LITERATURE REVIEW

Does research support the current conservative care recommendations for pregnancy-related diastasis rectus abdominis? A scoping review

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Abstract
Pregnancy-related diastasis rectus abdominis (DRA) is a widespread condition. The current evidence for its conservative management is contradictory, as are the criteria for making a diagnosis, which has stimulated debate among practitioners. The aim of this scoping review was to synthesize the existing peer-reviewed literature to determine whether there is evidence to support or refute recently published recommendations for the conservative care of perinatal DRA. These guidelines suggest that it should be approached from the perspective of considering the linea alba (LA) as an integrative component of the thoracopelvic abdominal system, which assumes functional relationships between the structures of the thorax and pelvis. Specifically, the present authors explored whether relationships exist between: (1) the LA and breathing mechanics; (2) pelvic floor muscle (PFM) function; (3) lumbopelvic pain (LPP) control; and (4) aspects of the structure and function of the abdominal wall. Of the 31 studies included, none were found relating to the LA and breathing mechanics, 11 investigated PFM function, 10 explored LPP, and 18 examined the LA with respect to the structure and/or function of the abdominal wall. The research reviewed does not appear to substantiate several of the recommendations for the conservative care of DRA, but does align with cited gaps in knowledge about this condition. The studies included neither support nor necessarily refute the relationships between breathing, PFM function and LPP. This scoping review also highlights the limitations of the current characterization of DRA and related assessment strategies, particularly the reliance on heterogeneous measurements of inter-recti distance as the primary and sometimes only measurement to inform clinical reasoning with respect to the condition.

Keywords: conservative care, pregnancy-related diastasis rectus abdominis, scoping review.

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Introduction
Diastasis rectus abdominis (DRA) is a widening or "separation" of the abdominal muscles at the linea alba (LA), a fibrous raphe running along the sheaths of the rectus abdominis muscles (Gilleard & Brown 1996; Axer *et al.* 2001). The condition can affect women at any time during their lives, and is particularly common during the perinatal period. However, the aetiology and pathophysiology of DRA are poorly understood.

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One hypothesis is that it may be related to persistent mechanical strain at the LA, which might explain why DRA often occurs during the perinatal period: pregnancy puts a continuous mechanical strain on the LA (Boissonnault & Blaschak 1988). This expansion results in a widening of the LA, and an increase in interrecti distance (IRD), i.e. the distance between the rectus abdominis muscle bellies. As defined by a widened LA, DRA is a common occurrence during and after pregnancy (Gilleard & Brown 1996; Brauman *et al.* 2008; Akram & Matzen 2014), but it is also present beyond the perinatal period, occurring in postmenopausal women (Spitznagle *et al.* 2007) and men (Lockwood 1998). The abdominal wall and specifically the ability of the LA to transmit force across the midline is understood to relate to several functions within the human body, including the maintenance of posture, trunk and pelvic motor control, respiration, intra-abdominal pressure (IAP) regulation, and support of the abdominal viscera (Axer *et al.* 2001; Benjamin *et al.* 2014). Alteration of these functions may occur in individuals with DRA.

A clinical diagnosis of DRA is most commonly made using palpation, and is established by determining whether the distance between the rectus abdominis heads, i.e. the IRD, is wider than normal (Noble 1982; Beer *et al.* 2009; Van de Water *et al.* 2016; Berg-Poppe *et al.* 2022). Although ultrasound imaging (USI) has been found to be a more precise and reliable measure of IRD than palpation (Mota *et al.* 2012; Keshwani *et al.* 2015, 2016; Van de Water *et al.* 2016; Hills *et al.* 2018a), there is no consensus on a cut-off to diagnose or characterize this condition using any form of measurement, and a clinically meaningful distance has yet to be determined (Akram & Matzen 2014; Benjamin *et al.* 2014; Sperstad *et al.* 2016; Dufour *et al.* 2019). The current literature commonly references the work of Beer *et al.* (2009), who classified women as having DRA if their mean IRD (measured at 3 cm above the umbilicus) was greater than the ninetieth percentile of the standard values reported for nulliparous women (> 2.2 cm). In fact, in a recent systematic review of 14 studies of exercise intervention for DRA, eight followed Beer *et al.*'s (2009) criteria to diagnose DRA (Berg-Poppe *et al.* 2022). However, variation in the operational definition of DRA exists, and thus, its diagnosis depends on factors such as the use of different IRD cut-off values, test locations along the LA and the approach to measurement (e.g. palpation, callipers, USI or computed tomography).

From a perinatal perspective, using Beer *et al.*'s (2009) definition would mean 45.4% and 32.6% of postpartum women at 6 months and 1 year, respectively, suffer from DRA (Sperstad *et al.* 2016). However, it has recently been proposed that such a narrow IRD in the postpartum period results in an overestimate of the prevalence of DRA: more recent research found a mean of closer to 3 cm in a population of 84 women postpartum (Mota *et al.* 2018). Furthermore, Kaufmann *et al.* (2022) recently conducted a retrospective cross-sectional study that aimed to define DRA in adult men and women using computed tomography. These authors found that an IRD of 3.4 cm measured at 3 cm above the umbilicus represented the eightieth percentile of asymptomatic adults (Kaufmann *et al.* 2022). Therefore, the definition of DRA may need to be revised to reflect these results (Mota *et al.* 2018; Kauffman *et al.* 2022), and furthermore, the properties of the LA itself may need to be considered, as opposed to characterizing it as a feature of the IRD (Dufour *et al.* 2019).

Conservative care approaches for DRA remain rooted in the notion that therapeutic exercises, specifically those that target the deep abdominal muscles, are important when treating DRA and restoring abdominal wall function (Keeler *et al.* 2012; Dufour *et al.* 2019; Berg-Poppe *et al.* 2022). Dufour *et al.* (2019) conducted a Delphi study with a select group of Canadian expert physiotherapists to establish clinical expert-based recommendations for the conservative care of pregnancy-related DRA. The researchers found that these physiotherapists agreed that the condition should be considered from the perspective that the LA is an integral component of the thoracopelvic abdominal system. A summary of the relevant recommendations is presented in Table 1 (Dufour *et al.* 2019). Although this group of experts differed on the majority of items in the study, they agreed that breathing mechanics, PFM function, lumbopelvic control, and the structure and function of the abdominal wall should all be considered when applying a comprehensive approach to the treatment of DRA (Dufour *et al.* 2019). This consensus was based only on clinical opinion, and it is currently unknown if the available research literature supports these perspectives. Therefore, the aim of the present scoping review was to assess and synthesize the existing peer-reviewed literature to determine whether there is evidence to support or refute

Table 1. Expert-based recommendations (Dufour *et al*. 2019): (LA) linea alba

Factor	Recommendation	Care domain
Breathing	Encourage a breathing pattern that promotes tension-free diaphragmatic breathing	Prenatal
	Avoid sustained directed closed-glottis Valsalva pushing	Intrapartum
	Encourage a breathing pattern that promotes tension-free diaphragmatic breathing	Early postpartum
	Encourage a breathing pattern that promotes tension-free diaphragmatic breathing	Later postpartum
Pelvic floor	Encourage a breathing pattern that promotes tension-free diaphragmatic breathing	Prenatal
	Avoid sustained directed closed-glottis Valsalva pushing	Intrapartum
	Encourage a breathing pattern that promotes tension-free diaphragmatic breathing	Early postpartum
	Avoid exercises in which the continence mechanism is not maintained	Early postpartum
	Commence inner-unit exercises that facilitate optimal isometric and synergistic activation, progressing to functional outer-unit exercises	Late postpartum
	Approach exercises in which the continence mechanism is not maintained with caution	Late postpartum
	Assess pelvic floor function via digital palpation or ultrasound	Assessment
Lumbopelvic control and pain	Advocate the sacrum-freeing position	Intrapartum
	Advocate neutral spine	Pregnancy and postpartum
	Address pelvic girdle and thoracic spine movement	Late postpartum
Abdominal wall	Commence inner-unit exercises that facilitate optimal isometric and synergistic activation, progressing to functional outer-unit exercises	Prenatal
	Avoid exercises that concentrically engage the superficial abdominal muscles	Prenatal
	Commence inner-unit exercises that facilitate optimal isometric and synergistic activation, progressing to functional outer-unit exercises	Early postpartum
	Avoid exercises that concentrically engage the superficial abdominal muscles	Early postpartum
	Commence inner-unit exercises that facilitate optimal isometric and synergistic activation, progressing to functional outer-unit exercises	Late postpartum
	Modify exercises that cause doming or invagination of the LA	Late postpartum
	Assess generation of tension in the LA with a voluntary pelvic floor contraction	Assessment
	Assess the LA at rest to determine the depth and contractile quality of the tissues (qualitative assessment)	Assessment

the recommendations for perinatal DRA (Dufour *et al.* 2019). Specifically, the authors explored whether a relationship exists between: (1) the LA and breathing mechanics; (2) PFM function; (3) lumbopelvic pain (LPP); and (4) the structure and function of the abdominal wall.

Materials and methods

Given the limited body of research on this topic, a scoping review was determined to be an appropriate approach to investigating potential relationships between the LA and breathing mechanics, PFM function, LPP control, and the structure and function of the abdominal wall. This enables the mapping of key concepts underpinning a research area, and is useful when it is this complex and has yet to be comprehensively reviewed (Arksey & O'Malley 2005).

A five-stage methodological framework (Arksey & O'Malley 2005; Levac *et al.* 2010) was used to guide the scoping review. The following steps were used to complete the process: (1) identify the research question; (2) identify relevant studies; (3) select studies for more-detailed analysis; (4) chart the data; and (5) collate, summarize and report the results. In keeping with these guidelines, a systematic appraisal of the literature was not performed.

The present study took place over more than 4 years, involved three separate literature searches and the roles of the authors changed during this time. As such, as a final quality-control measure, they commissioned a full audit of all correspondence about this project, and completed a collaborative review of all three searches using the Covidence systematic review online software (www.covidence.org) (Veritas Health Innovation, Melbourne, Australia). Studies were cross-referenced with information collected on the data extraction forms and the results tables. Such a step was needed to ensure that the methods were reliable and clear, the results were complete, and the associated conclusions trustworthy.

Search strategy

Three separate searches were conducted between 2018 and 2022 for studies published between the earliest date available and July 2022. The following electronic bibliographic databases were searched to locate peer-reviewed literature: MEDLINE, EMBASE, CINAHL and PEDro. Hand and reference list searches were also employed (Peters 2017). To identify specific studies, terms and keywords related to "diastasis recti" and "linea alba" were sought using the Medical Subject Headings thesaurus. The other threads included terms related to "breathing", "pelvic floor", "spine" and "abdominal wall". For every search thread, both controlled vocabulary and free-text terms were used, as well as the synonyms and sub-terms associated with these terms, which were joined by the operator "OR". The primary thread was first searched independently, and then combined to each of the other three search threads using the operator "AND". An example of the search strategy can be found in Table 2. All stages of the data collection process involved two independent reviewers (S.D. and C.P.). First, manuscript titles and abstracts were screened according to predetermined selection criteria using the Covidence online software. Disagreement was resolved through discussion or with the help of a third reviewer. The inclusion of full-text articles was then determined through consensus or discussion with this third reviewer.

Selection criteria

Studies were deemed eligible if these included: (1) the adult population (alive or cadavers); (2)

Table 2. Search strategy: (DRA) diastasis rectus abdominus: and (DRAM) diastasis of the rectus abdominus muscle

	Search thread				
Variable	Primary	1	2	3	4
Key search terms	Rectus abdominis OR abdominal muscles OR abdominal wall OR DRA OR DRAM OR diastasis recti OR "diastasis recti abdominis" OR "diastasis rectus abdominus" OR abdominal separation AND linea alba	Rectus abdominis OR abdominal muscles OR abdominal wall OR DRA OR DRAM OR diastasis recti OR "diastasis recti abdominis" OR "diastasis rectus abdominus" OR abdominal separation AND linea alba AND pelvic floor OR pelvic floor muscles	Rectus abdominis OR abdominal muscles OR abdominal wall OR DRA OR DRAM OR diastasis recti OR "diastasis recti abdominis" OR "diastasis rectus abdominus" OR abdominal separation AND linea alba AND abdominal wall function OR abdominal wall AND function OR abdominal muscles function OR abdominal muscles AND function	Rectus abdominis OR abdominal muscles OR abdominal wall OR DRA OR DRAM OR diastasis recti OR "diastasis recti abdominis" OR "diastasis rectus abdominus" OR abdominal separation AND linea alba AND diaphragm AND function OR breathing patterns OR respiratory mechanics OR respiration	Rectus abdominis OR abdominal muscles OR abdominal wall OR DRA OR DRAM OR diastasis recti OR "diastasis recti abdominis" OR "diastasis rectus abdominus" OR abdominal separation AND linea alba AND spine OR Thoraco-pelvic OR thoracic AND pelvis AND stability OR function
Sampling strategy	Selective databases: from the fields of medicine, sports, allied health, nursing, science and social science within specified limits Journal hand-searching from reference lists				
Type of article	All original, peer-reviewed quantitative studies (randomized controlled trials, quasi-experimental, cross-sectional and cohort studies)				
Approaches	Citation searches, cross-referenced with Google scholar and contact with authors				
Language	English or French				
Range of years	January 1946 to July 2022				
Inclusion and exclusion criteria	Inclusion: adult (18–65 years) population (alive or cadavers), ≥1 outcome related to the anatomical structure and/or biological function of the linea alba, ≥1 outcome related to the four factors investigated (breathing mechanics, the anatomical structure and/or biological function of the pelvic floor muscles, the lumbopelvic spine or the abdominal wall), and original results published as a journal article Studies were excluded if these were published in a language for which a translation was not available to the research team				
Electronic Sources	MEDLINE, EMBASE, CINAHL and PEDro Hand-searching and reference list searching were also employed to locate peer-reviewed literature				
Type of article	All original, peer-reviewed quantitative studies (randomized controlled trials, quasi-experimental, cross-sectional and cohort studies)				

at least one outcome related to DRA or the LA; (3) at least one outcome related to the four factors investigated, i.e. either breathing mechanics, the anatomical structure and/or function of the PFMs, LPP, or the abdominal wall; and (4) original results published as a journal article. Studies were excluded if these were published in a language for which a translation was unavailable to our research team, and therefore, only studies published in English or French met the inclusion criteria. The intention of the selection criteria was to capture studies from all adult populations, and to not limit research to the perinatal period.

Data extraction

Two independent reviewers extracted data from included studies using the Covidence online software (S.D. and C.P.). The research group created a data extraction form to guide the collection of relevant data to be entered into tables. Retrieved articles were sorted into four categories corresponding to the four factors matching the aims of the study. Any discrepancies in the extracted data were resolved through discussion between the two reviewers (S.D. and C.P.), and discussed with the third reviewer if needed. The protocol for this scoping review is registered with Open Science Framework (S. Dufour, 17 July 2023: osf.io/r6nxj).

Results

The results from the three searches are summarized in Figure 1. These yielded 821 articles that were screened for titles and abstracts. From this, 396 full texts were found, of which 31 met the selection criteria and were included in the review. These are summarized in Tables 3–5. No studies were found relating to DRA and breathing mechanics. Several reported on more than one factor: 11 investigated the PFMs and DRA, 10 explored LPP and DRA, and 18 examined DRA and the function of the abdominal wall. The articles included presented various research designs, including cross-sectional, retrospective cohort, prospective cohort and randomized controlled trials, but unsurprisingly given the aim of the study, the majority were cross-sectional studies. Of those studies of the PFMs reviewed, nine concluded that there is no correlation between these muscles and DRA. However, the vast majority reported on symptoms of pelvic floor dysfunction (PFD) rather than the functional properties of the PFMs. Seven were cross-sectional and eight included perinatal subjects. Of the articles reviewed for LPP, six concluded that there is no association between LPP and DRA. Five of these were cross-sectional and seven included perinatal subjects. Of the four studies that did determine that there is an association, three did not pertain to perinatal subjects and the other was a surgical intervention study. Finally, of the articles reviewed for abdominal wall function, all 18 determined that there is a relationship between IRD or other structural features of the LA (e.g. stiffness), and functional properties of the abdominal wall. Eight of these were cross-sectional and 14 included perinatal subjects.

Discussion

Current conservative approaches for DRA care appear to be based on the idea that the ability of the LA to transmit forces across the midline may have an impact on a woman's breathing mechanics, PFM function, lumbopelvic mechanics, and the structure and function of the abdominal wall. However, the results of the present scoping review indicate that the published research neither supports nor refutes these collective hypotheses. However, the relationship between the structure of the abdominal wall (primarily assessed by IRD) and abdominal wall function (primarily assessed by strength, endurance and observing muscle behaviour with functional movements) does appear to be supported. Several research groups have proposed the idea that additional assessments are warranted including: direct assessment of the LA, such as the distortion index (Lee & Hodges 2016) or tissue stiffness (Beamish *et al.* 2019); functional outcomes of the abdominal wall (Benjamin *et al.* 2014; Dufour *et al.* 2019; Fuentes Aparicio *et al.* 2021); and quality of life (QOL) outcomes (Fuentes Aparicio *et al.* 2021) inclusive of body image (Keshwani *et al.* 2018). These may garner a more clinically meaningful approach to the management of DRA. Furthermore, the recent expert-based recommendations emphasized the need to assess various anatomical and functional aspects of the LA in addition to the measure of IRD (Dufour *et al.* 2019). However, the current literature does not appear to reflect such a multidimensional approach to characterizing, assessing and diagnosing DRA. Rather, it characterizes DRA as almost primarily related to IRD, a surrogate measure of the LA, and most often, an IRD of greater than two finger widths or 2.2 cm on USI (Beer *et al.* 2009) is used as

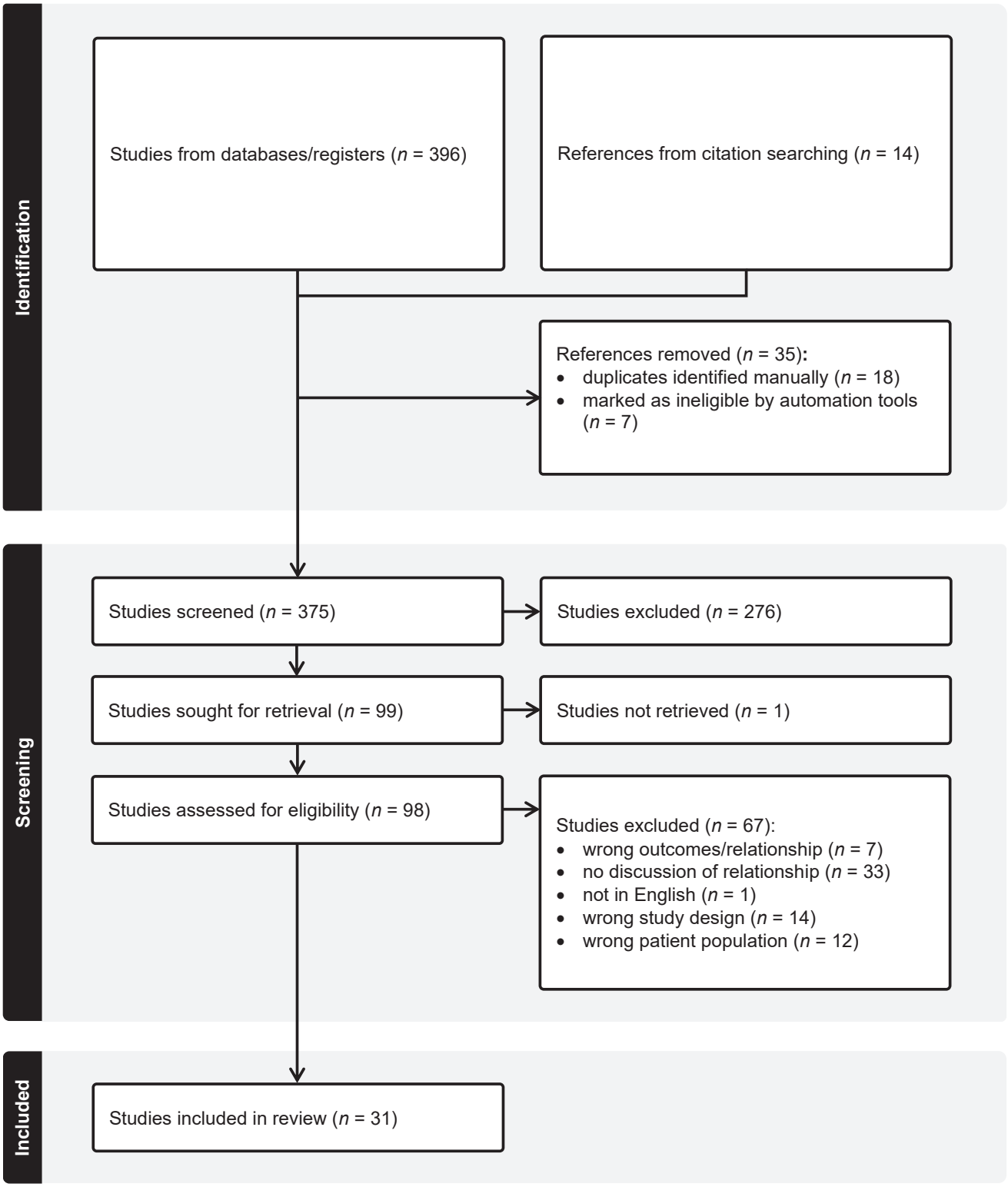

Figure 1. PRISMA flow diagram (Page *et al.* 2021) for the studies included.

the cut-off to categorize this condition. The present review aligns with findings from Hills *et al.* (2018b), who highlighted that the physical and functional implications of DRA have yet to be systematically established. This suggests that the testing of existing exercise protocols and associated rehabilitation strategies has been potentially premature.

Breathing mechanics

The present scoping review yielded no studies demonstrating an association between DRA, and breathing or diaphragm mechanics. The authors acknowledge that the lack of literature exploring a connection between breath and DRA does not necessarily mean that none exists. Rather, the findings of this scoping review do

Table 3. Summary of the relevant findings from the peer-reviewed literature for pelvic floor muscle (PFM) function ($n = 11$): (ICIQ-UI SF) International Consultation on Incontinence Questionnaire – Urinary Incontinence Short Form; (SD) standard deviation; (POP) pelvic organ prolapse; (IRD) inter-recti distance; (USI) ultrasound imaging; (DRA) diastasis rectus abdominis; (SUI) stress urinary incontinence; (PFDI-20) Pelvic Floor Distress Inventory; (POP-Q) Pelvic Organ Prolapse Quantification System; (UI) urinary incontinence; (ICIQ-VS) International Consultation on Incontinence Questionnaire – Vaginal Symptoms; (FI) faecal incontinence; (PFD) pelvic floor dysfunction; (95% CI) 95% confidence interval; (ICIQ-FLUTS) International Consultation on Incontinence Questionnaire – Female Lower Urinary Tract Symptoms; (PFIQ) Pelvic Floor Impact Questionnaire; (LPP) lumbopelvic pain; and (TrA) trans-versus abdominis

Reference	Study design	Sample size (n)	Participants [median age and age range (years)]	PFM function outcome	Linea-alba-related outcome	Relevant findings
Bø *et al.* (2017)	Prospective cohort	178/299	Nulliparous pregnant women (28.7)	PFM strength by manometry (ICIQ-UI-SF)	IRD measured by USI	DRA indicated greater PFM strength (38.9 cmH_2O) than no DRA (38.9 cmH_2O) ($P = 0.02$) No difference in ICIQ-UI SF scores No differences between DRA and no DRA for any PFM variables Higher postpartum POP in DRA versus no DRA ($P = 0.001$)
Braga (2020)	Cross-sectional	73 (SUI = 35; no SUI = 38)	Primiparous women at 6 months postpartum with and without SUI [38 (18–44)]	Urodynamically proven SUI (ICIQ-UI SF)	IRD measured by USI	No statistical differences in the value (mean ± SD) of DRA: 1.76 ± 0.81 cm in group with SUI versus 1.69 ± 0.79 cm in group with no SUI ($P = 0.91$)
Eisenberg *et al.* (2021)	Prospective cohort	36	Primiparous, postpartum women [28 (21–38)]	PFM morphology via USI (PFDI-20)	IRD measured by USI	No correlation between PFM USI measurements and the presence or extent of DRA No significant correlations between PFDI-20 scores (mean ± SD) and the severity of DRA, despite differences in the urinary symptoms section of the questionnaire (no DRA = 12.5 ± 22.8, DRA = 26.8 ± 18.2, $P = 0.01$)
Fei *et al.* (2021)	Retrospective cohort	229	Postpartum women (30.6)	PFM digital palpation (POP-Q) Unvalidated self-reported symptoms	IRD measured by USI	No difference in the occurrence of UI and POP comparing women with and without DRA, even changing the cut-off values (IRD = 20, 30, 40 and 50 mm) for determining DRA
Harada *et al.* (2022)	Cross-sectional	150	Peri- and postmenopausal women (52.5)	ICIQ-UI SF ICIQ-VS	IRD measured by callipers	Two-thirds (66%) of the participants reported at least one pelvic floor complaint: 61.33% only UI, 0.66% only POP, 0.66% only FI, 1.33% both UI and FI, and 2% both POP and UI There was an estimated 2.6-fold increase in the risk of PFD with DRA (95% CI = 1.21–5.55)

Continued/

Table 3. (*Continued*)

Reference	Study design	Sample size (*n*)	Participants [median age and age range (years)]	PFM function outcome	Linea-alba-related outcome	Relevant findings
Hills *et al.* (2018b)	Cross-sectional	40 (DRA = 18; no DRA = 22)	Primiparous women at 12 months postpartum (31.9)	ICIQ-VS ICIQ-FLUTS	IRD measured by USI	No difference in symptom scores were found between the women with and without DRA using the ICIQ-VS and ICIQ-FLUTS
Keshwani *et al.* (2018)	Cross-sectional	32	Primiparous women at < 4 weeks postpartum [32 (18–35)]	PFDI PFIQ	IRD measured by USI	No correlation was found between the PFDI and PFIQ scores and IRD
Parker *et al.* (2009)	Cross-sectional	100	Postpartum women with DRA or lumbopelvic pain, or PFD [*n* = 39 (controls, *n* = 53)], history of laparoscopy (*n* = 8) (41.4)	PFDI PFIQ	IRD measured by callipers	Greater incidence of DRA among patients seeking physiotherapy intervention for any of the specified diagnoses of LPP or PFD altogether, as compared to a control group No relationship was found when PFD was isolated from LPP
Spitznagle *et al.* (2007)	Retrospective chart review	541 (DRA = 281; no DRA = 260)	Women (52.5)	Unvalidated self-reported symptoms	IRD measured by digital palpation	More PFD symptoms with DRA (66%) versus no DRA (53%) Participants with DRA were older, reported higher gravity and parity, and had weaker PFMs than those without DRA
Theodorsen *et al.* (2019)	Cross-sectional	38	Postpartum women (34.6)	PFM assessed via USI	IRD measured by USI	Mean ± SD IRD at rest 25.7 ± 8.5 mm, and 26.9 ± 8.8 mm during a PFM contraction [mean difference = 1.2 (95% CI = 0.7–1.7) mm] ($P < 0.001$) Both PFM and TrA contraction, and combined PFM and TrA contraction increased IRD in postpartum women with DRA IRD was augmented by PFM contraction, but there was no correlation between PFD and IRD
Wu *et al.* (2021)	Cross-sectional	644	Women [58 (18–90)]	ICIQ-UI SF	IRD measured by computed tomography	The incidence of DRA was 28.4% Age (with age > 50 years being protective), the number of pregnancies, body mass index and diabetes were influencing factors for DRA No correlation between DRA and pelvic floor function was found

Table 4. Summary of the relevant findings from the peer-reviewed literature for lumbopelvic pain ($n = 10$): (LPP) lumbopelvic pain; (VAS) visual analogue scale; (IRD) inter-recti distance; (USI) ultrasound imaging; (LBP) low back pain; (DRA) diastasis rectus abdominis; (ODI) Oswestry Disability Index; (NPRS) Numerical Pain Rating Scale; (RMQ) Roland Morris Questionnaire; (PFD) pelvic floor dysfunction; and (df) degree of freedom

Reference	Study design	Sample size	Participants [median age and age range (years)]	LPP outcome	Linea-alba-related outcome	Relevant findings
Bellido Luque *et al.* (2015)	Prospective cohort	21	Adults with primary midline hernias ≥2 cm (20–60)	VAS for LBP	IRD measured by USI	Reduction of LBP at 12 months (preoperatively = 4.3, postoperatively = 2.2; $P < 0.001$) was found with lower postoperative IRD
Eisenberg *et al.* (2021)	Prospective cohort	36	Postpartum women [28 (21–38)]	ODI	IRD measured by USI	DRA did not correlate with LPB-related disability
Fernandes da Mota *et al.* (2015)	Prospective cohort	84	Primiparous women (31.6)	Unvalidated self-reported LPP	IRD measured by USI	DRA at 6 months postpartum was not associated with LPP pain Women with DRA were not more likely to report LPP pain than women without DRA ($P > 0.05$) The odds ratio observed was approximately 1 (0.991), showing that women with DRA have the same risk of LPP as those without DRA
Gallus *et al.* (2016)	Case report	1	Postpartum woman (24)	Unvalidated measure of LPP	IRD measured via surgical techniques	Abdominoplasty combined with physiotherapy intervention corrected LBP
Hills *et al.* (2018b)	Cross-sectional	40	Primiparous women at 12 months postpartum (31.9)	NPRS RMQ	IRD measured by USI	Self-reported LBP and pelvic pain, and self-reported PFD due to LBP, do not differ between women with and without DRA No difference between DRA (mean = 1) and no DRA (mean = 0) ($P = 0.22$)
Keshwani *et al.* (2018)	Cross-sectional	32	Primiparous women at <4 weeks postpartum [32 (18–35)]	VAS for LBP VAS for LPP	IRD measured by USI	No significant correlation was found between IRD and symptom severity on the VASs for LBP ($P = 0.449$) and pelvic pain ($P = 0.491$)
Parker *et al.* (2009)	Cross-sectional	100	Postpartum women with DRA or LPP, or PFD [$n = 39$ (controls, $n = 53$)], history of laparoscopy ($n = 8$) (42.4)	ODI VAS	IRD measured by callipers	The incidence of DRA was 74.4% in the PFD group ($n = 39$), 50.9% in the control group ($n = 53$) and 100% in the laparoscopic surgery group ($n = 8$) There was a significant association between the groups, and the presence or absence of DRA ($\chi^2 = 10.238$; df = 2,2; $P = 0.006$) There was no significant difference for LBP pain between those that had a DRA and those that did not There were no significant differences found between DRA groups for the scales used to measure LPP pain
Sperstad *et al.* (2016)	Prospective cohort	299	Nulliparous pregnant women followed to 12 months postpartum (28.7)	Unvalidated self-reported LPP	IRD measured by digital palpation	No difference in reported LPP ($P = 0.10$) in women with and without DRA
Whittaker *et al.* (2013)	Cross-sectional	50	Women and men (46.6)	ODI	IRD measured by USI	Significantly wider IRD correlated with LPP (IRD = 13.0 ± 8.8) than in the group without pain (IRD = 7.4 ± 3.2, $P = 0.005$)
Wu *et al.* (2021)	Cross-sectional	644	Women [58 (18–90)]	ODI	IRD measured by computed tomography	This study showed that the association between DRA and LBP was significant

Table 5. Summary of the relevant findings from the peer-reviewed literature for abdominal wall function ($n = 18$): (LA) linea alba; (IRD) inter-recti distance; (USI) ultrasound imaging; (USE) ultrasound shear wave elastography; (DRA) diastasis rectus abdominis; (RA) rectus abdominis; (95% CI) 95% confidence interval; (ICC) intraclass correlation coefficient; and (SD) standard deviation

Reference	Study design	Sample size	Participant [median age and age range (years)]	Abdominal wall function outcome	LA-related outcome	Relevant findings
Beamish *et al.* (2019)	Cross-sectional	20	Women (31)	Curl-up test	IRD and LA stiffness measured by USI and USE	Women without DRA experienced the greatest stiffness in their LA during the semi-curl-up and the lowest stiffness in their LA at rest, while women with no DRA did not experience any increase in mean or peak stiffness in their LA during the head-lift or the semi-curl-up compared to rest Among women in both groups, mean and peak LA stiffness was lower at the superior border of the umbilicus than it was at the other sites during the semi-curl-up The amount of distortion was a function of IRD and LA stiffness
Brauman (2008)	Cross-sectional	8	Men (25.1)	Electromyographic activity from the abdominal muscles (i.e. the RA and external obliques) during a series of static abdominal brace contractions in a modified sit-kneel position, which is designed to keep the spine in a neutral posture Target contraction levels were set to 25%, 50% and 100% of maximum capability	IRD measured by USI	The amount of lateral movement of the RA was exponentially related to the ratio of oblique muscle to RA muscle force
Chiarello & McAuley (2013)	Cross-sectional	56	Men ($n = 11$), nulliparous women ($n = 22$) and parous women ($n = 23$) [34.8 (19–64)]	Curl-up test	IRD measured by callipers and USI	Parous women decrease their IRD through a curl-up, which is not the case in nulliparous women
Chiarello *et al.* (2016)	Cross-sectional	56	Men and women [34.7 (19–64)]	Curl-up test	IRD measured by callipers and USI	IRD measurements with callipers were similar to those made with USI, with ICCs (model 3,2) of 0.79 and 0.71 with abdominal muscles at rest and contracted, respectively The parous group's IRD significantly decreased from rest to contraction at both locations, whereas the nulliparous and male groups' IRDs did not significantly change from rest to contraction The nulliparous group's IRD was significantly narrower than the other groups at rest at both locations, and narrower than the parous group during active contraction

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Table 5. (*Continued*)

Reference	Study design	Sample size	Participant [median age and age range (years)]	Abdominal wall function outcome	LA-related outcome	Relevant findings
Criss *et al.* (2014)	Prospective cohort	13	Dynamometer for all physical measurements	IRD measured by dynamometry	IRD measured by dynamometry	Mean hernia width was 12.5 cm (range = 5–19 cm) There were improvements in all measures (physical and quality of life) postoperatively ($P < 0.05$)
Eisenberg *et al.* (2021)	Prospective cohort	36	Postpartum women [28 (21–38)]	Flexion Endurance Test Dynamic Abdominal Flexion Endurance Test	IRD measured by USI	A significant reduction in abdominal force and endurance was observed in the DRA2–3 group compared with the DRA0–1 group ($0.025 < P < 0.04$) In extended DRA, the abdominal muscles were significantly compromised and weaker
Gallus *et al.* (2016)	Case report	1	Postpartum woman (24)	Curl-up test	IRD measure by tape measure during surgery	Abdominoplasty improved abdominal function during curl-ups
Gillard *et al.* (2018)	Cross-sectional	41	Postpartum women [43 (18–44)]	Different postural conditions Sitting versus standing	IRD measured by USI	IRD was wider when standing versus lying at both the superior umbilicus and umbilicus by 0.30 cm (95% CI = 0.21–0.39) and 0.20 cm (95% CI = 0.11–0.30), respectively ($P < 0.001$) There was high intra-rater reliability within (ICC = 3.3) and between sessions (ICC = 3.1) at all sites measured
Gunnarsson *et al.* (2015)	Cross-sectional	57	Adults (55 women and two men) with symptoms from their DRA undergoing surgery (39.8)	Trunk flexion, extension and isokinetic muscle strengths Maximal strength (peak torque) and maximal work measured during the flexion and extension tests (30° and 60°)	IRD measured by computed tomography	For both the flexion and extension tests (30° and 60°), as well as the isometric test, there was a significant positive relationship between intraoperative width ("true" width) beneath the umbilicus and muscle strength There was no correlation between the width measured above the umbilicus at surgery and muscle strength measured with the dynamometer (flexion 30°, $P = 0.76$; flexion 60°, $P = 0.52$; extension 30°, $P = 0.17$; extension 60°, $P = 0.17$; and isometric, $P = 0.79$) Neither preoperative clinical assessment ($P = 0.17$–0.54) nor evaluation by computed tomography ($P = 0.06$–0.90) correlated with muscle strength
Hills *et al.* (2018b)	Cross-sectional	40 (DRA = 18; no DRA = 22)	Primiparous women at 12 months postpartum (31.9)	Trunk muscle torque Sit-up test	IRD measured by USI	Women with DRA had lower trunk muscle rotation torque and scored lower on the sit-up test than those without DRA IRD was negatively correlated with both trunk rotation torque ($\rho = -0.367$) and sit-up test score ($\rho = -0.514$)

Continued/

Table 5. (*Continued*)

Reference	Study design	Sample size	Participant [median age and age range (years)]	Abdominal wall function outcome	LA-related outcome	Relevant findings
Kamel & Yousif (2017)	Prospective cohort	62	Postpartum women (29.5)	Abdominal strength by isokinetic testing	IRD measured by USI	Both groups showed highly significant ($P < 0.05$) improvement in all outcomes Intergroup comparisons showed significant improvement ($P < 0.05$), indicating that abdominal exercise correlates with a lower IRD
Lee & Hodges (2016)	Cross-sectional repeated measures	37	Postpartum women with DRA, and matched nulliparous and male controls (34)	Drawing-in manoeuvre Curl-up test	IRD and LA distortion measured by USI	Activation of the transversus abdominis muscle before a curl-up did not consistently narrow IRD, but did equate to less distortion
Liaw *et al.* (2011)	Cross-sectional	60	Postpartum women ($n = 40$) and age-matched nulliparous controls ($n = 40$) (25–37)	Trunk flexion and rotation strength and endurance measured by curl-up test	IRD measured by USI	A higher IRD related to lower abdominal muscle function at 7 weeks and 6 months postpartum was found [$r = 0.34$–0.51 ($P < 0.05$)], except for trunk flexion strength at 6 months postpartum ($P = 0.064$) [$r = 0.38$ ($P = 0.040$)] All abdominal strength and endurance measurements were less than those of nulliparous females (all $P < 0.001$)
Mota *et al.* (2012)	Test–retest	24	Postpartum (< 6 months) women ($n = 12$) and women with different parities (0–2 children, at least 1 year old) ($n = 12$) [30.5 (16–55)]	Rest Curl-up Drawing-in manoeuvre	IRD measured by USI	No significant differences were found in IRD between postpartum women and those with different parities The smallest IRD values were from the abdominal crunch exercise, and the greatest were from the drawing-in exercise
Mota *et al.* (2015)	Longitudinal descriptive	84	Nulliparous pregnant women [32 (25–37)]	Drawing-in manoeuvre Sit-up test	IRD measured by USI	The drawing-in exercise led to a significant increase in the width of the IRD Performing the abdominal crunch exercise led to a significant narrowing of the IRD ($P < 0.01$)
Pascoal *et al.* (2014)	Preliminary case control	20	Postpartum women ($n = 10$) and nulliparous controls ($n = 10$) [29 (18–44)]	Abdominal muscle contraction assessed by USI	IRD measured by USI	IRD was greater in the postpartum group than the controls A larger IRD correlated with lower isometric contraction compared with rest (mean ± SD = 10.7 ± 3.1 mm versus 13.4 ± 3.1 mm; mean difference = 2.8 mm; 95% CI = 1.2 to 4.5) No interaction was found between the groups with respect to muscle contraction
Sancho *et al.* (2015)	Cross-sectional	38	Primiparous women (32)	Curl-up test	IRD measured by USI	No differences in IRD, either above or below the umbilicus, were found between the vaginal and Caesarean birth groups
Tran *et al.* (2016)	Cross sectional	11	Men and women [48.5 (40–62)]	Four activities: rest, pullback loading, abdominal breathing and the Valsalva manoeuvre	IRD and LA measured by USE	Local stiffness of the abdominal wall is related to physical activity

not support or refute a connection based on the material that was reviewed. Clinically, a popular perspective, as determined by Dufour *et al.* (2019), contends that breathing mechanics and the status of the respiratory diaphragm hold relevance when it comes to abdominal wall rehabilitation. Specifically, of the 28 expert recommendations generated, four relate to breathing (Table 1). These clinical proposals may arguably relate to an intermediate connection between the pelvic floor and the diaphragm (Ashton-Miller & DeLancey 2007). A recent systematic review of six studies confirmed that breathing interventions modified PFM function (Mateus-Vasconcelos *et al.* 2018), highlighting a potential relationship. Given the priority that experts gave to PFM function in the assessment and management of DRA, further exploration of the role of breathing appears to be warranted. A small study evaluating the impact of a Pilates-based intervention found both an improvement in abdominal wall muscle hypertrophy and increased respiratory muscle strength (Giacomini *et al.* 2016). However, such findings do not confirm a connection between the breathing diaphragm and the abdominal wall *per se*, and a relationship has yet to be captured with the current method of assessing DRA using IRD. More research is needed to substantiate the recommendation that breathing strategies should be used as a therapeutic intervention for DRA.

Pelvic floor muscle function

The present authors found that the majority of the studies included in this review ($n = 9$) did not find a relationship between PFM function and DRA. Given that DRA was characterized by IRD in these studies, the data indicate that an IRD beyond the established "normal" cut-off generally was not correlated with symptoms of PFD or physical PFM findings. Of these nine studies, all reported on symptoms, and eight used validated and psychometrically sound self-reported measures (Parker *et al.* 2009; Bø *et al.* 2017; Hills *et al.* 2018b; Keshwani *et al.* 2018; Braga *et al.* 2020; Eisenberg *et al.* 2021; Fei *et al.* 2021; Wu *et al.* 2021). Two of the eight also used physical measures of the pelvic floor to triangulate PFM findings (Bø *et al.* 2017; Fei *et al.* 2021). Of the studies that demonstrated an association between PFD and DRA, two based this association on self-reported symptoms (Spintznagle *et al.* 2017; Harada *et al.* 2022), and one operationally defined DRA with an IRD much lower than most of the literature (Spintznagle *et al.* 2017). Thus, the conclusions need to be considered with caution. The only study that used USI to measure both PFM function and IRD also found an association between PFM function and DRA (Theodorsen *et al.* 2019), i.e. that contraction of the PFMs correlated with a change in IRD.

Some of the heterogeneity in the findings probably relates to variations in the assessments used to establish PFM status (in particular, the use of unvalidated self-reported methods) in some studies (Spitznagle *et al.* 2007; Fei *et al.* 2021). One of the 11 studies reported a conflicting finding with regard to PFM status and DRA: none of the physical measurements of PFM function (assessed by USI) found a relationship with DRA, but symptoms of PFD (evaluated with the Pelvic Floor Distress Inventory) indicated a correlation between increased urinary symptoms and DRA, as measured by IRD (Eisenberg *et al.* 2021). Therefore, the relationship between PFM function and DRA remains elusive; however, a lack of correlation is certainly more convincing. In their systematic review, Benjamin *et al.* (2019) also reported some inconsistency between pelvic floor conditions and DRA, and no correlation between DRA and urinary incontinence (UI), but they did identify a correlation between DRA and pelvic organ prolapse (POP). Furthermore, a more-recent qualitative synthesis of 14 studies found that there is no correlation between DRA and urinary incontinence, or voiding symptoms (Fuentes Aparicio *et al.* 2021). The global literature base appears to lean in the direction of the present authors' finding that no robust association between PFM function and DRA seems to exist.

Of the 28 expert recommendations regarding pregnancy-related DRA (Table 1), seven are related specifically to the pelvic floor, and another six are linked to the concept of IAP, which would imply a relationship with the pelvic floor (Dufour *et al.* 2019). Recommendations regarding PFM function span every perinatal stage (i.e. pre-, intra-, early, post- and late postnatal), and also include assessment recommendations. However, further research is needed to substantiate these proposals. The current literature points to a relationship between PFM function and DRA, but not PFD and DRA.

Lumbopelvic control and lumbopelvic pain

As indicated above, the current expert-based recommendations suggest that DRA should be considered from the perspective of the LA as

an integrative component of the thoracopelvic abdominal system, which assumes functional relationships between the structures of the thorax and pelvis. A widened IRD may impose changes or challenges to lumbopelvic motor control, and may correspond with LPP (Dufour *et al.* 2019). However, this notion has yet to be clearly established, and pain as an experience is certainly distinct from motor control. The present scoping review yielded 10 studies that examined the relationship between DRA and LPP, and the majority ($n = 6$) found no association (Parker *et al.* 2009; Fernandas da Mota *et al.* 2015; Sperstad *et al.* 2016; Hills *et al.* 2018b; Keshwani *et al.* 2018; Eisenberg *et al.* 2021). Of the four that confirmed an association, the populations were not perinatal and two were surgical intervention studies (Whittaker *et al.* 2013; Bellido Luque *et al.* 2015; Gallus *et al.* 2016; Wu *et al.* 2021). Specifically, the latter papers, one of which was a case report, were notably distinct from the rest of the literature examining the LPP factor, and particular caution should be taken when considering those findings.

The present authors' results align with recent research by Gluppe *et al.* (2021). Their large cross-sectional study found that women who presented with DRA, including those in the perinatal period, tend to have weaker abdominal muscles and a higher prevalence of abdominal pain (odds ratio = 0.02, 95% confidence interval = 0.00–0.61, $P = 0.026$), but no higher prevalence of back or pelvic girdle pain than women without DRA (Gluppe *et al.* 2021). Furthermore, a recent systematic review investigating the relationship between low back pain (LBP) and DRA found that 61.5% of the studies reviewed did not find any association (Sokunbi *et al.* 2023). These findings were also corroborated by Fuentes Aparicio *et al.* (2021), who found no correlation between DRA and LBP, and mixed data regarding DRA and LBP-related disability. Six of the nine studies used a validated back pain disability scale (Oswestry Disability Index, $n = 5$; Roland–Morris Questionnaire, $n = 1$) to classify LBP (Parker *et al.* 2009; Whittaker *et al.* 2013; Hills *et al.* 2018b; Keshwani *et al.* 2018; Eisenberg *et al.* 2021; Wu *et al.* 2021), while three relied on unvalidated self-reported methods (Fernandas da Mota *et al.* 2015; Gallus *et al.* 2016; Sperstad *et al.* 2016). All six papers that did not find an association between DRA and LPP involved women in the perinatal period, which potentially suggests a clearer understanding of other factors responsible for LPP in this population. Hills *et al.* (2018b) and Eisenberg *et al.* (2021) were the only authors who distinguished between pain ratings and pain-related disability, which represents an important difference. Once again, heterogeneity and lack of clarity with regard to assessment protocols for LPP, LPP disability and IRD contributed to the lack of consistency in the findings of this scoping review.

The present authors' generally found no association between LPP and DRA, which is not surprising considering the link between spinal pain points and nociplastic mechanisms (Fitzcharles *et al.* 2021). Furthermore, the most recent systematic review examining the efficacy of stability exercises as a treatment for pregnancy-related pelvic girdle pain confirmed that this approach is not efficacious (Almousa *et al.* 2018). Therefore, the lack of association between LPP and DRA, as measured by IRD, is not surprising.

Canadian physiotherapists recommend that healthcare providers address impairments in the pelvis and thorax to ensure the adoption of a relevant and comprehensive approach to pregnancy-related DRA (Dufour *et al.* 2019). These perspectives do not specifically refer to pain, but rather, focus on lumbopelvic function. The present scoping review does not support or refute the idea that a widened IRD is related to challenges to lumbopelvic motor control, but it confirms that there appears to be no relationship between DRA and LPP. More research is needed to further tease out these factors, including distinguishing between pain and pain-related disability, which are not well-differentiated in the existing literature.

Abdominal wall function

Abdominal wall function represents the only factor investigated that was associated with DRA, as characterized by IRD, in all the studies reviewed ($n = 18$). Ten used a variation of a curl-up or sit-up (trunk flexion) test to determine a relationship between abdominal wall function and DRA, which was evaluated in terms of IRD in all cases (Liaw *et al.* 2011; Chiarello & McAuley 2013; Mota *et al.* 2015; Sancho *et al.* 2015; Chiarello *et al.* 2016; Gallus *et al.* 2016; Lee & Hodges 2016; Hills *et al.* 2018b; Beamish *et al.* 2019). Three studies used a drawing-in manoeuvre (Mota *et al.* 2012, 2015; Lee & Hodges 2016), seven evaluated the abdominal wall using dynamometry (Brauman *et al.* 2008; Criss *et al.* 2014; Gunnarsson *et al.* 2015; Kamel & Yousif 2017; Hills *et al.* 2018b; Eisenberg *et al.* 2021), and two employed a combination of tasks and postures to determine the impact of these

movements on the LA, which was evaluated in terms of IRD (Liaw *et al.* 2011; Tran *et al.* 2016; Gillard *et al.* 2018; Hills *et al.* 2018b). Although all the studies confirmed that there was an association between abdominal wall activation and properties of the LA (typically measured as IRD only), the assessment protocols varied, particularly with respect to how IRD was determined. Despite the heterogeneity in the methods of assessment used, the curl-up tasks resulted in a narrowing of IRD while in-drawing caused widening of IRD among perinatal populations (Pascoal *et al.* 2014; Mota *et al.* 2015; Sancho *et al.* 2015; Chiarello *et al.* 2016; Lee & Hodges 2016). Notably, the pattern is different in men and women who are not pregnant: IRD appears to be neither reduced nor increased from its resting width when measured in a curl-up position (Chiarello & McAuley 2013; Pascoal *et al.* 2014; Lee & Hodges 2016). The research reviewed suggests that the ability of non-pregnant and non-parous women to maintain the width of the LA during a curl-up task does not seem to return to what is observed in nulliparous individuals after pregnancy.

Ten studies focused on the effects of IRD on the performance of the abdominal muscles (Brauman *et al.* 2008; Liaw *et al.* 2011; Criss *et al.* 2014; Pascoal *et al.* 2014; Gunnarsson *et al.* 2015; Gallus *et al.* 2016; Kamel & Yousif 2017; Hills *et al.* 2018b; Beamish *et al.* 2019; Eisenberg *et al.* 2021), and these all suggest that there is an inverse relationship between IRD and trunk flexor strength. In a cohort study, Criss *et al.* (2014) observed an increase in the isokinetic strength of the trunk flexor muscles in women and men after surgical restoration of the LA. Other research groups determined a relationship between IRD and trunk strength, although different measures were used (Liaw *et al.* 2011; Hills *et al.* 2018b).

Only two studies have attempted to investigate other properties of the LA beyond IRD, i.e. LA stiffness (Beamish *et al.* 2019) and distortion (Lee & Hodges 2016; Beamish *et al.* 2019). Beamish *et al.* (2019) found that DRA was associated with low LA stiffness and distortion during a semi-curl-up task, and that the amount of distortion was a function of IRD and LA stiffness. This suggests that the capacity to stiffen the LA may be a good predictor of its function. However, the implications of LA stiffness or distortion on the symptoms or functional abilities of women with DRA, as defined by an increase in IRD, are currently unknown. Notably, none of the 14 studies used self-reported measures to determine if there is a potential relationship between DRA, and abdominal wall structure and function. More research is needed to explore the relationship between the broader abdominal wall and the LA following more-standardized and homogenous assessment approaches that go beyond only measuring IRD. Furthermore, a recent systematic review investigating a broad range of self-reported symptoms and outcomes of DRA found reduced QOL as a result of compromised physical health and functioning, poorer physical perception, lower body image satisfaction, and higher degrees of abdominal pain, which is frequently perceived as discomfort or bloating, all of which are important care dimensions to assess (Fuentes Aparicio *et al.* 2021).

Of the 28 expert recommendations regarding pregnancy-related DRA, eight are specifically about the broader abdominal wall and another six concern IAP (Dufour *et al.* 2019). Additionally, these suggest that DRA should be approached from the perspective of considering the LA as an integral component of the thoracopelvic abdominal system, which assumes functional relationships between the structures of the thorax and pelvis. Although the studies in the present scoping review confirm a relationship between the abdominal wall and the LA, the nature of this connection requires further exploration and clarity in order to guide clinical practice. A recent systematic review by Berg-Poppe *et al.* (2022) evaluating the effect of exercise on DRA confirmed the benefit of abdominal exercises for improving IRD, but these authors also found that many of the studies examined fall short of substantiating the current recommendations for the treatment of pregnancy-related DRA. A call for improved assessment methods for DRA has been recently made (Opala-Berdzik *et al.* 2023), particularly the need for a standardized protocol for measuring IRD. The present review highlights the clinical relevance of assessing the functional properties of the abdominal wall and self-reported clinical outcomes that cannot be physically measured, such as QOL and body image. Such improvements in DRA characterization and assessment would probably further elucidate the relationship between DRA and broader abdominal wall function.

Limitations

Although the present scoping review provides valuable insight into the current state of knowledge of DRA, several limitations should be

considered when interpreting the findings. First, it may have been limited by the prejudices of the reviewers, who may have sought favourable associations between DRA and the four factors studied (i.e. breathing, PFM function, LPP and abdominal wall function). However, an attempt to minimize this bias was made by using multiple reviewers and a consensus strategy for deciding which studies to include. Secondly, the aim of this scoping review was to map the current available evidence onto the expert recommendations for the conservative care of perinatal DRA, and a methodological quality assessment of the studies included was not conducted (Tricco *et al.* 2016). However, it should be noted that the literature is generally of lower methodological quality. Furthermore, this research took place over a period of several years that spanned a global pandemic that interrupted its trajectory and had an impact on associated methodological procedures. However, a key strength of this review is the expertise of the authors and their collaborators with respect to its content and methods, and the due diligence that was performed in light of the challenges encountered. Thirdly, relevant articles may have been missed because only the reference lists of selected studies were reviewed. This review ultimately found that IRD is the measure that characterizes DRA. In hindsight, the authors recognize that not using the search term "inter-recti distance" potentially resulted in some important studies being missed, and suggest that future reviews of DRA include it.

In conclusion, the current literature does not appear to substantiate several of the recommendations and associated interventions for the conservative care of DRA. The studies included in the present scoping review do not support or refute the relationships between breathing, PFM function and LPP. However, it may be that the current mode of measurement falls short of determining potential correlations. Therefore, several of the current recommendations for clinical practice made by a group of Canadian experts appear to be in need of substantiation. The relationship between the broader abdominal wall and proprieties of the LA, namely IRD, appears to represent an established association. However, from a broad perspective, the implications of the functional consequences of DRA, not merely as a feature of IRD, require further study to enable enhanced clinical application. The present scoping review also highlights the limitations of the current characterizations of DRA and related assessment strategies, particularly the reliance on heterogeneous IRD measurement as the primary and sometimes only measurement to inform clinical reasoning about this condition.

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Conflicts of interest

The authors have none to declare.

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