Journal of Developmental Origins of Health and Disease

www.cambridge.org/doh

Self-reported mental health status of donor sperm-conceived adults

Damian H. Adams[1], Adam Gerace[2], Michael J. Davies[3] and Sheryl de Lacey[4]

[1]Caring Futures Institute, College of Nursing and Health Sciences, Flinders University, Bedford Park, South Australia, 5042, Australia; [2]School of Health, Medical and Applied Sciences, Central Queensland University, Wayville, South Australia, 5034, Australia; [3]The Robinson Institute, The University of Adelaide, Adelaide, South Australia, 5001, Australia; and [4]College of Nursing and Health Sciences, Flinders University, Bedford Park, South Australia, 5042, Australia.

Original Article

Cite this article: Adams DH, Gerace A, Davies MJ, and de Lacey S. (2022) Self-reported mental health status of donor sperm-conceived adults. *Journal of Developmental Origins of Health and Disease* **13**: 220–230. doi: 10.1017/S2040174421000210

Received: 10 November 2020
Revised: 14 March 2021
Accepted: 20 March 2021
First published online: 31 May 2021

Keywords:
Donor conception; health survey; mental health; online; outcome; self-reported

Address for correspondence:
Damian H. Adams, College of Nursing and Health Sciences, Flinders University, Bedford Park, South Australia, 5042, Australia.
Email: adam0072@flinders.edu.au

Abstract

While donor-conceived children have similar mental health outcomes compared to spontaneously conceived children, there is an inconsistency between studies investigating mental health outcomes of donor-conceived people in adulthood. This study is an online health survey that was completed by 272 donor sperm-conceived adults and 877 spontaneously conceived adults from around the world. Donor sperm-conceived adults had increased diagnoses of attention deficit disorder ($P = 0.004$), and autism ($P = 0.044$) in comparison to those conceived spontaneously. Donor sperm-conceived adults self-reported increased incidences of seeing a mental health professional ($P < 0.001$), identity formation problems ($P < 0.001$), learning difficulties ($P < 0.001$), panic attacks ($P = 0.038$), recurrent nightmares (sperm $P = 0.038$), and alcohol/drug dependency ($P = 0.037$). DASS-21 analysis revealed that donor sperm-conceived adults were also more stressed than those conceived spontaneously ($P = 0.013$). Both donor sperm and spontaneously conceived cohorts were matched for sex, age, height, alcohol consumption, smoking, exercise, own fertility, and maternal smoking. The increase in adverse mental health outcomes is consistent with some studies of donor-conceived adult mental health outcomes. These results are also consistent with the Developmental Origins of Health and Disease (DOHaD) phenomenon that has linked adverse perinatal outcomes, which have been observed in donor-conceived neonates, to increased risk of chronic disease, including mental health. Further work is required to reconcile our observations in adults to contrary observations reported in donor-conceived children.

Introduction

The mental health and psychological adjustment of those conceived with donor gametes have been of interest for researchers investigating the role of parent–child biological relatedness and family functioning. A systematic review of 11 studies that investigated the psychological outcomes of adolescents (11–18 years), conceived from donor gametes concluded that donor-conceived adolescents were well adjusted psychologically.[1] However, four of these studies used the same sampling frame (the same participants), while another two studies contained adolescents that crossed over into both publications thereby reducing both the number of unique participants analysed and the strength of the conclusions drawn. Studies of younger children have also concluded that they too are psychologically well adjusted compared to their spontaneously conceived peers.[2–4]

Some of these studies, both of young children and adolescents are under-powered with relatively small sample sizes or implement exclusion criteria restricting participants to healthy singletons making conclusions about the overall mental health of donor-conceived children difficult even though the results so far are reassuring. Furthermore, such investigations are often limited by either the young person's lack of knowledge of their conception or that the researchers did not assess disclosure. It has been shown through a systematic review that most donor-conceived children and adolescents/young adults have not had their conception disclosed to them, which may introduce a source of bias in the study sampling frame.[5] Similarly, of those studies included in the systematic review of adolescent outcomes,[1] not all offspring were aware of their conception and, in the case for heterosexual parents, less than 10% had disclosed to their child about their conception. Without the children or adolescents knowing the nature of their conception, it is therefore difficult to examine the relationship between knowledge of conception and psychological outcomes.

While this flaw is noted, these previous studies provide data on the mental health outcomes of donor-conceived young people. Conversely, in the case of adult outcomes, there is a dearth of studies investigating the mental health of adults conceived with donor gametes in comparison to spontaneously conceived adults where the additional elapsed time, and challenges of adult

functioning, may reveal specific deficits not apparent in childhood. Although, there are reports in which some adult donor-conceived people have experienced negative feelings surrounding their conception, including feelings of abandonment and deception, and depression.[6–10] Adult studies, by nature, require the informed consent of the participant and therefore represent a different subset of the donor-conceived population as these adults know that they are donor-conceived unlike those studies investigating childhood outcomes. A different sample bias will therefore often be inherent in the adult studies through self-selection than those observed in the childhood studies where participation was decided by their parents and potentially involves non-disclosure of their donor conception status.

Due to a lack of studies investigating the mental health of donor-conceived adults in comparison to those who are spontaneously conceived systematically, studies are required to examine not only the mental health status of donor-conceived adults but whether it differs from reports of outcomes of donor-conceived children and adolescents. We, therefore, conducted an online survey of the self-reported physical and mental health of donor sperm-conceived adults in comparison to those who were spontaneously conceived to determine if any differences were reported between the two study groups. This paper reports the findings of mental health data. The physical health outcomes have been reported previously.[11]

Methods

This quantitative study investigated the physical and mental health outcomes of donor-conceived adults in comparison to those conceived spontaneously. The method has been reported previously for the physical health outcomes,[11] but will be described briefly here and include specific differences that pertain to the mental health outcomes assessed.

Participants

A sample of adults aged 18 years and over who could understand English and had internet access was sought for this study. Donor-conceived people were recruited through advertising on various Facebook groups that contain donor-conceived members and through organisations that deal with donor conception. Further recruiting of donor-conceived and spontaneously conceived adults was performed by advertising online through Flinders University, the survey recruitment website Prolific and snowballing.

Measures

Respondents completed the questionnaire anonymously on the SurveyMonkey (SurveyMonkey Inc., San Mateo, CA, USA) website between 1 December 2017 and 31 March 2018. Questions were developed to cover a range of mental health outcomes. The questions covered the following categories: demographics, information regarding the respondent's birth, their general health and lifestyle, mental health outcomes diagnosed by a mental health professional, mental health outcomes that reflected the respondent's own experience, and the Depression Anxiety Stress Scale 21 (DASS-21).[12]

The DASS-21 was used to assess how the respondent was feeling over the previous week, unlike all other reported measures which describe the mental health history of the respondent. Subsequently, the DASS-21 is more representative of their current mental health status. All questions were voluntary except for the respondent's age, sex, and birth status (donor sperm or spontaneously conceived), and whether they had received fertility treatment themselves.

Statistical analyses

Statistical analysis was conducted using SPSS V25 (IBM Corporation, New York, USA). All analyses are of donor sperm-conceived outcomes in comparison to spontaneously conceived outcomes. The effect of sex and maternal complications was analysed through stratification of cohorts as these are known to be associated with mental health outcomes.[13,14] Furthermore, the effect of the country of birth on outcomes was assessed through the analysis of Australian respondents as these represented the largest group of participants.

Continuous variables were summarised using means and standard deviation. They were then subjected to two-tailed, Student's *t*-test to determine significance. Binomial outcomes are presented in tables as the number of 'yes' responses and as a percentage of the total number of responses received for each question. These results were analysed using two-tailed Pearson's chi-squared analysis. Two-tailed Fisher's Exact Tests were used when cross-tabulation resulted in > 20% of cells having an expected count of less than 5 in a 2×2 table. Cross tabulations larger than 2×2 implemented Likelihood Ratios when > 20% of cells had an expected count of less than 5. Free text input outcomes for unlisted diagnosed mental health outcomes and which mental health professional(s) the respondent had seen were subjected to quantitative content analysis. Free text responses were coded and collapsed into categories of 'unlisted diagnosed conditions' or 'type of mental health professional visited'. These were then subjected to a right-tailed chi-squared distribution analysis. DASS-21 analysis used means and standard deviation, and results were then subjected to two-tailed, Student's *t*-test to determine significance.

Large surveys with multiple comparisons can be adversely affected by false-positive results. Subsequently, the Benjamini–Hochberg procedure was implemented on the binomial health outcomes using a false discovery rate at alpha 0.05 level to correct for false positives.[15] However, it was not used on content analysis data as these were grouped post-hoc, nor was it used for DASS-21 analysis. Results were deemed to be statistically significant if $P < 0.05$.

Ethical standards

All procedures contributing to this work comply with the Australian ethical standards and guidelines of the National Statement on Ethical Conduct in Human Research[16] in accordance with the National Health and Medical Research Council Act,[17] and with the Declaration of Helsinki.[18] All participants provided informed consent prior to undertaking the survey. This study was approved by the Flinders University Social and Behavioural Research Ethics Committee (Approval number: 7827).

Results

The total sample of 1149 respondents consisted of the following by mode of conception: Donor Sperm-Conceived ($n = 272$) and Spontaneously-Conceived ($n = 877$) participants. Questionnaire completion time averaged 10 min, 17 s, with a completion rate of 78%. Response rates could not be calculated due to the number of people viewing the advertisement being unknown. Furthermore, the number of donor-conceived people that exist worldwide is unknown.

https://doi.org/10.1017/S2040174421000210 Published online by Cambridge University Press

Characteristics of respondents

Respondent characteristics by grouping are presented in Table 1. No significant differences were observed between the donor sperm-conceived group and those conceived spontaneously in terms of their mean age, mean height, sex, alcohol consumption, current smoking status, amount and level of exercise per week, and whether they had received fertility treatment themselves. The groups did differ, however, in terms of donor sperm-conceived adults having a lower current mean weight ($P = 0.035$), and a lower BMI ($P = 0.023$). Higher levels of education, specifically post-graduate degrees, were observed for donor sperm-conceived adults than spontaneously conceived adults ($P < 0.001$). Lower prevalence of being a former smoker was reported for donor sperm-conceived adults ($P = 0.032$). Additionally, higher incidences of currently using prescribed medications ($P = 0.002$), and recreational/illicit drugs ($P = 0.047$) were observed in the donor sperm-conceived group compared to those conceived spontaneously.

Donor sperm-conceived adults reported significantly higher birth and gestational characteristics of being born as a twin ($P = 0.004$), and higher prevalence of maternal complications during their mother's pregnancy ($P = 0.001$).

The five largest countries by the number of respondents for the country of birth and country of current residence is presented in Table 2. All countries and number of respondents are listed in Supplementary Table S1. Belgium, the Netherlands and the United States of America had a higher proportion of donor sperm-conceived respondents than those conceived spontaneously, while Australia and the United Kingdom had a higher proportion of those conceived spontaneously.

Diagnosed mental health outcomes

In comparison to those conceived spontaneously, donor sperm-conceived adults reported significantly higher prevalence of being diagnosed by a mental health professional with attention deficit disorder/attention deficit hyperactivity disorder (10.2% v 3.9%, $P = 0.004$), and autism/autism spectrum disorder (5.3% v 2.0%, $P = 0.044$) (Table 3).

Donor sperm-conceived adults also reported being diagnosed with a significantly higher prevalence of mental health issues not classified in the categories listed (13.2% v 7.2%, $P = 0.038$), and were able to describe these with free text input. Quantitative content analysis showed that the three categories with the greatest frequency of free text input responses were borderline personality disorder, obsessive-compulsive disorder, and post-traumatic stress disorder. All other disorders/conditions were labelled as 'ungrouped' (such as oppositional defiance disorder, body dysmorphic disorder, adjustment disorders, schizophrenia, and panic disorders). No significant differences were observed between donor sperm-conceived adults and those conceived spontaneously in the quantitative content analysis (Table 3).

Own experience mental health outcomes

In terms of respondent's experiences rather than formal diagnosis of mental health issues, donor sperm-conceived adults were significantly more likely to report higher prevalence of having suffered panic attacks (53.7% v 43.3%, $P = 0.038$), recurrent nightmares (26.1% v 17.8%, $P = 0.038$), having difficulty forming their identity (51.8% v 14.1%, $P < 0.001$), an alcohol/drug dependency (11.5% v 5.9%, $P = 0.037$), and to have reported learning difficulties (16.9% v 7.1%, $P < 0.001$) (Table 4). Free text inputs of the significantly increased frequency of seeing a mental health professional (69.8% v 49.5%, $P < 0.001$) were subjected to content analysis using the categories of psychologist (46.5% v 33.0%, $P < 0.001$), psychiatrist (21.6% v 16.2%, $P = 0.048$), and other mental health professional (all other medical health professionals as designated by the respondent such as general practitioner, psychotherapist, mental health nurse, counsellor, cognitive behavioural therapist, etc.) (15.5% v 9.8%, $P = 0.013$).

Depression, anxiety and stress scales (DASS-21)

The mean total DASS-21 score of donor sperm-conceived adults was higher than those spontaneously conceived, however, the difference was not statistically significant (Table 5). Donor sperm-conceived adults were significantly more stressed in the past week when compared to spontaneously conceived adults (13.43 v 11.65, $P = 0.013$), but did not experience current elevated levels of depression or anxiety.

Effect of sex

Spontaneously conceived females were significantly more likely than spontaneously conceived males to self-report being diagnosed with depressive disorder (34.4% v 16.4%, $P < 0.001$), anxiety disorder (35.8% v 13.9%, $P < 0.001$), and other non-listed mental health conditions (8.5% v 1.9%, $P = 0.023$) (Table 6). Content analysis of free text input for other diagnosed conditions not listed revealed that female spontaneously conceived adults were more likely to be diagnosed with post-traumatic stress disorder (PTSD) (4.3% v 0.6%, $P = 0.026$). Donor sperm-conceived females did not report any statistically significant differences in the frequencies of being diagnosed with depressive disorder, anxiety disorder, bipolar, ADD/ADHD, autism/ASD, or any other non-listed mental health condition.

In terms of the respondent's own experience, spontaneously conceived females were significantly more likely than spontaneously conceived males to self-report experiencing panic attacks (48.5% v 21.4%, $P < 0.001$), recurrent nightmares (20.5% v 6.3%, $P < 0.001$), eating disorders (14.3% v 3.8%, $P = 0.007$), and seeing a mental health professional (53.1% v 34.6%, $P < 0.001$) (Table 6). Conversely, they were significantly less likely to self-report a dependency on alcohol or drugs (4.7% v 10.7%, $P = 0.023$). Content analysis of free text input for which mental health professional was consulted showed that spontaneously conceived females were more likely to visit a psychologist (36.5% v 18.2%, $P < 0.001$), and other mental health professionals such as a general practitioner, psychotherapist, mental health nurse, counsellor, or cognitive behavioural therapist (11.3% v 3.8%, $P = 0.004$). No differences were observed between female and male spontaneously conceived adults in terms of self-reported frequencies of identity formation issues, insomnia, or learning difficulties. Similar to diagnosed mental health outcomes, donor sperm-conceived females were no different from their donor sperm-conceived male peers in all outcome measures except for self-reports of increased visits to a psychologist (49.3% v 29.4%, $P = 0.031$).

While the donor sperm-conceived cohort exhibited no differences between females and males in their mental health outcomes apart from visits to a psychologist; spontaneously conceived females, in contrast, fared worse than their spontaneously

https://doi.org/10.1017/S2040174421000210 Published online by Cambridge University Press

Table 1. Characteristics of respondents

	Spontaneous	Donor Sperm Conceived	
	N Total [877]	N Total [272]	*P*
Age, Mean (SD)	33.2 (12.5)	32.6 (10.3)	0.395
Sex, %			0.074*
Female	80.8	86.0	
Male	18.8	14.0	
Other	0.3	0	
Multiplicity of Own Birth, %			**0.004***
Singleton	98.5	95.2	
Twin	1.0	4.4	
Multiple (3 or more)	0.5	0.4	
Mother Had Maternal Complications, %			**0.001**[a]
Yes	12.6	17.3	
No	75.0	63.1	
Don't know	12.4	19.6	
Mother Smoked During Pregnancy, %			0.598[a]
Yes	16.0	15.1	
No	79.0	81.2	
Don't know	5.0	3.7	
Highest Level of Education Attained, %			< **0.001**[a]
Less than high school	2.5	2.6	
High school degree or equivalent	27.1	16.5	
Vocational qualifications	11.4	8.1	
University/College undergraduate degree	39.0	41.2	
University/College postgraduate degree	20	31.6	
Height, Mean cm (SD)	168.8 (9.2)	169.0 (9.3)	0.724
Weight, Mean kg (SD)	74.7 (18.6)	72.0 (17.4)	**0.035**
BMI, Mean (SD)	26.2 (6.4)	25.2 (6.0)	**0.023**
Currently Smoke, %	7.9	9.4	0.455
Former Smoker, %	30.0	22.9	**0.032**
Alcoholic Drinks Consumed Per Week			0.758[a]
0–1	62.7	60.3	
2–4	20.8	23.7	
4–10	13.0	12.1	
10+	3.5	3.9	
Low/Moderate Exercise Per Week, Mean (SD)	4.7 (5.0)	4.9 (4.3)	0.720
High/Strenuous Exercise Per Week, Mean (SD)	1.4 (1.9)	1.3 (1.6)	0.546
Prescribed Medications, %	39.1	49.8	**0.002**
Recreational/Illicit Drugs, %	6.8	10.5	**0.047**
Fertility Treatment Themselves, %	6.7	3.9	0.094

[ ], Total respondents. *P* value using Students two-tailed *t*-test versus spontaneously conceived unless specified by alternative test below.
[a]Pearson Chi-squared (two-tailed) *P* value versus spontaneously conceived. Chi-squared results are based on total Chi-squared table results of all outcomes and not individual outcome groupings (i.e., all of the All Donor Conceived outcomes versus all Spontaneously Conceived outcomes).
*Likelihood Ratio *P* value versus spontaneously conceived people used instead of Fisher's Exact Test for when > 20% of cells in Chi-squared table have expected values less than 5 in tables larger than 2 × 2. Note, percentages may not equal 100% due to rounding.

https://doi.org/10.1017/S2040174421000210 Published online by Cambridge University Press

Table 2. Country of birth and residency (top 5 countries by number of participants)

	Spontaneous				Donor Sperm Conceived			
	Birth N	Birth %	Resid. N	Resid. %	Birth N	Birth %	Resid. N	Resid. %
Australia	372	46.3	490	55.9	78	30.7	85	31.3
Belgium	23	2.9	21	2.4	16	6.3	19	7.0
Netherlands	89	11.1	70	8.0	57	22.4	59	21.7
United Kingdom	190	23.7	186	21.2	16	6.3	17	6.3
United States of America	86	10.7	90	10.3	77	30.3	84	30.9

Descriptive table of countries of birth and current residence.

Table 3. Diagnosed mental health outcomes

	Spontaneous		Donor Sperm-Conceived			
	n (Total)	%	n (Total)	%	*P*	BH *P*
Depressive Disorder	255 (820)	31.1	97 (245)	39.6	0.013*	0.089
Anxiety Disorder	258 (817)	31.6	88 (245)	35.9	0.204	0.597
Bipolar	13 (814)	1.6	2 (244)	0.8	0.541[b]	0.899
ADD/ADHD	32 (815)	3.9	25 (245)	10.2	< 0.001*	**0.004***
Autism/ASD	16 (818)	2.0	13 (244)	5.3	0.005*	**0.044***
Other[a]	59 (816)	7.2	32 (243)	13.2	0.004*	**0.038***
BPD	9 (816)	1.1	2 (243)	0.8	1.000[b]	–
OCD	10 (816)	1.2	4 (243)	1.6	0.538[b]	–
PTSD	29 (816)	3.6	14 (243)	5.8	0.126	–
Ungrouped	18 (816)	2.2	11 (243)	4.5	0.052	–

BPD, borderline personality disorder; OCD, obsessive-compulsive disorder; PTSD, post-traumatic stress disorder; Other, all other disorders/conditions not grouped into the above categories such as oppositional defiance disorder, body dysmorphic disorder, adjustment disorders, schizophrenia, and panic disorders. Pearson Chi-squared (two-tailed) *P* value versus spontaneously conceived people; BH, Benjamini–Hochberg procedure adjusted *P* value versus spontaneously conceived people; ADD, attention deficit disorder; ADHD, attention deficit hyperactivity disorder; ASD, autism spectrum disorder.
**P* value significant ($P < 0.05$).
[a]Mental health diagnoses in the 'Other' category which had free text input were then subjected to quantitative content analysis which is reported below the dashed line. Note that the n of the categories below the line do not equal those in 'Other' due to multiple responses for certain respondents and also some respondents not completing the free text input.
[b]Fisher's exact test (two-tailed) *P* value versus spontaneously conceived people used instead of Pearson chi-squared for when > 20% of cells in chi-squared table have expected values less than 5.

conceived male peers in a variety of mental health outcomes except for alcohol and drug dependency, which was elevated in males. DASS-21 results were not stratified by sex as it is a separate instrument.

Effect of maternal complications

Stratifying by maternal complications revealed that those spontaneously conceived adults whose mothers experienced maternal complications during pregnancy were significantly more likely than those whose mothers did not experience any maternal complications to self-report being diagnosed with 'Other' non-listed mental health conditions (16.0% v 5.9%, $P = 0.005$) (Table 7). The content analysis did not reveal any significant differences in which conditions were diagnosed. Spontaneously conceived adults whose mothers experienced maternal complications were no different to those gestated without maternal complications in terms of being diagnosed with depressive disorder, anxiety disorder, bipolar, ADD/ADHD, or autism/ASD. No differences were also observed in the diagnosed mental health outcomes between donor sperm-conceived adults whose mothers experienced maternal complications and those who did not experience maternal complications.

In terms of the respondent's own experience, spontaneously conceived adults whose mothers experienced maternal complications during pregnancy were significantly more likely to self-report experiencing recurrent nightmares (36.3% v 14.7%, $P < 0.001$), eating disorders (23.0% v 10.1%, $P = 0.004$), insomnia (42.0% v 24.0%, $P = 0.004$), learning difficulties (13.9% v 4.9%, $P = 0.011$), and seeing a mental health professional (67.3% v 46.3%, $P = 0.003$) (Table 7). Content analysis of free text input for which mental health professional was consulted revealed no differences between the groups. No differences were observed between spontaneously conceived adults in terms of self-reported frequencies of panic attacks, identity formation issues, or dependency on alcohol and/or drugs. Similar to diagnosed mental health outcomes, donor sperm-conceived adults whose mothers experienced maternal complications during pregnancy were not significantly different to those whose mothers did not experience any maternal complications in all outcome measures.

Stratifying outcomes by maternal complications showed that the donor sperm-conceived cohort exhibited no differences in their mental health outcomes. In contrast, spontaneously conceived adults reported increased incidences of adverse mental health outcomes if their mother had experienced maternal complications during pregnancy.

https://doi.org/10.1017/S2040174421000210 Published online by Cambridge University Press

Table 4. Own experience mental health outcomes

	Spontaneous		Donor Sperm-Conceived			
	n (Total)	%	n (Total)	%	*P*	BH *P*
Panic Attacks	354 (817)	43.3	131 (244)	53.7	0.004*	**0.038***
Identity Formation Difficulty	115 (818)	14.1	127 (245)	51.8	< 0.001*	< **0.001***
Recurrent Nightmares	146 (818)	17.8	64 (245)	26.1	0.004*	**0.038***
Alcohol/Drug Dependency	48 (818)	5.9	28 (243)	11.5	0.003*	**0.037***
Eating Disorder	102 (817)	12.5	47 (243)	19.3	0.007*	0.051
Insomnia	217 (814)	26.7	78 (243)	32.1	0.097	0.411
Learning Difficulties	58 (812)	7.1	41 (242)	16.9	< 0.001*	< **0.001***
Seen Mental Health Professional[a]	404 (816)	49.5	171 (245)	69.8	< 0.001*	< **0.001***
Psychologist	269 (816)	33.0	114 (245)	46.5	<0.001*	–
Psychiatrist	132 (816)	16.2	53 (245)	21.6	0.048*	–
Other	80 (816)	9.8	38 (245)	15.5	0.013*	–

Pearson Chi-squared (two-tailed) *P* value versus spontaneously conceived people. BH, Benjamini–Hochberg procedure adjusted *P* value versus spontaneously conceived people. BH correction not performed on content analysis. Other = all other medical health professionals as designated by the respondent such as general practitioner, psychotherapist, mental health nurse, counsellor, cognitive behavioural therapist.
**P* value significant ($P < 0.05$).
[a]Mental health professional as designated by the respondent.

Table 5. DASS-21 outcomes

	Spontaneous	Donor Sperm-Conceived	
	Score [769]	Score [227]	*P*
Total DASS 21 Score, Mean (SD)	*27.32 (25.14)*	*30.26 (24.55)*	*0.102*
Depression Score, Mean (SD)	9.40 (10.50)	10.09 (10.06)	0.343
Anxiety Score, Mean (SD)	6.27 (7.77)	6.74 (7.66)	0.406
Stress Score, Mean (SD)	11.65 (9.74)	13.43 (9.74)	**0.013***

[ ], Total respondents included in analysis. Respondents that did not answer every question were excluded.
**P* value significant ($P < 0.05$) using Students two tailed *t*-test versus spontaneously conceived.

Effect of the country of birth

The effect of country of birth was determined by restricting outcome measures to Australians only because they represented the largest group for both donor sperm-conceived and spontaneously conceived adults. Stratifying by country of birth revealed that donor sperm-conceived Australians were not more likely than those Australians conceived spontaneously to self-report being diagnosed with depressive disorder, anxiety disorder, bipolar, ADD/ADHD, autism/ASD, or any other non-listed mental health condition (Table 8).

In terms of the respondent's own experience, donor sperm-conceived Australians were significantly more likely to self-report having difficulty forming their identity (54.3% v 13.6%, $P < 0.001$), but not for the self-reported frequencies of panic attacks, recurrent nightmares, identity formation issues, dependency on alcohol and/or drugs, eating disorders, insomnia, learning difficulties, or visiting a mental health professional (Table 8).

Limitations

Sample bias occurs in this study due to respondents self-reporting their mental health conditions. Reporting bias was reduced in some instances in which respondents were required to only answer 'yes' to those conditions which had been diagnosed by a medical or mental health professional. False discovery rate was subsequently controlled through the use of the Benjamini–Hochberg procedure in the statistical analysis.

We were able to obtain a sample of self-identified donor sperm-conceived people through online support and networking groups which were used as the primary recruitment source for donor sperm-conceived respondents. Thereby making them a self-identified subset sample of donor sperm-conceived adults. These respondents potentially have concerns with their conception and may be looking for support or advice in finding information about their biological (donor) parent or siblings.[19,20] With the majority of donor-conceived adults not being aware of how they were conceived,[5] it is not possible to get a representative cross-section of the donor sperm-conceived population. Subsequently, caution must be used in extrapolating the findings to the broader adult donor-conceived population. Other researchers have reported the same sample bias issue.[8,9,21,22] Until non-disclosure to the child of their origins no longer occurs, the sample bias issue will continue to be an issue for researchers. Notwithstanding, the use of online networking groups such as Facebook has been used by other authors to recruit donor-conceived individuals for studies.[23,24]

On many demographic variables, the donor sperm-conceived cohort and spontaneously conceived cohorts were comparable to each other. However, within each cohort, there was a sex bias towards women with over 80% of women in all groups. Sex differences occur in the prevalence of different mental health disorders,[25] and therefore, the results are not representative of a cross-section of donor sperm-conceived people. However, no significant difference was found between sex proportions of the different groups in the study, and therefore, the respondent's sex did not adversely affect group to group comparisons. Additionally, good invariance between men and women has been found with the use of the DASS-21,[26] and accordingly, the sex variation between females and males in this study should not affect DASS-21 outcomes.

https://doi.org/10.1017/S2040174421000210 Published online by Cambridge University Press

Table 6. Significant mental health outcomes by sex

	Spontaneous						Donor Sperm-Conceived					
	Female n (Total)	%	Male n (Total)	%	*P*	BH *P*	Female n (Total)	%	Male n (Total)	%	*P*	BH *P*
Diagnosed Outcomes												
Depressive Disorder	227 (659)	34.4	26 (159)	16.4	< 0.001	< **0.001***	88 (211)	41.7	9 (34)	26.5	0.092	0.710
Anxiety Disorder	235 (657)	35.8	22 (158)	13.9	< 0.001	< **0.001***	81 (211)	38.4	7 (34)	20.6	0.045	0.540
Other Diagnosed Outcomes[a]	56 (656)	8.5	3 (160)	1.9	0.004	**0.023***	31 (209)	14.8	1 (34)	2.9	0.059[c]	0.637
PTSD	28 (656)	4.3	1 (160)	0.6	**0.026***	–	14 (209)	6.7	0 (34)	0	0.228[c]	–
Own Experience												
Panic Attacks	318 (656)	48.5	34 (159)	21.4	< 0.001	< **0.001***	117 (210)	55.7	14 (34)	41.2	0.115	0.776
Recurrent Nightmares	135 (657)	20.5	10 (159)	6.3	< 0.001	< **0.001***	59 (211)	28.0	5 (34)	14.7	0.102	0.734
Alcohol/Drug Dependency	31 (657)	4.7	17 (159)	10.7	0.004	**0.023***	21 (209)	10.0	7 (34)	20.6	0.085[c]	0.710
Eating Disorder	94 (656)	14.3	6 (159)	3.8	0.001	**0.007***	45 (209)	21.5	2 (34)	5.9	0.032	0.540
Seen Mental Health Professional[b]	348 (655)	53.1	55 (159)	34.6	< 0.001	< **0.001***	151 (211)	71.6	20 (34)	58.8	0.133	0.845
Psychologist	239 (655)	36.5	29 (159)	18.2	< **0.001***	–	104 (211)	49.3	10 (34)	29.4	**0.031**	–
Other Mental Health Professional	74 (655)	11.3	6 (159)	3.8	**0.004***	–	35 (211)	16.6	3 (34)	8.8	0.246	–

PTSD, post-traumatic stress disorder; BH, Benjamini–Hochberg procedure adjusted *P* value versus spontaneously conceived people.
**P* value significant ($P < 0.05$).
[a]Mental health diagnoses in the 'Other Diagnosed Outcomes' category which had free text input were then subjected to quantitative content analysis. Categories with significant differences are reported below the first dashed line.
[b]Mental health professional as designated by the respondent. Other Mental Health Professional = all other medical health professionals as designated by the respondent such as general practitioner, psychotherapist, mental health nurse, counsellor, cognitive behavioural therapist which are reported below the second dashed line when significant. Pearson Chi-squared (two-tailed) *P* value versus spontaneously conceived people.
[c]Fisher's exact test (two-tailed) *P* value versus spontaneously conceived people used instead of Pearson Chi-squared for when > 20% of cells in chi-squared table have expected values less than 5.

Table 7. Significant mental health outcomes by maternal complications

	Spontaneous						Donor Sperm-Conceived					
	Yes n (Total)	%	No n (Total)	%	*P*	BH *P*	Yes n (Total)	%	No n (Total)	%	*P*	BH *P*
Diagnosed Outcomes												
Other Diagnosed Outcomes[a]	16 (100)	16.0	36 (613)	5.9	< 0.001	**0.005***	7 (44)	15.9	20 (151)	13.2	0.653	1.000
Own Experience												
Recurrent Nightmares	37 (101)	36.6	90 (614)	14.7	< 0.001	< **0.001***	13 (44)	29.5	33 (152)	21.7	0.280	1.000
Eating Disorder	23 (100)	23.0	62 (614)	10.1	< 0.001	**0.004***	10 (44)	22.7	25 (150)	16.7	0.358	1.000
Insomnia	42 (100)	42.0	147 (612)	24.0	< 0.001	**0.004***	19 (44)	43.2	42 (150)	28.0	0.056	0.961
Learning Difficulties	14 (101)	13.9	30 (609)	4.9	0.001	**0.011***	7 (44)	15.9	21 (149)	14.1	0.764	1.000
Seen Mental Health Professional[b]	68 (101)	67.3	284 (613)	46.3	< 0.001	**0.003***	31 (44)	70.5	105 (152)	69.1	0.862	1.000

BH, Benjamini–Hochberg procedure adjusted *P* value versus spontaneously conceived people.
**P* value significant ($P < 0.05$).
[a]Mental health diagnoses in the 'Other Diagnosed Outcomes' category which had free text input were then subjected to quantitative content analysis.
[b]Mental health professional as designated by the respondent. Pearson Chi-squared (two-tailed) *P* value versus spontaneously conceived people.

Inter-item reliabilities were not measured for each of the mental health outcomes presented in this survey which is a limitation of this study. However, the DASS-21 as a separate instrument has been reported to have good inter-item reliability and has been validated through numerous studies with a systematic review and analysis showing that the bifactor DASS-21 structure returned Cronbach's alpha values of 0.90–0.95 for the total scale, 0.82–0.92 for the depression scale, 0.74–0.88 for the anxiety scale, and

https://doi.org/10.1017/S2040174421000210 Published online by Cambridge University Press

Table 8. Significant mental health outcomes in Australian respondents

	Spontaneous		Donor Sperm-Conceived			
	n (Total)	%	n (Total)	%	*P*	BH *P*
Own Experience						
Identity Formation Difficulty	46 (338)	13.6	38 (70)	54.3	< 0.001	< **0.001***

Pearson Chi-squared (two-tailed) *P* value versus spontaneously conceived people. BH, Benjamini–Hochberg procedure adjusted *P* value versus spontaneously conceived people.
**P* value significant ($P < 0.05$).

0.76–0.90 for the stress scale across a variety of cultures and countries.[27] These cultures/countries included those representing the majority of respondents in this survey.

The diagnostic criteria for each mental health outcome may differ according to the country in which that diagnosis occurred. Furthermore, the meaning that each country/culture may apply to each outcome measure may vary. Subsequently, the invariance between each diagnosed and own experience outcomes are unknown and, therefore, a limitation of this study. The respondent's own experience, which can be described as 'self-rated health', is nonetheless a valid measurement in young adults.[28] The average age of respondents in this survey (donor sperm-conceived = 32.6 years, spontaneously conceived = 33.2 years), could subsequently be described as being young adults. Additionally, increasing validity of self-rated health has meant that it has become a strong predictor of mortality.[29] The reliability of self-rated health, such as the NHANES data used as reference data in this study, has been reported to have moderate test-retest reliability.[30] In general, however, self-reports of health, including mental health, are commonly used in epidemiological studies.[31]

Limitations aside, this study represents the first attempt to characterise mental health outcomes from a subset of adults conceived with the use of donated gametes, which is a rapidly growing sector in the population that have been poorly studied. A strength of this study is that the donor sperm-conceived cohort in comparison to those spontaneously conceived was well-matched with no significant differences in terms of their: mean age, mean height, sex ratios, alcohol consumption, current smoking status, levels of exercise conducted per week, whether their mother smoked during pregnancy, and whether they had received fertility treatment themselves.

Discussion

This study highlighted that the adult donor sperm-conceived respondents in this survey experienced more mental health issues than their counterparts and were more likely to have seen a mental health professional. Out of the DASS-21 categories of recent depression, anxiety and stress, only stress was found to be significantly elevated in the donor sperm-conceived cohort. These findings reflect previous reports highlighting that some donor sperm-conceived adults have issues with their conception both mentally and emotionally.[32–34]

The number of adverse mental health differences experienced by the donor sperm-conceived participants in this study in comparison to those conceived spontaneously were more numerous than the physical health outcomes observed in the same cohort.[11] However, due to the age of the cohort, we may anticipate further differences in age-related chronic diseases to emerge in future years. Physical and mental health are both directly and indirectly linked.[35] This link may contribute to the finding of increased mental health issues observed in the donor sperm-conceived cohort, which also reported increased incidences of adverse physical health outcomes. Furthermore, considering that some donor-conceived people feel that they suffer as a consequence of being separated from biological kin, the loss of family history, the lack of medical health history, and being deceived of their origins by their parents,[36] these may potentially be associated with the poorer mental health outcomes observed in this study.

The lack of significance for the DASS-21 depression score is in contrast to the elevated incidences of donor sperm-conceived respondents being diagnosed with a depressive disorder. However, the DASS-21 assessment is of how the respondent felt during the previous week and is not necessarily indicative of their diagnosed mental health history.

The mental health outcomes analysis after stratification by sex, maternal complications of pregnancy and country of birth, was hampered by a lack of statistical power in the donor sperm-conceived cohort due to sample size and the number of reports. Subsequently, no conclusions can be drawn on the effects that these may have had on the mental health outcomes of adult donor sperm-conceived people except for an observed increase in the difficulty in forming their identity for Australian donor sperm-conceived adults. The identity formation difficulty is consistent with previous literature.[36] For spontaneously conceived adults, the sample size was significantly larger, thereby imparting greater confidence in the stratification analysis.

In spontaneously conceived females, an increased incidence of adverse mental health outcomes including depressive disorder, anxiety disorder, PTSD, panic attacks, recurrent nightmares, eating disorders, and seeing a mental health professional were observed. However, males were more likely to suffer from substance abuse issues with a dependency on alcohol or drugs. These sex-based differences are consistent with previously published data highlighting that females are more likely to experience mental health issues including anxiety, depression, PTSD, and mood disorders, while men are more likely to experience substance abuse.[13,37]

Spontaneously conceived adults whose mothers experienced pregnancy complications were significantly more likely to report being diagnosed with other non-listed mental health conditions and to experience increased incidences of recurrent nightmares, eating disorders, insomnia, learning difficulties, and visiting a mental health professional. Maternal complications, in particular, hypertensive disorders of pregnancy in spontaneous conceptions have been associated with increased mental health disorders in the adult offspring.[14,38] Therefore, the findings of increased adverse mental health outcomes for adult donor sperm-conceived people that was associated with an increase in reported maternal complications during pregnancy is consistent with the literature.

There is very little published literature on quantitative mental health outcomes for the adult donor-conceived population.

https://doi.org/10.1017/S2040174421000210 Published online by Cambridge University Press

However, there is one study which has reported that donor sperm-conceived adults had no significant differences in mental health compared to similar-aged emerging adults.[39] Interestingly this study was conducted in a cohort of younger adults in comparison to our study, and that these adults were raised in lesbian-parent families in which the use of donor conception is typically not hidden from the child/adult. Subsequently, that cohort is likely to have key differences making comparisons difficult.

Studies of donor-conceived children, in general, show positive results in terms of psychological adjustment. Notwithstanding the limitations of those studies, adult participants in this survey had more self-reported adverse outcomes than their spontaneously conceived peers. While this study is not without its limitations, the results are consistent with the observations of outcomes in other adult donor-conceived studies.[6–10] The difference between children and adults may reflect instrumentation effects from the assessment methodology and capacity for self-report or the emergence of mental problems due to aging effects,

Disclosure to a person of their donor sperm-conceived status at an early age has been associated with less psychological trauma.[9,40] Parental attitudes towards disclosure has changed over time from being mostly opposed to disclosure,[41–44] to increasing openness.[45–48] While the age of disclosure or discovery of their conception was not investigated, many participants in this study were conceived during a period when secrecy was the accepted practice. Subsequently, many respondents in this study may have had their conception disclosed in adulthood, which may contribute to the findings.

Additionally, they may have reassessed their feelings concerning their conception and started searching for information once they had started their own family, or after the death of a parent. These situations have been observed in adult adoptees.[49] Similarities between adoptees and donor-conceived people in terms of biological family separation, loss of family and health histories, and being deceived of their origins have been reported.[49–51] Therefore, the poorer mental health of adult donor sperm-conceived people might also potentially be influenced by adulthood triggers. Adult adoptees have been shown to suffer worse mental health outcomes than non-adoptees,[52–55] and therefore, the results of this study are also consistent with studies on adult adoptee outcomes.

An alternative and possible contributing factor to the differences observed between donor-conceived children and adults is that developmental defects only become apparent through adult based psychological diagnoses and under conditions of adult functioning. This factor is plausible if one considers variations in adult function as an extension of the already demonstrated increased risk of adverse perinatal outcomes in donor-conceived neonates.[56–58] Furthermore, studies have highlighted that perinatal outcomes such as low birth weight (<2500 g), are associated with adverse adult psychological outcomes and responses,[59,60] including ADHD,[61,62] as was found in this study. These findings of adverse perinatal outcomes being associated with poorer adulthood mental health outcomes are a function of the Developmental Origins of Health and Disease (DOHaD) phenomenon.[59]

The implications for DOHaD on mental health outcomes are further highlighted by the increased incidence of preeclampsia associated with the use of donor sperm.[63–65] The results from this study are also consistent with published data showing a correlation between preeclampsia and an increased risk for mental disorders in the offspring,[14,66,67] that also include depression,[68] ADHD, and ASD.[69]

The donor sperm-conceived adult cohort self-reported significantly higher incidences of being diagnosed with various mental health issues, as well as experiencing an increased range of adverse mental health outcomes in comparison to the spontaneously conceived adult cohort. As is the case with adoption, donor conception may be an important consideration for clinicians when dealing with mental health issues of donor-conceived people. With very few studies investigating the mental health and emotional well-being of adult donor-conceived people, more studies are required.

Acknowledgements. The authors would like to thank the following organisations for their support in advertising the survey: VARTA (Victorian Assisted Reproductive Treatment Authority); Donor Children online registry; Donor Conception Network (United Kingdom); Donor Conception Support Group (Australia); FIOM (Netherlands); and VANISH (Victorian Adoption Network for Information and Self Help). The authors would also like to thank the administrators of the following Facebook groups: Worldwide Donor Conceived People Network; We Are Donor Conceived; RUDC; Donor Conceived Offspring, Siblings, Parents (Sperm or Egg); DNA for the Donor Conceived; TangledWebs; and the email list PCVAI – People Conceived Via Artificial Insemination, for advertising the survey on our behalf.

Financial Support. D.A. is supported by an Australian Government Research Training Program Scholarship.

Conflicts of Interest. None.

Supplementary material. To view supplementary material for this article, please visit https://doi.org/10.1017/S2040174421000210

References

1. Ilioi EC, Golombok S. Psychological adjustment in adolescents conceived by assisted reproduction techniques: a systematic review. *Hum Reprod Update*. 2015; 21(1), 84–96.
2. Golombok S, Blake L, Casey P, Roman G, Jadva V. Children born through reproductive donation: a longitudinal study of psychological adjustment. *J Child Psychol Psychiatry*. 2013; 54(6), 653–660.
3. Golombok S, Readings J, Blake L, *et al.* Children conceived by gamete donation: psychological adjustment and mother-child relationships at age 7. *J Fam Psychol*. 2011; 25(2), 230–239.
4. Kovacs GT, Mushin D, Kane H, Baker HW. A controlled study of the psycho-social development of children conceived following insemination with donor semen. *Hum Reprod*. 1993; 8(5), 788–790.
5. Tallandini MA, Zanchettin L, Gronchi G, Morsan V. Parental disclosure of assisted reproductive technology (ART) conception to their children: a systematic and meta-analytic review. *Hum Reprod*. 2016; 31(6), 1275–1287.
6. Schrijvers A, Bos H, van Rooij F, Gerrits T, van der Veen F, Mochtar M, *et al.* Being a donor-child: wishes for parental support, peer support and counseling. *J Psychosom Obstet Gynaecol*. 2019; 40(1), 29–37.
7. Harrigan MM, Dieter S, Leinwohl J, Marrin L. "It's just who I am . . . I have brown hair. I have a mysterious father": an exploration of donor-conceived offspring's identity construction. *J Fam Comm*. 2015; 15(1), 75–93.
8. Mahlstedt PP, LaBounty K, Kennedy WT. The views of adult offspring of sperm donation: essential feedback for the development of ethical guidelines within the practice of assisted reproductive technology in the United States. *Fertil Steril*. 2010; 93(7), 2236–2246.
9. Jadva V, Freeman T, Kramer W, Golombok S. The experiences of adolescents and adults conceived by sperm donation: comparisons by age of disclosure and family type. *Hum Reprod*. 2009; 24(8), 1909–1919.
10. Turner AJ, Coyle A. What does it mean to be a donor offspring? The identity experiences of adults conceived by donor insemination and the implications for counselling and therapy. *Hum Reprod*. 2000; 15(9), 2041–2051.
11. Adams DH, Gerace A, Davies MJ, De Lacey S. Self-reported physical health status of donor sperm conceived adults. *J Dev Orig Health Dis*. 2020, Online ahead of print.

12. Lovibond SH, Lovibond PF. *Manual for the Depression Anxiety Stress Scales*. Second edition, 1995. Psychology Foundation of Australia, Sydney, Australia.
13. Seedat S, Scott KM, Angermeyer MC, *et al.* Cross-national associations between gender and mental disorders in the World Health Organization World Mental Health Surveys. *Arch Gen Psychiatry*. 2009; 66(7), 785–795.
14. Tuovinen S, Raikkonen K, Pesonen AK, *et al.* Hypertensive disorders in pregnancy and risk of severe mental disorders in the offspring in adulthood: the Helsinki Birth Cohort Study. *J Psychiatr Res*. 2012; 46(3), 303–310.
15. Benjamini Y, Hochberg Y. Controlling the false discovery rate: a practical and powerful approach to multiple testing. *J R Stat Soc Series B Stat Methodol*. 1995; 57(1), 289–300.
16. NHMRC. *National Statement on Ethical Conduct in Human Research*, 2007. National Health and Medical Research Council, Commonwealth of Australia, Australia.
17. CoA. National Health and Medical Research Council Act. Australia: Commonwealth of Australia, 1992.
18. WMA. Declaration of Helsinki - Ethical Principles for Medical Research Involving Human Subjects. France: World Medical Association, 2013.
19. Slutsky J, Jadva V, Freeman T, *et al.* Integrating donor conception into identity development: adolescents in fatherless families. *Fertil Steril*. 2016; 106(1), 202–208.
20. Rodino IS, Burton PJ, Sanders KA. Donor information considered important to donors, recipients and offspring: an Australian perspective. *Reprod Biomed Online*. 2011; 22(3), 303–311.
21. Zadeh S, Ilioi EC, Jadva V, Golombok S. The perspectives of adolescents conceived using surrogacy, egg or sperm donation. *Hum Reprod*. 2018; 33(6), 1099–1106.
22. Persaud S, Freeman T, Jadva V, *et al.* Adolescents conceived through donor insemination in mother-headed families: a qualitative study of motivations and experiences of contacting and meeting same-donor offspring. *Child Soc*. 2017; 31(1), 13–22.
23. Lozano EB, Fraley RC, Kramer W. Attachment in donor-conceived adults: Curiosity, search, and contact. *Pers Relatsh*. 2019; 26(2), 331–344.
24. Nelson MK, Hertz R, Kramer W. Gamete donor anonymity and limits on numbers of offspring: the views of three stakeholders. *J Law Biosci*. 2016; 3(1), 39–67.
25. WHO. Gender and women's mental health. Gender disparities and mental health: The facts, 2014. World Health Organization. Accessed June 23, 2020. Available from: https://www.who.int/mental_health/prevention/genderwomen/en/
26. Gomez R, Summers M, Summers A, Wolf A, Summers J. Depression Anxiety Stress Scales-21: measurement and structural invariance across ratings of men and women. *Assessment*. 2014; 21(4), 418–426.
27. Lee J, Lee EH, Moon SH. Systematic review of the measurement properties of the Depression Anxiety Stress Scales-21 by applying updated COSMIN methodology. *Qual Life Res*. 2019; 28(9), 2325–2339.
28. Fosse NE, Haas SA. Validity and stability of self-reported health among adolescents in a longitudinal, nationally representative survey. *Pediatrics*. 2009; 123(3), e496–e501.
29. Schnittker J, Bacak V. The increasing predictive validity of self-rated health. *PLoS One*. 2014; 9(1), e84933.
30. Zajacova A, Dowd JB. Reliability of self-rated health in US adults. *Am J Epidemiol*. 2011; 174(8), 977–983.
31. Singh-Manoux A, Martikainen P, Ferrie J, Zins M, Marmot M, Goldberg M. What does self-rated health measure? Results from the British Whitehall II and French Gazel cohort studies. *J Epidemiol Community Health*. 2006; 60(4), 364–372.
32. Allan S. Report of the review of the Assisted Reproductive Treatment Act 1988. Australia: Sonia Allan for the South Australian Minister for Health, 2017.
33. VLRC. Inquiry into access by donor conceived people to information about the donors. Australia: Victoria Law Reform Committee, Victorian Government Printer, 2012.
34. Allan S. The Review of the Western Australian Human Reproductive Technology Act 1991 and the Surrogacy Act 2008 Australia: Sonia Allan for the Western Australian Minister for Health, 2019.
35. Ohrnberger J, Fichera E, Sutton M. The relationship between physical and mental health: A mediation analysis. *Soc Sci Med*. 2017; 195, 42–49.
36. Adams DH. Conceptualising a child-centric paradigm: do we have freedom of choice in donor conception reproduction? *J Bioeth Inq*. 2013; 10(3), 369–381.
37. Steel Z, Marnane C, Iranpour C, *et al.* The global prevalence of common mental disorders: a systematic review and meta-analysis 1980-2013. *Int J Epidemiol*. 2014; 43(2), 476–493.
38. Tuovinen S, Aalto-Viljakainen T, Eriksson JG, *et al.* Maternal hypertensive disorders during pregnancy: adaptive functioning and psychiatric and psychological problems of the older offspring. *BJOG*. 2014; 121(12), 1482–1491.
39. Koh AS, Bos HMW, Gartrell NK. Predictors of mental health in emerging adult offspring of lesbian-parent families. *J Lesbian Stud*. 2019; 23(2), 257–278.
40. Ilioi E, Blake L, Jadva V, Roman G, Golombok S. The role of age of disclosure of biological origins in the psychological wellbeing of adolescents conceived by reproductive donation: a longitudinal study from age 1 to age 14. *J Child Psychol Psychiatry*. 2017; 58(3), 315–324.
41. Leeton J, Backwell J. A preliminary psychosocial follow-up of parents and their children conceived by artificial insemination by donor (AID). *Clin Reprod Fertil*. 1982; 1(4), 307–310.
42. Milsom I, Bergman P. A study of parental attitudes after donor insemination (AID). *Acta Obstet Gynecol Scand*. 1982; 61(2), 125–128.
43. Klock SC, Jacob MC, Maier D. A prospective study of donor insemination recipients: secrecy, privacy, and disclosure. *Fertil Steril*. 1994; 62(3), 477–484.
44. Durna EM, Bebe J, Steigrad SJ, Leader LR, Garrett DG. Donor insemination: attitudes of parents towards disclosure. *Med J Aust*. 1997; 167(5), 256–259.
45. Godman KM, Sanders K, Rosenberg M, Burton P. Potential sperm donors', recipients' and their partners' opinions towards the release of identifying information in Western Australia. *Hum Reprod*. 2006; 21(11), 3022–3026.
46. Mac Dougall K, Becker G, Scheib JE, Nachtigall RD. Strategies for disclosure: how parents approach telling their children that they were conceived with donor gametes. *Fertil Steril*. 2007; 87(3), 524–533.
47. Shehab D, Duff J, Pasch LA, Mac Dougall K, Scheib JE, Nachtigall RD. How parents whose children have been conceived with donor gametes make their disclosure decision: contexts, influences, and couple dynamics. *Fertil Steril*. 2008; 89(1), 179–187.
48. Isaksson S, Sydsjö G, Skoog Svanberg A, Lampic C. Disclosure behaviour and intentions among 111 couples following treatment with oocytes or sperm from identity-release donors: follow-up at offspring age 1-4 years. *Hum Reprod*. 2012; 27(10), 2998–3007.
49. Crawshaw M. Lessons from a recent adoption study to identify some of the service needs of, and issues for, donor offspring wanting to know about their donors. *Hum Fertil (Camb)*. 2002; 5(1), 6–12.
50. Feast J. Using and not losing the messages from the adoption experience for donor-assisted conception. *Hum Fertil (Camb)*. 2003; 6(1), 41–45.
51. Triseliotis J. Donor insemination and the child. *Politics Life Sci*. 1993; 12(2), 195–197.
52. Tieman W, van der Ende J, Verhulst FC. Psychiatric disorders in young adult intercountry adoptees: an epidemiological study. *Am J Psychiatry*. 2005; 162(3), 592–598.
53. Cubito DS, Brandon KO. Psychological adjustment in adult adoptees: assessment of distress, depression, and anger. *Am J Orthopsychiatry*. 2000; 70(3), 408–413.
54. Wierzbicki M. Psychological adjustment of adoptees: a meta-analysis. *J Clin Child Psychol*. 1993; 22(4), 447–454.
55. Bohman M, von Knorring AL. Psychiatric illness among adults adopted as infants. *Acta Psychiatr Scand*. 1979; 60(1), 106–112.
56. Moreno-Sepulveda J, Checa MA. Risk of adverse perinatal outcomes after oocyte donation: a systematic review and meta-analysis. *J Assist Reprod Genet*. 2019; 36(10), 2017–2037.
57. Adams DH, Clark RA, Davies MJ, de Lacey S. Update on: a meta-analysis of sperm donation offspring health outcomes - 2018 update. *J Dev Orig Health Dis*. 2018; 9(5), 561–562.

https://doi.org/10.1017/S2040174421000210 Published online by Cambridge University Press

58. Mascarenhas M, Sunkara SK, Antonisamy B, Kamath MS. Higher risk of preterm birth and low birth weight following oocyte donation: a systematic review and meta-analysis. *Eur J Obstet Gynecol Reprod Biol*. 2017; 218, 60–67.
59. O'Donnell KJ, Meaney MJ. Fetal origins of mental health: the developmental origins of health and disease hypothesis. *Am J Psychiatry*. 2017; 174(4), 319–328.
60. Ward AM, Moore VM, Steptoe A, Cockington RA, Robinson JS, Phillips DI. Size at birth and cardiovascular responses to psychological stressors: evidence for prenatal programming in women. *J Hypertens*. 2004; 22(12), 2295–2301.
61. Sucksdorff M, Lehtonen L, Chudal R, Suominen A, Joelsson P, Gissler M, *et al*. Preterm Birth and Poor Fetal Growth as Risk Factors of Attention-Deficit/Hyperactivity Disorder. *Pediatrics*. 2015; 136(3), e599–e608.
62. Banerjee TD, Middleton F, Faraone SV. Environmental risk factors for attention-deficit hyperactivity disorder. *Acta Paediatr*. 2007; 96(9), 1269–1274.
63. Smith GN, Walker M, Tessier JL, Millar KG. Increased incidence of preeclampsia in women conceiving by intrauterine insemination with donor versus partner sperm for treatment of primary infertility. *Am J Obstet Gynecol*. 1997; 177(2), 455–458.
64. Gonzalez-Comadran M, Urresta Avila J, Saavedra Tascon A, *et al*. The impact of donor insemination on the risk of preeclampsia: a systematic review and meta-analysis. *Eur J Obstet Gynecol Reprod Biol*. 2014; 182, 160–166.
65. Kyrou D, Kolibianakis EM, Devroey P, Fatemi HM. Is the use of donor sperm associated with a higher incidence of preeclampsia in women who achieve pregnancy after intrauterine insemination? *Fertil Steril*. 2010; 93(4), 1124–1127.
66. Dachew BA, Scott JG, Mamun A, Alati R. Hypertensive disorders of pregnancy and the risk of anxiety disorders in adolescence: findings from the Avon Longitudinal Study of Parents and Children. *J Psychiatr Res*. 2019; 110, 159–165.
67. Lahti-Pulkkinen M, Girchenko P, Tuovinen S, *et al*. Maternal hypertensive pregnancy disorders and mental disorders in children. *Hypertension*. 2020; 75(6), 1429–1438.
68. Tuovinen S, Räikkönen K, Kajantie E, *et al*. Depressive symptoms in adulthood and intrauterine exposure to pre-eclampsia: the Helsinki Birth Cohort Study. *BJOG*. 2010; 117(10), 1236–1242.
69. Sun BZ, Moster D, Harmon QE, Wilcox AJ. Association of preeclampsia in term births with neurodevelopmental disorders in offspring. *JAMA Psychiatry*. 2020; 77(8), 823–829.

https://doi.org/10.1017/S2040174421000210 Published online by Cambridge University Press