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REVIEW ARTICLE

A systematic review of non-invasive modalities used to identify women with anal incontinence symptoms after childbirth

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Abstract

Introduction and hypothesis Anal incontinence following childbirth is prevalent and has a significant impact upon quality of life (QoL). Currently, there is no standard assessment for women after childbirth to identify these symptoms. This systematic review aimed to identify non-invasive modalities used to identify women with anal incontinence following childbirth and assess response and reporting rates of anal incontinence for these modalities.

Methods Ovid Medline, Allied and Complementary Medicine Database (AMED), Cumulative Index of Nursing and Allied Health Literature (CINAHL), Cochrane Collaboration, EMBASE and Web of Science databases were searched for studies using non-invasive modalities published from January 1966 to May 2018 to identify women with anal incontinence following childbirth. Study data including type of modality, response rates and reported prevalence of anal incontinence were extracted and critically appraised.

Results One hundred and nine studies were included from 1602 screened articles. Three types of non-invasive modalities were identified: validated questionnaires/symptom scales ($n = 36$ studies using 15 different instruments), non-validated questionnaires ($n = 50$ studies) and patient interviews ($n = 23$ studies). Mean response rates were 92% up to 6 weeks after childbirth. Non-personalised assessment modalities (validated and non-validated questionnaires) were associated with reporting of higher rates of anal incontinence compared with patient interview at all periods of follow-up after childbirth, which was statistically significant between 6 weeks and 1 year after childbirth ($p < 0.05$).

Conclusions This systematic review confirms that questionnaires can be used effectively after childbirth to identify women with anal incontinence. Given the methodological limitations associated with non-validated questionnaires, assessing all women following childbirth for pelvic-floor symptomatology, including anal incontinence, using validated questionnaires should be considered.

Keywords Anal incontinence · Faecal incontinence · Post-natal · Patient-reported outcomes · Questionnaires

Introduction

Anal incontinence is a common condition affecting up to 20% of adult women [1]. It has a profound and significant effect on quality of life (QoL) [2] and is associated with significant healthcare costs [3]. The joint International Urogynaecological Association/International Continence Society (IUGA/ICS) definition of anal incontinence symptoms include faecal incontinence defined as involuntary loss of faeces (solid and/or liquid stool), and flatus incontinence defined as involuntary loss of flatus [4]. The main aetiological factor in the development of anal incontinence in women is childbirth that causes injury to the anal sphincter complex, pelvic nerves or both [5]. The condition often goes unrecognised at the time of delivery and, even when managed inappropriately, can lead to lasting problems, which are frequently unreported to healthcare providers [6].

Many women may perceive anal incontinence symptoms to be normal following childbirth, and barriers to accessing care in this context include shame and embarrassment, as well as a lack of knowledge of potential treatments, many of which are minimally invasive [7]. Many general practitioners are

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also unaware of treatments and local care pathways for these women [8]. In the UK and many other countries, there is no standardised assessment for women in the postnatal period to identify those who have anal incontinence symptoms. This is despite a number of routine healthcare contacts during this time, including with midwives, general practitioners and health visitors, which potentially yield opportunities for the condition to be assessed and appropriate access to care provided. A number of patient-reported outcome measures and symptom scales are available that could potentially be used in this context. If women with anal incontinence symptoms are identified in a timely fashion after childbirth, there is an opportunity to offer them access to appropriate care. This may include physiotherapy and assessment in a functional bowel clinic under the care of a colorectal team with access to endoanal ultrasound scanning and manometry, followed by appropriate treatment.

The primary aim of this systematic review was to identify non-invasive modalities used to detect women with anal incontinence symptoms following childbirth. Secondary aims were comparison of response and prevalence rates of anal incontinence symptoms using the different types of modalities identified. It was anticipated that the non-invasive modalities would include tools such as questionnaires and patient-reported outcome measures, which are increasingly used in clinical practice to identify patients with sensitive and potentially embarrassing symptoms.

Methods

This systematic review of the literature followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [9] and was designed to capture studies in which a population of women had been studied after childbirth and a non-invasive modality or tool was used to identify anal incontinence symptoms. This systematic review was registered prospectively on an international prospective register of systematic reviews (PROSPERO) database (registration number: CRD42017082508). The study population was women following childbirth. The intervention studied was any non-invasive modality that enabled identification of anal incontinence symptoms. Ovid Medline, Allied and Complementary Medicine Database (AMED), Cumulative Index of Nursing and Allied Health Literature (CINAHL), Cochrane library, EMBASE and Web of Science databases were searched using medical subject heading (MeSH) theme faecal incontinence and the keyword anal incontinence (which is not currently a MeSH theme). These were combined using Boolean AND operators with the following MeSH themes: prevalence, incidence, communication, decision making, surveys and questionnaires, access, pathway, care, antenatal, postnatal and computer/Internet for studies published between January 1966 and May 2018 (inclusive). Studies included were limited to adult women and restricted to English language publications. Conference abstracts were excluded. The rationale for restricting to English was to identify tools suitable for use in the UK population and because the research team lacked the language skills and resources to translate papers published in other languages. Only studies that specifically assessed women following childbirth or in which this group was identified separately within study results were included. The following were excluded:

- Studies assessing prevalence in community-based adults
- Studies in which women had already been identified with anal incontinence following childbirth (interventional studies including women with known incontinence after childbirth)
- Studies that used invasive modalities, such as endoanal ultrasound or manometry

The primary outcome was type of modality used. Secondary outcomes were response rates to the identified modalities and prevalence rates of anal incontinence, including flatus and liquid and solid stool, in order to compare the prevalence of each.

Two reviewers (TGG and SCR) independently reviewed all abstracts identified by the literature search to find papers of potential interest, which were then read by two reviewers (TGG and HV) to identify those that were relevant. Studies were included upon agreement of both reviewers. Disparities were resolved by consensus and, if required, arbitration by a third reviewer (SJ). A manual search of the reference list of each manuscript was conducted by both reviewers to identify further studies of relevance. The same two reviewers independently extracted study data onto an electronic data collection form. These were compared, and a summary table of consensus data was compiled. Critical appraisal of study quality was undertaken according to the principles of the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement for observational studies and Centre for Evidence-Based Medicine questionnaires for cross-sectional surveys [10, 11] to assess data quality, similar to methods used in previous comparable systematic reviews. Studies were scored out of four for data quality, with one point for use of representative sampling, one point for response rate >50%, one point for a self-administered and robustly validated assessment tool (administered in its original format and language of validation and not altered by the authors of the relevant study) and one point for 95% confidence interval (CI) for the estimated prevalence of anal incontinence of no more than 2%. Studies scoring 3+ were deemed to be of high quality.

Differences in mean prevalence of anal incontinence were compared for the different modalities identified using paired *t* test. A p value <0.05 was considered statistically significant.

Results

We identified 1602 studies (excluding duplicates) for screening, with 1296 discarded on title and abstract alone. Of the remaining studies, 306 were reviewed in full; 109 studies for a total of 80,935 women were included for final analysis, 33 of which scored ≥3 for data quality (Fig. 1; Supplementary Tables 1–3).

Three types of modality were used: validated patient-reported outcome measures or symptom scales, i.e. instruments that have undergone an element of psychometric testing (36 studies; Supplementary Table 1) [2, 12–46], non-validated questionnaires (50 studies; Supplementary Table 2) [17, 47–95] and patient interview, both face to face and via telephone (23 studies; Supplementary Table 3) [96–118]. Of the 36 studies using a validated patient-reported outcome measure or symptom scale, 15 instruments were used (Table 1).

The duration of follow-up varied between 38 days and 34 years. Eleven studies conducted follow-up within 6 weeks of delivery [12, 47–49, 63–65, 81, 96, 107, 108], 52 after 6 weeks and up to 1 year [13–21, 28–33, 40, 41, 46, 50–57, 66–71, 82–85, 97–106, 109–114, 118], 16 between 2 and 5 years [22, 32, 42–45, 58, 59, 72, 86–90, 93, 94] and 26 >5 years [2, 23–27, 33–38, 60–62, 73–78, 91, 92, 115–117]. Four studies did not collect data on length of time to follow-up after childbirth [39, 79, 80, 95].

Seven studies did not report response rates to the modality used to assess symptoms [47, 56, 83, 92, 98, 110, 118]. The mean response rate was 84% when follow-up was ≤6 weeks, 72% when between 6 weeks and 1 year, 70% when between 2 and 5 years and 68% when >5 years. Reported response rates for questionnaires and patient interviews were similar (Supplementary Table 4).

Study populations included women with different characteristics, with four broadly different population types being identified:

(1) Forty-four studies of only primiparous women following different modes of delivery, including spontaneous vaginal delivery, instrumental delivery and caesarean section [12–27, 47–62, 96–106])
(2) Thirty-seven studies of women with mixed parities and mixed modes of delivery [28–39, 63–80, 95, 107–111]
(3) Twenty-four studies of women diagnosed with obstetric anal sphincter injury (OASI) [42–45, 81–92, 112–117]

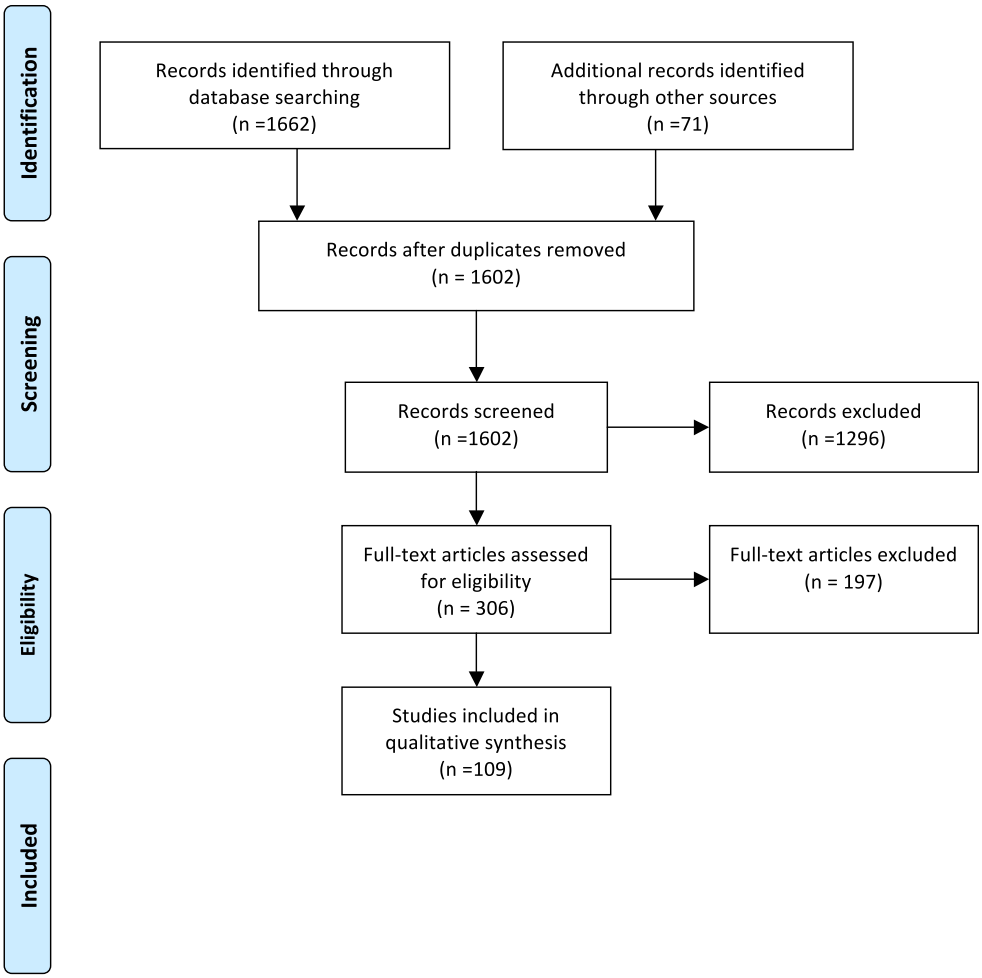

Fig. 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram showing selection of articles for review

Table 1 Validated patient-reported outcome measures or symptom scales identified in this systematic review, including other languages of validation in which these measures are available

Validated patient-reported outcome measure/symptom scale	Validation paper reference	PROM/ symptom scale	Studies using PROM/scale	Original language of validation	Subsequent language(s) of validation
Jorge and Wexner score	Jorge and Wexner, 1993 [5]	Paper-based	17	English	Swedish, Danish, French, German, Spanish, Italian, Dutch, Turkish
Anal Incontinence Score	Pescatori et al., 1992 [119]	Paper-based	5	Italian	English, French, Norwegian
Colorectal Anal Distress Inventory (CRADI)	Barber et al., 2001 [120]	Paper-based	2	English	Finnish, Korean, Greek, Brazilian Portuguese, Spanish, Hebrew, Turkish, Chinese
Epidemiology of Prolapse and Incontinence Questionnaire (EPIQ)	Lukacz et al., 2005 [121]	Paper-based	2	English	Spanish
Faecal Incontinence Questionnaire	Reilly et al., 2000 [122]	Paper-based	1	English	–
Australian Pelvic Floor Symptom Questionnaire	Baessler et al., 2009 [123]	Paper-based	1	English	Serbian, French, German
Bowel Symptom Questionnaire (BSQ)	Talley et al., 1995 [124]	Paper-based	1	English	–
St. Mark's Score	Maeda at el, 2007 [125]	Paper-based	1	English	Norwegian, French, German, Spanish, Italian, Dutch, Turkish
Vaizey Incontinence score	Vaizey et al., 1999 [126]	Paper-based	1	English	French, German, Spanish, Italian, Dutch, Norwegian, Turkish
Park's score	Browning and Parks, 1983 [127]	Paper-based	1	English	Dutch
Personal Assessment Questionnaire (PAQ, now revised to ePAQ-Pelvic Floor)	Hiller et al., 2002 Radley et al., 2006 [128, 129]	Electronic	1	English	Italian
Manchester Health Questionnaire	Bugg et al., 2001 [130]	Paper-based	1	English	–
Modified Manchester Health Questionnaire	Kwon et al., 2005 [131]	Paper-based	1	English	–
Danish Anal Sphincter Rupture Questionnaire (DASRQ)	Due and Ottensen, 2009 [132]	Paper-based	1	Danish	–
Faecal Incontinence Quality of Life Survey (FIQoL)	Rockwood et al., 2000 [133]	Paper-based	1	English	Spanish, Japanese, French, Turkish, Norwegian, German

PROM Preferred Reporting Items for Systematic Reviews and Meta-Analyses

(4) Four studies of women who had undergone instrumental delivery with forceps or ventouse [46, 93, 94, 118]

A variety of different definitions were used in these studies. Generally, definitions were based on functional bowel symptom criteria or symptom severity scales. The reported rates for overall anal incontinence at different points of follow-up is shown in Table 2. Supplementary Tables 1–3 show prevalence rates in each study of flatus, liquid stool, solid stool and overall anal incontinence [4].

Overall reported rates of different types of anal and faecal incontinence varied between study populations and follow-up period. Reported prevalence of anal incontinence was higher when non-personalised assessment tools (questionnaires and patient-reported outcome measures, both validated and non-validated) were used, compared with patient interview (Table 2). There were statistically significant differences in the prevalence of anal incontinence at follow-up between 6 weeks and 1 year when validated and non-validated questionnaires were used compared with patient interview (Tables 3 and 4). At all other points of follow-up, there was no statistically significant difference in prevalence of anal incontinence identified by the three different non-invasive modalities (Tables 3, 4, and 5).

Discussion

This is an up-to-date systematic review of non-invasive modalities used to identify women with anal incontinence symptoms following childbirth and is the first to specifically assess tools used for that purpose; 14 validated instruments were identified

Table 2 Comparison of faecal incontinence type and response rates for non-personalised [Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PROM/questionnaire)] and personalised (interview) modalities at different times of follow-up

Modality	No. studies	Response rate (mean ± 2 SD)	Overall anal incontinence (mean ± 2 SD)
Follow-up at ≤6/52 weeks after childbirth			
Validated questionnaire/PROM	1	100%	21%
Non-validated questionnaire	7	92% ± 0.2%	22% ± 0.2%
Patient interview (telephone/face to face)	3	66% ± 0.4%	16% ± 0.1%
Follow-up after 6/52 weeks up to 1 year after childbirth			
Validated questionnaire/PROM	16	65% ± 0.4%	27% ± 0.3%
Non-validated questionnaire	18	76% ± 0.3%	21% 0.4%
Patient interview (telephone/face to face)	17	74% ± 0.2%	12% ± 0.2%
Follow-up between 2 and 5 years after childbirth			
Validated questionnaire/PROM	6	66% ± 0.5%	33% ± 0.2%
Non-validated questionnaire	10	74% ± 0.2%	38% ± 0.3%
Patient interview (telephone/face to face)	0	No data	No data
Follow-up >5 years after childbirth			
Validated questionnaire/PROM	12	62% ± 0.3%	26% ± 0.3%
Non-validated questionnaire	11	68% ± 0.3%	31% ± 0.4%
Patient interview (telephone/face to face)	3	91% ± 0.1%	22% ± 0.1%

SD standard deviation

that appear to be suitable. Our review also confirms that the prevalence of anal incontinence symptoms is high, affecting up to 50% of first-time mothers in the first year after childbirth in studies published in 2014 and 2016 [16, 19]. Strengths of this review are the rigorous search strategy employed to find relevant studies of non-invasive modalities used successfully to identify women with anal incontinence after childbirth. Limitations include the heterogeneity in definitions used to describe anal or faecal incontinence symptoms, which in some cases may have underestimated their prevalence. Disparity in definition, or lack of definition, of what constitutes obstetric anal sphincter injury may also have contaminated the results. The use of non-validated questionnaires and patient interviews (supplementary Tables 2 and 3) may have also resulted in over- or under-reporting of symptoms. The small number of studies for the three non-invasive modalities at various points of follow-up may have resulted in type 2 statistical errors when comparing prevalence rates using the paired *t* test. The use of a search strategy excluding papers not published in English may have also resulted in missing non-invasive modalities potentially relevant to this systematic review.

Whilst there was a degree of heterogeneity in the definitions used to report anal incontinence, these definitions were based on functional bowel symptom criteria or symptom severity scales. Some studies sought to only assess faecal incontinence (excluding flatus incontinence), potentially underestimating anal incontinence rates, and some reported faecal incontinence rates that actually included flatus incontinence. When extracting data from all papers, the IUGA/ICS definition of anal incontinence [4] was used (supplementary Tables 1–3). Flatus incontinence is the most common symptom in the spectrum of anal incontinence. Frank incontinence of liquid or solid stool is less common but has a greater impact on QoL [134]. However, studies assessing patient preferences for end points in anal incontinence treatment indicate that flatus incontinence, faecal frequency and faecal urgency are among the most bothersome symptoms and have a significant impact on QoL [135]. It is therefore important to include and assess for flatus incontinence when assessing anal incontinence.

Table 3 Comparison of mean prevalence rates reported for anal incontinence using validated questionnaires/symptom scales or patient interview

Follow-up	Validated questionnaire (mean ± 2 SD)	Patient interview (mean ± 2 SD)	*T* value	*P* value	95% CI
6 weeks or less	21% (1 study)	16% ± 0.1% (3 studies)	1.0	0.500	−64.38 to 75.38
6/52 to 1 year	27% ± 0.3% (16 studies)	12% ± 0.2% (17 studies)	3.700	0.0021*	6.04 to 22.46
2–5 years	33% ± 0.2% (6 studies)	No data	–	–	–
>5 years	26% ± 0.3% (12 studies)	22% ± 0.1% (3 studies)	1.162	0.365	−30.57 to 17.57

SD standard deviation, *CI* confidence interval

*Statistical significance

Table 4 Comparison of mean prevalence rates reported for anal incontinence using non-validated questionnaires/symptom scales or patient interview

Follow-up	Non-validated questionnaire (mean ± 2 SD)	Patient interview (mean ± 2 SD)	*T* value	*P* value	95% CI
≤6 weeks	22% ± 0.2% (7 studies)	16% ± 0.1% (3 studies)	1.672	0.236	−8.07 to 18.34
6/52 weeks to 1 year	21% 0.4% (18 studies)	12% ± 0.2% (17 studies)	2.391	0.029*	1.123 to 18.67
2–5 years	38% ± 0.3% (10 studies)	No data	–	–	–
>5 years	31% ± 0.4% (11 studies)	22% ± 0.1% (3 studies)	1.311	0.320	−15.74 to 29.54

SD standard deviation, *CI* confidence interval

*Statistical significance

A number of studies ($n = 31$) in this systematic review were published before Sultan's classification system for Obstetric Anal Sphincter Injury (OASI) was published and became well established in clinical practice [136]. The populations identified in this systematic review include studies that may contain a larger number of patients with either unrecognised or inadequately repaired third- or fourth-degree perineal tears, resulting in a higher rate of anal incontinence symptoms than would be expected with current practices. However, reported rates of tears (obstetric anal sphincter injury) have actually risen in the last 10 years [137, 138]. This has previously been attributed in part to increased detection and reporting of third- and fourth-degree tears; however, this is also now considered to be due to inconsistencies in preventing OASI in different units, inconsistencies in midwifery and obstetric training and skills, lack of awareness of risk factors, the long-term impact of OASI and variations in practice between midwives and obstetricians [138]. Measures to help reverse this trend are being implemented, with a current trial of a national care bundle devised by the Royal College of Obstetricians and Gynaecologists (UK) and supported by the Royal College of Midwives (UK) [139], which makes use of the increasing evidence for specific manual perineal protection manoeuvres [140]. It is clear that women are at risk of anal incontinence following childbirth, and there is a lack of interventions to identify affected women following childbirth and to help them access care and treatment.

The type of modality used (validated questionnaire/symptom scale, non-validated questionnaire, patient interview) was a significant factor in the reported prevalence of anal incontinence symptoms (Table 2). Lower rates of symptoms were observed when personalised data collection methods (face-to-face or telephone interview) were used, compared with non-personalised, self-completed questionnaires (validated and non-validated) (Tables 2, 3, 4, and 5). This was demonstrated at both short- and long-term periods of follow-up (Table 2) and was statistically significant at the 6 weeks to 1 year follow-up period (Tables 3 and 4). This finding mirrors those of systematic reviews [1] in which reporting was lower in face-to-face and telephone interviews compared with self-completed questionnaires. Differences in prevalence rates of anal incontinence between different assessment modalities did not reach statistical significance at the other points of follow-up. This may be due to a type 2 statistical error because of small sample sizes for these periods, compared with the 6 weeks to 1 year follow-up period, where sample sizes were large enough to demonstrate a statistically significant effect.

Using non-personalised methods (self-completed questionnaires), which may be perceived as less intimidating, results in increased rates of disclosure for urinary incontinence compared with patient interview [141, 142]. We anticipate this would also be the case for reporting anal incontinence symptoms.

Two main barriers to accessing care for faecal incontinence described in a recently published, well-designed qualitative study were embarrassment and stigma, which manifested as deeply felt shame in violating a social taboo to not talk about bowel

Table 5 Comparison of mean prevalence rates reported for anal incontinence using validated questionnaires/symptom scales or non-validated questionnaires

Follow-up	Validated questionnaire (mean ± 2 2SD)	Non-validated questionnaire (mean ± 2 SD)	*T* value	*P* value	95% CI
6 weeks or less	21% (1 study)	22% ± 0.2% (7 studies)	2.011	0.295	−10.71to 14.71
6/52 to 1 year	27% ± 0.3% (17 Studies)	21% ± 0.4% (18 studies)	0.901	0.382	−7.41 to 18.23
2–5 years	33% ± 0.2% (6 studies)	38% ± 0.3% (10 studies)	1.571	0.178	−24.70 to 6.00
>5 years	26% ± 0.3% (12 studies)	31% ± 0.4% (11 studies)	0.621	0.552	−29.90 to 17.20

SD standard deviation, *CI* confidence interval

symptoms [7]. This is often compounded by normative thinking, with patients feeling that faecal incontinence may be a normal symptom following childbirth and a lack of knowledge about the condition and fear of investigation or treatment. Therefore, many women living with anal incontinence symptoms after childbirth may not seek healthcare. This is despite a number of interactions healthcare professionals, including midwives, health visitors and general practitioners, during the post-natal period, such as routine post-natal follow-up, infant vaccinations and developmental assessments. These contacts present a number of opportunities in which a self-completed questionnaire could be administered routinely to identify women with anal incontinence symptoms, potentially enabling their access to care. The relatively high response rates to modalities evaluated in this systematic review (Table 1) suggest that using an appropriate questionnaire to assess pelvic floor symptoms, including anal incontinence, in the first year after childbirth would result in good response rates in clinical practice.

The 15 validated patient-reported outcome measures/symptom scales identified by this systematic review have all undergone psychometric testing in populations of women with anal incontinence; however, comparison of their psychometric properties is outside the scope of this review. Fourteen of those tools would appear to be suitable for identifying anal incontinence symptoms following childbirth. The Faecal Incontinence Quality of Life (FIQoL) questionnaire [133] is used to assess health-related QoL in patients previously identified as having faecal incontinence, rather than as a means to identify those with the symptom, and is therefore not suitable for administration to women following childbirth unless they are known to have anal incontinence.

The Jorge and Wexner score [5], Vaizey incontinence score [126], Colorectal Anal Distress Inventory [120], Danish Anal Sphincter Rupture Questionnaire [132], St. Mark's Score [125], Park's Score [127], Bowel Symptom Questionnaire [124], Faecal Incontinence Questionnaire [122], Anal Incontinence Score [119] and Manchester Health Questionnaire [130] (now the Modified Manchester Health Questionnaire [131]) are paper-based instruments that assess anal incontinence and bowel symptoms. The Australian Pelvic Floor Questionnaire [123], Epidemiology of Prolapse and Incontinence Questionnaire [121] and Personal Assessment Questionnaire (PAQ) [128] are comprehensive paper-based questionnaires assessing prolapse, vaginal symptoms and urinary incontinence in addition to anal incontinence symptoms; it has subsequently been further validated in an electronic format (ePAQ) [129]. The validated questionnaires in this systematic review were administered to populations in ten different languages (Supplementary Table 1).

When using patient-reported outcome measures including questionnaires and symptom scales, it is important to use instruments that are psychometrically robust with evidence of their validity, reliability and functionality. This reduces bias and ensures the validity of results. Studies in which non-validated questionnaires are used may potentially be subject to measurement error and lack the ability to accurately measure changes in health status [143] and conclusions drawn cannot be made with confidence. Validated instruments should be used when available.

In conclusion, this systematic review identified three types of non-invasive modalities that can be used to identify women with anal incontinence following childbirth. The key clinical message is that using non-personalised assessment methods (validated and non-validated questionnaires/symptom scales) is likely to be more effective than patient interview when assessing intimate and embarrassing symptoms such as anal incontinence, which is a prevalent symptom following childbirth with a significant potential to negatively impact health-related QoL. Therefore, the role of a national standard assessment for all women following childbirth using validated questionnaires to assess for pelvic floor symptoms, including anal incontinence, should be considered. Validated questionnaires and symptoms scales should be used in preference to non-validated tools owing to the methodological limitations of using non-validated instruments. Further psychometric validation of the validated measures identified in this systematic review is required in populations of post-natal women before recommending their use as part of routine clinical practice in this context. The value and cost of using appropriate validated tools and subsequently providing access to care and support also warrants further research.

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Compliance with ethical standards

Conflicts of interest Professor Stephen Radley is a director and shareholder of ePAQ Systems Limited, an NHS spin-out technology company, largely owned by Sheffield Teaching Hospitals NHS Foundation Trust. Mr. Radley did not collect or analyse the data included in this systematic review.

The other authors have no financial or commercial interests in ePAQ Systems Ltd. or other conflicts of interest to declare.

References

1. Sharma A, Yuan L, Marshall RJ, Merrie AE, Bissett IP. Systematic review of the prevalence of faecal incontinence. Br J Surg. 2016;103:1589–97.
2. Samarasekera DN, Bekhit MT, Wright Y, Lowndes RH, Stanley KP, Preston JP, et al. Long-term anal continence and quality of life following postpartum anal sphincter injury. Color Dis. 2008;10(8):793–9.
3. Mellgren A, Jensen LL, Zetterström JP, Wong WD, Hofmeister JH, Lowry AC. Long-term cost of fecal incontinence secondary to obstetric injuries. Dis Colon Rectum. 1999;42(7):857–65.

4. Sultan AH, Monga A, Lee J, Emmanuel A, Norton C, Santoro G, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female anorectal dysfunction. Neurourol Urodyn. 2017;36(1):10–34.
5. Jorge JM, Wexner SD. Etiology and management of fecal incontinence. Dis Colon Rectum. 1993;36(1):77–97.
6. Brown HW, Wexner SD, Lukacz ES. Factors associated with care seeking among women with accidental bowel leakage. Female Pelvic Med Reconstr Surg. 2013;19(2):66–71.
7. Brown HW, Rogers RG, Wise ME. Barriers to seeking care for accidental bowel leakage: a qualitative study. Int Urogynecol J. 2017;28(4):543–51.
8. Thekkinkattil DK, Lim M, Finan PJ, Sagar PM, Burke D. Awareness of investigations and treatment of faecal incontinence among the general practitioners: a postal questionnaire survey. Color Dis. 2008;10(3):263–7.
9. Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gøtzsche PC, Ioannidis JP, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. PLoS Med. 2009;6(7):e1000100.
10. Von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP, et al. The strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. Int J Surg. 2014;12(12):1495–9.
11. Munn Z, Moola S, Riitano D, Lisy K. The development of a critical appraisal tool for use in systematic reviews addressing questions of prevalence. Int J Health Policy Manag. 2014;3(3):123.
12. Fynes M, Donnelly VS, O'Connell PR, O'Herlihy C. Cesarean delivery and anal sphincter injury. Obstet Gynecol. 1998;92(4):496–500.
13. Solans-Domènech M, Sánchez E, Espuña-Pons M. Urinary and anal incontinence during pregnancy and postpartum: incidence, severity, and risk factors. Obstet Gynecol. 2010;115(3):618–28.
14. Frudinger A, Halligan S, Bartram CI, Spencer J, Kamm MA, Winter R. Assessment of the predictive value of a bowel symptom questionnaire in identifying perianal and anal sphincter trauma after vaginal delivery. Dis Colon Rectum. 2003;46(6):742–7.
15. Donnelly V, Fynes M, Campbell D, Johnson H, O'Connell PR, O'Herlihy C. Obstetric events leading to anal sphincter damage. Obstet Gynecol. 1998;92(6):955–61.
16. Rogers RG, Leeman LM, Borders N, Qualls C, Fullilove AM, Teaf D, et al. Contribution of the second stage of labour to pelvic floor dysfunction: a prospective cohort comparison of nulliparous women. BJOG Int J Obstet Gynaecol. 2014;121(9):1145–54.
17. Hatem M, Pasquier JC, Fraser W, Lepire E. Factors associated with postpartum urinary/anal incontinence in primiparous women in Quebec. J Obstet Gynaecol Can. 2007;29(3):232–9.
18. Leeman L, Rogers R, Borders N, Teaf D, Qualls C. The effect of perineal lacerations on pelvic floor function and anatomy at 6 months postpartum in a prospective cohort of nulliparous women. Birth. 2016;43(4):293–302.
19. Johannessen H, Wibe A, Stordahl A, Sandvik L, Backe B, Mørkved S. Prevalence and predictors of anal incontinence during pregnancy and 1 year after delivery: a prospective cohort study. BJOG Int J Obstet Gynaecol. 2014;121(3):269–80.
20. Chan SS, Cheung RY, Yiu KW, Lee LL, Chung TK. Prevalence of urinary and fecal incontinence in Chinese women during and after their first pregnancy. Int Urogynecol J. 2013;24(9):1473–9.
21. Durnea CM, Khashan AS, Kenny LC, Tabirca SS, O'Reilly BA. The role of prepregnancy pelvic floor dysfunction in postnatal pelvic morbidity in primiparous women. Int Urogynecol J. 2014;25(10):1363–74.
22. Gartland D, MacArthur C, Woolhouse H, McDonald E, Brown SJ. Frequency, severity and risk factors for urinary and faecal incontinence at 4 years postpartum: a prospective cohort. BJOG Int J Obstet Gynaecol. 2016;123(7):1203–11.
23. Damon H, Bretones S, Henry L, Mellier G, Mion F. Long-term consequences of first vaginal delivery-induced anal sphincter defect. Dis Colon Rectum. 2005;48(9):1772–6.
24. Evers EC, Blomquist JL, McDermott KC, Handa VL. Obstetrical anal sphincter laceration and anal incontinence 5-10 years after childbirth. Am J Obstet Gynecol. 2012;207(5):425–e1.
25. Dolan LM, Hilton P. Obstetric risk factors and pelvic floor dysfunction 20 years after first delivery. Int Urogynecol J. 2010;21(5):535–44.
26. Nilsson I, Åkervall S, Milsom I, Gyhagen M. Long-term effects of vacuum extraction on pelvic floor function: a cohort study in primipara. Int Urogynecol J. 2016;27(7):1051–6.
27. Gyhagen M, Bullarbo M, Nielsen TF, Milsom I. The prevalence of urinary incontinence 20 years after childbirth: a national cohort study in singleton primiparae after vaginal or caesarean delivery. BJOG Int J Obstet Gynaecol. 2013;120(2):144–51.
28. Soligo M, Livio S, De Ponti E, Scebba I, Carpentieri F, Serati M, et al. Pelvic floor assessment after delivery: how should women be selected? Eur J Obstet Gynecol Reprod Biol. 2016;206:153–7.
29. Torrisi G, Minini G, Bernasconi F, Perrone A, Trezza G, Guardabasso V, et al. A prospective study of pelvic floor dysfunctions related to delivery. Eur J Obstet Gynecol Reprod Biol. 2012;160(1):110–5.
30. Pinta TM, Kylänpää ML, Teramo KA, Luukkonen PS. Sphincter rupture and anal incontinence after first vaginal delivery. Acta Obstet Gynecol Scand. 2004;83(10):917–22.
31. Guise JM, Morris C, Osterweil P, Li H, Rosenberg D, Greenlick M. Incidence of fecal incontinence after childbirth. Obstet Gynecol. 2007;109(2, Part 1):281–8.
32. Wagenius J, Laurin J. Clinical symptoms after anal sphincter rupture: a retrospective study. Acta Obstet Gynecol Scand. 2003;82(3):246–50.
33. Mous M, Muller SA, De Leeuw JW. Long-term effects of anal sphincter rupture during vaginal delivery: Faecal incontinence and sexual complaints. BJOG Int J Obstet Gynaecol. 2008;115(2):234–8.
34. Baud D, Meyer S, Vial Y, Hohlfeld P, Achtari C. Pelvic floor dysfunction 6 years post-anal sphincter tear at the time of vaginal delivery. Int Urogynecol J. 2011;22(9):1127–34.
35. Handa VL, Blomquist JL, Knoepp LR, Hoskey KA, McDermott KC, Muñoz A. Pelvic floor disorders 5-10 years after vaginal or cesarean childbirth. Obstet Gynecol. 2011;118(4):777.
36. Altman D, Ekström Å, Forsgren C, Nordenstam J, Zetterström J. Symptoms of anal and urinary incontinence following cesarean section or spontaneous vaginal delivery. Am J Obstet Gynecol. 2007;197(5):512–e1.
37. Faltin DL, Otero M, Petignat P, Sangalli MR, Floris LA, Boulvain M, et al. Women's health 18 years after rupture of the anal sphincter during childbirth: I. fecal incontinence. Am J Obstet Gynecol. 2006;194(5):1255–9.
38. Soerensen MM, Buntzen S, Bek KM, Laurberg S. Complete obstetric anal sphincter tear and risk of long-term fecal incontinence: a cohort study. Dis Colon Rectum. 2013;56(8):992–1001.
39. Fritel X, Ringa V, Varnoux N, Zins M, Bréart G. Mode of delivery and fecal incontinence at midlife: a study of 2,640 women in the Gazel cohort. Obstet Gynecol. 2007;110(1):31–8.
40. Vaccaro C, Clemons JL. Anal sphincter defects and anal incontinence symptoms after repair of obstetric anal sphincter lacerations in primiparous women. Int Urogynecol J. 2008;19(11):1503–8.
41. Andrews V, Thakar R, Sultan AH. Outcome of obstetric anal sphincter injuries (OASIS)—role of structured management. Int Urogynecol J. 2009;20(8):973.

42. Norderval S, Nsubuga D, Bjelke C, Frasunek J, Myklebust I, Vonen B. Anal incontinence after obstetric sphincter tears: incidence in a Norwegian county. Acta Obstet Gynecol Scand. 2004;83(10):989–94.
43. Richter HE, Nager CW, Burgio KL, Whitworth R, Weidner AC, Schaffer J, et al. Incidence and predictors of anal incontinence after obstetric anal sphincter injury in primiparous women. Female Pelvic Med Reconstr Surg. 2012;21(4):182.
44. Tin RY, Schulz J, Gunn B, Flood C, Rosychuk RJ. The prevalence of anal incontinence in post-partum women following obstetrical anal sphincter injury. Int Urogynecol J. 2010;21(8):927–32.
45. Jangö H, Langhoff-Roos J, Rosthøj S, Sakse A. Mode of delivery after obstetric anal sphincter injury and the risk of long-term anal incontinence. Am J Obstet Gynecol. 2016;214(6):733–e1.
46. Fitzpatrick M, Behan M, O'Connell PR, O'Herlihy C. Randomised clinical trial to assess anal sphincter function following forceps or vacuum assisted vaginal delivery. BJOG Int J Obstet Gynaecol. 2003;110(4):424–9.
47. Rieger N, Schloithe A, Saccone G, Wattchow D. A prospective study of anal sphincter injury due to childbirth. Scand J Gastroenterol. 1998;33(9):950–5.
48. Zetterström J, Mellgren A, Jensen LL, Wong WD, Kim DG, Lowry AC, et al. Effect of delivery on anal sphincter morphology and function. Dis Colon Rectum. 1999;42(10):1253–60.
49. Donnelly VS, O'herlihy C, Campbell DM, O'Connell PR. Postpartum fecal incontinence is more common in women with irritable bowel syndrome. Dis Colon Rectum. 1998;41(5):586–9.
50. Faltin DL, Sangalli MR, Roche B, Floris L, Boulvain M, Weil A. Does a second delivery increase the risk of anal incontinence? BJOG Int J Obstet Gynaecol. 2001;108(7):684–8.
51. Chaliha C, Sultan AH, Bland JM, Monga AK, Stanton SL. Anal function: effect of pregnancy and delivery. Am J Obstet Gynecol. 2001;185(2):427–32.
52. Faltin DL, Boulvain M, Irion O, Bretones S, Stan C, Weil A. Diagnosis of anal sphincter tears by postpartum endosonography to predict fecal incontinence. Obstet Gynecol. 2000;95(5):643–7.
53. Fenner DE, Genberg B, Brahma P, Marek L, DeLancey JO. Fecal and urinary incontinence after vaginal delivery with anal sphincter disruption in an obstetrics unit in the United States. Am J Obstet Gynecol. 2003;189(6):1543–9.
54. Zetterstrom JP, López A, Anzén BO, Dolk A, Norman M, Mellgren A. Anal incontinence after vaginal delivery: a prospective study in primiparous women. BJOG Int J Obstet Gynaecol. 1999;106(4):324–30.
55. van Brummen HJ, Bruinse HW, van de Pol G, Heintz AP, van der Vaart CH. Defecatory symptoms during and after the first pregnancy: prevalences and associated factors. Int Urogynecol J. 2006;17(3):224–30.
56. Brown SJ, Gartland D, Donath S, MacArthur C. Fecal incontinence during the first 12 months postpartum: complex causal pathways and implications for clinical practice. Obstet Gynecol. 2012;119(2):240–9.
57. Svare JA, Hansen BB, Lose G. Prevalence of anal incontinence during pregnancy and 1 year after delivery in a cohort of primiparous women and a control group of nulliparous women. Acta Obstet Gynecol Scand. 2016;95(8):920–5.
58. Koops SS, Vervest HA, Oostvogel HJ. Anorectal symptoms after various modes of vaginal delivery. Int Urogynecol J. 2003;14(4):244–9.
59. Pollack J, Nordenstam J, Brismar S, Lopez A, Altman D, Zetterstrom J. Anal incontinence after vaginal delivery: a five-year prospective cohort study. Obstet Gynecol. 2004;104(6):1397–402.
60. Nordenstam J, Altman D, Brismar S, Zetterström J. Natural progression of anal incontinence after childbirth. Int Urogynecol J. 2009;20(9):1029–35.
61. Gyhagen M, Åkervall S, Milsom I. Clustering of pelvic floor disorders 20 years after one vaginal or one cesarean birth. Int Urogynecol J. 2015;26(8):1115–21.
62. Halle TK, Salvesen KÅ, Volløyhaug I. Obstetric anal sphincter injury and incontinence 15–23 years after vaginal delivery. Acta Obstet Gynecol Scand. 2016;95(8):941–7.
63. Rajeshkannan N, Pathmeswaran A. Prevalence of postpartum anal incontinence: a cross sectional study in northern Sri Lanka. Ceylon Med J. 2013;58(2):76–9.
64. Hall W, McCracken K, Osterweil P, Guise JM. Frequency and predictors for postpartum fecal incontinence. Am J Obstet Gynecol. 2003;188(5):1205–7.
65. Abramowitz L, Sobhani I, Ganansia R, Vuagnat A, Benifla JL, Darai E, et al. Are sphincter defects the cause of anal incontinence after vaginal delivery? Dis Colon Rectum. 2000;43(5):590–6.
66. Hannah ME, Hannah WJ, Hodnett E, Chalmers B, Kung R, Willan A, et al. Outcomes at 3 months after planned cesarean vs planned vaginal delivery for breech presentation at term: the international randomized term breech trial. JAMA. 2002;287(14):1822–31.
67. Haadem K, Dahlström JA, Lingman G. Anal sphincter function after delivery: a prospective study in women with sphincter rupture and controls. Eur J Obstet Gynecol Reprod Biol. 1990;35(1):7–13.
68. MacArthur C, Glazener CM, Wilson PD, Herbison GP, Gee H, Lang GD, et al. Obstetric practice and faecal incontinence three months after delivery. BJOG Int J Obstet Gynaecol. 2001;108(7):678–83.
69. Eason E, Labrecque M, Marcoux S, Mondor M. Anal incontinence after childbirth. Can Med Assoc J. 2002;166(3):326–30.
70. Obioha KC, Ugwu EO, Obi SN, Dim CC, Oguanuo TC. Prevalence and predictors of urinary/anal incontinence after vaginal delivery: prospective study of Nigerian women. Int Urogynecol J. 2015;26(9):1347–54.
71. Glazener CM, Abdalla M, Stroud P, Templeton A, Russell IT, Naji S. Postnatal maternal morbidity: extent, causes, prevention and treatment. BJOG Int J Obstet Gynaecol. 1995;102(4):282–7.
72. Palm A, Israelsson L, Bolin M, Danielsson I. Symptoms after obstetric sphincter injuries have little effect on quality of life. Acta Obstet Gynecol Scand. 2013;92(1):109–15.
73. Ryhammer AM, Bek KM, Laurberg S. Multiple vaginal deliveries increase the risk of permanent incontinence of flatus and urine in normal premenopausal women. Dis Colon Rectum. 1995;38(11):1206–9.
74. Fornell EU, Matthiesen L, Sjödahl R, Berg G. Obstetric anal sphincter injury ten years after: subjective and objective long term effects. BJOG Int J Obstet Gynaecol. 2005;112(3):312–6.
75. Glazener CM, MacArthur C, Hagen S, Elders A, Lancashire R, Herbison GP, et al. Twelve-year follow-up of conservative management of postnatal urinary and faecal incontinence and prolapse outcomes: randomised controlled trial. BJOG Int J Obstet Gynaecol. 2014;121(1):112–20.
76. MacArthur C, Glazener C, Lancashire R, Herbison P, Wilson D. Exclusive caesarean section delivery and subsequent urinary and faecal incontinence: a 12-year longitudinal study. BJOG Int J Obstet Gynaecol. 2011;118(8):1001–7.
77. Nygaard IE, Rao SS, Dawson JD. Anal incontinence after anal sphincter disruption: a 30-year retrospective cohort study. Obstet Gynecol. 1997;89(6):896–901.
78. Bollard RC, Gardiner A, Duthie GS, Lindow SW. Anal sphincter injury, fecal and urinary incontinence. Dis Colon Rectum. 2003;46(8):1083–8.
79. McKinnie V, Swift SE, Wang W, Woodman P, O'boyle A, Kahn M, et al. The effect of pregnancy and mode of delivery on the prevalence of urinary and fecal incontinence. Am J Obstet Gynecol. 2005;193(2):512–7.

80. Goldberg RP, Kwon C, Gandhi S, Atkuru LV, Sorensen M, Sand PK. Prevalence of anal incontinence among mothers of multiples and analysis of risk factors. Am J Obstet Gynecol. 2003;189(6): 1627–30.
81. Sultan AH, Kamm MA, Hudson CN, Bartram CI. Third degree obstetric anal sphincter tears: risk factors and outcome of primary repair. BMJ. 1994;308(6933):887–91.
82. Haadem K, Ohrlander S, Lingman G. Long-term ailments due to anal sphincter rupture caused by delivery—a hidden problem. Eur J Obstet Gynecol Reprod Biol. 1988;27(1):27–32.
83. Chaliha C, Kalia V, Stanton SL, Monga AS, Sultan AH. Antenatal prediction of postpartum urinary and fecal incontinence. Obstet Gynecol. 1999;94(5):689–94.
84. Uustal Fornell EK, Berg G, Haalböök O, Matthiesen LS, Sjödahl R. Clinical consequences of anal sphincter rupture during vaginal delivery. J Am Coll Surg. 1996;183(6):553–8.
85. Mazouni C, Bretelle F, Battar S, Bonnier P, Gamerre M. Frequency of persistent anal symptoms after first instrumental delivery. Dis Colon Rectum. 2005;48(7):1432–6.
86. Tetzschner T, Sorensen M, Lose G, Christiansen J. Anal and urinary incontinence in women with obstetric anal sphincter rupture. Int J Gynecol Obstet. 1997;56(2):222.
87. Haadem K, Ling L, Dahlstrom A, Ohrlander S. Anal sphincter function after delivery rupture. Obstet Gynecol. 1987;70(1):53–6.
88. Gjessing H, Backe B, Sahlin Y. Third degree obstetric tears; outcome after primary repair. Acta Obstet Gynecol Scand. 1998;77(7):736–40.
89. Kumar R. Anal incontinence and quality of life following obstetric anal sphincter injury. Arch Gynecol Obstet. 2012;285(3):591–7.
90. Poen AC, Felt-Bersma RJ, Strijers RL, Dekker GA, Cuesta MA, Meuwissen SG. Third-degree obstetric perineal tear: long-term clinical and functional results after primary repair. Br J Surg. 1998;85(10):1433–8.
91. Sørensen SM, Bondesen H, Istre O, Vilmann P, Serensen SM. Perineal rupture following vaginal delivery long-term consequences. Acta Obstet Gynecol Scand. 1988;67(4):315–8.
92. de Leeuw JW, Vierhout ME, Struijk PC, Auwerda HJ, Bac DJ, Wallenburg HC. Anal sphincter damage after vaginal delivery. Dis Colon Rectum. 2002;45(8):1004–10.
93. Sultan AH, Johanson RB, Carter JE. Occult anal sphincter trauma following randomized forceps and vacuum delivery. Int J Gynecol Obstet. 1998;61(2):113–9.
94. Johanson RB, Heycock E, Carter J, Sultan AH, Walklate K, Jones PW. Maternal and child health after assisted vaginal delivery: five-year follow up of a randomised controlled study comparing forceps and ventouse. BJOG Int J Obstet Gynaecol. 1999;106(6): 544–9.
95. Kunduru L, Kim SM, Heymen S, Whitehead WE. Factors that affect consultation and screening for fecal incontinence. Clin Gastroenterol Hepatol. 2015;13(4):709–16.
96. Belmonte-Montes C, Hagerman G, Vega-Yepez PA, Hernández-de-Anda E, Fonseca-Morales V. Anal sphincter injury after vaginal delivery in primiparous females. Dis Colon Rectum. 2001;44(9):1244–8.
97. Meyer S, Schreyer A, De Grandi P, Hohlfeld P. The effects of birth on urinary continence mechanisms and other pelvic-floor characteristics. Obstet Gynecol. 1998;92(4):613–8.
98. Groutz A, Fait G, Lessing JB, David MP, Wolman I, Jaffa A, et al. Incidence and obstetric risk factors of postpartum anal incontinence. Scand J Gastroenterol. 1999;34(3):315–8.
99. Farrell SA, Allen VM, Baskett TF. Anal incontinence in primiparas. J SOGC. 2001;23(4):321–6.
100. Borello-France D, Burgio KL, Richter HE, Zyczynski H, FitzGerald MP, Whitehead W, et al. Fecal and urinary incontinence in primiparous women. Obstet Gynecol. 2006;108(4): 863–72.
101. Yang X, Zhang HX, Yu HY, Gao XL, Yang HX, Dong Y. The prevalence of fecal incontinence and urinary incontinence in primiparous postpartum Chinese women. Eur J Obstet Gynecol Reprod Biol. 2010;152(2):214–7.
102. Jelovsek JE, Piccorelli A, Barber MD, Tunitsky-Bitton E, Kattan MW. Prediction models for postpartum urinary and fecal incontinence in primiparous women. Female Pelvic Med Reconstr Surg. 2013;19(2):110–8.
103. Crawford LA, Quint EH, Pearl ML, DeLancey JO. Incontinence following rupture of the anal sphincter during delivery. Obstet Gynecol. 1993;82(4):527–31.
104. Lal M, Mann CH, Callender R, Radley S. Does cesarean delivery prevent anal incontinence? Obstet Gynecol. 2003;101(2):305–12.
105. Brincat C, Lewicky-Gaupp C, Patel D, Sampselle C, Miller J, DeLancey JO, et al. Fecal incontinence in pregnancy and post partum. Int J Gynecol Obstet. 2009;106(3):236–8.
106. Lipschuetz M, Cohen SM, Liebergall-Wischnitzer M, Zbedat K, Hochner-Celnikier D, Lavy Y, et al. Degree of bother from pelvic floor dysfunction in women one year after first delivery. Eur J Obstet Gynecol Reprod Biol. 2015;191:90–4.
107. Sultan AH, Kamm MA, Hudson CN, Thomas JM, Bartram CI. Anal-sphincter disruption during vaginal delivery. N Engl J Med. 1993;329(26):1905–11.
108. Sultan AH, Kamm MA, Hudson CN. Pudendal nerve damage during labour: prospective study before and after childbirth. BJOG Int J Obstet Gynaecol. 1994;101(1):22–8.
109. Tetzschner T, Sørensen M, Jønsson L, Lose G, Christiansen J. Delivery and pudendal nerve function. Acta Obstet Gynecol Scand. 1997;76(4):324–31.
110. Baydock SA, Flood C, Schulz JA, MacDonald D, Esau D, Jones S, et al. Prevalence and risk factors for urinary and fecal incontinence four months after vaginal delivery. J Obstet Gynaecol Can. 2009;31(1):36–41.
111. MacArthur C, Bick DE, Keighley MR. Faecal incontinence after childbirth. BJOG Int J Obstet Gynaecol. 1997;104(1):46–50.
112. Sørensen M, Tetzschner T, Rasmussen OØ, Bjarnesen J, Christiansen J. Sphincter rupture in childbirth. Br J Surg. 1993;80(3):392–4.
113. Walsh CJ, Mooney EF, Upton GJ, Motson RW. Incidence of third-degree perineal tears in labour and outcome after primary repair. Br J Surg. 1996;83(2):218–21.
114. Laine K, Skjeldestad FE, Sanda B, Horne H, Spydslaug A, Staff AC. Prevalence and risk factors for anal incontinence after obstetric anal sphincter rupture. Acta Obstet Gynecol Scand. 2011;90(4): 319–24.
115. Size EH. Prevalence and severity of anal incontinence in women with and without additional vaginal deliveries after a fourth-degree perineal laceration. Dis Colon Rectum. 2005;48(1):66–9.
116. Sangalli MR, Floris L, Faltin D, Weil A. Anal incontinence in women with third or fourth degree perineal tears and subsequent vaginal deliveries. Aust N Z J Obstet Gynaecol. 2000;40(3):244–8.
117. Size EH. Anal incontinence among women with one versus two complete third-degree perineal lacerations. Int J Gynecol Obstet. 2005;90(3):213–7.
118. Sultan AH, Kamm MA, Bartram CI, Hudson CN. Anal sphincter trauma during instrumental delivery. Int J Gynecol Obstet. 1993;43(3):263–70.
119. Pescatori M, Anastasio G, Bottini C, Mentasti A. New grading and scoring for anal incontinence. Dis Colon Rectum. 1992;35(5):482–7.
120. Barber MD, Kuchibhatla MN, Pieper CF, Bump RC. Psychometric evaluation of 2 comprehensive condition-specific quality of life instruments for women with pelvic floor disorders. Am J Obstet Gynecol. 2001;185(6):1388–95.
121. Lukacz ES, Lawrence JM, Buckwalter JG, Burchette RJ, Nager CW, Luber KM. Epidemiology of prolapse and incontinence

questionnaire: validation of a new epidemiologic survey. Int Urogynecol J. 2005;16(4):272–84.
122. Reilly WT, Talley NJ, Pemberton JH, Zinsmeister AR. Validation of a questionnaire to assess fecal incontinence and associated risk factors. Dis Colon Rectum. 2000;43(2):146–53.
123. Baessler K, O'Neill SM, Maher CF, Battistutta D. Australian pelvic floor questionnaire: a validated interviewer-administered pelvic floor questionnaire for routine clinic and research. Int Urogynecol J. 2009;20(2):149–58.
124. Talley NJ, Newman P, Boyce PM, Paterson KJ, Owen BK. Initial validation of a bowel symptom questionnaire* and measurement of chronic gastrointestinal symptoms in Australians. Aust NZ J Med. 1995;25(4):302–8.
125. Maeda Y, Vaizey CJ, Norton C. St. Mark's incontinence score. Dis Colon Rectum. 2007;50(12):2252.
126. Vaizey CJ, Carapeti E, Cahill JA, Kamm MA. Prospective comparison of faecal incontinence grading systems. Gut. 1999;44(1):77–80.
127. Browning GG, Parks AG. Postanal repair for neuropathic faecal incontinence: correlation of clinical result and anal canal pressures. Br J Surg. 1983;70(2):101–4.
128. Hiller L, Radley S, Mann CH, Radley SC, Begum G, Pretlove SJ, et al. Development and validation of a questionnaire for the assessment of bowel and lower urinary tract symptoms in women. BJOG Int J Obstet Gynaecol. 2002;109(4):413–23.
129. Radley SC, Jones GL, Tanguy EA, Stevens VG, Nelson C, Mathers NJ. Computer interviewing in urogynaecology: concept, development and psychometric testing of an electronic pelvic floor assessment questionnaire in primary and secondary care. BJOG Int J Obstet Gynaecol. 2006;113(2):231–8.
130. Bugg GJ, Kiff ES, Hosker G. A new condition-specific health-related quality of life questionnaire for the assessment of women with anal incontinence. BJOG Int J Obstet Gynaecol. 2001;108(10):1057–67.
131. Kwon S, Visco AG, Fitzgerald MP, Ye W, Whitehead WE. Pelvic floor disorders network. Validity and reliability of the modified Manchester health questionnaire in assessing patients with fecal incontinence. Dis Colon Rectum. 2005;48(2):323–34.
132. Due U, Ottesen M. The Danish anal sphincter rupture questionnaire: validity and reliability. Acta Obstet Gynecol Scand. 2009;88(1):36–42.
133. Rockwood TH, Church JM, Fleshman JW, Kane RL, Mavrantonis C, Thorson AG, et al. Fecal incontinence quality of life scale. Dis Colon Rectum. 2000;43(1):9–16.
134. Rasmussen JL, Ringsberg KC. Being involved in an everlasting fight–a life with postnatal faecal incontinence. A qualitative study. Scand J Caring Sci. 2010;24(1):108–15.
135. Heymen S, Palsson O, Simren M, Whitehead WE. Patient preferences for endpoints in fecal incontinence treatment studies. Neurogastroenterol Motil. 2017;29:e13032.
136. Sultan AH. Obstetrical perineal injury and anal incontinence. Clin Risk. 1999;5(6):193–6.
137. Patterns of maternity care in English NHS Hospitals 2013/2014. Available at: https://www.rcog.org.uk/en/guidelines-research-services/audit-quality-improvement/clinical-indicators-project/ Accessed 20 Jan 2018.
138. Gurol-Urganci I, Cromwell DA, Edozien LC, Mahmood TA, Adams EJ, Richmond DH, et al. Third- and fourth-degree perineal tears among primiparous women in England between 2000 and 2012: time trends and risk factors. BJOG. 2013;120:1516–25.
139. The OASI Care Bundle Project. Royal College of Obstetricians and Gynaecologists. Available at: https://www.rcog.org.uk/OASICareBundle Accessed 20 Jan 2018.
140. Poulsen MØ, Madsen ML, Skriver-Møller AC, Overgaard C. Does the Finnish intervention prevent obstetric anal sphincter injuries? A systematic review of the literature. BMJ Open. 2015;5(9):e008346.
141. Bachman JW. The patient-computer interview: a neglected tool that can aid the clinician. Mayo Clin Proc. 2003;78:67–78.
142. Gray T, Li W, Campbell P, et al. Evaluation of coital incontinence by electronic questionnaire: prevalence, associations and outcomes in women attending a urogynaecology clinic. Int Urogynecol J. 2017. https://doi.org/10.1007/s00192-017-3380-x.
143. Dowrick AS, Wootten AC, Murphy DG, Costello AJ. "We used a validated questionnaire": what does this mean and is it an accurate statement in urologic research? Urology. 2015;85(6):1304–11.