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Original Research

Sensory Processing Patterns in Emerging Adult Women with Primary Dysmenorrhea: A Cross-Sectional Study

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Abstract

Objectives: The objective of this study was to examine the sensory processing patterns of emerging adult women with primary dysmenorrhea (PD) and those without PD.
Materials and Methods: A total of 540 women were included in the study, divided into two groups: the study group (SG, n = 300) and the control group (CG, n = 240). The Adolescent/Adult Sensory Profile (AASP) was utilized to assess sensory processing patterns and sensory modalities. The severity of PD was assessed using a visual analog scale (VAS) with a range of 0 to 10. The participants' weight and height were recorded, and the body mass indexes were calculated.
Results: As evidenced by the AASP scores, participants in the SG demonstrated heightened levels of sensory sensitivity in comparison to those in the CG ($p < 0.05$). PD reported heightened levels of sensory sensitivity across multiple domains, including taste/smell, movement, visual, touch, activity level, and auditory processing ($p < 0.05$).
Conclusion: This article highlights the significance of considering sensory processing patterns in the assessment and management of PD among emerging adult women. By recognizing and addressing sensory sensitivities, healthcare providers can improve the quality of care and support for individuals navigating the challenges of menstrual pain.

Keywords: *adult, dysmenorrhea, sensory process, women*

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Introduction

Primary dysmenorrhea (PD) is a prevalent gynecological condition among women of reproductive age (Aouad et al., 2022). Without any discernible pelvic pathology, it is typified by lower abdominal pain that feels like cramps at the start of menstruation. Back discomfort, nausea, vomiting, and diarrhea could accompany the pain (Ferries-Rowe et al., 2020). The most prevalent gynecological issue among young adults and adolescents who are menstruation is PD. PD typically appears during the start of an adolescent's reproductive cycle. The incidence of PD increases during adolescence and subsequently declines with age. The PD typically manifests in emerging adult women between the ages of 18 and 25 (Aouad et al., 2022; Santos et al., 2022).

Women in the emerging adult period (18-25 years old) generally include individuals in the university period and transitioning to work (Hochberg & Corner, 2020). PD causes pain that affects the quality of life and has implications for public health, occupational health, and family medicine. It is not only a gynecological issue for emerging adult women but also a significant health problem that can result in short-term school absences and job loss (Mendelson et al., 2023).

The International Association for the Study of Pain (IASP) defines dysmenorrhea as a significant recurring pain disorder characterized by dysregulated somatosensory processing (Barbosa Silva et al., 2024; Bernardi et al., 2017). It has been observed that women experiencing menstrual pain may encounter difficulties with sensory processing behaviors, such as light and tactile sensitivity (Slater et al., 2015). Therefore, identifying pain-related issues in PD is crucial for maintaining good health and well-being. Nausea, vomiting, and diarrhea are common symptoms accompanying pain in PD. Women with this condition may also experience sensory processing difficulties, such as sensitivity to light and touch and increased sensitivity to cold (Baran & Yılmaz, 2024; Schrepf et al., 2023). Sensory processing patterns refer to how individuals perceive and respond to sensory stimuli from their environment. These patterns include various senses, such as sight, sound, touch, taste, and smell. Each sense plays a pivotal role in shaping an individual's experiences and well-being (Takahashi et al., 2020).

Pain generation occurs when the neurological threshold level changes from high to low, resulting in an increased response to sensory stimuli. Excessive responses to sensory stimuli, including pain, can have a profound impact on a woman's daily functioning (Casale et al., 2021). It is, therefore, crucial to conduct a more comprehensive examination of the correlation between pain and sensory processing behaviors (Baran & Yılmaz, 2024).

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PD is a condition characterized by painful menstrual cramps without any underlying medical condition. It affects a significant portion of the female population, especially in adulthood (Knox et al., 2019; Slater et al., 2015). Although the physical symptoms of this condition are well documented, its impact on sensory processing patterns remains a topic worthy of investigation. The above findings suggest that the sensory processing behaviors of women with PD may differ from the norm. However, there is limited literature that mentions sensory processing difficulties in women with PD.

It is essential to understand the intricate relationship between sensory processing patterns and PD to advance our knowledge of this common yet often misunderstood condition. Recent studies have begun to explore the connection between sensory processing and menstrual health, highlighting the need for a deeper investigation into this area (Ikarashi et al., 2020; Schreiber & Solebo, 2023; Baran & Yılmaz, 2024). The first objective of this study was to examine the sensory processing patterns and special sensory modalities of emerging adult women with PD and women without PD. This focus on sensory processing in the context of PD is particularly timely, given the increasing recognition of sensory processing issues as a critical factor in managing chronic pain conditions (Sabu, 2021). The second objective of this study was to examine the special sensory modalities of emerging adult women with PD and women without PD. By investigating this correlation, we aimed to inform the development of more comprehensive strategies for managing dysmenorrhea, ultimately enhancing the well-being of those affected. As predicted by the literature, women with PD were expected to demonstrate greater sensory processing difficulties than women without PD (Baran & Yılmaz, 2024). By investigating this correlation, we aim to inform the development of more comprehensive strategies for managing dysmenorrhea, ultimately enhancing the well-being of those affected.

Material and Methods

Procedure

This cross-sectional study was conducted in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines, which are typically employed in cross-sectional studies (Appendix 1).

The study was conducted with the participation of female university students. The study was disseminated via private correspondence channels, including WhatsApp groups, social media platforms (Facebook, Instagram, Twitter, etc.), and email and messaging services where university students are present. Eligibility was determined through the administration of an

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online screening questionnaire. Prior to the commencement of the study, the participants were informed of the study's goal and methodology. All participants were required to sign an informed consent form. Eligibility for the trial was based on the absence of any indication of a medical condition that could account for PD. On the day of the assessment, participants were requested not to take any painkillers. Subsequently, the participants were requested to complete a questionnaire that encompassed demographic data, menstrual cycle information, and the intensity of menstrual pain, as measured by the Visual Analog Scale (VAS), on either the first or second day of menstruation. The Adolescent/Adult Sensory Profile (AASP), a self-report questionnaire intended to evaluate sensory processing patterns, was then administered to the participants. Every participant had their height and weight measured, and body mass indices were computed. The procedure, which was conducted in the same order during the menstrual phase, required each individual to dedicate approximately 25–30 minutes of their time. There was no cost to participate.

Ethical Considerations

The study was approved by the Biruni University Non-Invasive Clinical Research Ethics Committee (file number: 2020/45-19) in accordance with ethical standards for research. All the procedures performed were in accordance with the ethical standards of the national research standards and with the Helsinki Declaration and its later amendments. Informed consent was obtained from all the individual participants included in the study.

Participants

The G*Power 3.1.9.7 software was employed to determine the requisite sample size for the study. The power analysis indicated that a total of 228 individuals should be included in the study, with 114 in the research group and 114 in the control group. This was based on a 90% confidence interval and a 5% margin of error.

Menstrual pain was first measured in everyone with a VAS, with scores ranging from 0 to 10. The study group (SG) consisted of subjects who self-reported severe menstrual pain, as defined by a Visual Analogue Scale (VAS) score of >6 points, and who had a history of dysmenorrhea that began shortly after menarche. Subjects who scored ≤2 on the VAS for menstrual pain were placed in the control group (CG).

Dysmenorrhea was defined as 12–72 hours of abdominal pain accompanied by one or more of the following symptoms: nausea, diarrhea, fatigue, or headache, occurring during each menstrual cycle (for three consecutive menstrual cycles). All participants were required to meet the following inclusion criteria: 1) Women aged 18 to 25 years, 2) A regular menstrual cycle

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of 27-32 days, and 3) Nulliparity.

The following exclusion criteria were applied: 1) Acute or chronic pelvic disease, 2) Physical illness that causes pain, 3) Smoking, 4) History of pregnancy and/or childbirth, and 5) Use of any psychotropic medication and hormonal contraception in the past six months.

Out of the 1350 women who were invited to participate in the study, 570 participants were included. A total of 540 women were included in the study, with 30 individuals meeting the exclusion criteria. Of these, 300 formed the SG, and 240 formed the CG. The process for enrolling participants in the study is shown in Figure 1.

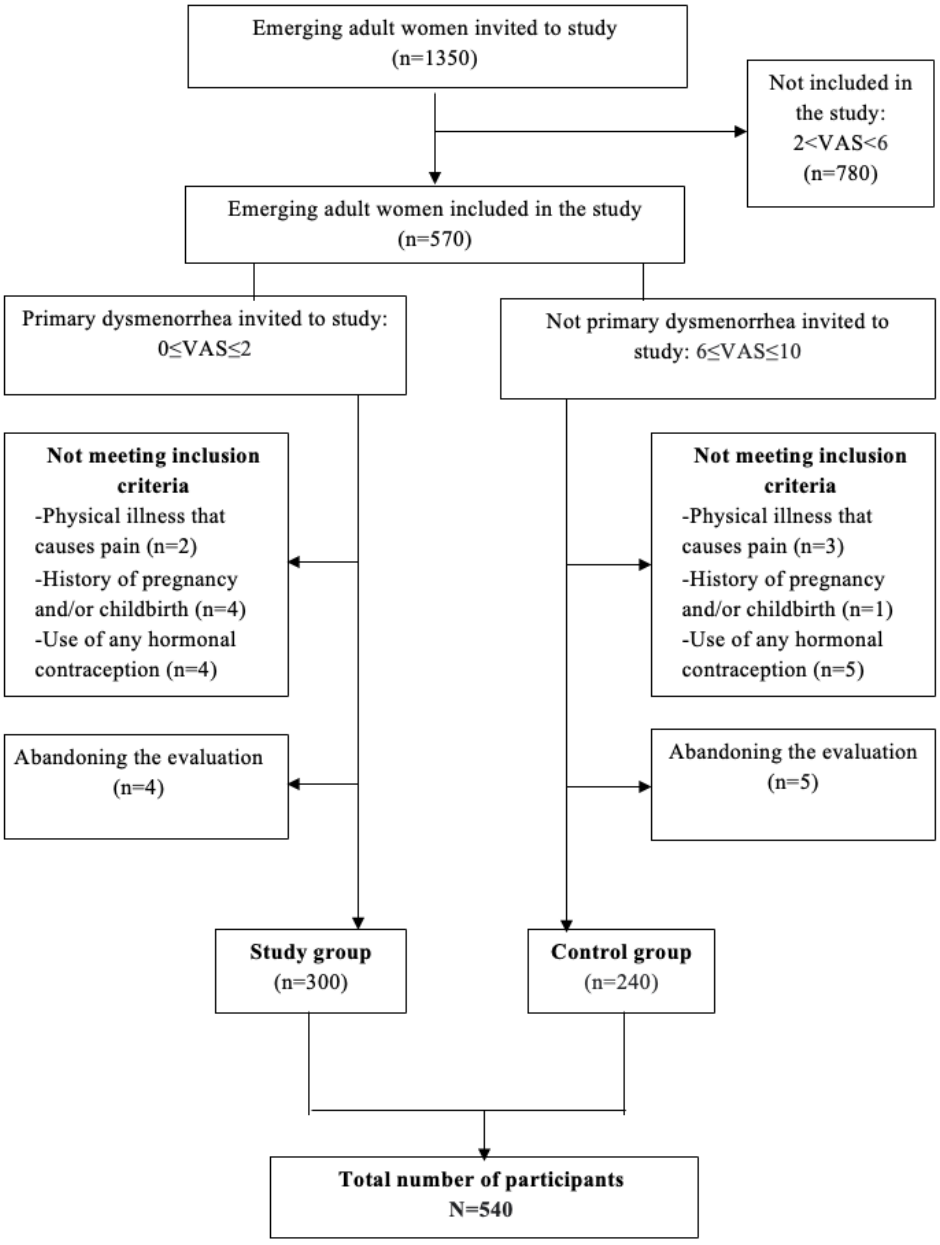

Figure 1. Flow chart

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Measurements

Demographic Information Form

The demographic information form encompasses a range of data points, including age, years of education, body mass index (BMI), age at menarche, length of menstrual cycle, and duration of menstrual bleeding.

Visual Analog Scale

The menstrual pain severity of female participants in our study was determined using the VAS. VAS is a simple and effective method for measuring pain intensity and monitoring pain. The scale consists of a 10 cm horizontal line, where A value of 0 means there is no pain, and a value of 10 means there is intense pain (Price et al., 1983). Participants were asked to rate the intensity of pain felt during their last menstrual cycle on a scale of 0-10. The Visual Analog Scale (VAS) is a simple and commonly used method for measuring pain intensity and monitoring pain levels (Yılmaz & Şahin, 2019; Pakniat et al., 2019).

Adolescent/Adult Sensory Profile (AASP)

The study evaluated the sensory processing patterns of the participants using the AASP, a 60-item scale that assesses the response of six specific sensory modalities to various stimuli. The AASP is suitable for individuals aged 11 and above and is divided into four categories, each representing a different sensory processing pattern. These categories include sensory avoidance, low registration, sensory sensitivity, and sensory seeking. The 60 items are equally divided into 15 items for each category (Dunn & Brown, 2002). Participants are asked to rate their response frequency to sensory events/experiences using a five-item Likert scale. Every item receives a score between 5 and 75 points. Higher scores indicate greater development in sensory processing patterns. Norm values differ for each age group (11-18, 18-65, and 65 and over). For instance, a higher rating in the 'low enrollment' model indicates a stronger inclination to ignore sensory stimuli (Dunn & Brown, 2002). The Turkish version of the test was adapted by Üçgül et al. (Üçgül et al., 2017).

Data Analysis

Software known as the SPSS v.26 was used to perform statistical analysis. We evaluated the normality distributions of numerical variables with the Shapiro Wilk Test and skewness/steepness values. We calculated mean (mean), standard deviation (SD), and minimum-maximum (min-max) values for numerical variables. We created frequency (%) tables for ordinal variables. Since the distribution of the data was normal, parametric tests were used. The independent sample t-test was employed to compare SG and CG. A general type I

error level of 5% was used to infer statistical significance, with $p<0.05$ being accepted as the level of significance.

Results

Participant Characteristics

A total of 540 emerging adult women participated in the study, with 300 included in the SG (those with a history of primary dysmenorrhea) and 240 in the CG (those without a history of primary dysmenorrhea). The demographic characteristics of the dysmenorrhea and control groups were found to be similar. No significant difference was observed in the fields of age, education, BMI, OAB, length of the menstrual cycle, or length of the menstrual bleeding ($p>0.05$). However, a statistically significant difference was found between the VAS scores of participants in the SG and CG ($p<0.05$). The findings regarding the characteristics of the participants are presented in Table 1.

Table 1. Characteristics of the participants by groups

Characteristics	SG[#]	CG[#]	t score	*p*-value
Age (years)	21.67 (1.70)	22.05 (1.56)	0.115	0.945
Education (years)	1.62 (0.29)	1.58 (0.32)	1.564	0.276
BMI (kg/m^2)	21.65 (2.54)	21.34 (3.87)	0.952	0.865
AAM (years)	14.84 (5.27)	15.40 (1.53)	3.266	0.123
Length of the menstrual cycle (days)	28.25 (8.95)	28.89 (9.12)	2.128	0.378
Length of the menstrual bleeding (days)	5.61 (1.18)	5.95 (1.23)	1.455	0.107
Menstrual pain intensity (VAS, cm)	8.95 (1.65)	1.12 (0.91)	**7.157**	**0.000**

Notes: [#]Data presented as mean (SD). Bold data, $p<0.05$ (significance).
Abbreviations: SG, study group; CG, control group; BMI, body mass index; AAM, age at menarche; VAS, visual analogue scale; SD, standard deviation.

Sensory Processing Patterns

The AASP revealed a statistically significant difference in sensory processing patterns between the SG and CG in the sensory sensitivity quadrant ($p<0.05$). As indicated by the AASP scores, participants in the SG exhibited higher levels of sensory sensitivity compared to those in the CG (Table 2).

Table 2. Findings on the sensory processing patterns

Sensory processing patterns	SG[#]	CG[#]	t score	*p*-value
Low Registration	25.65 (2.18)	26.23 (2.05)	0.125	0.913
Sensation Seeking	46.50 (3.15)	46.43 (3.46)	0.154	0.975
Sensory Sensitivity	47.98 (7.86)	30.76 (2.89)	**5.125**	**0.001**
Sensation Avoiding	40.75 (2.76)	38.65 (2.55)	3.547	0.012

Notes: [#]Data presented as mean (SD). Bold data, $p<0.05$ (significance).
Abbreviations: SG, study group; CG, control group; SD, standard deviation.

Specific Sensory Modalities

Further examination of all specific sensory modalities revealed significant differences between the SG and CG ($p<0.05$). Participants with PD reported higher levels of sensory sensitivities across multiple domains, including taste/ smell, movement, visual, touch, activity level, and auditory processing ($p<0.05$). The results of the study regarding the specific sensory modalities are presented in Table 3.

Table 3. Findings on the specific sensory modalities in sensitivity pattern

Specific sensory modalities	Sensory processing pattern	SG[#]	CG[#]	t score	*p*-value
Taste/smell	Sensitivity	4.32 (2.41)	2.55 (0.56)	**5.012**	**0.002**
Movement	Sensitivity	11.87 (3.22)	7.12 (0.98)	**4.985**	**0.003**
Visual	Sensitivity	11.65 (3.45)	5.76 (0.75)	**5.998**	**0.000**
Touch	Sensitivity	10.46 (3.21)	6.15 (0.81)	**4.875**	**0.003**
Activity level	Sensitivity	4.54 (2.35)	2.15 (0.42)	**5.162**	**0.001**
Auditory	Sensitivity	13.15 (3.85)	7.21 (1.11)	**5.127**	**0.001**

Notes: [#]Data presented as mean (SD). Bold data, $P<0.05$ (significance).
Abbreviations: SG, study group; CG, control group; SD, standard deviation.

Discussion

The study examined the sensory processing patterns of emerging adult women with and without PD, using the AASP to measure sensory sensitivity. The results demonstrated significant differences in sensory processing between those with and without PD, indicating the impact of menstrual pain on sensory experiences. Our study found that individuals with PD exhibited greater sensory sensitivity than those without the condition. This suggests a potential link between menstrual pain and heightened sensory processing. Furthermore, the results indicated that specific sensory modalities, including vision, taste, smell, hearing, touch, and movement, were more sensitive in participants with PD than in those without the condition. These findings suggest that dysmenorrhea can affect sensory processing in various domains,

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including somatic and perceptual experiences. For instance, individuals with PD may exhibit heightened sensitivity to visual stimuli, increased awareness of auditory cues, or alterations in taste and olfactory perception during menstruation.

Sensory sensitivity represents a pivotal aspect of temperament or personality that demands thorough examination, particularly in the context of its correlation with the menstrual cycle. Sensory sensitivity, defined as a biologically based predisposition to respond strongly to various stimuli, has been identified as a significant factor in sensory processing (Costa-Lopez et al., 2021; Greven et al., 2019). Individuals with heightened sensory sensitivity may experience more pronounced sensory disturbances, which can manifest in either a broad or selective manner (Turjerman-Levi & Kluger, 2022). Recent studies have found that women may experience increased sensory sensitivity during menstruation, particularly in relation to pain perception (Hellman et al., 2020; Schrepf et al., 2023). Schrepf et al. (2023) observed that women with PD demonstrated sensory sensitivity to pain during menstruation. This indicates that the condition is becoming increasingly prevalent. Studies suggest that changes may occur in the sensory modulation process during special periods of hormonal changes, such as the menstrual cycle, and that the pain threshold may also change in relation to this (Iacovides et al., 2015; Nazaré et al., 2014). Our study also found significant sensory processing behaviors that occur in parallel with the perceived pain level of women during menstruation. The distinctions in sensory processing between individuals with PD and without PD have significant clinical implications. Healthcare providers who work with emerging adult women should be aware of the potential sensory sensitivities associated with dysmenorrhea and consider these factors in the assessment and management of menstrual pain. The integration of sensory processing interventions alongside conventional pain management strategies may enhance the efficacy of interventions and outcomes for individuals with PD.

It is noteworthy that there were discrepancies in specific sensory modalities between participants with high and low pain levels. Recent studies have demonstrated that individuals with primary dysmenorrhea (PD) frequently display heightened sensitivity to diverse stimuli across distinct phases of the menstrual cycle. However, the observed outcomes may vary depending on the nature of the stimulation, the body region under examination, and the specific menstrual phase (Schrepf et al., 2023; (Iacovides et al., 2015). As indicated by Iacovides et al. (2015), individuals with high pain sensitivity demonstrate elevated sensory sensitivity across a range of domains, including vision, taste, smell, hearing, and movement. This is particularly relevant as individuals with high pain sensitivity tend to exhibit increased sensory sensitivity in

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multiple domains, including visual, auditory, and olfactory senses. This heightened sensory perception may exacerbate menstrual discomfort and contribute to a state of sensory overload during menstruation (Tu et al., 2022). This heightened sensory sensitivity has the potential to significantly impact an individual's daily functioning and overall quality of life, contributing to a heightened state of distress and difficulties in managing menstrual pain (Atta et al., 2016; Joshi et al., 2015). The convergence of sensory sensitivities across various modalities may result in an enhanced perception of disorder and distress among individuals experiencing both menstrual pain and sensory processing challenges (Oksuz Yalvac et al., 2024)

Limitations

Although our study provides valuable insights into the sensory processing patterns associated with PD, it is important to acknowledge several limitations. First, the forms and participation criteria used in this study, while carefully designed, may have influenced the outcomes. Specifically, the inclusion criteria focused on specific age groups and university students, which may not fully represent the broader population of women with PD. This limited characterization of participants could restrict the applicability of the findings to different demographics. Second, while our cross-sectional design allowed us to identify associations between sensory processing patterns and PD, it does not permit causal inferences. Longitudinal studies are needed to explore the temporal dynamics of sensory changes in response to menstrual pain. Additionally, the reproducibility of our findings is an important consideration. Future studies should aim to replicate these results in different settings and with varied methodologies to ensure the robustness of our conclusions. Lastly, while the clinical significance of our findings is promising, further research is required to establish how these sensory processing patterns translate into clinical practice. Understanding the practical implications of these findings will be crucial for developing effective interventions and support strategies for women with PD.

Conclusion

In conclusion, this study emphasizes the impact of PD on sensory processing patterns in emerging adult women. It highlights the need for further research and clinical attention to the sensory aspects of menstrual pain. By integrating sensory-based approaches into the management of dysmenorrhea, healthcare providers can better support the well-being and quality of life of individuals affected by this common yet often overlooked condition.

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Appendix-1

STROBE Statement—checklist of items that should be included in reports of observational studies.

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	2, 3
Objectives	3	State specific objectives, including any prespecified hypotheses	3
Methods			
Study design	4	Present key elements of study design early in the paper	3
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	3-5
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	4, 5
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	No applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6, 7
Bias	9	Describe any efforts to address potential sources of bias	
Study size	10	Explain how the study size was arrived at	4

Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	4, 5
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6, 7
		(b) Describe any methods used to examine subgroups and interactions	No applicable
		(*c*) Explain how missing data were addressed	No applicable
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	3
		(*e*) Describe any sensitivity analyses	No applicable

Continued on next page

Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	4
		(c) Consider use of a flow diagram	Figure 1, Page 5
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Table 1
		(b) Indicate number of participants with missing data for each variable of interest	No applicable
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	
		Cross-sectional study—Report numbers of outcome events or summary measures	5
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	No applicable
		(*b*) Report category boundaries when continuous variables were categorized	6, 7
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	No applicable
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	No applicable
Discussion			
Key results	18	Summarise key results with reference to study objectives	8-11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	10
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	8-11
Generalisability	21	Discuss the generalisability (external validity) of the study results	10-11
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Title page

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*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.