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Preconception health beliefs and intentions predict behaviours among expectant male partners: a cross-sectional study

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Abstract

Background The preconception period allows couples to plan and prepare for pregnancy. However, males can often consider this integral public health topic as a female domain. To better understand and support behaviour change for males before conception, this study aimed to identify and explore the preconception and pregnancy planning health beliefs and intentions of expectant male reproductive partners of pregnant women in Australia.

Methods An online cross-sectional survey [2020–2021] among males aged 18–49 years who were the reproductive partner (expectant partner) of a pregnant female. Recruitment occurred via social media. The 80-item survey consisted of five sections. Survey items regarding beliefs and intentions were formulated using the Theory of Planned Behaviour. Associations between participants' beliefs, subjective norms, perceived behavioural control, and intentions related to three outcomes (regular exercise, healthy diet, and alcohol avoidance) were estimated using Structural Equation Modelling.

Results Expectant partners' ($n = 136$) had a mean age of 31 years. Their beliefs toward regular exercise and their perceived behavioural control to exercise regularly were associated with a greater intention to exercise regularly (Standardised estimate $\beta = 0.54$; $p = 0.0087$ and $\beta = 0.43$; $p = 0.02$, respectively). The beliefs of expectant partners toward alcohol avoidance and their perceived behavioural control toward alcohol avoidance were associated with a greater intention to avoid alcohol ($\beta = 0.43$; $p < 0.001$ and $\beta = 0.36$; $p < 0.001$, respectively). For the healthy diet outcome, subjective norms of expectant partners, and perceived behavioural control to adopt a healthy diet were associated with an intention to adopt a healthy diet ($\beta = 0.23$; $p = 0.04$ and $\beta = 0.47$; $p < 0.001$, respectively). Intention was in turn associated with behaviour for all three outcomes.

Conclusion Our study demonstrated that the preconception intentions of expectant partners were associated with their preconception behaviours; especially for the intention to exercise regularly or to avoid alcohol. Further studies examining paternal preconception health beliefs, and intentions and the motivations behind health behaviours for males are needed to help develop targeted preconception health promotion messages and interventions that support males to optimise their preconception health.

Keywords Preconception, Pregnancy planning, Male, Beliefs, Intentions

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Text box 1. Contributions to the literature

• Highlights the influence of engaging expectant male partners before pregnancy.
• The beliefs of expectant partners regarding alcohol consumption before pregnancy were incongruent with their behaviours.
• Partner opinion is an important consideration regarding expectant partners consumption of a healthy diet before pregnancy.
• Further public health research to better understand how expectant partners' beliefs regarding preconception health behaviours influence their intentions and behaviours is warranted.

Introduction

Health prior to a pregnancy - preconception health - is synonymous with preventive health and is considered a public health priority for reproductively aged populations across the globe [1]. A conscious decision to attempt pregnancy, referred to as 'pregnancy intention', allows couples to plan and prepare for pregnancy by initiating healthful behaviours such as undertaking regular exercise, adopting a healthy diet, and avoiding alcohol to improve their chance of a healthy pregnancy and child. Preconception health and health behaviours, as well as pregnancy spacing and timing, are important considerations for both females and males with research suggesting preconception health behaviours and modifiable risk factors can have both short and long-term health implications for parents and their children [2–4]. Males are duly recognised as having a direct and indirect influence on pregnancy and offspring outcomes whereby they can indirectly support maternal behaviours during preconception [5, 6] while their own preconception behaviours can have direct genetic [7] and epigenetic consequences [8]. Yet, evidence describing reproductive males' preconception health and health behaviours is only newly emerging, partly because capturing and reporting the preconception health behaviours of males can be difficult [9]. From the available evidence, a recent review of paternal preconception modifiable risk factors identifies several health behaviours of males which report adverse pregnancy and offspring outcomes such as alcohol, smoking, and nutritional exposures [3]. This review also highlighted many gaps in understanding male preconception health for behaviours such as physical activity, a healthy diet, and alcohol consumption that needed to be addressed through further research.

Males have been identified as often not aware of the concept of preconception health nor its importance [10, 11] and they may appear reluctant during discussions [12]. Moreover, males less frequently seek health care support than females [9] and health care professionals, including general practitioners, often do not feel comfortable with their knowledge regarding male preconception health and fertility issues [13]. Often males consider such integral public health topics to be a female domain [12] despite often agreeing with the importance placed on paternal preconception health and care [14] and possessing a general willingness to use preconception care services [10]. A Swedish longitudinal study investigating males' pregnancy planning behaviour, for example, examined males' preparations for pregnancy and found only a small portion of men (17%) adjusted their preconception behaviours to improve their health [15].

It is important for researchers, practitioners, policy makers and all stakeholders of preconception health to understand the relationships between paternal preconception behaviours and paternal preconception beliefs, and intentions to better support behaviour change for males before conception, and effectively target appropriate preconception messages and interventions [16]. Exploring the belief-behaviour relationship that drives the motivational factors of male's behavioural intentions can assist to better understand subsequent paternal preconception behaviours. Therefore, the aim of this study was to examine pathway associations of preconception and pregnancy planning health beliefs with intentions and behaviours among expectant male reproductive partners (expectant partners) of pregnant women.

Methods

Study design

We conducted an observational study utilizing data from an online cross-sectional survey conducted between December 2020 and September 2021. The survey included a convenience sample of expectant partners.

Participants and survey administration

Expectant partners were eligible to participate if they were male, aged 18 to 49 years, and the reproductive partner of a pregnant female. Targeted advertising was utilized on social media platforms (i.e. Instagram, Facebook, Twitter) for participants to be recruited from the general public; a small financial incentive was provided for participation. A screening instrument was used at the start of the survey to ensure participants met the eligibility criteria [an Australian male, aged 18 to 49 years, and the reproductive partner of a pregnant female] and to collect their name and email address. Any individual meeting the study eligibility criteria and who consented to participate then completed the survey via the online survey platform Qualtrics™. The recruitment strategy was also initiated by the pregnant female who received a hyperlink instructing them to complete the survey and to also forward a survey link onto their male reproductive partners.

Survey instrument and data

A paper-based survey was initially developed and tested by three individuals, feedback was provided which resulted in the survey being built into Qualtrics™ and retested (See Supplementary File 1). The final survey consisted of 80-items across five sections including [1] "About you" (sociodemographic characteristics); [2] "Your current pregnancy" (retrospective assessment of the degree and timing of pregnancy planning using the partners version of the London Measure of Unplanned Pregnancy (LMUP) [17]; [3] "Your health behaviours" (changes in preconception health and health behaviours); [4] "Pre-pregnancy health information and advice" (knowledge on the importance of preconception health, the content of preconception care, and the source(s) of this information); and [5] "Your health history" (health and pregnancy history).

Participant demographics

The survey sought expectant partners' gender, age, private health insurance cover, highest qualification completed, employment status, relationship status, financial manageability status, identity as Aboriginal or Torres Strait Islander, first language spoken, country of birth, and health care card access.

Participant health history, health status, and pregnancy planning

Expectant partners rated their current general health [excellent-poor] and reported any longstanding illness, disability or infirmity; as well as body weight and height which were used to calculate and classify body mass index (BMI). The survey examined how the pregnancy was identified, their pregnancy intention, if the pregnancy resulted from fertility treatment, and contraception use 6 months before pregnancy.

Participant health behaviours

Survey questions identified expectant partners' health behaviours before pregnancy including alcohol consumption, smoking, physical activity, healthy diet, and supplements used. Alcohol consumption, a healthy diet, smoking, and physical activity were identified based on any history of use and use three months and six months prior to pregnancy. In addition, proximal preconception outcomes were reported related to physical activity, alcohol, and a healthy diet (i.e. I exercised regularly, ate a healthy diet, and avoided alcohol) for at least 6 months before their partners' pregnancy. Other potential preconception health behaviours such as following a weight loss diet, getting tested for a sexually transmitted disease (STI), visiting a dentist, checking immunization status, or undergoing surgery to help lose weight were also reported.

Participant preconception beliefs, and intentions

Survey items regarding beliefs and intentions were formulated using the Theory of Planned Behaviour (TPB), a framework best suited to the research question and widely utilized. The TPB examines the belief-behaviour relationship and aims to provide an explanation for the influences of behaviour, thereby understanding and even predicting behaviour [18]. The TPB model suggests that belief-based measures drive intentions, which are controlled by norms, subjective norms, and perceived behavioural control to determine behaviour [19]. This study reported the beliefs, intentions, subjective norms, and perceived behavioural control for three outcomes which have been identified as research gaps in the preconception literature for males [3, 20] (1) regular exercise, (2) healthy diet, and (3) alcohol avoidance. Each outcome was measured on a seven-point scale; expectant partners' beliefs were measured in the survey ranging from important to not important, being pleasant to unpleasant, being good to bad, or from being extremely likely to extremely unlikely (i.e. My doing regular exercise during the 6 months prior to partners pregnancy is… important/not important). Intentions were measured in the survey by questions reporting from extremely likely to extremely unlikely for participants (i.e. I intend to exercise regularly for at least 6 months before my partner becomes pregnant… extremely likely/unlikely). Expectant partners' behaviours in the survey were measured in one question which ranged from definitely true to definitely false (i.e. I exercised regularly for at least 6 months before my partner became pregnant…true/false).

Data analysis

Survey data were imported into STATA statistical software – version 17, cleaned, and prepared for analysis by the research team. Descriptive statistics detailed participant demographic characteristics, preconception health history, health status and pregnancy intention, as well as preconception health behaviours, beliefs, and intentions. BMI was calculated using participant weight and height and classified according to the World Health Organization (WHO) BMI classification [21]. Pregnancy intention was evaluated using the LMUP for women's partners; a validated and widely used measure to identify the degree of planning/intention for a current/recent pregnancy [17]. The LMUP score ranges from 0–12, with a higher score indicating greater pregnancy planning/intention [22]. The LMUP score was categorised as 'Planned' (10 or 11), 'Ambivalent' (between 4 and 9), or `Unplanned' (3 or less) [17].

Structural Equation Modelling (SEM) was used to estimate associations between TPB concepts, using survey items to construct latent variables. Parcelling [16] was applied to items used to estimate the latent constructs if convergence or an acceptable model fit was unable to be achieved, and then if this was unsuccessful the concepts were represented by single items in a path model. The indicators used in the path model were rationalized by two members of the research team and comprised a single variable for each construct (See Supplementary Table 1). Regression paths were included to estimate the level of association between beliefs, subjective norms, perceived behavioural control, and intention, and between intention and behaviour. Model fit was established through the Comparative Fit Index (CFI), Tucker Lewis Index (TLI), the Root Mean Square Error of Approximation (RMSEA) and Standardised Root Mean Square Residual (SRMR). Item non-response was dealt with by using full information maximum likelihood when estimating the model. Standardised path coefficients were estimated. The analysis was conducted with the Lavaan package [23] in R (version 4.3.1). A power analysis was not conducted on the sample. A formal sample size calculation for a specific effect size prior to the analysis as was not conducted as this research was based upon a secondary analysis question. The proposed model was not like models used in simulations for sample size requirements [24] so the 'sample size lower bound' [25] was checked for an anticipated effect size of regression paths of 0.4, and with up to 5 latent variables. The lower bound was 100, which was considered close enough to the study sample ($n = 94$) that analysis would proceed.

Results

The study sample comprised 156 expectant partners and most identified as reproductive males ($n = 146$) who were included in this study. The proportion of planned pregnancies in this study (65.2%) is higher than the proportion of intended pregnancies for Australian couples (60%) [26].

The proposed models for each type of behaviour, including the paths between latent variables and the items used to estimate each concept appear in Fig. 1.

Participant demographics

The mean age of expectant partners was 31 years (see Table 1). A large proportion of expectant partners were employed full-time [≥ 35 hours/week] (87.6%) and married (69.1%) while over half held private health insurance (59.9%) and/or a university qualification (53.4%) and/or reported that 'It is not too bad' to manage financially (52.7%). A small proportion of expectant partners identified as Aboriginal and Torres Strait Islander (4.1%).

Participant health history, status, and pregnancy planning

Expectant partners generally rated their health status as good (60.8%) with some reporting a longstanding illness, disability, or infirmity (15.4%) (see Table 2). About one third of expectant partners had a normal weight (33.3%), overweight (35.4%), or obesity (31.2%). According to the LMUP categories, most pregnancies were planned (65.2%), while a very small minority were unplanned (0.7%). Further, many expectant partners confirmed the pregnancy using a home pregnancy test (71.9%) and one in 10 pregnancies were conceived via fertility treatment

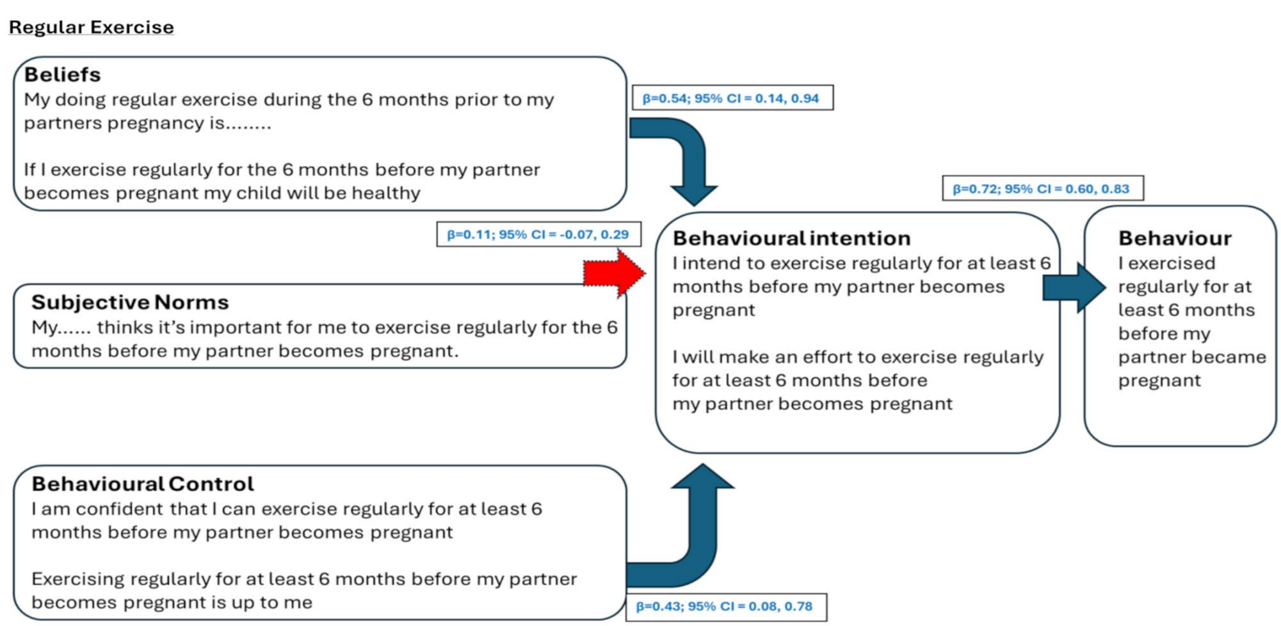

Fig. 1 Theory of Planned Behaviour (TPB) path models

Table 1 Sociodemographic characteristics of expectant male partners

Characteristics	Mean (SD; min, max)
Age ($n=136$)	31.0 (4.6; 19, 44)
Highest level of education ($n=146$)	**N (%)**
Year 10 or less	7 (4.7)
Year 12 of equivalent	10 (6.8)
Vocational education [Apprenticeship/Diploma/Certificate]	51 (34.9)
University qualification	78 (53.4)
Private health insurance ($n=146$)	87 (59.9)
Employment status ($n=146$)	
Full-time work (≥ 35 h/week)	128 (87.6)
Part-time work (< 35 h/week)	10 (6.8)
Casual/temp work (irregular hours)	3 (2.0)
Not currently working	5 (3.4)
Relationship status ($n=146$)	
Married	101 (69.1)
De facto	41 (28.0)
Other	4 (2.7)
Financial manageability ($n=146$)	
It is impossible/It is difficult all the time	12 (8.2)
It is difficult some of the time	26 (17.8)
It is not too bad	77 (52.7)
It is easy	31 (21.2)
Identify as Aboriginal or Torres Strait Islander ($n=146$)	6 (4.1)
First language other than English ($n=145$)	16 (11.0)
Born outside Australia ($n=146$)	32 (21.9)
Health care card ($n=146$)	45 (30.8)

(9.5%). Half of the expectant partners reported that they did not use contraception prior to their most recent pregnancy as they were trying to conceive (50.0%).

Participant preconception health behaviours

The majority of expectant partners reported history of any alcohol consumption (88.8%) (see Table 3). Many expectant partners who reported a history of alcohol consumption also reported alcohol consumption in the three months before pregnancy (62.0%). Less than half of all expectant partners had a history of ever smoking (37.5%) and of those with a history of ever smoking, less than half were smoking in the three months prior to conception (45.1%). The majority of expectant partners reported any exercise in the three months before conception (71.3%) with a mean number of hours per week at approximately six (mean 6.3; SD 5.3). The most common health behaviours before pregnancy were visiting a dentist (76.9%) or checking immunization status (28.2%), while the most common supplements used before pregnancy were an ordinary multivitamin (10.0%) or omega 3 (6.3%).

The associations between preconception beliefs, subjective norms, perceived behavioural control, and intentions and behaviours

Median scores, and the interquartile range (IQR, 25% and 75% percentiles), for preconception beliefs, norms, perceived behavioural control, and intentions and behaviours were measured on a seven-point scale from extremely likely to extremely unlikely (see Table 4). SEM model fit for the outcomes exercise and alcohol was adequate (Supplementary Table 2), and a path model was used for diet due to issues with convergence and model fit. The models for each concept are presented in Figs. 1 and 2, and Fig. 3.

For the exercise outcomes, results indicated that the beliefs of expectant partners toward regular exercise and their perceived behavioural control to exercise regularly were associated with a greater intention to exercise regularly (Standardised estimate $\beta=0.54$; $p=0.0087$ and $\beta=0.43$; $p=0.02$, respectively). The subjective norms of expectant partners were not associated with an intention to exercise regularly $\beta=0.11$; $p>0.05$). Similarly for alcohol, the beliefs of expectant partners toward alcohol avoidance and their perceived behavioural control toward alcohol avoidance were associated with a greater intention to avoid alcohol ($\beta=0.43$; $p<0.001$ and $\beta=0.36$; $p<0.001$, respectively). For the healthy diet outcome, subjective norms regarding a healthy diet as expressed by

Table 2 Health history, health status, and pregnancy planning of expectant male partners

Characteristics	*N* (%)
General health status ($n=97$)	
Excellent	22 (22.6)
Good	59 (60.8)
Fair	15 (15.4)
Poor	1 (1.0)
Longstanding illness, disability, or infirmity ($n=97$)	15 (15.4)
BMI classification ($n=144$)	
Underweight	0 (0.0)
Normal weight	48 (33.3)
Pre-obesity	51 (35.4)
Obese class I	30 (20.8)
Obese class II/III	15 (10.4)
LMUP Category ($n=139$)	
Planned	90 (65.2)
Ambivalent	48 (34.7)
Unplanned	1 (0.7)
Confirmation of pregnancy ($n=146$)	
Home pregnancy test	105 (71.9)
From a health professional	8 (5.4)
My partner told me	33 (22.6)
Pregnancy resulting from fertility treatment ($n=146$)	14 (9.5)
Contraception use [6 months before partner's pregnancy] ($n=130$)	
Yes	43 (33.0)
No – I was trying to conceive	65 (50.0)
No – I was not trying to conceive	22 (16.9)

LMUP, London Measure of Unplanned Pregnancy

an expectant partner and perceived behavioural control to adopt a healthy diet were associated with an intention to adopt a healthy diet ($\beta = 0.23$; $p = 0.04$ and $\beta = 0.47$; $p < 0.001$, respectively). The beliefs of expectant partners toward a healthy diet and the subjective norms of their health care providers towards a healthy diet were not associated with the intention for a healthy diet ($\beta = 0.07$; $p > 0.05$ and $\beta = 0.13$; $p > 0.05$, respectively). Intention was in turn associated with behaviour for all three outcomes.

Discussion

Our study advances the understanding of paternal preconception health by examining the relationships and pathways between expectant partner's health beliefs, and intentions and behaviours around dietary practices, alcohol avoidance, and regular exercise before pregnancy. Considering the majority of pregnancies in our study were planned (65.2%), key findings suggest that preconception beliefs about exercise and alcohol predict intention to exercise regularly and to avoid alcohol. Further, the confidence/control about being able to exercise regularly, eat a healthy diet and avoid alcohol all predict intention for these behaviours amongst expectant partners. Partner opinion on the importance of eating a healthy diet was an important predictor for intention to eat a healthy diet. Also, expectant partners' intentions for all three behaviours predicted behaviour, most strongly for exercise.

Most expectant partners in our study undertook regular exercise in the three months before conception. Previous research investigating behavioural intention to exercise has explored mixed gender populations, such as university students [27, 28]. This work provides varied results and suggests that intention to exercise does not always translate into practice [29]. Evidence exploring physical activity specifically among males during preconception is lacking [3]. However, evidence does suggest that the health behaviours of males can have a direct and indirect influence on pregnancy and offspring outcomes. Nuances in sociodemographic characteristics such as being educated may justify the intent for physical activity among expectant partners in our study given approximately one in two held a university qualification. In our study, when comparing regular exercise with a healthy diet or avoiding alcohol, the behavioural intention to regularly exercise was not influenced by the subjective expectations of others. Specifically, our study found expectant partners' intention to exercise may be less often influenced by other individuals in their lives, such as their reproductive partners or male or female family and friends. The reason for this finding, however, is unclear. It is possible that men are instead relying on their own personal beliefs

Table 3 Preconception health behaviours of expectant male partners ^*All items scored on a 7-point scale (0–7)*

Characteristics	***N* (%)**
Alcohol behaviours (*n* = 134)	
History of alcohol consumption ever	119 (88.8)
Consumption in the three months before conception (n = 116)	72 (62.0)
	Mean (SD; min, max)
*Total average units consumed per week in the 3 months before conception *During the week*	2.6 (3.5; 0,20)
*Total average units consumed per week in the 3 months before conception *On the weekend*	4.9 (5.3; 0, 30)
I avoided alcohol for at least 6 months before my partners pregnancy ^ (n = 95)	4.4 (2.6; 0,7)
Smoking behaviours (*n* = 136)	**N (%)**
History of ever smoking	51 (37.5)
Smoking in the three months prior to conception (n = 51)	23 (45.1)
Exercise behaviours (*n* = 136)	
Any exercise in the 3 months before conception	97 (71.3)
	Mean (SD: min, max)
Hours of exercise per week in the 3 months before conception (n = 97)	6.3 (5.3: 1, 35)
I exercised regularly for at least 6 months before my partners pregnancy (n = 95)	3.1 (2.4; 0,7)
Preconception health behaviours (*n* = 78)	**N (%)**
Follow a weight loss diet	15 (19.2)
Get tested for a sexually transmitted infection	11 (14.1)
Visit the dentist	60 (76.9)
Check immunisation status	22 (28.2)
Undergo surgery to help lose weight	-
I ate a healthy diet for at least 6 months before my partners pregnancy (n = 93)	2.7 (1.5;0,7)
Supplements used before pregnancy	
Folic acid (n = 82)	3 (3.6)
Ordinary multivitamin (n = 80)	8 (10.0)
Vitamin C (n = 82)	2 (2.4)
Zinc (n = 79)	3 (3.8)
Omega 3 (n = 79)	5 (6.3)
Antioxidants (n = 80)	1 (1.2)
Herbal medicines (n = 80)	1 (1.2)
Other (n = 80)	6 (7.5)

and responding to their personal health needs, and the subsequent individualised health benefits resulting from a regular exercise regime, rather than relying on external factors as motivations to exercise regularly. Considering the inherent risks of sedentary lifestyles and the rising global prevalence of overweight and obesity [30, 31], our finding that intention to exercise regularly is related to exercise behaviour is promising for paternal preconception intervention development. However, our finding relating to expectant partners preconception exercise must also consider the influence of their beliefs, subjective norms, and their perceived control of their behaviour on their intention to exercise. These three factors underpinning intention must be targeted in future research to develop a clear understanding of exercise for males during preconception. The health impacts of regular exercise have been investigated for males during preconception in a limited number of studies; a review exploring paternal preconception modifiable risk factors identified only two papers relevant to exercise and both papers reported no associations between paternal preconception physical activity and adverse pregnancy or offspring outcomes [3]. Hence, further studies are needed to explore opportunities for promoting physical activity among males who plan to become a parent during the preconception period to motivate and facilitate a behaviour change to support their own life-long health and possibly that of their family.

The beliefs of expectant partners in our study toward alcohol avoidance during preconception were associated with a greater intention to avoid alcohol. However, most expectant partners consumed alcohol in the three months before conception. The disconnect between expectant partners' beliefs about alcohol (avoiding alcohol is important) and their behaviours regarding alcohol (avoiding alcohol) before pregnancy may be due to alcohol, as an addictive drug, being culturally encouraged in Australia [32] despite public health campaigns

Table 4 Preconception health beliefs and intentions of expectant male partners **All items scored on a 7-point scale (0–7)*

CONSTRUCT		Behaviour		
		Regular Exercise (*n* = 95)	Healthy Diet (*n* = 93)	Alcohol Avoidance (*n* = 95)
		Median (IQR)	Median (IQR)	Median (IQR)
Past behaviour	I……. regularly for at least 6 months before becoming pregnant [definitely true/definitely false]	3 (1,5)	3 (2,4)	5 (2,7)
Beliefs	My………. during the 6 months prior to becoming pregnant is			
	[important/not important]	3 (2,4.5)	2 (1,4)	4 (2,6)
	[pleasant/unpleasant]	2 (1,4)	2 (1,3)	3 (1,5)
	[good/bad]	1 (0,3)	1 (1,3)	2 (1,4)
	If I……. for 6 months before becoming pregnant my child will be healthy [extremely likely/extremely unlikely]	3 (2,4)	3 (2,4)	3 (2,4)
Intentions	I intend to……. for at least 6 months before becoming pregnant [extremely likely/extremely unlikely]	3 (1,4)	2 (1,4)	3 (1,6)
	I will make an effort to……… for at least 6 months before becoming pregnant [extremely likely/extremely unlikely]	3 (1,4)	2 (1,4)	3 (1,6)
Control	I am confident I can………. for at least 6 months before becoming pregnant [extremely likely/extremely unlikely]	3 (1,4)	2 (1,3)	3 (1,5)
	……….for 6 months before becoming pregnant is up to me [extremely likely/extremely unlikely]	1 (0,2)	1 (1,2)	1 (0,3)
Norms	Most people like me ……… for 6 months before becoming pregnant [extremely likely/extremely unlikely]	4 (2,5)	4 (3,5)	4 (3,6)
Subjective Norms	My reproductive partner thinks it's important for me to……. for 6 months before becoming pregnant [strongly agree/strongly disagree]	3 (2,4)	2 (1,4)	3.5 (2,5)
	My older female relatives (e.g., mother, grandmother, aunt) thinks it's important for me………. for 6 months before becoming pregnant [strongly agree/strongly disagree]	3 (2,5)	3 (2,5)	3 (2,5)
	My older male relatives (e.g., father, grandfather, uncle) thinks it's important for me to………. for 6 months before becoming pregnant [strongly agree/strongly disagree]	4 (3,5)	4 (2,5)	4 (3,6)
	My male friends and family of similar age thinks it's important for me to………. for 6 months before becoming pregnant [strongly agree/strongly disagree]	4 (2,5)	4 (2,5)	4 (2,6)
	My female friends and family of similar age thinks it's important for me to……. for 6 months before becoming pregnant [strongly agree/strongly disagree]	3 (2,5)	3 (2,4)	3 (2,5)
	My health care provider thinks it's important for me to……. for 6 months before becoming pregnant [strongly agree/strongly disagree]	2 (1,3)	2 (1,3)	2 (1,4)

highlighting the general health risks and adverse effects of alcohol use [33]. Considering the normalization of alcohol consumption in Australian society, due to social acceptability and regular availability, a 'culture of intoxication' [32] exists, especially for younger males [34]. It may be that the cultural context and addictive properties of alcohol both play their part in challenging the beliefs of males to abstain from drinking alcohol during preconception, as is demonstrated in our study. Health behaviours such as alcohol consumption and tobacco smoking can interrelate and often co-exist [35] within a complex environment of social and cultural norms [36] and this link may also explain why close to half of the expectant partners in our study who had ever smoked chose to smoke in the three months prior to their partners pregnancy. Expectant partners in our study who hold the belief to avoid alcohol during preconception yet report alcohol consumption or smoking in the three months before conception is concerning due to the potential for adverse pregnancy and offspring outcomes such as foetal birth defects [37] and child behavioural problems [38]. Associations between alcohol consumption or smoking and adverse and pregnancy outcomes have also been identified in a recent review of paternal preconception modifiable risk factors [3]. Understanding future fathers' resistance to changing alcohol consumption and smoking patterns during preconception requires further research which can guide Governments to consider instituting overarching preconception guidelines focusing on males as well as females, and couples. To better support the disparity between males' preconception beliefs and their behaviours towards alcohol, and their behaviours while consuming alcohol such as smoking, industry collaborations must be strengthened to facilitate the effective translation of alcohol related information between researchers, practitioners, health and community organisations, and the general public.

Many expectant partners in our study did not report consuming a healthy diet in the six months before conception. However, our analysis did reveal that the healthy

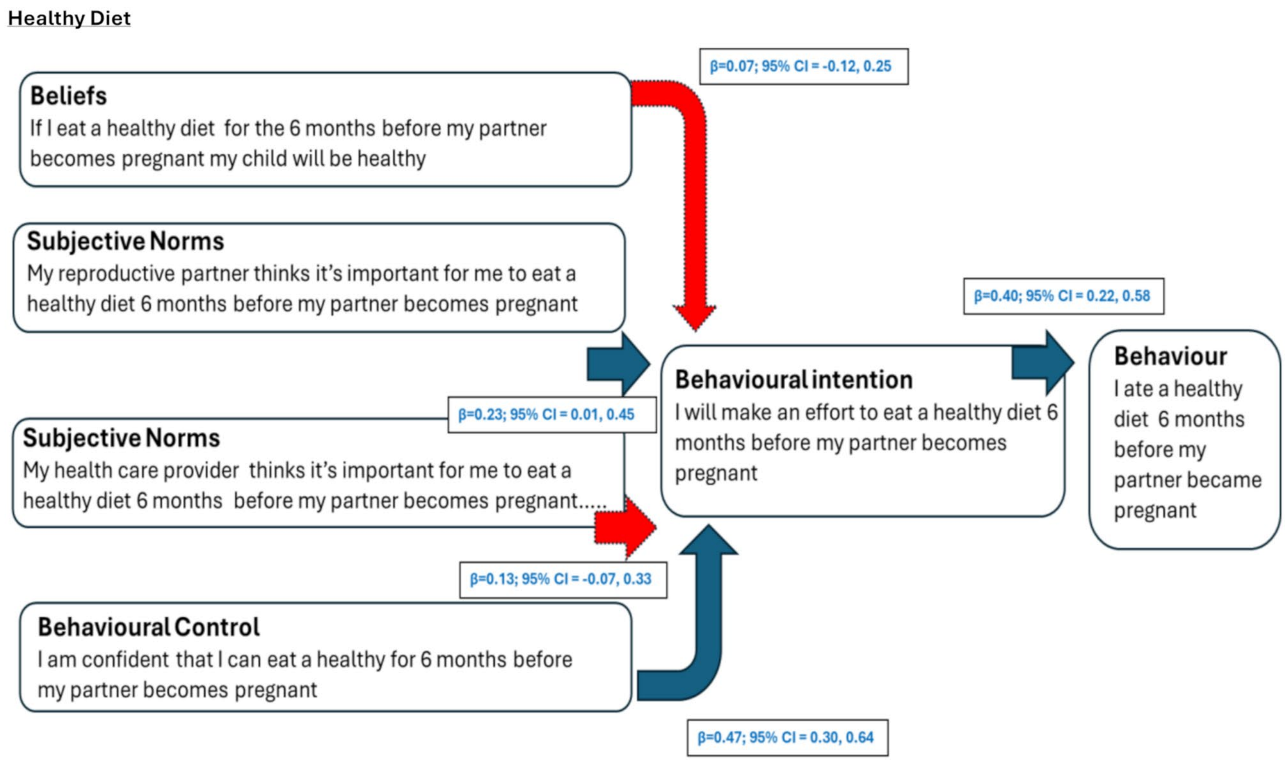

Fig. 2 Theory of Planned Behaviour (TPB) path models

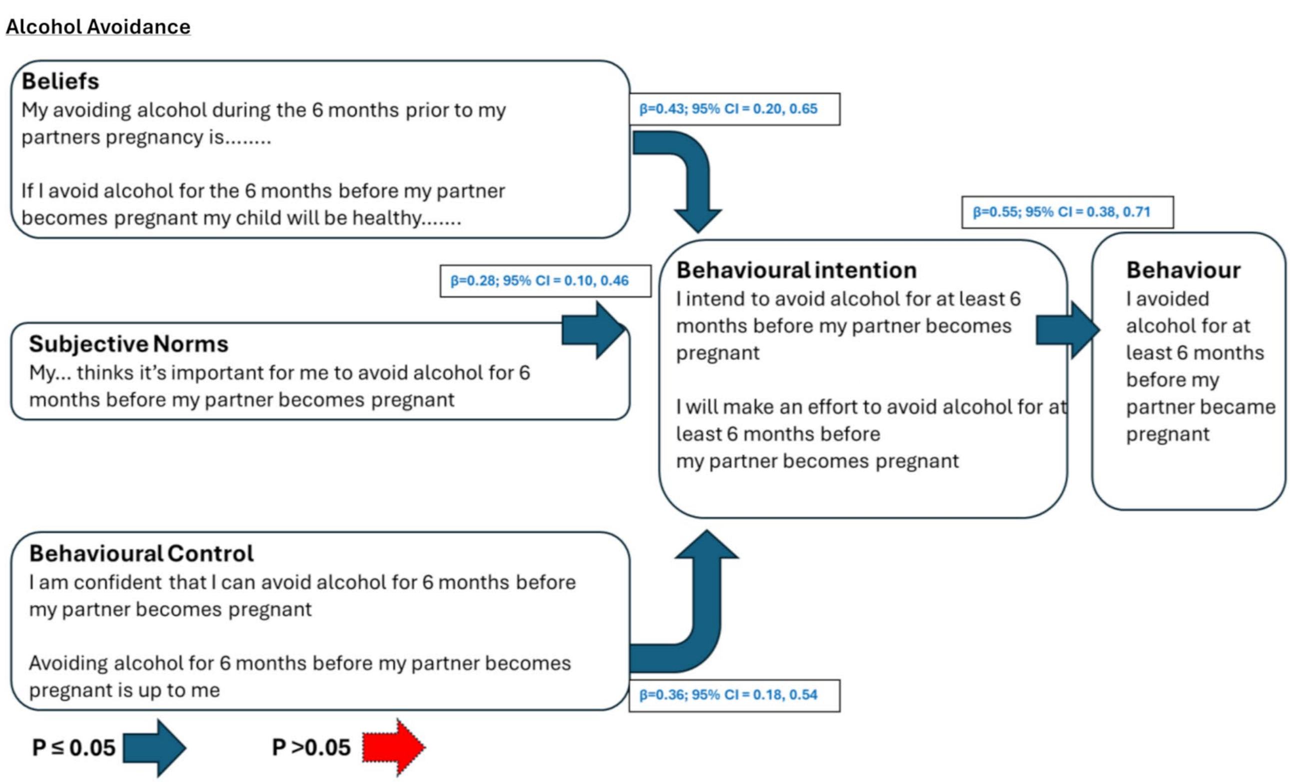

Fig. 3 Theory of Planned Behaviour (TPB) path models

diet of some expectant partners was most often influenced by their reproductive partners, more so than their health care provider. The dietary beliefs of males, for example beliefs regarding healthy eating or binge drinking, are only marginally investigated, among male consumers [39], and are often based on outdated evidence [40, 41]. More recent literature highlights the importance of initiating healthful dietary regimes for males during preconception, validating the effects of poor paternal dietary patterns and paternal nutrition on pregnancy and offspring outcomes [3, 42]. Most expectant partners in our study were married and, indeed, being in a committed relationship can have an influence on an individual's behaviours which impact their health [43] including their diet. Many expectant partners in our study worked full-time and, due to the convenience, cost and availability of certain foods, may have resorted to foods often deemed nutritionally imbalanced or even 'unhealthy' such as packaged, preprepared or 'fast food' [44]. The diets of expectant partners in our study must also be understood within the context of wider cultural stereotypes such as masculine eating and drinking beliefs often associated with a low concern for unhealthy eating/drinking [39] and the consumption of disproportionate amounts of macronutrients [45]. Our study identifies an expectant partner's healthy diet as influenced by their reproductive partner. As such, the influence of the couple or the family on a male's diet is noteworthy and signals an important challenge for public health policy makers and researchers to pursue the food habits of males and to assess the perceived behavioural control of males to maintain a healthy diet during preconception and when planning a pregnancy.

Our study provides new insights, being the first to examine the influence of males, as expectant partners, and their beliefs, norms, and perceived behavioural control on intentions and subsequent preconception health behaviours. This sample also displays a number of other health conditions which may further affect the behavioural decisions of expectant partners. Future research should examine some of the potential influence of health status and other factors on intentions for expectant partners. A key strength of our study is the data collection directly from male expectant partners rather than being reported by their female partners and while their partner was still pregnant – addressing an important gap in paternal preconception research to date [3]. Although, our study is not without limitations. Firstly, when conducting analysis, issues were identified with using the SEM model to fit the healthy diet outcome which could only be resolved by utilizing a path model which was selected by two members of the research team. As such, the determination of each healthy diet variable may attract researcher-bias toward the final SEM model and regression results. Also, participants were recruited via social media; hence, sampling bias may influence the findings of this study. Despite the global use and acceptance of social media, recruitment via this medium is unlikely to provide a true representation of the target population during preconception. As such, the absence of national data describing demographic characteristics of expectant fathers in Australia limits the ability to determine the representativeness of the study sample. Therefore, the study recruitment strategy and small sample size of this study may not report an entirely accurate representation of Australian male ethnicities or males as reproductive partners of pregnant Australian women [46, 47]. In addition, the SEM model did not account for characteristics such as BMI or smoking due to the complexity of the model and the need for extra paths to different latent variables. Furthermore, this study uses past behaviours to predict future intention and therefore had to be supported by a proxy measure of preconception behaviour. Finally, self-reporting on a survey may also present the potential for self-reporting bias.

Conclusion

Our study highlights the importance of engaging males as expectant partners during preconception to characterize their beliefs and intentions which are exacted through their personal values (norms), the values of others (subjective norms) and their perceived behavioural control. Overall, our study demonstrated that expectant partners' preconception beliefs about exercise and alcohol predict their intention to exercise regularly and avoid alcohol. Further, the confidence/ perceived behavioural control about being able to exercise regularly, eat a healthy diet and avoid alcohol all predict intention for these behaviours. Partner opinion on the importance of eating a healthy diet was an important predictor for expectant partners' intention to eat a healthy diet. Importantly, expectant partners' intentions for all three behaviours predicted behaviour, most strongly for exercise. Further studies examining paternal preconception health beliefs, and intentions and the motivations behind health behaviours for males are needed to help develop targeted preconception health promotion messages and interventions that support males to optimise their preconception health.

Abbreviations

TPB	Theory of Planned Behaviour
LMUP	London Measure of Unplanned Pregnancy
STI	Sexually transmitted disease
BMI	Body mass index
UK	United Kingdom
SEM	Structural Equation Modelling
CFI	Comparative Fit Index
TLI	Tucker Lewis Index
RMSEA	Root Mean Square Error of Approximation
SRMR	Standardised Root Mean Square Residual

NIHR Health and Social Care Research
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Supplementary Information

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Supplementary Material 1

Supplementary Material 2

Supplementary Material 3

Supplementary Material 4

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Author contributions
AS initiated the survey, administered the survey process, and collected data. TC, AS, KR and DS developed the analysis plan. KR undertook the SEM analysis and TC was responsible for descriptive data analysis. AS, JA, DS and KR contributed to interpretation of results. TC drafted the manuscript with input from AS, JA, DS and KR. All authors read and approved the final manuscript.

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Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
Study ethics approval was obtained from the Human Research Ethics Committee [HREC] at the University of Technology Sydney [UTS] (ETH24-9519), in accordance with the Declaration of Helsinki. Informed consent was obtained from each participant prior to survey commencement.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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