Physiotherapy 127 (2025) 101771

The impact of physical changes to appearance on people with vertebral fragility fracture: a qualitative study

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Abstract

Objectives The aim of this study was to explore the experiences of people with Vertebral Fragility Fracture (VFF) due to osteoporosis and the impact of the physical changes resulting from their condition.
Design Interpretive qualitative research using semi-structured individual interviews
Participants Eighteen people with VFF were interviewed; nine men and nine women. Participants ranged in age from 55 to 92 years and had between 1 and 10 previous vertebral fragility fractures.
Setting Interviews were offered in participants own homes, at the hospital or by Microsoft TEAMS or telephone. These were audio-recorded, transcribed verbatim, and analysed through reflexive thematic analysis.
Results Results are presented within four themes: loss of height; finding spinal curvature upsetting, the impact on looking good and whether having a stoop was inevitable or could be prevented by active engagement.
Conclusion The findings show the negative impact on self-image caused by the physical manifestations of a VFF and that these can be as significant and distressing as pain and functional limitations.

This information is useful for physiotherapists treating people with vertebral fragility fractures offering insight into the patients' experiences of these physical changes.

Contribution of the Paper

- Height loss, hyperkyphosis and physical appearance impact on self- image. In this paper we report the major impact on the self-image and self-esteem of the physical changes associated with VFF in both men and women.
- Physiotherapists being made more aware of the impact of these changes for patients will enable them to be sensitive to this when treating them for back pain or postural rehabilitation.

Keywords: Osteoporosis; Patient experience; Vertebral fragility fracture

Background

Osteoporosis is a disease with increasing prevalence as the population ages, with estimated prevalence in the UK of 21.9% of women and 6.7% of men aged over 50 years [1,2]. Vertebral fragility fractures (VFFs), may result from low energy trauma such as a fall or may be associated with daily activities such as forward bending, lifting, or changing position. These fractures present a significant health and economic burden and can result

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https://doi.org/10.1016/j.physio.2025.101771

in increased morbidity and mortality even if initially asymptomatic [3]. They are commonly associated with back pain, fatigue, low mood, restrictions in physical function and activities of daily living, and marked, persistent reductions in quality of life (QoL) [2,3]. Vertebral fractures can cause spinal deformities, such as height loss, excess spinal curvature or thoracic hyperkyphosis. This can restrict pulmonary function, cause abdominal problems, result in balance deficits and falls [2] and a 2.5 to 4.1 increase in risk of sustaining further vertebral fractures (vertebral and non-vertebral) within the next 24 months [4] It can also lead to emotional problems such as anxiety, depression, and low self-esteem [5]. Qualitative studies have investigated the impact of being diagnosed with osteoporosis and VFF and the struggle that both women and men may have in coming to terms with that diagnosis and its implications for their future health and lifestyle [5–7].

The negative impact of VFF on quality of life has been highlighted showing an increased risk of anxiety and depression and self-image in women [8,9] and ongoing emotional impact of managing osteoporosis in everyday life [9]. This self-image is usually negative with interviewees reporting fear of decline with pain, changes to physical appearance and a sense of vulnerability [9–11]. Much less is written about the impact on men, but studies highlight the social construction of masculinity impacts their experience and magnifies the impact on their self-image and how they see themselves within their close relationships and wider society [6,12–14].

The Opt-In trial (ISRCTN 14465704) evaluated the clinical and cost effectiveness of two physiotherapy interventions for people with VFF [15]. It included an embedded qualitative arm where participants were interviewed about their experiences of participating in the study. During the baseline assessment measures height was measured using a stadiometer and the thoracic kyphosis angle was measured using the flexicurve. During these assessment processes participants commented on their experiences of having physical measurements taken and this prompted the research team to further explore the impact of physical changes that occur with VFF on people living with the condition.

The aim of this study was to explore the impact of the physical changes associated with osteoporosis on men and women participating in the Opt-In trial.

Methods

The study has been reported following the recommendations of the consolidated criteria for the reporting of qualitative research (COREQ) [Appendix 1].

The study was situated within interpretivism, using reflexive thematic analysis as described by Braun and Clarke [16].

Participants

We obtained ethical approval from West of Scotland research ethics committee [21/WS/0071; IRAS 287716]. Participants who had been recruited to the OPTIN trial were invited to participate in interviews exploring their experience of living with osteoporosis and following the Opt-In intervention. Eligibility for the Opt-In trial and hence this embedded qualitative study included men and post-menopausal women ≥ 55 years. Inclusion criteria for the study were: all women at least 1 year post-menopausal; osteoporosis confirmed by radiograph (X-ray) or dual energy x-ray absorptiometry (DEXA) scan T score ≤ −2.5 young adult mean at lumbar spine; one or more VFFs (of any severity and at any time-point post-fracture) confirmed by radiography, x-ray, MRI or DEXA scan; at least one episode of back pain in the previous 12 months; able to read and understand written and spoken English.

We used purposive non-probability sampling to select participants based on characteristics of a population and the objectives of the study. We used this selective sampling to approach and recruit both men and women, varying ages, living in differing geographical areas and with different VFF severity based upon self-report of current pain.

Approaching and recruitment

Participants were given an information sheet with reply slip and invited to contact the research team by either returning the reply slip in a pre-paid envelop or by e-mail if they were interested in taking part. Potential participants were contacted by the research team, their eligibility was confirmed, and a time arranged to conduct the interviews either in the participant's home, at the research centre or by telephone or Microsoft TEAMS depending on the participant's preference. Written consent was obtained before the interviews commenced.

Sample size

Qualitative sampling aims to generate ideas and insight: it does not aim to be statistically representative. We chose a sample that was heterogeneous and reflected different levels of disease severity, gender and duration of symptoms. As such, the sample was chosen for their "information power": i.e. their lived experience about the topic. [17].

Interviews

An interview topic guide was developed in cooperation with Patient, Public Involvement and Engagement (PPIE) partners who had lived experience of VFF. The interview guide was informed by an earlier qualitative synthesis the team conducted [18]. It was piloted on 3 patients before being used in the study with changes made based on their feedback, these were mostly minor changes to the wording of questions. The interviewer used the guide flexibly to explore the impact of osteoporosis on participants' lives; and the impact that the physical changes of the disease had on them physically and emotionally.

Research team, reflexivity and trustworthiness

Interviews were conducted by one of three researchers, (one male, two females: JR, KB, EH), all physiotherapists and post-doctoral researchers experienced in qualitative methodology and familiar with interviewing people with complex health conditions. All had contributed to the Opt-In trial and had an interest in the research topic.

The researchers made it clear to all participants that they wanted their frank opinions and recollections to endeavour to gather data that could inform other health care professionals and improve future patient experience.

Interviews were digitally audio recorded and transcribed verbatim by a professional transcribing service. Following transcription, all transcripts were checked for accuracy against the recordings and any transcribing errors corrected. Transcripts were not reviewed by participants after the interviews. Each section of interview text was analysed with verbatim narrative exemplars to illustrate the themes. All members of the research team, including our PPIE members contributed to the analysis and to comment on the fit of the direct quotes and themes [17].

Data analyses

We used the six stages of reflexive thematic analysis: familiarisation with the data; coding (a process that involves distilling meaning into concise phrases); generating initial themes (through constant comparison); developing and reviewing themes through discussion; refining and naming themes; writing up. Reflexive thematic analysis provides a method for distilling ideas from qualitative data into themes organised around a central idea. (13) Two researchers listened to check for accuracy and to become familiar with the data.

The analysis was conducted with transcribed data initially coded by one researcher (KB) and independently by another member of the research team (EH). Coding was discussed and further refined [17]. Transcript data were broken down into discrete units, coding each meaning unit to remain close to the data. An example of our coding is given in Fig. 1.

Results

Twenty-three people were approached, and eighteen consented to participate: nine men and nine women. The mean age was 73 years (range 55 to 92), and median number of previous fractures was 2.0 IQR [1 to 3.5]. Participant characteristics are shown in Table 1, using non attributable identifiers. Fifteen participants chose to be interviewed in their own homes, two by telephone and one by Microsoft TEAMS. All chose to be interviewed unaccompanied.

Four themes were developed relating to: loss of height; finding spinal curvature upsetting, the impact on looking good and whether having a stoop was inevitable or could be prevented by active engagement.

These themes and the supporting quotes were discussed with our PPIE member group who contributed to the analysis and added to the descriptions used.

I have shrunk both physically and as a person

This theme describes the personal impact of losing height: this impact could be physical, functional, and emotional.

I couldn't believe the change from being a fit upright healthy specimen to a shrunken shadow of myself. [F1]

Although some felt that height loss was an inevitable part of getting older and were relatively sanguine about it ("*you might expect as you get older everyone gets a little shorter and the young get taller" [M3]),* others felt self-consciousness and experienced a negative impact on their self-esteem.

Some felt that it was inevitable that they would continue to lose height and were sometimes hurt by inadvertent or tactless comments made by friends and family.

[I] Hate the comments of friends and family commenting on how much I have shrunk and how small I am now…its horrible feeling knowing it is only going to get worse and I'm not going to get those inches back. [F4]

The impact of height loss could be particularly distressing for male participants who felt a societal expectation that height was associated with manliness.

it was a real shock when I realised that both my wife and my son were towering over me, my son you might, but not my wife now towering over me…that really hurts. [M5]

Worst thing about losing height and being stooped is that I am now shorter than my wife. When I look at photos from weddings etc she towers over me even though she has stopped wearing heels, it is completely emasculating. [M2]

For others there were practical difficulties with being shorter, which contributed to feeling "old and useless".

I was so upset when I had my height and weight done and found I had lost 10 cm, being shorter catches you out in so many ways like having to ask strangers to lift things off the top shelf when you go shopping … it just makes you feel old and useless. [F7]

For both men and women there was an association between loss of height and poor self-image, sometimes linked to the social stigma of ageing.

I have gradually shrunk both physically and as a person. [F8]

I feel like I have grown old before my time and am viewed by others as being old and useless because I have shrunken so much and that has aged my appearance. [F3]

I am seen as the "hunchback"

This theme is underpinned by changes in self-image. During the physical assessments for the Opt-In trial a trace was made of the shape of participants' spinal curvature (kyphosis) and for some this was the first time they had seen a tangible representation of their curve.

Theme - Height - I have shrunk both physically and as a person.	
CODES	SUPPORTING VERBATIM QUOTATION
First time realised getting shorter	When I went to the doctor's I went on this thing that gave me my height, BMI, and all the rest of it. It twice or three times came up to say I was 5' 7½" which was ridiculous, I wouldn't have even got in the police at that height. I happened to look at my army record … it said I was 6' ½ and I thought 'Well I've lost five inches of height; how could I lose five inches of height? I don't feel as if I've shrunk.[M17] it was a real shock when I realised that both my wife and my son were towering over me, my son you might, but not my wife now towering over me…that really hurts. [M5] I was so upset when I had my height and weight done and found I had lost 10cm, being shorter catches you out in so many ways like having to ask strangers to lift things off the top shelf when you go shopping … it just makes you feel old and useless. [F7] . I happened to look at my army record … it said I was 6' ½ and I thought 'Well I've lost five inches of height; how could I lose five inches of height? I don't feel as if I've shrunk.[M17]
Emotional impact of height loss	I suppose I'm a little bit disappointed that I've lost a bit of height[F9] I couldn't believe the change from being a fit upright healthy specimen to a shrunken shadow of myself. [F1] I feel like I have grown old before my time and am viewed by others as being old and useless because I have shrunken so much and that has aged my appearance. [F3]
Practical impact	I was so upset when I had my height and weight done and found I had lost 10cm, being shorter catches you out in so many ways like having to ask strangers to lift things off the top shelf when you go shopping … it just makes you feel old and useless. [F7]
Less of a man	Worst thing about losing height and being stooped is that I am now shorter than my wife. When I look at photos from weddings etc she towers over me even though she has stopped wearing heels, it is completely emasculating. [M2] It was a real shock when I realised that both my wife and my son were towering over me, my son you might, but not my wife now towering over me…that really hurts. [M5]
Emotional impact- diminished	I have gradually shrunk both physically and as a person. [F8] I hate the comments of friends and family commenting on how much I have shrunk and how small I am now…its horrible feeling knowing it is only going to get worse and I'm not going to get those inches back. [F4] I feel I'm not the person I was somehow although I am but because of my condition and the way I appear to them I'm a lesser person. That maybe just be me but that's how I feel yeah.[M13]
Pragmatic acceptance / humour	you might expect as you get older everyone gets a little shorter and the young get taller" [M3] The loss is a bit of a pain [laughs], I'm getting shorter but in the wrong places.[F5]

Fig. 1. Example of coding into a theme.

Table 1
Participant characteristics.

ID	Age (years)	Gender	Years since diagnosis	Number of VFF	Location of vertebral fractures*	Interview length (minutes)
F1	75	F	6	2	UT, LT	39
F2	84	F	12	1	UT	30
F3	82	F	13	2	LT, UL	59
F4	92	F	5	7	UT (2), LT (6), LL (2)	40
M5	74	M	24	10	Ut (2), LT (6), LL (2)	44
F6	76	F	24	2	LT, LL	54
M7	62	M	10	1	UL	36
F8	73	F	4	2	UT	38
F9	68	F	5	1	UL	29
F10	60	F	5	1	UL	37
F11	83	F	2	2	LT, LL	66
M12	78	M	11	1	UT	44
M13	66	M	6	5	UT (2), LT (3)	73
M14	71	M	4	4	LT (1), UL (3)	52
M15	69	M	8	2	LT, UL	49
M16	90	M	10	4	UT, LT (2), UL	49
M17	55	M	3	3	UT, LT (2)	67
M18	70	M	8	1	UL	51

VFF – Vertebral Fragility Fracture.
* UT Upper Thoracic; LT Lower Thoracic; UL Upper Lumbar; LL Lower Lumbar.

Seeing the curvature of my back did upset me, because I've not seen it like that on a piece of paper, umm obviously I do look at myself in the mirror from time to, that upset me, nothing else upset me. [M1]

I was concerned about the shape of my spine, how hunched I was and curved. But I can stand straight. I was concerned. I was also concerned that apparently, I've lost a couple of inches. I've always been quite tall, but it seems I've lost a couple of inches. [F2]

Physical changes had a profound impact on sense of self, and some felt labelled or stigmatised.

My wife has started to call me the hunchback of Notre Dame…can see what she means but am powerless to do anything about it and hate the label she has given me. [M7]

I was always brought up to stand up straight and look the world in the eye, now I'm some shuffling old crone who looks at the floor. [F9]

Participants found it impossible to hide the characteristic changes in body shape and the pronounced kyphosis that is the stereotyped hallmark of osteoporosis and spinal fractures.

I don't recognise my body now

A further impact from physical changes related to reduced choice of clothing. Female participants felt sad that they could no longer wear smart clothes or a "nice outfit". Some found it difficult to buy clothes that made them feel good, or that disguised their physical changes.

I knew my back was bad because when I put an outfit on, and I turn sideways it didn't look very good at the back. I thought oh dear, maybe this is not the thing to wear. It doesn't show my best side. I actually almost cried when I got into the car because it was the first time that I couldn't find anything to buy. [F5]

Some of the clothes that I really love in my wardrobe, I would like to wear them. I've been buying clothes I realise for years that disguise my back. But recently my back has become a little bit more rounded and just that alone makes me so upset. [F4]

For some, choice of clothes was closely linked to self-concept.

As I've shrunk even more it takes away my self-esteem as I have always prided myself on being well turned out and looking good; now I still want to look good but I'm just a shadow of what I used to be. [F6]

If I put normal clothes on, they look dreadful on me, I used to take pride in my appearance but now I look like a bag lady as nothing fits or disguises my hump and belly. [F2]

The distress caused by clothes no longer looking good was emphasised specifically in relation to having a protuberant stomach. There were differences in the way that this was expressed between men and women, with the men less distressed and likening it to having a "beer belly without the drinking".

I hate the fact that my stomach sticks out and I have lost any semblance of a waistline, looks like I have become a right fat bastard or that I'm about to give birth any minute. [M9]

As well as now being a short arse my gut sticks out so much, I have to decide whether to wear my trousers over it or under with a belt. [M4]

Some were distressed about "losing your waistline" or developing a "pot belly" (a result of a shortened torso from

lost vertebral height). There was a feeling of injustice that the physical loss of height made them look ”fatter”, despite no changes to their weight or diet. Some felt that the combination of having a shrunken frame, stooped posture, and a protuberant stomach was unfair and underserved.

I've lost my waistline; my stomach sticks out now, so it looks as if I've put a ton of weight on even though I'm actually the same now as I've always been, I just look a fat lump with a pot belly. [M6]

I've always had a trim figure and prided myself on keeping my weight down and dieting. Now it doesn't matter what I eat I'm still left with a sticking out tummy that makes me look fat and frumpy. [F7]

At least I have found out in time to do something about it

The final theme is underpinned by hope. Some felt that because they had been diagnosed “in time”, they could be treated, and further decline prevented. Not all participants felt that a stooped posture (hyper-kyphosis) was inevitably progressive. Some were interested to find out about the degree of their spinal curve because this motivated them to engage fully in their pharmaceutical and physical treatment programmes. There was a sense that you did not see the physical changes unless someone pointed them out, and it was good to find out in good time to do something about it.

You don't see yourself sometimes as others see you. So, when they actually measured it and I said to her "Can I see what the curve is?"; to actually know that curve is there and it's not me not standing up straight, it is because of the result of that. But also, it does make you aware to try and stand up straighter, to make sure you don't go any further. [F4]

I was motivated to go and see a physio when my wife told me that I was looking more and more like my mother every day, and then I suddenly realised that, yes, I was starting to actually walk with a curved back. I couldn't actually straighten it. [M8]

Attention to posture and “spine straightening exercises” were described as important to try to ward off physical decline and avoid a “dowagers hump” or “hunchback”.

I have to keep doing my exercises and taking a grip or I'll end up like all those other old women with a Dowager's hump looking like a witch. [F7]

… and I remember, I mean I think my maternal grandmother was quite stooped you know, before she died, so you know I'm hoping I can avoid that; So that's something of a motivation to do the exercises. [M5]

Participants felt that exercise was beneficial and that it would reduce progression to a stooped posture, or that through exercise they could correct the spinal curve. This was a strong motivator to follow an exercise programme.

Discussion

In this study we sought to explore the impact of the physical changes associated with osteoporosis on men and women with the disease. The study adds to the existing knowledge base about how men and women are impacted by the physical changes that arise from osteoporosis and VFF. The experiences are multifaceted and whilst there are some differences in viewpoint that were expressed between the men and women who we interviewed there was essential commonality in the overarching themes.

Previous interview studies of women with VFF or osteoporosis have focused on their narrative of the experience of being diagnosed or the process of learning to live with the pain and functional limitations that come with the condition [8,11]. Similarly, for the few studies that have explored the experiences of men and have focussed on the impact of having a disease perceived to be associated with women only, the impact on masculinity and how they accessed health care management [6,12–14]. The innovation of this study is to explore perceptions of body image and the impact on self-concept.

Self-image

Our findings highlight that VFF has an impact on both physical image and self-image. The deforming aspects of the disease were seen as a physical manifestation of the underlying disease, which unlike pain, could not be hidden or dismissed as they were confronted by the physical reminders of either height loss, stooped posture, or protuberant stomach every time they caught sight of themselves in a mirror or window.

For those that recognised that they were shorter and less upright, this was brought into focus when they underwent a clinical examination either as part of the research trial assessments or during routine check-ups with their health provider. The impact of the increased awareness of the physical features of their condition came as a shock to some. This has similarities with the report of Reventlow *et al.* [7] who explored the impact of bone scans and seeing image results on women with osteoporosis. They found that when the body's concealed parts are made visible, sensations and feelings are exposed and that the graphic representation led to a reconstruction of body image, shaped by cultural context that had implications for women's sense of bodily identity in everyday life.

For the men we interviewed there was a link between the physical changes of loss of stature and loss of an erect posture and their construction of masculinity and how they perceived a man was expected to present in society. This resonates with the clear findings by Minns Lowe *et al.* [6] of how having VFF impacted on a man's sense of self and changed how he perceived himself.

Gender differences

There may be differences in the language that men and women use to describe the impact of the physical changes.

In our study, men used different stories about their bodies and tended to use humour, or self-deprecating comments, unlike the narratives from the women. This is in line with previous studies that have found that the capacity to laugh at yourself is highly valued by men in describing their healthcare experiences [18] and that men and women have gendered responses to health and illness [19]. In contrast the women we interviewed seemed to be far more self-judgemental and saw no humour in their altered appearance. In this they presented according to the classifications used by Wilkins who characterised those who described themselves in derogatory ways as 'the disparaged self' suggesting a lack of self-worth and self-respect [20]. Although the lived experience of gender (and its presentation) is multifaceted, health care professionals should be vigilant to the impact of gender on the experience of illness.

Use of language

Throughout the interviews the subjects used emotive language to describe their physical appearance. The terminology used to describe these changes was unremittingly negative: "stooped"; "bent"; "shrunken"; "withered"; "crone like". The physical appearance of a "hunched" back (hyper-kyphosis) was described with reference to the Victor Hugo character, Quasimodo, the "hunchback of Notre Dame", or related to the "crone" or "hag", popularly characterised as a woman who is "decrepit, ugly, malicious, or sinister". This negative societal image of the changes associated with osteoporosis has been reported in other studies on women such as Paier who summarised the changes as the Specter of the Crone [10] and in men by Minns Lowe [6].

What was also clear was the distress caused by thoughtless use of language by friends and family and health care providers in describing physical changes. It is recognised that verbal communication is an important factor in therapeutic relationships with health care practitioners and that negative language can trigger nocebo effect in patients and lead to increased health anxiety and illness beliefs [21]. The use of stigmatising language in healthcare communication is well recognised and recommendations exist to guide clinicians to avoid harmful narratives [22]. Given the well-documented association between osteoporosis and depression [23–25] the insensitive use of language to describe physical changes is particularly insensitive and may contribute to poor self-esteem or mental health problems.

Getting worse is an inevitability

The onset of a VFF may be sudden and dramatic, or silent and insidious. It can lead to intense pain and a rapid reduction in function with a perception that this will lead on an inevitable downward trajectory to further limitation and transformation to a physical appearance associated with elderly relatives. It is recognised that the effect of VFF on quality of life can be greater and of longer duration compared with other types of osteoporotic fractures [26] Despite this there are effective, multifaceted pharmacological and non-pharmacological treatments that are effective in managing VFF and progressive decline is not inevitable [27–33]. However, from our interviews most respondents felt that the best they could hope to achieve was a slowing of their decline through personalised exercise and medication and that a downward trajectory was inevitable.

Participants reported that progressive physical deformity such as increasing kyphosis provided a physical manifestation of their problems. For some this threat of deformity is just as impactful as the limitations of pain and functional loss. However, other participants expressed a positive mindset that they had agency and power to escape inevitable stooping, if they were vigilant about loss of height and progression of their kyphosis and worked hard at physical exercise and rehabilitation.

Strength and limitations

We used a purposive sampling strategy to include men and women. Although one in five men will sustain one or more osteoporotic fractures in their lifetime [1], most of the research reporting the experience of people with VFF has excluded the perspective of men. Qualitative research does not aim to be statistically representative, but to develop ideas by gathering the experiences of people with lived experience. All our sample were English speaking and self-identified as White British. Future research to explore the experiences of others, for example, experiences of minoritised ethnic communities, using an intersectional lens, would add to the understanding of the experience of osteoporosis. We did not aim to achieve data saturation as the concept of data saturation is not compatible with Reflexive Thematic Analysis and other interpretive methodologies (16); but ensured through our purposive sampling and interviews that we had good information power.

To support the trustworthiness of our themes, research team members worked collaboratively to interpret the data, develop codes and themes, and to challenge and discuss disconfirming evidence [32]. Our research team varied in age and gender, offering a differential perspective on analytical decisions. Our PPIE advisory group who had helped pilot the interviews also contributed to the thematic analysis and advised on the terms used as summary headings for the themes. We also present verbatim exemplars to support the credibility of findings.

It is not possible to avoid the influence of the researcher and/or interviewer bringing their own personality and experiences to the interaction with the interviewees.

Researchers do not enter the field with an empty head. Our team acted as critical friends to challenge our situated position where we felt it impacted on analysis. This qualitative study aimed to explore the experience of the OPTIN trial and yet this study describes themes that explore the impact of VFF on body and self-image that go beyond the study setting. As such, we have confidence that our findings express truths that are transferable beyond this setting and can contribute to improvements in care.

Conclusions

Our findings highlight the personal and social impacts that accompany the physical changes of VFF. They also underscore potential gender differences in response to physical change. These differences manifested in the way they described their appearance, with men using humour to deflect the impact. Health care professionals should be aware that the changes in physical appearance have a major impact on the self-image and self-esteem of people with VFF. An understanding of the impact of the physical changes associated with VFF is important for physiotherapists who are treating them for vertebral pain or posture correction.

Declarations

Ethical approval was provided by the West of Scotland research ethics committee reference: committee [21/WS/0071; IRAS 287716].

Funding

The research was supported by a grant from the Chartered Society of Physiotherapy Charitable Trust – RP-19-01.

Declaration of Competing Interest

All authors declare that they have no conflicts of interest.

Acknowledgements

This work was funded by a research grant from the Chartered Society of Physiotherapy Charitable Trust, UK [RP-19-01].

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.physio.2025.101771.

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