journal of Urban Health*; 2001: Springer-Verlag; 2001. p. 458-67.
21. Weinger K, O'Donnell KA, Ritholz MD. Adolescent views of diabetes-related parent conflict and support: A focus group analysis. *Journal of Adolescent Health*. 2001;29(5):330-6.
22. Leonard BJ, Garwick A, Adwan JZ. Adolescents' perceptions of parental roles and involvement in diabetes management. *Journal of Pediatric Nursing*. 2005;20(6):405-14.
23. Kovacs Burns K, Nicolucci A, Holt RIG, Willaing I, Hermanns N, Kalra S, et al. Diabetes Attitudes, Wishes and Needs second study (DAWN2™): Cross-national benchmarking indicators for family members living with people with diabetes. *Diabetic Medicine*. 2013;30(7):778-88.
24. The Diabetes Control and Complications Trial Research Group. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. *N Engl J Med* 1993;329:977-986.
25. Fisher L, Mullan JT, Arean P, Glasgow RE, Hessler D, Masharani U. Diabetes distress but not clinical depression or depressive symptoms is associated with glycemic control in both cross-sectional and longitudinal analyses. *Diabetes Care*. 2010;33(1):23-8.
26. Skovlund SE, Peyrot M. The Diabetes Attitudes, Wishes, and Needs (DAWN) program: A new approach to improving outcomes of diabetes care. *Diabetes Spectrum*. 2005;18(3):136-42.
27. Due P, Holstein Br, Lund R, Modvig J, Avlund K. Social relations: network, support and relational strain. *Social Science and Medicine*. 1999;48(5):661-73.

Table 1. Characteristics of PWD by household composition

	Partner and other adult(s) n=1661	Partner but no other adult(s) n=4211	Other adult(s) but no partner n=1241	Neither partner nor other adult(s) n=1483
Age, mean years (SD)	54.4 (11.8)	55.2 (12.6)	55.3 (15.9)	60.0 (10.8)
Female, % (n) ^a	47.4 (755)	44.2 (1818)	64.1 (716)	57.3 (784)
Diabetes type, % (n) ^a				
Type 1 diabetes	10.5 (222)	14.4 (638)	17.5 (279)	13.4 (229)
Type 2 non-medicated	18.3 (303)	19.8 (833)	16.7 (238)	20.0 (326)
Type 2 non-insulin	38.2 (603)	36.1 (1441)	34.0 (396)	35.9 (497)
Type 2 insulin	33.0 (533)	29.7 (1299)	31.8 (328)	30.7 (431)
Diabetes duration, mean years (SD) ^a	9.6 (10.1)	11.4 (10.5)	11.3 (10.5)	14.3 (9.4)
With complications, % (n) ^a	69.6 (1223)	63.3 (2939)	79.0 (932)	73.8 (1118)
At least some college educationa, % (n)	85.7 (964)	78.3 (2189)	79.5 (721)	62.6 (686)
Lives with...., % (n) ^{ab}				
Son/daughter(s) under 18 years of age	25.4 (421)	22.8 (961)	11.0 (137)	12.9 (191)
Son/daughter(s) aged 18 years and above	87.0 (1408)	0	64.8 (594)	0
Parents	11.7 (216)	0	24.6 (473)	0
Other adults relatives	10.5 (173)	0	20.2 (268)	0
Other non-relative adults	1.0 (55)	0	4.7 (86)	0
Live alone	0	0	0	88.4 (1273)
Country, % (n) ^a				
Mexico	22.5 (111)	42.2 (212)	28.8 (133)	8.6 (44)
US	9.7 (52)	55.2 (280)	11.2(62)	23.9 (145)
Canada	10.4 (62)	55.2 (256)	11.0 (61)	26.1 (121)
France	11.9 (75)	60.3 (272)	6.8 (46)	21.0 (107)
Germany	8.5 (41)	54.6 (269)	9.0 (47)	27.8 (145)
Netherlands	13.8 (67)	54.7 (273)	3.8 (20)	28.3 (142)
Denmark	6.2 (31)	64.4 (323)	2.4 (12)	27.1 (136)
UK	11.5 (53)	54.7 (276)	9.2 (51)	24.6 (120)
Italy	23.3 (118)	46.5 (233)	15.3 (83)	14.9 (70)
Spain	24.7 (122)	45.2 (243)	16.8 (69)	13.3 (68)
Poland	24.5 (114)	44.3 (236)	15.1 (79)	16.1 (72)
Russian Fed.	19.5 (98)	42.0 (213)	16.5 (84)	22.0 (112)
Algeria	25.1 (130)	31.1 (163)	35.2 (182)	8.5 (44)
Turkey	24.7 (121)	53.0 (267)	12.3 (68)	10.0 (50)
India	37.5 (164)	37.9 (198)	22.8 (116)	1.8 (22)
Japan	29.9 (134)	43.7 (216)	13.2 (85)	13.5 (73)
China	34.5 (168)	56.1 (281)	7.6 (43)	1.8 (12)

The percentages, means and regression models used to explore significant differences are weighted on age, gender, region and education corresponding to the distribution of these factors on general country data

^aOverall significant differences ($p < 0.0001$) for household composition

^bParticipant may have data in more than one category

Table 2. Diabetes-specific social support by household composition

	Partner and other adult(s) n=1661^d	Partner but no other adult n=4211^d	Other adult(s) but no partner n=1241^d	Neither partner nor other adult(s) n=1483^d
Provision:				
Most supportive person in diabetes care, % (n) (pre-defined options in the questionnaire)				
Spouse/Partner ^{ab}	68.6 (1140)	82.1 (3400)	0	3.3 (72)
Other adult ^{ab}	19.1 (284)	0	76.0 (869)	39.3 (558)
No adult ^{ab}	12.3 (233)	17.9 (791)	24.0 (341)	57.4 (823)
Number of people to talk to about own diabetes				
Mean number (SD) ^{ab}	6.5 (16.6)	4.1 (7.4)	4.4 (7.1)	3.0 (4.9)
No one to talk to about own diabetes, % (n) ^{ab}	16.9 (199)	18.5 (546)	17.2 (160)	23.9 (316)
Level:				
DSDSP (DAWN Support for Diabetes Self-management Profile)				
Composite score, mean (SD) ^{ab}	70.3 (27.3)	70.2 (26.1)	69.7 (26.8)	59.6 (25.3)
High to moderate support from ^c , % (n) :				
Family ^{ab}	95.4 (1501)	88.7 (3470)	89.3 (1025)	60.0 (807)
Friends and people close to you ^{ab}	77.6 (1106)	69.6 (2512)	75.0 (835)	54.4 (769)
People at work or school ^{ab}	39.2 (569)	35.6 (1266)	27.2 (432)	19.0 (302)
Health care team ^{ab}	88.5 (1470)	85.2 (3549)	83.0 (1015)	83.2 (1167)
Other people in your community ^{ab}	53.4 (653)	38.9 (1258)	49.2 (495)	25.4 (358)

The percentages, means and regression models used to explore significant differences are weighted on age, gender, region and education corresponding to the distribution of these factors on general country data

^aOverall significant differences (p<0.0001) for Household composition without adjustment

^b Overall significant differences (p<0.002) for Household composition after adjustment of age, gender, diabetes duration, educational level and diabetes type in multiple regression models (one model estimated for each measure of social support)

^c Participant may have data in more than one category

^d Due to a small number of missing values, n varies to a small degree in the columns below

Table 3. Psychological outcomes by household composition

	Partner and other adult(s) n=1661	Partner but no other adult(s) n=4211	Other adult(s) but no partner n=1241	Neither partner nor other adult n=1483
Psychological well-being, WHO-5 (mean)				
Model 1 ^a	56.0 ^{cd}	58.2 ^{bd}	50.7 ^{bce}	56.7 ^d
Model 2 ^a	56.2 ^{cd}	58.4 ^{bd}	51.2 ^{bce}	57.8 ^d
Worries about nighttime hypoglycemic events (%)				
Model 1 ^a	50.2 ^d	50.9 ^d	58.4 ^{bce}	51.0 ^d
Model 2 ^a	47.8 ^d	49.5 ^d	59.4 ^{bce}	51.2 ^d
Worries about hypoglycaemic events (%)				
Model 1 ^a	57.3 ^{de}	55.3 ^d	62.7 ^{bce}	52.0 ^{bd}
Model 2 ^a	55.6 ^d	53.3 ^d	61.4 ^{bce}	53.2 ^d
Diabetes distress, PAID (mean)				
Model 1 ^a	36.2 ^d	36.2 ^d	40.8 ^{bce}	34.7 ^d
Model 2 ^a	36.1 ^{de}	35.6 ^d	40.2 ^{bce}	34.1 ^{bd}
Diabetes empowerment (mean)				
Model 1 ^a	36.7 ^{cde}	38.8 ^{bd}	42.0 ^{bce}	39.1 ^{bd}
Model 2 ^a	38.1 ^{cd}	40.0 ^{bde}	42.4 ^{bce}	38.1 ^{cd}

The regression models used to explore significant differences are weighted on age, gender, region and education corresponding to the distribution of these factors on general country data

Model 1 is adjusted for age, gender, diabetes duration, educational, diabetes type

Model 2 includes age, gender, diabetes duration, educational, diabetes type and social support (number of people to talk to about diabetes, support from family, support from friends or people close)

^aOverall significant differences ($p < 0.0001$) for household composition

^bSignificantly ($P < 0.05$) different from 'Partner and other adult'

^cSignificantly ($P < 0.05$) different from 'Partner but no other adult'

^dSignificantly ($P < 0.05$) different from 'Other adult but no partner'

^eSignificantly ($P < 0.05$) different from 'Neither partner nor other adults'

Table 4. Differences in psychological outcomes by social support indicators

	Psychological well-being, WHO-5 (mean difference (SD))	Worries about hypoglycaemic events (odds ratio [CI])	Worries about nighttime hypoglycemic events (odds ratio [CI])	Diabetes distress, PAID (mean difference (SD))	Diabetes empowerment (mean difference (SD))
Provision:					
People most supportive in diabetes care, % (n) (pre-defined options in the questionnaire)					
Spouse/Partner vs other adult or no adult	3.42 (0.5) ^a	1.02 [0.95-1.0]	1.01 [0.97-1.01]	0.01 (0.5)	3.06 (0.5) ^a
Other adult vs partner or no adult	-5.77 (0.6) ^a	1.09 [1.07-1.12] ^a	1.08 [1.05-1.11] ^a	3.97 (0.6) ^a	4.95 (0.6) ^a
No adult vs adult	0.58 (0.6)	0.89 [0.86-0.91]	0.91 [0.89-0.94] ^a	-3.10 (0.7) ^a	-9.47 (0.6) ^a
Number of people to talk to about own diabetes					
No one to talk to about own diabetes vs. more than one to talk to	-4.28 (0.6) ^a	0.89 [0.87-0.92] ^a	0.90 [0.87-0.92] ^a	-3.10 (0.9)	-8.65 (0.6) ^a
Level: DSDSP					
High to moderate support from:					
1.Family vs. 2,3,4 and 5	3.19 (0.8) ^a	1.09 [1.06-1.13] ^a	1.05 [1.02 -1.09] ^b	- 0.95 (0.8)	7.81 (0.6) ^a
2.Friends and people close to you vs 1,3,4 or 5	4.87 (0.6) ^a	1.06 [1.03-1.09] ^a	1.04 [1.01-1.06] ^b	- 0.93 (0.6)	9.04 (0.5) ^a
3.People at work or school vs. 1,2,4,or 5	6.9 (0.6) ^a	1.06 [1.04-1.09] ^a	1.05 [1.03 -1.08] ^a	- 2.74 (0.6) ^a	6.61 (0.5) ^a
4.Health Care team vs. 1,2,3 or 5	4.19 (0.7) ^a	1.02 [1.00-1.05]	1.01[0.99 -1.05]	0.11 (0.7)	3.61 (0.6) ^a
5.Other people in your community vs 1,2,3 or 4	3.49 (0.6) ^a	1.03[1.01-1.05] ^b	1.02 [0.96-1.06]	- 0.21 (0.6)	5.95 (0.5) ^a

The regression models used to explore significant differences are weighted on age, gender, region and education corresponding to the distribution of these factors on general country data. Furthermore the models include age, gender, diabetes duration, educational, diabetes type

^aSignificant differences (p<0.0001)

^bSignificant differences (p<0.05)